Green Infrastructure Vision

for Southeast Michigan

SEMCOG *. . . Shaping the future of Southeast Michigan*

Southeast Michigan Council of Governments

SEMCOG ***. . . Shaping the future of Southeast Michigan***

Mission

SEMCOG, the Southeast Michigan Council of Governments, is the only organization in Southeast Michigan that brings together all of the region's governments to solve regional challenges.

SEMCOG strengthens local governments and regional decision making by:

- Providing data and unbiased analysis for informed decision making affecting Southeast Michigan and its local governments;
- Promoting the efficient use of tax dollars for both long-term infrastructure investment and shorter-term governmental efficiency;
- Delivering direct assistance to member governments in the areas of transportation, environment, and community and economic development;
- Solving regional issues that go beyond the boundaries of individual local governments; and
- Advocating on behalf of Southeast Michigan in Lansing and Washington.

Green Infrastructure Vision for Southeast Michigan

© SEMCOG 2014

Abstract

The *Green Infrastructure Vision for Southeast Michigan* is a framework that guides preservation and future implementation of green infrastructure in Southeast Michigan. The vision benchmarks the amount of green infrastructure in the region, visions future green infrastructure opportunities, and recommends strategic implementation approaches. The vision details the various benefits of green infrastructure, including economic value, water quality, air quality, and recreation. The *Green Infrastructure Vision for Southeast Michigan* can be viewed online at www.semcog.org.

The work that provided the basis for this publication was supported by grants from and in cooperation with the U.S. Department of Housing and Urban Development, the U.S. Department of Transportation, and the U.S. Environmental Protection Agency, as well as local membership contributions. The substance and findings of the work are dedicated to the public. SEMCOG is solely responsible for the accuracy of the statements and interpretations contained in this publication. Such interpretations do not necessarily reflect the views of the federal agencies funding this work.

Permission is granted to cite portions of this publication, with proper attribution. The first source attribution must be "SEMCOG, the Southeast Michigan Council of Governments." Subsequently, "SEMCOG" is sufficient. Reprinting in any form must include the publication's full title page. SEMCOG documents and information are available in a variety of formats. Contact SEMCOG Information Services to discuss your format needs.

SEMCOG

Southeast Michigan Council of Governments
Information Center
1001 Woodward Avenue, Suite 1400
Detroit, MI 48226-1904
313-961-4266 • fax 313-961-4869
www.semcog.org • infocenter@semcog.org

Cover Photo Credits

Front cover: Wayne County Grow Zone located in the Venoy Park area of the Wayne County Lower Rouge Parkway in the City of Westland.

Acknowledgements

Thank you to the many stakeholders who provided input into the development of the Green Infrastructure Vision for Southeast Michigan, including the Green Infrastructure Vision Task Force.

Mayor Bryan Barnett, City of Rochester Hills and Task Force Chair

Members

Mary Alfonso, City of Detroit
Margi Armstrong, Clean Water Action
Andrew Bahrou, Michigan Department of Environmental Quality Southeast Michigan Office
Tara Beatty, City of Rochester Hills
Kristen Bennett, Michigan Department of Natural Resources
Mary Bohling, Michigan Sea Grant
Meghan Bonfiglio, Washtenaw County
Morse Brown, Southeast Michigan Resource Conservation and Development Council
Chris Bunch, Six Rivers Regional Land Conservancy
Don Carpenter, Lawrence Technological University
Charles Cross, University of Detroit Mercy
Melissa Damaschke, Sierra Club
Ryan Dividock, Oakland County
Chris Dorle, Detroit Future City
Matthew Dreger, City of Mount Clemens
Lauri Elbing, The Nature Conservancy
Lori Eschenburg, St. Clair County
Jim Francis, Michigan Department of Natural Resources
Ivich Fraser, United States Forest Service
Brad Garmon, Michigan Environmental Council
Malik Goodwin, Detroit Economic Growth Corporation
Dawn Gramza, City of Luna Pier
Kerry Gray, City of Ann Arbor
Martha Gruelle, Wildlife Habitat Council
Kim Hiller, Livingston County Road Commission
Jeffrey Johnson, Wayne County
Cary Junior, Charter Township of Royal Oak
Shawn Keenan, City of Auburn Hills
James Keglovitz, Oakland County
Erin Kelly, NextEnergy
Kathleen Kline-Hudson, Livingston County
Ric Lawson, Huron River Watershed Council
Simone Lightfoot, National Wildlife Federation - Great Lakes National Resouce Center
Kathryn Lynch-Underwood, City of Detroit
Steven Manor, City of Howell
Nina Misuraca-Ignaczak, Clinton River Watershed Council
Karen Mondora, City of Farmington Hills
Paul Muelle, Huron-Clinton Metroparks
Noel Mullett, Wayne County
Richard Murphy, Michigan Suburbs Alliance
Bob Newport, USEPA Region 5
Anthony Nowicki, City of Wixom
Kris Olsson, Huron River Watershed Council
John Paskus, Michigan Natural Featrues Inventory Michigan State University Extension
Robert Peven, Monroe County
Yousef Rabhi, Washtenaw County
Jodee Raines, The Fred A. & Barbara M. Erb Family Foundation
Cyndi Roper, Clean Water Action
Cyndi Ross, Friends of The Rouge
Laura Rubin, Huron River Watershed Council
Rebecca Salminen-Witt, The Greening of Detroit
Gerard Santoro, Macomb County
Kevin Sayers, Michigan Department of Natural Resources
James Schultz, MDOT - Metro Region
Michelle Selzer, Office of The Great Lakes
Lynne Seymour, Macomb County
Helen Sharpley, City of Detroit
Brandy Siedlaczek, City of Southfield
Mark St. Charles, Green Oak Charter Township
Cynthia Stump, ITC Holdings Corporation
John Swiatkowski, Charter Township of Harrison
Anita Twardesky, Riverside Kayak Connection, LLC
Anne Vaara, Clinton River Watershed Council
Guy Williams, Detroiters Working for Environmental Justice
Kristen Wiltfang, Oakland County
Thomas Woiwode, Community Foundation for Southeast Michigan
Lev Wood, City of Grosse Pointe Farms

Table of Contents

Executive Summary **1**

Introduction **3**
Southeast Michigan - Greening Our Region

Chapter 1 ..... **7**
Quantity of Green Infrastructure

Chapter 2 ..... **15**
Quality of Green Infrastructure

Chapter 3 ..... **21**
Accessibility to the Green Infrastructure Network

Chapter 4 ..... **28**
Connectivity of the Green Infrastructure Network

Chapter 5 ..... **32**
Green Infrastructure and Water Quality

Chapter 6 ..... **37**
Green Infrastructure and Air Quality

Chapter 7 ..... **42**
Green Infrastructure and Transportation (Green Streets)

Chapter 8 ..... **47**
Green Infrastructure and Vacant Land

Chapter 9 ..... **50**
Green Infrastructure and the Economy

Chapter 10 ..... **55**
Green Infrastructure Vision for Southeast Michigan

Chapter 11 ..... **59**
Sustaining our Green Infrastructure Network: Maintenance, Financing, and Partnerships

Chapter 12 ..... **62**
Visioning Green Infrastructure in Southeast Michigan

Chapter 13 ..... **73**
Implementing the Green Infrastructure Vision

Appendices
Appendix A 75
Appendix B 80
Appendix C 88
Appendix D 92

List of Data Displays

Figures

Figure 1 Green Infrastructure Vision in Southeast Michigan 2
Figure 2 Percent tree Canopy by Census Block, Southeast Michigan 9
Figure 3 Location of Parks Greater than 200 Acres 12
Figure 4 Vegetation Circa 1800, Southeast Michigan 16
Figure 5 Living Legacy Lands, Southeast Michigan 17
Figure 6 Distance to Parks 200 Acres or Larger, Southeast Michigan 23
Figure 7 Knowledge Workers and Large Recreation Areas, Southeast Michigan 24
Figure 8 Parcel Distance to Existong Nonmotorized Trails, Southeast Michigan 25
Figure 9 Public Boat Launches, Southeast Michigan 26
Figure 10 Regional Trails and Public Green Infrastructure, Southeast Michigan 30
Figure 11 Land Bird Migration, Southeast Michigan 31
Figure 12 SEMCOG Watersheds, Southeast Michigan 36
Figure 13 Major Roads, Southeast Michigan 43
Figure 14 Percent Vacant Land, City of Detroit 48
Figure 15 Green Infrastructure Regional Assets, Southeast Michigan 57
Figure 16 Green Infrastructure Vision, Southeast Michigan 64
Figure 17 Green Infrastructure Vision, Livingston County 65
Figure 18 Green Infrastructure Vision, Macomb County 66
Figure 19 Green Infrastructure Vision, Monroe County 67
Figure 20 Green Infrastructure Vision, Oakland County 68
Figure 21 Green Infrastructure Vision, St. Clair County 69
Figure 22 Green Infrastructure Vision, Washtenaw County 70
Figure 23 Green Infrastructure Vision, Wayne County 71
Figure 24 Green Infrastructure Vision, City of Detroit 72

Tables

Table 1 Green Infrastructure Elements in Southeast Michigan 4
Table 2 Percent Green Infrastructure by County 8
Table 3 Land Cover, Southeast Michigan 8
Table 4 Percentage Tree Canopy by County 8
Table 5 Potential Wetlands and Adjacent Vacant Land by County 10
Table 6 Park Acreage by County 11
Table 7 Agricultural Land by County 13
Table 8 Riparian Corridors by County 14
Table 9 State Designated Natural Areas 16
Table 10 Distance to Park (in miles) 22
Table 11 Households by Type, 2010-2040 27
Table 12 Riparian Corridors on Public Land 29
Table 13 Water Area in Southeast Michigan (acres) 32
Table 14 Green Infrastructure Opportunities (acres) within Southeast Michigan,Subwatersheds over 10 percent impervious surfaces 34
Table 15 Comparison of Growth Areas and Emissions in United States, 1980-2012 38
Table 16 Annual Pollutant Emissions in Southeast Michigan - All Sources 39
Table 17 Estimated Pollutant Reduction from Tree Canopy 39
Table 18 Annual Pollutant Removal Due to Extent of Tree Canopy (tons) 40
Table 19 Land Cover in Transportation Corridors 40
Table 20 Tree Canopy Benefits along Roadways (Existing and Future) 41
Table 21 Land Cover within Major Road Rights-of-Way (acres) 44
Table 22 Vacant Land Adjacent to Green Infrastructure 48
Table 23 Residential Property Value Premiums Near Parks 50
Table 24 Expenditures for Fishing, Hunting, and Wildlife Watching in Michigan 52
Table 25 Agricultural Contributions by County 54

Executive Summary

Green infrastructure includes parks, lakes, wetlands, and trees, as well as constructed green roofs, bioswales, and rain gardens. Southeast Michigan is home to over 180,000 acres of public parks, over 900,000 acres of trees, the only international wildlife refuge in North America, and the largest coastal wetland system in the Great Lakes. Green infrastructure is increasingly being recognized for its contribution not only to environmental quality, but also to placemaking, economic values, and healthy communities – things that are vitally important to individual communities and the region.

Additionally, green infrastructure can be used to protect and restore many of the region's jewels – inland lakes and streams – as well as the Great Lakes from Lake Huron through the St. Clair River, Lake St. Clair, and Detroit River to Lake Erie. These waterways are nationally recognized and bring billions annually to Michigan's economy.

The *Green Infrastructure Vision for Southeast Michigan* ties all the components of the region's green infrastructure together into an identified system and, for the first time, benchmarks the green infrastructure that we have, visions where we want to go, and provides policy recommendations on how to get there.

Development of the vision included numerous stakeholder engagement sessions to gather input on priorities for Southeast Michigan's green infrastructure in the future, including:

- **Green Infrastructure Vision Task Force.** Comprised of more than 60 representatives from local governments; state and federal agencies; environmental, transportation, educational, and economic development groups. This task force met over a two-year period providing guidance throughout development of the vision.
- **Stakeholder Visioning Sessions.** Nine stakeholder visioning sessions with more than 300 participants were held throughout Southeast Michigan to provide input into regional policies and direct input into local green infrastructure opportunities.
- **Pulse of the Region Survey on Green Infrastructure Priorities.** 854 people from across Southeast Michigan completed this regional survey.
- **October 2013 General Assembly**. Elected officials were surveyed during a polling session at the General Assembly on their green infrastructure priorities.

Regional Policies

Based on this stakeholder input, along with significant data gathering and analysis, 10 regional policies and 75 sub-policies (see Appendix A) were developed. The overarching regional policies are:

- While there are many different types of green infrastructure and many owners of it, Southeast Michigan's green infrastructure is a network that needs to be managed as a system.
- Additional public green infrastructure should focus on connecting the public network together, focusing on riparian corridors and trails as well as meeting unmet recreation needs.
- Southeast Michigan has high quality, unique natural areas that need to be managed, preserved and, in some cases, restored.
- Public accessibility to the green infrastructure network is paramount, including access to parks, trails, water, and ensuring public spaces are designed for all residents.
- Increasing tree canopy is a priority because of the numerous benefits, including water quality, property value enhancement, aesthetics, and connecting the green infrastructure network in urban areas.
- In urban areas, constructed green infrastructure should be focused on publicly-owned land such as roads and government property, as well as areas with large impervious surfaces, such as private parking lots, to improve the quality of local and regional water resources.
- The transportation network is a key component of the regional green infrastructure network, through development of green streets and complete streets in addition to connecting the green infrastructure network.
- Vacant property provides a unique opportunity to increase connectivity, buffer high-quality areas, improve public access to waterways, and provide long-term solutions in high-vacancy areas including providing a local food source.

- Education of and promotion to elected officials and the public about the environmental, economic, and social benefits of the green infrastructure network is needed.
- Sustainability of the green infrastructure is essential, including maintenance, fiscal sustainability, and innovative partnerships.

Green Infrastructure Visioning Maps

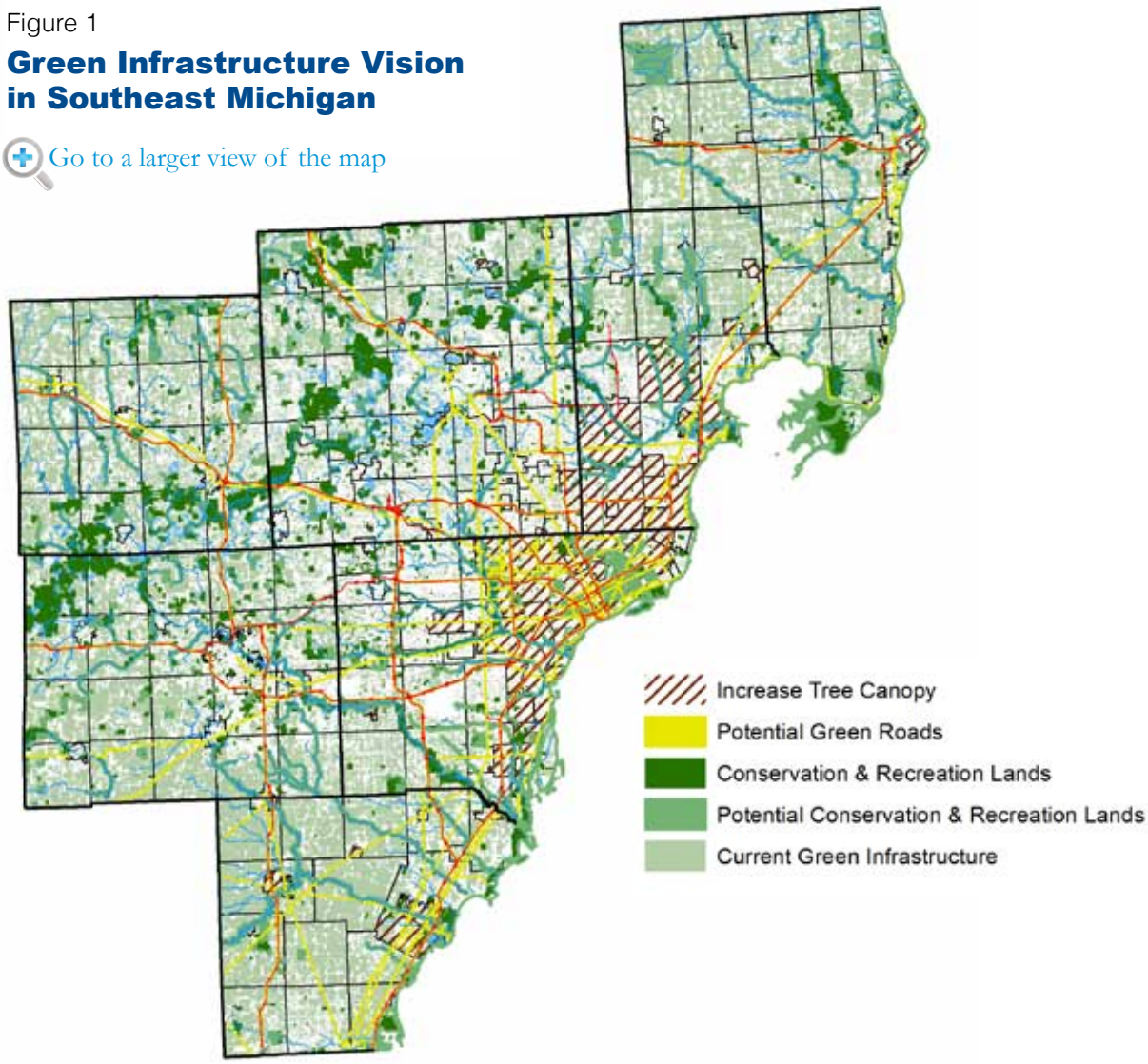
The regional policies, along with stakeholder input, were the basis for developing a regional map of green infrastructure. The regional map includes:

1. **Current green infrastructure network** – Shows the larger green infrastructure network of tree canopy (both private and public land), agricultural lands, and wetlands based on the 2010 land cover analysis for Southeast Michigan.
2. **Recreation and Conservation Land** – Highlights the region's public parks and conservation lands.
3. **Potential Recreation and Conservation Land** – Highlights green infrastructure that could be added to the public green infrastructure network.
4. **Potential Green Roads** – Illustrates major roads that could either increase tree canopy or implement constructed green infrastructure (e.g., bioswales, rain gardens).
5. **Increase Tree Canopy** – Communities with less than 20 percent tree canopy are highlighted as a priority for increasing tree canopy.

Figure 1

Green Infrastructure Vision in Southeast Michigan

Go to a larger view of the map



Southeast Michigan - Greening Our Region

Our region's nature and environment…our parks, lakes, rivers, streams, wetlands, prairies, woodlands, and other natural areas provide benefits to residents, provide essential habitat to wildlife, and contribute to the economic resurgence of our region and state.

In fact, Southeast Michigan can boast these environmetal assets:

- Access to 90 percent of the country's fresh water and 20 percent of the world's fresh water.
- 180,000 acres of public parks and over 1,000 miles of trails and side paths.
- St. John's Marsh is the largest coastal wetland system in the Great Lakes.
- The world's only international wildlife refuge.
- Nationally recognized fisheries.
- Hundreds of millions to the economy from agriculture.

The *Green Infrastructure Vision for Southeast Michigan* was developed to optimize the use of green infrastructure in achieving six interrelated outcomes for a successful future. This vision is one component in facilitating collaboration to align scarce public revenues by focusing on economic prosperity, desirable communities; reliable, quality infrastructure; fiscally sustainable public services; healthy, attractive environmental assets; and access to services, jobs, markets, and amenities.

What is Green Infrastructure?

Green infrastructure is defined in two broad categories in Southeast Michigan. First, it includes ecosystems that are present in the natural, undisturbed environment such as wetlands, woodlands, prairies, and parks. The second category includes constructed or built green infrastructure such as rain gardens, bioswales, community gardens, and agricultural lands. Table 1 highlights and defines various green infrastructure elements in Southeast Michigan.

Within these natural and built categories of green infrastructure, it's critical that green infrastructure be evaluated as an integrated system. Each green infrastructure technique alone provides specific function and value, but as a system the green infrastructure network sets the framework to balance the ecological and environmental value these resources bring, along with the quality of life and economic value to our region.

Where is Green Infrastructure Located?

Green infrastructure can be located almost anywhere. In fact, we have over 180,000 acres of green infrastructure in Southeast Michigan! Much of our green infrastructure is located in parks, schools, along riparian corridors, even along main streets of our downtowns.

Table 1

Green Infrastructure Elements in Southeast Michigan

Green Infrastructure Element	Definition
Agricultural lands	Rural land used with the growing of food as the primary function, but can also provide ecological benefits.
Community gardens	Urban and/or residential land used to grow food, but can also provide ecological services.
Conservation easements	Public and private land designated for conservation in perpetuity.
Critical habitats/Regionally significant features	Areas unique to Southeast Michigan that are critical to protect and enhance, such as the Detroit River International Wildlife Refuge and St. John's Marsh.
Public access sites	Sites that allow access to our region's rivers and lakes.
Rain gardens, bioswales, green roofs	Techniques that follow the natural water cycle. Manages rainfall by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source.
Recreational land	Public and private land designated for recreation such as parks, forests, hunting preserves, etc.
Riparian corridors	Land that exists between water bodies (lakes, rivers, streams, and wetlands) and higher dry upland areas (forests, fields, cities and suburban property).
Trails (land and water trails)	Designated trails designed for walking, hiking, biking, cross-country skiing, snowmobiling, canoeing, kayaking ,and other recreational activities.
Wetlands, floodplains	Floodplains, Michigan-designated wetlands, and constructed wetlands or other natural features that provide similar functions.
Woodlands, trees, street trees, urban forests	Areas of tree canopy cover that exist in multiple forms such as woodlots, private landscapes, street trees, urban forests.

"The number one reason people choose to live in Rochester Hills is our environmental characteristics and natural amenities. The development of this vision helps solidify the role natural resources play in our region's quality of life."

Bryan Barnett

Mayor of Rochester Hills and Chairperson of the Green Infrastructure Vision Task Force

Examples of Green Infrastructure Types and Locations

Urban

Street trees
Community gardens in previous vacant lots
Small active or passive recreational parks
Rain gardens and bioswales along roads and parking lots
Green roofs
Nonmotorized paths that connect with urban trails

Suburban

Regional parks and recreation areas
Rain gardens and bioswales along roads and parking lots
Conservancy land
Trails
School yard habitat

Rural

Agricultural land
Riparian corridors
Natural areas, such as wetlands, woodlands, and prairies

What is the Southeast Michigan Green Infrastructure Vision?

Southeast Michigan is home to over 4.7 million people, covering 4,600 square miles and seven counties with 180,000 acres of parks and almost 100,000 acres of water. The region uniquely stretches along the Great Lakes corridor from Lake Huron to the connecting channels of the St. Clair River, Lake St. Clair, the Detroit River, and finally along the western shores of Lake Erie. These distinctive features create vast opportunities to explore green infrastructure opportunities within the region and along this corridor.

While much of the land use is single-family residential, there are still significant areas of agricultural land in the region and large quantities of vacant land. Local governments and residents of Southeast Michigan recognize the value of green infrastructure elements. This vision incorporates those values and sets forth opportunities for protecting and expanding green infrastructure elements, restoring degraded natural areas, and making connections between green infrastructure features to ensure a viable future.

"Natural resources are critical to the reinvention of Michigan."

Keith Creagh
Director of the Michigan Department of Natural Resources

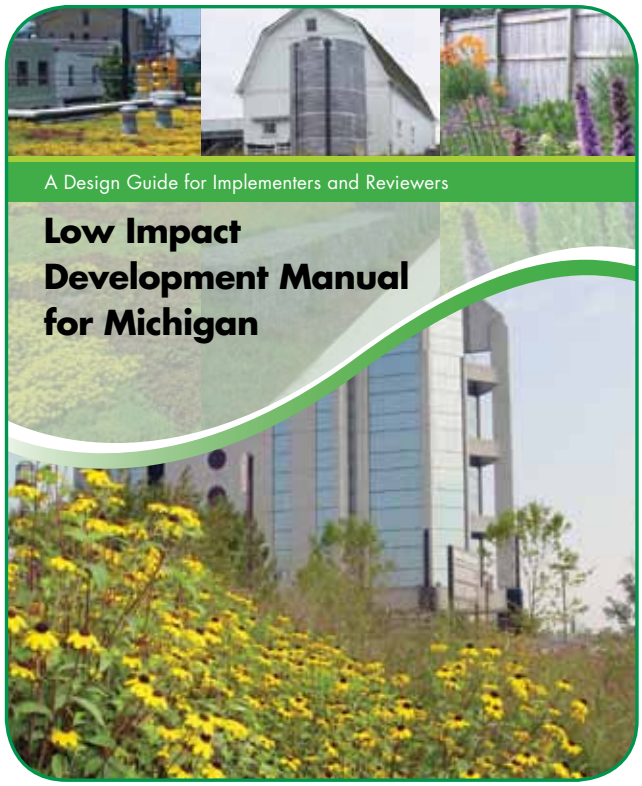
The goal is to create a regional vision that ties all of the components of our region's green infrastructure together into an identified system. To accomplish this, for the first time, Southeast Michigan benchmarked the green infrastructure that we have, visioned where we want to go, and developed policy recommendations on how to get there.

What are the benefits of Green Infrastructure?

Green infrastructure provides social, environmental, and economic benefits to Southeast Michigan:

- **Water quality:** Green infrastructure reduces the amount of polluted stormwater runoff entering our rivers and lakes. In cities with combined sewer systems, green infrastructure is being used to reduce runoff into the combined sewer system as a mechanism to impact system overflows.
- **Flooding:** Green infrastructure lessens flood risk by slowing and reducing stormwater runoff into waterways.
- **Water supply:** Harvesting rainwater is good for outdoor irrigation and some indoor uses. Water infiltrated into the soil recharges groundwater and increases flow into rivers.
- **Quality of life:** Green infrastructure provides aesthetic benefits to the area by increasing the amount of a community's green space.
- **Recreation**: Green infrastructure can provide recreational and tourism opportunities including increased access to hiking, hunting, fishing, and bird watching.

- **Economic:** Green infrastructure can increase residential property values located near trails, parks, and waterways. In addition, green infrastructure is one way to attract and retain the knowledge-based workforce in our region.
- **Traffic calming:** Green infrastructure techniques along roads not only reduce stormwater pollution, but can also be used to slow traffic and provide a buffer between the roadway and pedestrians.
- **Habitat improvements and linkages:** Green infrastructure can provide needed links in habitat corridors to strengthen and support rare and important areas in the community.
- **Air quality:** Increased vegetation positively impacts air quality through carbon sequestration, in addition to the reduction of fugitive dust and air pollution.
- **Health:** Green infrastructure encourages outdoor physical activity, which leads to a healthier population and reduction in chronic diseases.
- **Save money:** Green infrastructure can reduce a community's infrastructure costs by using natural systems rather than built systems.
- **Energy and climate:** Implementing techniques such as green roofs, increased tree plantings around buildings, converting turfgrass to grow zones, and reclaiming stormwater for use onsite can reduce energy consumption and save money.



The Low Impact Development (LID)Manual for the State of Michigan is a helpful guide to those wanting technical information on implementing rain gardens, bioswales, pervious pavement, and other LID techniques.

Moving toward implementation

Communities across Southeast Michigan have been actively involved in planning and implementation of green infrastructure for many years. These activities include:

- Regional, county, and local parks and recreation plans,
- State grant priority setting (e.g., Michigan Natural Resources Trust Fund),
- Stormwater management activities,
- Watershed management plans,
- Nonmotorized (biking and walking) planning and projects,
- Capital improvement programs,
- State Pure Michigan campaign, and
- Regional water quality/air quality campaigns.

This vision sets the stage for the next step in green infrastructure – the integration of these activities both throughout a community and within the various levels of government and numerous stakeholder initiatives.

"Natural infrastructure is a win-win fortifying healthy lands and waters: the backbone of our economy and quality of life."

Helen Taylor, Director
The Nature Conservancy in Michigan

Quantity of Green Infrastructure

The amount of green infrastructure is an important consideration in developing the green infrastructure vision. It's important that the right mix of green infrastructure is available to meet multiple desired outcomes – recreation, quality of life, protection of our lakes and rivers, and so on. Green infrastructure can be broken into various categories – both natural and manmade. This section focuses on total green infrastructure Southeast Michigan, as well as breakdown for tree canopy, wetlands, parks, agricultural lands, riparian corridors, and constructed green infrastructure.

Existing Green Infrastructure

Green infrastructure includes natural areas and built green infrastructure. In benchmarking the amount of green infrastructure in the region, SEMCOG relied primarily on the land cover information from 2010 aerial imagery and SEMCOG's land use information. For this analysis, green infrastructure includes all tree canopies in the region, as well as agricultural areas and wetlands. This analysis of total green infrastructure does not quantify the amount of built green infrastructure, such as rain gardens or bioswales. However, when taking a regional and county benchmark, it is anticipated that the geographic acreage of the built green infrastructure is small in comparison, but is critical in the overall green infrastructure fabric for the critical role it plays, including protecting the region's water quality.

Table 2 summarizes green infrastructure acreage in Southeast Michigan. It includes the percentage of the total area, as well as the percentage of the green infrastructure that is tree canopy. For example, Monroe County has 67 percent green infrastructure, with 28 percent of that number coming from tree canopy. That is because much of the green infrastructure network in Monroe County is agricultural. In comparison, 86 percent of green infrastructure in Oakland County comes from tree canopy. This can be linked to the large amounts of recreation land, natural areas, and communities with high tree canopy.

Table 2

Percent Green Infrastructure by County

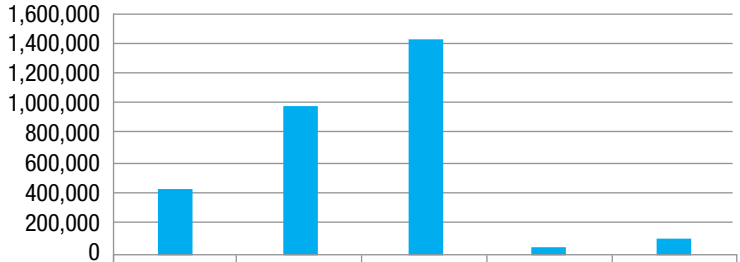
Area	Total Land Cover Area (Acres)	Percent Green Infrastructure	Percent Tree Canopy of Total GI
Livingston	374,633	61%	63%
Macomb	309.977	45%	53%
Monroe	359,557	67%	28%
Oakland	580,501	45%	86%
St. Clair	467,236	67%	45%
Washtenaw	462,342	62%	51%
Wayne	395,303	30%	81%
Wayne, excluding Detroit	305,376	32%	81%
Detroit	89,187	19%	85%
Region	2,949,548	54%	56%

Tree Canopy

Tree canopy is one element of green infrastructure that supports numerous outcomes. Trees provide necessary habitat; improve aesthetics; add to a pedestrian friendly downtown; increase local property values, including local business revenue; and provide water quality and air quality benefits.

Table 3

Land Cover, Southeast Michigan



	Impervious	Tree Canopy	Open Space	Bare	Water
Area (acres)	410,074	986,619	1,431,372	28,685	91,551
Percent (%)	14%	33%	49%	1%	3%

Table 3 summarizes land cover for the region. The regional land cover estimates a 33 percent tree canopy for Southeast Michigan. Tree canopy within each county ranges from a low of 20 percent to a high of 44 percent (Table 4).

At the community level, there are many urbanized communities with tree canopies between six and 10 percent. Figure 2 highlights the percent tree canopy by census block group.

Table 4

Percentage Tree Canopy by County

Area	Tree Canopy (%)
Livingston	41
Macomb	26
Monroe	20
Oakland	44
St. Clair	32
Washtenaw	35
Wayne	24
Wayne, excluding Detroit	26
Detroit	16

American Forests, the oldest national nonprofit conservation organization in the country, recommends an overall tree canopy of 40 percent, with tree canopy recommendations for specific areas of a region, including 50 percent tree canopy in suburban residential areas, 25 percent in urban residential areas, and 15 percent tree canopy in central business districts[1].

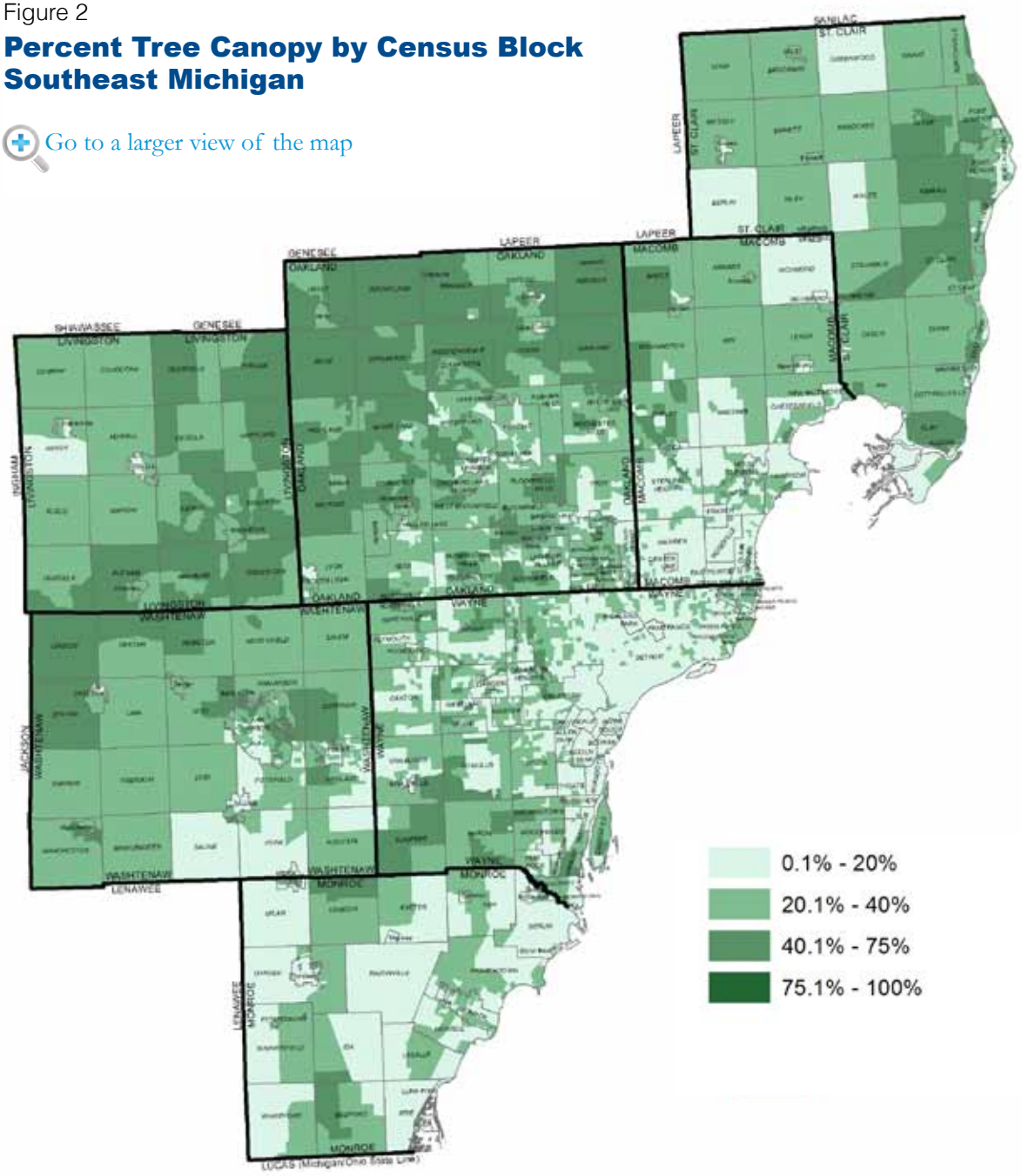
Regional Policy

Southeast Michigan will strive to meet the standards developed by American Forests, including a 40 percent tree canopy for the region. Increases in tree canopy will be focused in urban areas where tree canopy is below 20 percent, as well as specific land uses such as around industrial property, within riparian areas, central business districts, and along roadways and parking lots.

Figure 2

Percent Tree Canopy by Census Block Southeast Michigan

Go to a larger view of the map



Wetlands

Wetlands are a critical element of the green infrastructure fabric in Southeast Michigan. They serve numerous functions, including enhancing wildlife and fish habitat, protecting water quality, reducing localized flooding, and increasing recreational opportunities. Wetlands can be found in all land use types within the region, such as parks, as well as institutional, residential, industrial, and commercial areas.

SEMCOG estimated the amount of wetlands in the region based on a process using three data sources: National Wetland Inventory maps, hydric soils, and land cover, as mapped by the Michigan Department of Natural Resources' Michigan Resource Inventory System (MIRIS), through interpretation of aerial photographs. Where two of these data sources overlapped and through aerial verification, SEMCOG identified those areas as potential wetlands. Table 5 summarizes the potential wetlands in the region.

Green infrastructure alternatives for protecting and restoring wetlands include expanding existing wetlands, creating buffers in upland areas adjacent to high quality or sensitive wetlands, and constructing green infrastructure to reduce runoff to wetlands. One way to implement alternatives is to use vacant property near wetlands to construct additional green infrastructure. (Vacant land is defined as a land use that was commercial, industrial, or residential, but no longer has a structure on-site.)

The State of Michigan has regulatory control of all wetlands located contiguous to the Great Lakes, an inland lake, pond, river, or stream, as well as noncontiguous wetlands greater than five acres in size. Local control of these resources continues to be one way to protect the resources, and can include development of ordinances and the site plan review process.

Regional Policies

Seek opportunities to protect existing quality wetlands by using local development options, easements, and continuing the State of Michigan wetland protection program.

Buffer highly sensitive wetland areas and restore areas adjacent to wetlands using opportunities such as vacant land adjacent to existing wetlands.

Use green infrastructure to manage stormwater runoff and protect existing high-quality wetlands and natural areas from pollution and runoff volume.

Table 5

Potential Wetlands and Adjacent Vacant Land by County

Area	Wetlands [Approx] (acres)	Adjacent Vacant Land (acres)
Livingston	60,000	39,826
Macomb	26,000	27,906
Monroe	20,000	7,739
Oakland	77,000	51,450
St. Clair	62,000	29,050
Washtenaw	53,000	35,656
Wayne	42,000	25,233
Out Wayne	42,000	25,232
Detroit	100	1

Michigan's wetland statute, Part 303:

Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, defines a wetland as "land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation or aquatic life, and is commonly referred to as a bog, swamp, or marsh." The definition applies to public and private lands regardless of zoning or ownership.

Source: Michigan Department of Natural Resources

Southeast Michigan has a 33 percent tree canopy. However, in many urban communities, tree canopy is as low as six percent.

Table 6
Park Acreage by County

Area	Total Parks Area (Acres)	Total Parks Area (Acres) Greater than 200 Acres	Park Acres per 1,000 Residents	Vacant Land Adjacent to Parks (Acres)
Livingston	29,500	16,477	163	5,645
Macomb	14,184	9,111	17	2,164
Monroe	7,943	3,122	52	568
Oakland	61,053	36,585	51	7,942
St. Clair	24,955	17,065	153	3,571
Washtenaw	33,499	13,889	97	3,980
Wayne	25,899	13,493	14	2,082
Out Wayne	21,391	11,192	19	1,952
Detroit	4,814	2,300	7	130
Region	197,032	109,742	42	25,952

Parks

A large portion of the green infrastructure in Southeast Michigan, and the one most often recognized by the public, are parks. Parks in Southeast Michigan can be owned privately, by local communities, as well as by counties, the Huron Clinton Metropolitan Authority, State of Michigan, and federal agencies. During stakeholder visioning sessions, parks were listed as the top green infrastructure technique that stakeholders believe provides the highest economic value to their area.

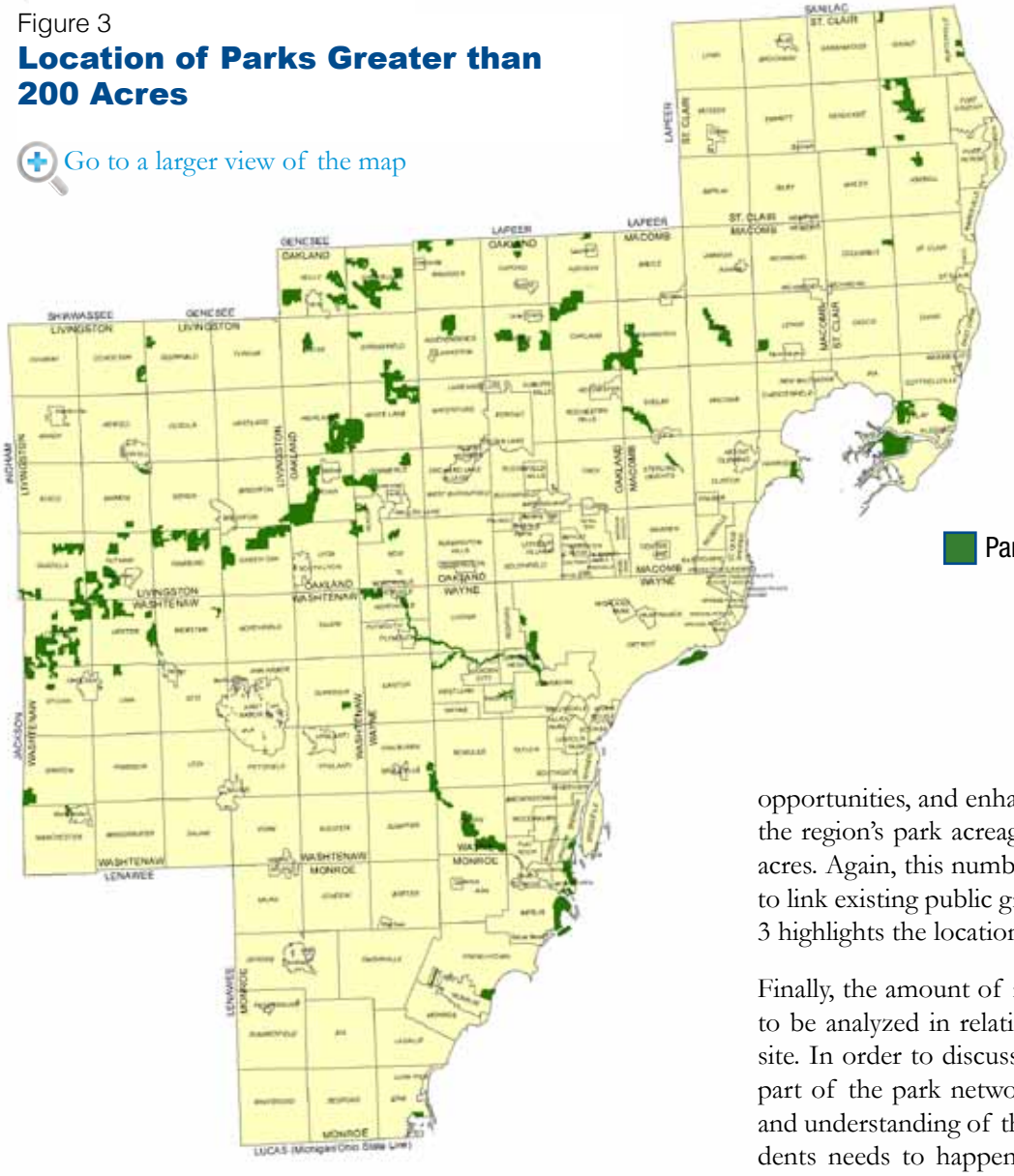
Southeast Michigan contains an estimated 197,000 acres of public parkland, with an estimate of 42 park acres per 1,000 residents. Table 6 summarizes this information by county. Park acres per 1,000 residents is one way to compare information across counties and outside of the region. Within Southeast Michigan, there is a wide range, from seven to 163 park acres per 1,000 residents. Information from the National Parks and Recreation Association has a median of 9.6 park acres per 1,000 residents, based upon 145 responders to their database[2]. This could include regions, cities, counties, and other entities. For comparison, urban counties within the State of Indiana range from four to 21 park acres per 1,000 residents.

The City of Detroit presents a different type of situation when it comes to quantity of parks. There are 316 total parks in the city, but 244, or 1,505 acres of which, have been closed between 2008 and 2013. When the closed parks are removed from the park catalog, there are 4.6 park acres per 1,000 residents. In addition, there are 32 limited maintenance parks accounting for 546 acres. After eliminating both closed and limited maintenance parks, there are 3.9 park acres per 1,000 residents.

Figure 3

Location of Parks Greater than 200 Acres

Go to a larger view of the map



Parks greater than 200 acres

This analysis, along with stakeholder input, indicates that new parks are not necessarily needed when looking at the regional picture (although at the local level, small pocket parks may still be needed). The analysis and stakeholder input does show the need to better link existing parks and natural areas together. Data such as vacant land adjacent to parks shows that there are opportunities to add to existing parks to link existing parks to each other, better enclose a park's geographic boundary, incorporate sensitive environmental resources, and allow for additional or new recreational uses. Table 6 summarizes the amount of vacant land located adjacent to parks.

Table 6 also summarizes the amount of larger parks in the region. Larger park areas provide multiple benefits to the region, including increased opportunities to efficiently manage and maintain the property, increased recreational opportunities, and enhanced habitat value. Almost half of the region's park acreage is within parks greater than 200 acres. Again, this number can be increased as we continue to link existing public green infrastructure together. Figure 3 highlights the location of parks greater than 200 acres.

Finally, the amount of recreation land in the region needs to be analyzed in relation to the programs offered at the site. In order to discuss increasing green infrastructure as part of the park network, a more thorough coordination and understanding of the current and future needs of residents needs to happen at a systematic level. The public doesn't necessarily "care" who owns the park, but often the owners of the park work in isolation in ensuring facilities and programs within their jurisdiction.

Regional Policies

Focus increasing protected green infrastructure along existing parks, natural areas, and riparian corridors. Opportunities to increase green infrastructure in these areas should be focused around ecologically significant areas, as well as vacant lots and large lots.

Protected green infrastructure should include large tracts of land, which provide habitat value, recreational opportunities, and quality-of-life benefits.

Conduct a regional assessment of recreational needs for the region to ensure systematic recreation planning.

Agricultural Land and Community Gardens

Agricultural land and community gardens both provide a local food source to Southeast Michigan, as well as economic benefits for the agricultural industry. Overall, Southeast Michigan has 434,055 acres of agricultural lands (Table 7). The 5,662 farmers in the SEMCOG region sold $395 million in products in 2007. Agricultural land also enhances sense of place within a community and region. One example is the large number of orchards and u-pick farms.

In addition to the benefits of agricultural land in the green infrastructure network, we must also ensure that these agricultural practices do not negatively impact other environmental assets in the region. This includes local water resources, as well as the Great Lakes. Fertilizers, pesticides, and sediment all have the potential to negatively impact the environment. However, the use of Generally Accepted Agricultural Management Practices, or GAAMPs, can be implemented to minimize these impacts.

Regional Policies

Preservation of high-valued agricultural lands and development of community gardens is encouraged as a tool to provide a local food network for Southeast Michigan and continue the economic viability of the agricultural industry.

Agricultural land should include the use of Generally Accepted Agricultural Management Practices, including riparian buffers, to reduce the impacts of agricultural practices on local water resources and the Great Lakes.

Table 7

Agricultural Land by County

Area	Agricultural Land (Acres)
Livingston	60,202
Macomb	38,338
Monroe	123,442
Oakland	11,461
St. Clair	107,546
Washtenaw	84,790
Wayne	8,276
Wayne, excluding Detroit	8,276
Detroit	0
Total	434,055

Riparian Corridor

Riparian corridors are the land adjacent to rivers and lakes. These areas provide important green infrastructure value to Southeast Michigan, including protecting local rivers and lakes, providing habitat corridors to animals, offering access to local waterways, and providing the potential for recreation such as nonmotorized trails.

The width of riparian corridors change based on typography, but this regional analysis focused on the riparian corridor located 50 feet on each side of the center of the river. Table 8 summarizes the riparian corridor area as more than 53,000 acres in Southeast Michigan, with 28,000 acres being tree canopy and 15,000 acres being open space. Because much of this open space is likely grass, it provides an opportunity to increase tree canopy within the riparian corridor. Tree canopy, in particular, provides essential ecological services within the riparian corridor including shading (cooling) the river/lake, and helping prevent bank erosion through the deep roots provided by trees. Both of these ecological benefits enhance water quality, reduce sediment deposition, and improve in-stream bug and fish population diversity.

An additional 37,000 acres in Southeast Michigan are adjacent to rivers and lakes (Table 8). (This acreage does extend outside of the 50-foot buffer.) This vacant land provides additional opportunity for increasing protected green infrastructure in order to provide increased public access to waterways, link protected riparian corridors together, and connect riparian corridors to upland parks and natural areas.

Table 8

Riparian Corridors by County

Area	Riparian Corridor Area (Acres)	Tree Canopy Area (Acres)	Open Space Area (Acres)	Adjacent Vacant Land (Acres)
Livingston	8,135	3,781	3,533	9,018
Macomb	6,406	3,719	1,621	3,120
Monroe	6,387	3,237	2,021	2,223
Oakland	8,549	4,904	2,298	9,929
St. Clair	9,798	5,641	2,729	4,714
Washtenaw	8,502	4,377	2,762	6,404
Wayne	5,657	3,023	1,021	1,857
Out Wayne	5,143	2,739	962	1,845
Detroit	514	284	59	12
Region	53,434	28,682	15,985	37,265

Regional Policies

Increase protected green infrastructure along existing parks, natural areas, and riparian corridors. Opportunities should focus around ecological significant areas as well as vacant lots and large lots.

Seek opportunities to increase tree canopy in open space areas along riparian corridors as a method to shade rivers and lakes, prevent erosion, and increase aesthetics.

Increase connections within riparian corridors. Connect to natural areas and parks using vacant properties to enhance wildlife and recreational corridors.

Constructed Green Infrastructure

Within the integrated network of green infrastructure are constructed green infrastructure techniques, sometimes referred to as low impact development techniques. This category of green infrastructure includes constructed practices such as rain gardens, bioswales, grow zones, permeable pavement, and even community gardens.

These constructed practices play an important role within the green infrastructure network providing ecological, environmental, economic, and social benefits. For example, these techniques primarily work to improve water quality by reducing stormwater runoff entering our water resources; however, their characteristics and designs also lead to greater economic value of adjacent properties, improved recreational opportunities with demonstrated habitat enhancements.

The recommended quantity of green infrastructure techniques is linked to the percentage of impervious surfaces in urban areas and subwatersheds. High impervious areas result in increased stormwater runoff pollutants, volume, and flow rates. Constructed green infrastructure should be installed to manage runoff from all impervious surfaces. When considering retrofitting impervious surfaces with green infrastructure, priorities should focus in those subwatersheds with impervious cover greater than 10 percent. These details and analyses are described in the Water chapter.

The connection between constructed green infrastructure techniques and improved water quality, higher economic value, reduced infrastructure costs, enhanced recreational opportunities, and advanced social benefits is demonstrated through numerous comparisons. The overarching theme for achieving these benefits starts with incrementally implementing green infrastructure in highly impervious areas. Priority areas for constructed green infrastructure techniques include roadways, institutional properties, downtown areas, and public and private parking lots.

Regional Policies

Seek opportunities to construct green infrastructure techniques in priority areas including roadways, institutional properties, downtown areas, and large parking lots.

Demonstrate the benefits of green infrastructure by implementing constructed green infrastructure on local government property.

Encourage constructed green infrastructure opportunities in local government plans and ordinances.

Quality of Green Infrastructure

Source: Michigan Department of Natural Resources

Southeast Michigan offers diverse types of green infrastructure in the region. In fact, the region possesses certain qualities that have global significance, including the St. Clair River Delta, which is one of the largest freshwater deltas on Earth; coastal marshes that have the biological productivity rivaling that of tropical rainforests; and tallgrass prairie and oak savanna ecosystems that contain hundreds of plant species. Figure 4 highlights the presettlement land cover for Southeast Michigan.

In addition to these rare areas, the region has hundreds of acres of quality wetlands and woodlands. These wetlands and woodlands comprise much of the green infrastructure network and can be found on both public and private property.

Numerous threats to quality habitat exist, including invasive species, habitat fragmentation resulting from development, and stormwater runoff. Preservation, restoration, and proper maintenance needs to be integrated into the green infrastructure network.

Southeast Michigan's Unique Places

Southeast Michigan was largely forested with pockets of prairies, oak savannas, wetlands, and marshes in the 1800s. The development of the region has led to large reductions of natural areas. For example, less than one percent of the original prairies and oak savannas remain in the region[1]. This has led to a number of native ecosystems to be globally imperiled, including:

- Great Lakes marsh,
- Lakeplain prairie, and
- Oak savanna.

In order to protect these unique places, the State of Michigan has designated certain areas within the state as "State Designated Natural Areas." Most of these areas are located on state property and are protected. Table 9 notes the state designated natural areas in Southeast Michigan.

Table 9

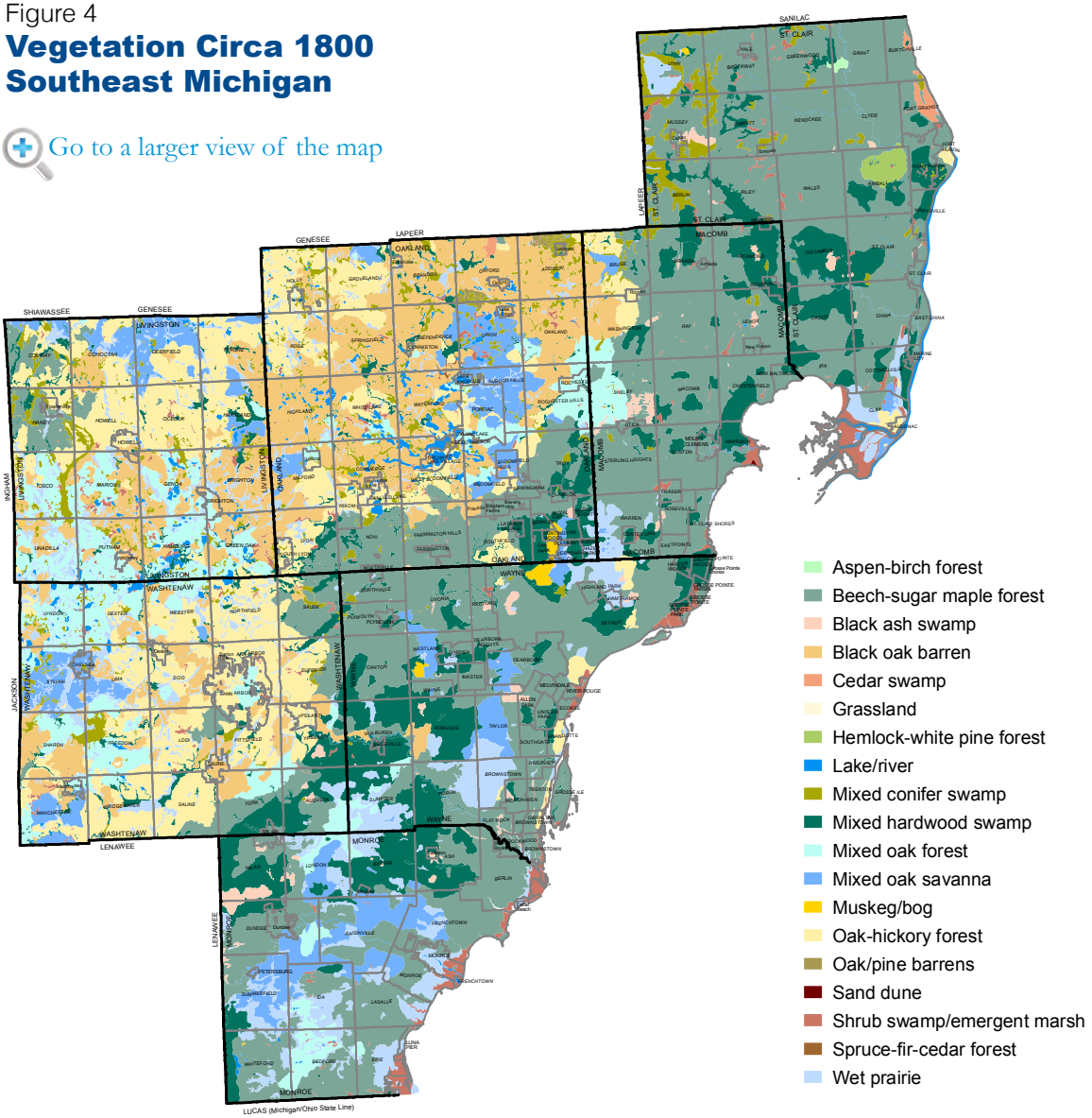
State Designated Natural Areas

Name	Location	County
Algonac Prairie and Savanna	Algonac State Park	St. Clair County
Dickinson Island/Harsen's Island Marshes	St. Clair Flats Wildlife Area	St. Clair County
St. John's Wet Prairie	St. Clair Flats Wildlife Area	St. Clair County
Shadbush Nature Study Area	Riverbend Park (formerly Rochester-Utica State Recreation Area)	Macomb County
Proud Lake Nature Study Area	Proud Lake Recreation Area	Oakland County
Minong-Petersburg Prairie	Petersburg State Game Area	Monroe County
Haven Hill Natural Area	Highland Recreation Area	Oakland County
Black Spruce Bog	Waterloo Recreation Area	Washtenaw/Jackson Counties

Figure 4

Vegetation Circa 1800 Southeast Michigan

Go to a larger view of the map



The Haven Hill Natural Area is also designated as a Natural National Landmark. The 5,900-acre area located in Oakland County, contains all forest types found in southern Michigan including swamp forest of tamarack, cedar, beech-maple forest, oak-hickory forest, and mixed hardwood forest. Additionally, the area is home to over 100 bird species and 17 species of mammals.

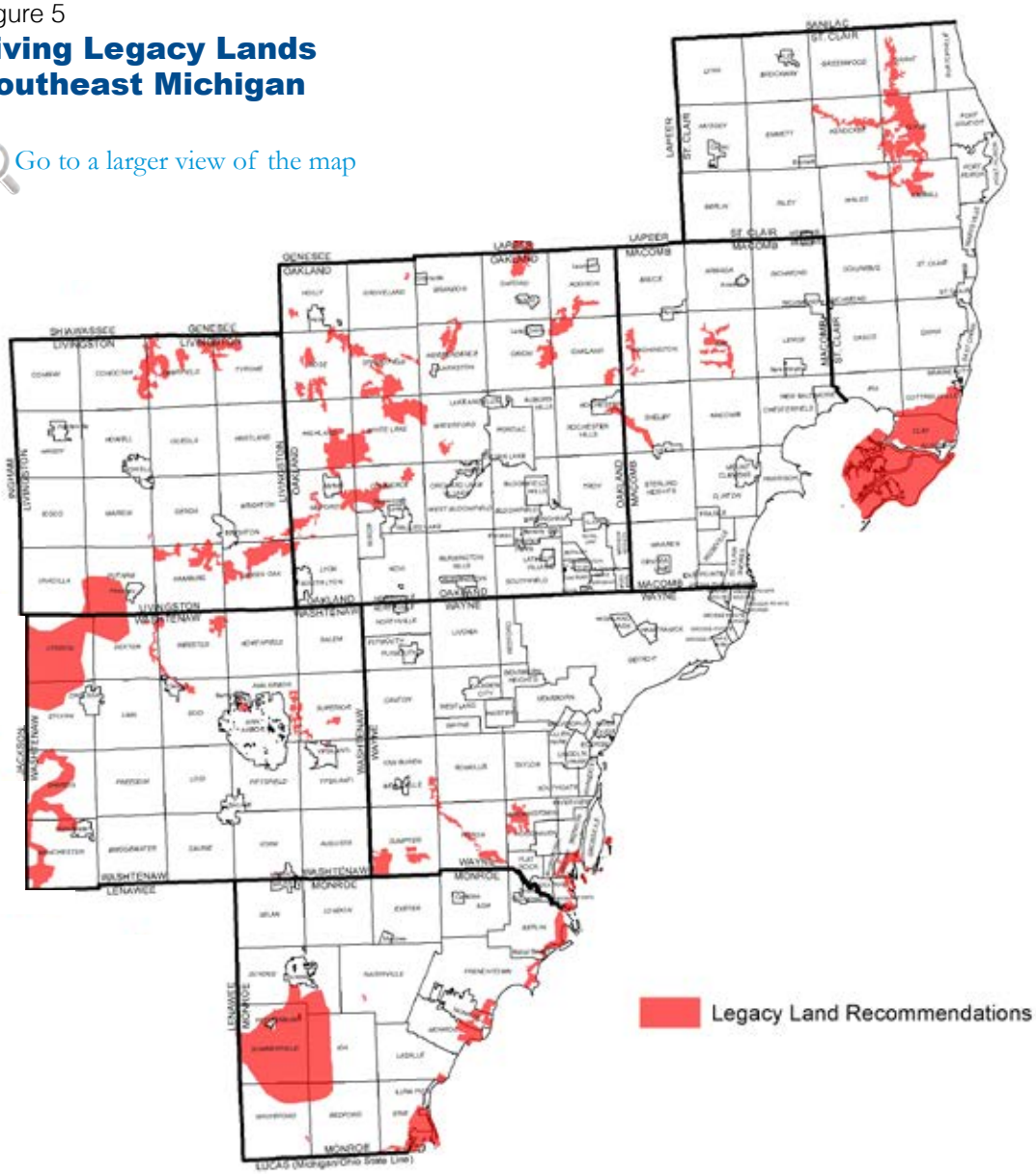
The National Natural Landmarks Program was established in 1962 and is administered by the National Parks Service. It encourages and recognizes the conservation of significant areas of natural history. It is the only natural areas program of national scope that identifies and recognizes the best examples of biological and geological features in both public and private ownership. Michigan hosts 12 of the 600 natural national landmarks.

The Michigan Department of Natural Resources (MDNR) also participates in the Living Legacies Initiative. Through this program, MDNR is working with many partners to identify, restore, and manage those natural places in Michigan that, together, best represent the diversity of Michigan's biological heritage. Living Legacies is about making sure that these many different natural areas and the life within them become a long-lasting legacy shared with residents and visitors. Figure 5 highlights Living Legacies lands in Southeast Michigan.

Figure 5

Living Legacy Lands Southeast Michigan

Go to a larger view of the map



Source: Michigan Department of Natural Resources

Wetlands and Woodlands

In addition to these rare natural areas, Southeast Michigan abounds with other natural resources that provide valuable functions to the region. This includes wetlands such as marsh, wet meadow, prairie fen, bog, swamp, vernal pools, and floodplain forests. Each of these is distinguished by its vegetation, hydrology, and chemistry.

Forests were the dominating vegetation in Southeast Michigan prior to European settlement. Hardwood swamp, conifer swamp, shrub swamp, and floodplain forest developed in low areas and along rivers. In upland areas, oak barrens and forests of beech maple and oak hickory grew. Today, only small remnants of these forest communities remain. In less developed areas of the region, large stances of woodlands and wetlands remain. This is especially true in some of Southeast Michigan's large recreation areas.

It's important not to overlook the role smaller wetlands, ponds, and stands of trees provide in the more urban environment. While technically, the ecological role these lands play may be less, they also provide important environmental, social, and economic benefits in that area.

Restoring historical wetland and woodlands areas is one way to connect the green infrastructure network. These connections help protect high-quality areas, allow for habitat linkages, and provide additional recreational opportunities.

Regional Policies

Seek opportunities to protect and restore unique natural areas in Southeast Michigan, including buffering high quality and rare natural areas to enhance protection of these resources. Work strategically with the Michigan Department of Natural Resources, the Nature Conservancy, and local land conservancies to coordinate activities.

Use restoration of historical wetlands and woodlands as an opportunity to link the green infrastructure network.

Preserve and restore smaller wetlands and woodlots within urban environments to provide local environmental, social, and economic benefits.

Unique Natural Areas in Southeast Michigan

Lake St. Clair Metropark Boardwalk and Coastal Marshland Restoration

Great Lakes Marshes are globally imperiled ecosystems that are at high risk for extinction. This $1.5-million project was one of the largest Great Lakes Marsh restoration projects in Southeast Michigan. It allows people to explore and experience the marsh in-depth and gain a fantastic educational experience. The heart of the project is an observation deck and a 700-foot boardwalk that cuts directly through the marshlands, giving visitors the opportunity to see and hear wildlife from within the marsh.

Detroit River International Wildlife Refuge

The Detroit River International Wildlife Refuge is the only International Wildlife Refuge in North America. The refuge includes islands, coastal wetlands, marshes, shoals, and waterfront lands along 48 miles of Detroit River and Western Lake Erie shorelines. The refuge includes Humbug Marsh, which was designated as Michigan's first "Wetland of International Importance" by the Ramsar Convention on Wetlands in 2010. Overall, the refuge protects habitat for 29 species of waterfowl, 65 kinds of fish, and 300 species of migratory birds. Recreational opportunities include hunting, fishing, wildlife viewing, photography, and environmental education.

St. Clair River Delta

The St. Clair River Delta is a unique feature in the Great Lakes. The delta is made up of many islands, bays, and distribution channels that have created a huge surface area of coastline supporting one of the largest coastal wetland systems in the Great Lakes. In addition, this area has one of the largest clusters of lakeplain prairie in the Great Lakes. Lakeplain prairie is a globally imperiled ecosystem. Historically, 158,000 acres of lakeplain prairie existed in Michigan. Today, only 745 acres, or 0.6 percent of the historical prairie, remain. Close to 160 different kinds of plants, including many showy prairie wildflowers such as blazing star and tall sun flower and grasses, such as big blue stem and Indian grass, grow in this part of the St. Clair River Delta.

Petersburg State Game Area

Petersburg State Game Area was identified as one of the last and largest contiguous areas of lakeplain praire and oak savanna in Southeast Michigan. Petersburg State Game Area's rare natural communities are home to many special plants and animals. For example, the game area is a release site for federally endangered Karner Blue Butterflies, which are captive-reared at the Detroit Zoo. The primary host plant for this butterfly is wild lupine; it is still found in abundance at Petersburg State Game Area.

Managing Our Natural Areas

Invasive species. More than any other environmental stressor, invasive species have the potential to do major damage to Southeast Michigan's natural areas. These organisms generally have no natural predators in the region to keep their numbers from expanding rapidly. Rapid population expansion of an invasive species can have a detrimental effect on the region's natural areas by attacking and eliminating native plant species that have strong habitat values as providers of food, shelter, spawning, and nursery opportunities. Examples of invasive plants include Autumn Olive, Black Locust, Common Buckthorn, Glossy Buckthorn, Japanese Barberry, Japanese Knotweed, Oriental Bittersweet, Phragmites, Purple Loosestrife, and Swallow-Wort.

Phragmites: Crowding Out Natural Areas

Phragmites australis (Common reed) is a highly invasive plant species growing in Southeast Michigan for about 20 years. Phragmites can be found in varying density throughout the region in road ditches, wetlands, inland lakes and their channels; along rivers, streams, and county drains; as well as along the shores, channels, islands, and wetlands of the Great Lakes.

Large stands of Phragmites have replaced high-quality communities of native plants over tens of thousands of acres of Michigan wetlands and coastal areas. The rapid expansion of this variety of Phragmites has resulted in adverse ecological, economic, and social impacts on the natural resources and people of the Great Lakes, including:

- Phragmites' impenetrable root mass chokes off water bodies, restricting access, and eliminating habitat for fish and wildlife.
- Phragmites restricts recreational activity – can eliminate canoeing and kayaking.
- The presence of Phragmites in marsh areas can restrict views of scenic vistas, leading to reduction in residential property values.
- Phragmites reduces wildlife diversity – reducing the quality of recreational opportunities.
- Phragmites is a visual hazard to public safety, due to diminished sight lines along waterways, trails, and road intersections.
- Phragmites threatens public safety as a fire hazard and contributes to localized flooding.

This invasive species has a strong capacity to spread by rhizomes (root system) and, once established in wetland ecosystems, becomes quite exclusive, crowding out native species. The nature of this invasive plant is such that wetlands and other natural areas invaded by this species cannot provide the benefits that healthy wetland communities normally provide, including fish and wildlife habitat, biodiversity, and a native plant community resiliency.

Emerald Ash Borer: Impacting our Green Infrastructure Network

The Emerald Ash Borer is an exotic beetle that was discovered near Detroit in 2002. Originating from Asia, this was the first time the beetle was seen outside of the eastern hemisphere. It is probable that the beetle arrived in wood packaging material from shipping containers and, once here, began to establish itself in the local landscape, free of predators. Ash trees are the preferred host of this beetle and, without any natural predators, millions of ash trees in Southeast Michigan have been decimated or are severely at risk. Since 2002, it has killed more than 30 million ash trees in Southeast Michigan and threatens 700 million ash trees throughout the state[7]. As a result, the State of Michigan is under quarantine restricting the movement of firewood or the planting of ash trees anywhere in Michigan. To date, Emerald Ash Borer has been found in 20 other states and Canada.

Invasive animals also threaten the green infrastructure network. Examples of invasive animals include Asian Long-horned Beetle, Hemlock Woolly Adelgid, Emerald Ashborer, Rusty Crawfish, and the potential threat of the Asian Carp.

MDNR and Michigan Natural Features Inventory developed goals and a suggested process for managing invasive species, including:

- Leadership and coordination throughout the process,
- Assess the threat,
- Prevention – the first line of defense,
- Early detection and rapid response – the second line of defense,
- Control, management, and restoration – the third line of defense, and
- Education and outreach to various stakeholders.[3]

Habitat fragmentation. Fragmentation of the green infrastructure network has occurred over time. This is due largely to the amount of impervious surfaces in Southeast Michigan; it accounts for 14 percent of land use, or 400,000 acres. Most of the fragmentation is in the urban area of the region. Fragmentation reduces the connectivity of the network and can lead to increased risk of environmental threats to natural areas, including invasive species and stormwater runoff.

Ensuring conservation planning as part of the development process for commercial, industrial, residential, and roads is a way to manage fragmentation. For example, the Michigan Department of Transportation is currently developing a conservation planning process as part of I-75 reconstruction in Monroe County. Habitat fragmentation will specifically be addressed in this study. Also, by mapping the green infrastructure network and highlighting areas of significant importance, local governments and developers can use this information during the planning process.

Stormwater runoff. Impervious surfaces impact fragmentation and, as a result, negatively impact environmental resources. Stormwater runoff is water that runs off of these impervious surfaces after a rainstorm or snowmelt. It carries pollutants and often adds an unnatural amount of water into local water resources. In order to use our environmental resources for recreational purposes, stormwater runoff needs to be managed to reduce pollution to our rivers and lakes.

Constructed green infrastructure can specifically be applied to manage stormwater runoff. The Water chapter of this vision document provides more detail on stormwater runoff, management options, and areas of opportunity.

There are just over 1,800 species of native Michigan plants. Of these, 31 are considered endangered and 210 are threatened. The Michigan Natural Features Inventory has compiled a database with information and images for over 400 rare plants species in Michigan. According to this database, each Southeast Michigan county has between 34-79 threatened and endangered species.

– To learn more about specific species, use the database at: **www.mnfi.anr.msu.edu/explorer/search.cfm.**

Regional Policies

Ensure that protected areas include maintenance plans for constructed green infrastructure, as well as maintaining the quality of natural areas such as managing invasive species (e.g., invasive Phragmites).

Incorporate conservation planning into the development process, including local ordinances and engineering standards to reduce the impacts of fragmenting the green infrastructure network.

Seek opportunities to reconnect green infrastructure areas that are currently fragmented.

Use constructed green infrastructure to manage the impacts of stormwater runoff to natural areas.

Accessibility to the Green Infrastructure Network

Source: Michigan Department of Natural Resources

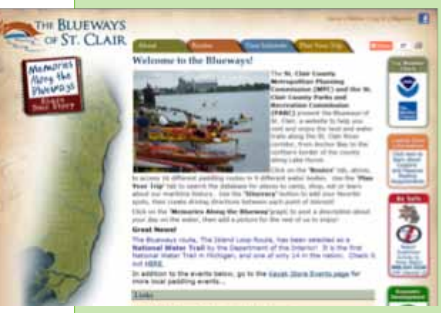
The green infrastructure network includes both private and public land. It can be located in parks, along roadways, agricultural land, and riparian corridors. The network provides numerous functions in Southeast Michigan, and a critical component is the accessibility of the public to the green infrastructure.

Most of the green infrastructure network is in private ownership. In Southeast Michigan, 87 percent of the over one million acres of green infrastructure is privately held. The amount of private green infrastructure is higher in rural areas due largely to the dominance of agricultural land (as much as 97 percent in St. Clair County). As the landscape changes to more suburban and urban land use types, the percent of publicly-owned green infrastructure increases. In Detroit, 38 percent of the green infrastructure is in public ownership. As gaps in the public green infrastructure network are identified, strategic investment in the public green infrastructure network can be implemented.

Additional analysis looked at various aspects of accessibility, including:

- Access to public parks,
- Access to public parks over 200 acres,
- Access as part of attracting and retaining young professionals,
- Using green infrastructure to provide access to waterways,
- Access to trails, and
- Universal design.

Blueways of St. Clair



The water trails system in St. Clair County does an excellent job of combining green infrastructure connectivity, accessibility, economic development, and marketing into one holistic program. The program connects urban and rural areas with 16 water trails and achieves accessibility with 26 points of beaches, kayak/boat launches, or public access sites, including four handicapped-accessible kayak launches. St. Clair County is marketing their water trails through a hands-on Blueways of St. Clair Web site that highlights the different paddling routes and contains a database for places to camp, shop, eat, or learn about maritime history. Finally, the Island Loop Route in St. Clair County has earned National Water Trail status. This again enhances the visibility of their unique program.

Detroit Strategic Framework

The City of Detroit recently completed a 24-month-long public process to develop a comprehensive strategic framework that guides decision-making around a shared vision that improves overall quality of life. This vision, known as Detroit Future City, recommends specific actions for working towards future goals. While the framework contains many aspects of community planning, it strategically includes opportunities for green infrastructure throughout the fabric of the city. These opportunities are both small- and large-scale. Smaller-scale techniques can be used on vacant property for neighborhood stabilization or to manage roadway runoff. Larger techniques include buffers along major highways in addition to assembling large parcels of land to convert to natural green infrastructure which includes reducing and eliminating the roadway network in areas of high vacancy.

Access to Public Parks

Public parks are one of the most recognizable types of green infrastructure. Public parks can range from small, neighborhood "pocket parks" to large recreation areas. Most notable is the ability of the public to access public parks from their neighborhoods. Walking distance to a park is generally accepted at .25 mile to .5 mile. As a region, and within the more urbanized counties, access to residential parcels from parks fall within this recommendation. Table 10 provides a summary of the distance to parks from residential parcels. It should be noted that the distance to all parks within the City of Detroit is .27 miles. However, when analyzing only open and limited maintenance parks, the distance to parks increases to .62 miles. For open parks only, the distance to parks increases to .88 miles on average, a significant increase over the regional average of .34 miles and not within the recommended average of .25 to .5 mile. However, this average may decrease as the Detroit Strategic Framework is implemented and vacant land is transformed into public green infrastructure.

In more rural communities, such as those parks within Monroe and St. Clair Counties, accessibility is beyond the average of the .25 to .5 mile recommendation. While the expectation of parks within .25 to .5 mile is less in rural areas, it should be a consideration in small towns within these counties.

It is also helpful at the local level to analyze the location of green infrastructure to important community assets, including downtown commercial areas, government buildings, and health care facilities. Table 10 illustrates that these facilities are also within the recommendation of .25 to .5 mile.

Regional policies

Seek opportunities to increase access to public parks within the City of Detroit and in small towns within rural areas to meet the recommendation of an average public access of .25 to .5 mile.

Incorporate access to public green infrastructure as part of local planning, including downtown/commercial revitalization, health care facilities, and government buildings.

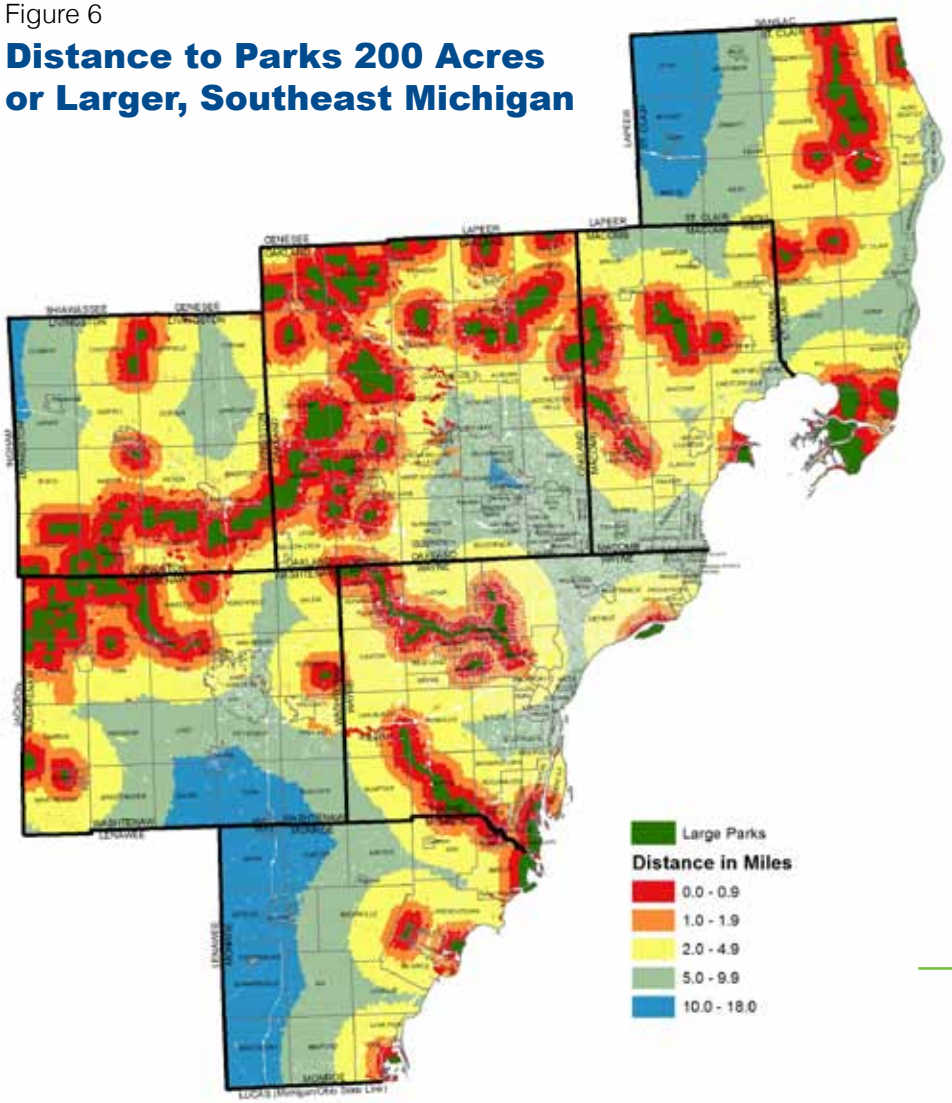
Table 10

Distance to Park (miles)

	Livingston	Macomb	Monroe	Oakland	St. Clair	Washtenaw	Wayne	Out Wayne	Detroit	Region
Commercial	0.34	0.37	0.50	0.28	0.39	0.30	0.28	0.30	0.27	0.31
Institutional	0.33	0.31	0.52	0.23	0.36	0.31	0.25	0.25	0.25	0.27
Medical	0.25	0.39	0.42	0.27	0.28	0.20	0.27	0.27	0.28	0.29
Mixed-Use	0.18	0.23	0.38	0.24	0.41	0.35	0.25	0.23	0.25	0.27
Residential	0.48	0.35	0.85	0.27	0.71	0.42	0.27	0.27	0.27	0.34
All Parcels Average	0.50	0.36	0.90	0.27	0.74	0.45	0.27	0.28	0.26	0.35

Figure 6

Distance to Parks 200 Acres or Larger, Southeast Michigan



A study conducted in Atlanta, Georgia found that youth ages 5 to 20 were two to three times more likely to take a walk if they lived close to open space or a park than their youth counterparts who didn't have a park close to home.[4]

Access to Public Parks over 200 Acres

As described in the Green Infrastructure Quantity chapter, large public parks provide additional recreational opportunities not available in smaller, local parks. These opportunities include mountain biking, hiking, and hunting, which often require use of a motor vehicle, so accessibility recommendations have been increased to a five-mile drive from residential property. On average at the regional level, residential parcels are within four miles of public parks over 200 acres. Livingston County has the closest proximity with the distance between residential parcels and large parks at 2.7 miles. The remaining counties average residential parcels within four-to-five miles of 200-acre public parks. Figure 6 illustrates the distance of public parks over 200 acres to residential parcels. Of note, there are some urbanized areas of the region that are beyond five miles. Since it is difficult to assemble large properties within the urbanized areas for parks, other green infrastructure elements, such as smaller parks and trails, should continue to be local priorities.

Additional analysis should include whether public recreational needs are currently being met within these large parks. For example, Huron Clinton Metropolitan Authority owns many of these larger parks, but hunting is not allowed on their property. Also, Macomb County public access to large parks is within the five-mile recommendation, but a specific use that has been identified as being missing is a public campground. So, a county may show good access for large public parks, but upon closer inspection, a large need could be unmet.

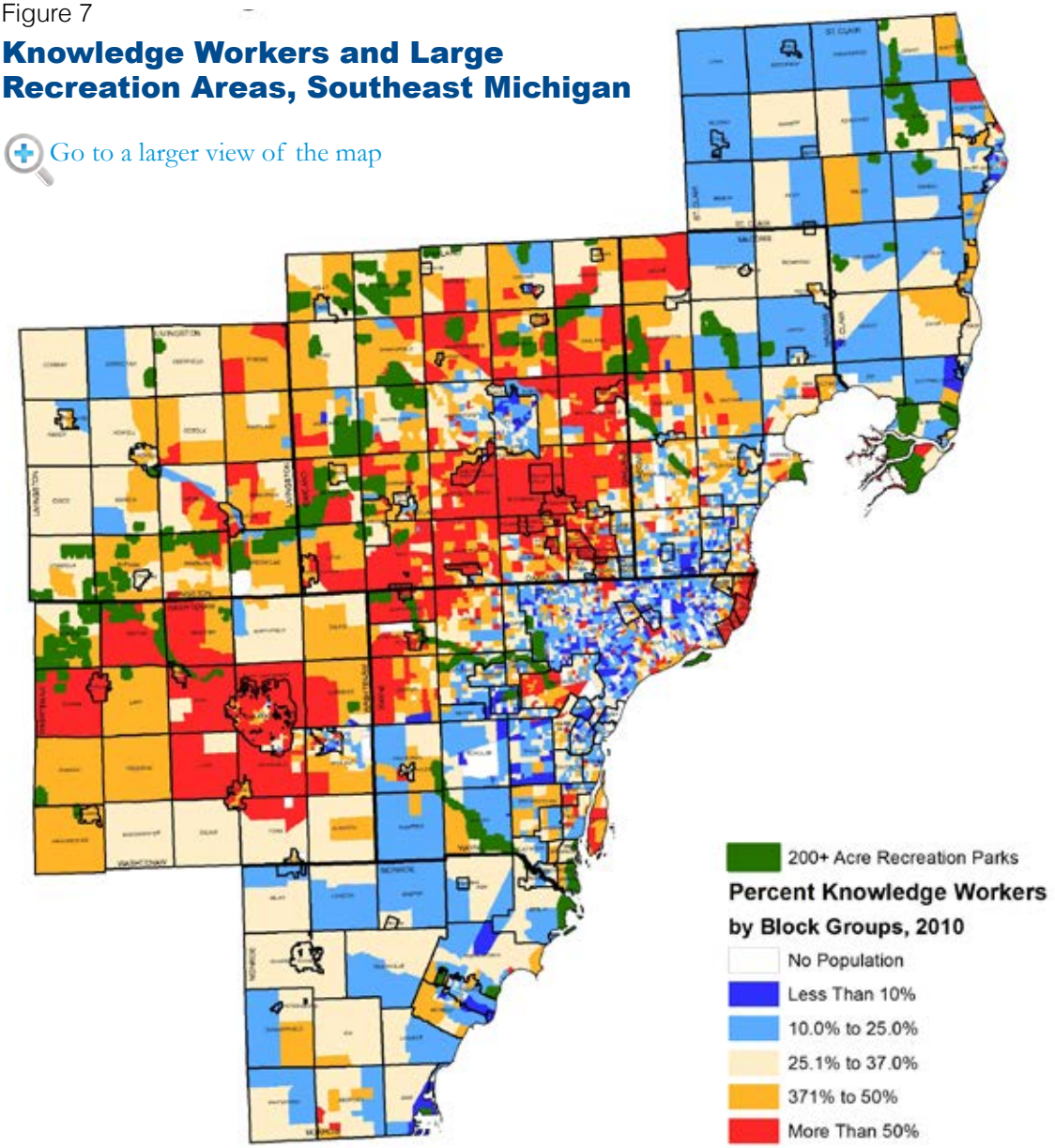
Regional policy

Partner with recreation providers to determine and address gaps between public recreational needs and the recreational opportunities provided within the existing large park system.

Figure 7

Knowledge Workers and Large Recreation Areas, Southeast Michigan

Go to a larger view of the map



Access to Attract and Retain Young Professionals

A significant change has occurred in the American economy. Industry today is composed of smokeless industries, high technology, and service-sector businesses, collectively referred to as the "New Economy." New Economy workers are selling their knowledge, as opposed to physical labor, as the main source of wealth creation and economic growth. These employees, referred to in studies as "knowledge workers" or "talent," work in a "footloose" sector — companies are not tied to a certain location in order to achieve a competitive advantage.[1]

Knowledge workers prefer places with a diverse range of outdoor recreational activities that are often associated with large recreation areas. Figure 7 highlights where the knowledge-based workforce lives compared to the locations of large recreation lands.

Regional Policy

Use green infrastructure as a mechanism to attract and retain the knowledge-based workforce.

Access to Water

There is a clear link between the green infrastructure network and access to rivers and lakes. In many of the stakeholder visioning sessions, access to water was ranked one of the green infrastructure elements that provides the highest economic value in their area. With the increased interest in kayaking and stand-up paddling sports, along with continued strong interest in boating, the need for public access will remain high. This includes traditional public boat launches (currently there are 117 in Southeast Michigan), as well as smaller, kayak launches. Currently, there is not a regional estimate of kayak launches, but local efforts are underway by counties and watershed organizations to map and increase these launches.

Access to rivers and lakes is important for other activities, including fishing, walking/hiking, picnicking, and simply, visual access to the water. One of the largest success stories on public access is on the Detroit River by the Detroit RiverFront Conservancy, Inc. The entire vision is

Source: Michigan Department of Natural Resources

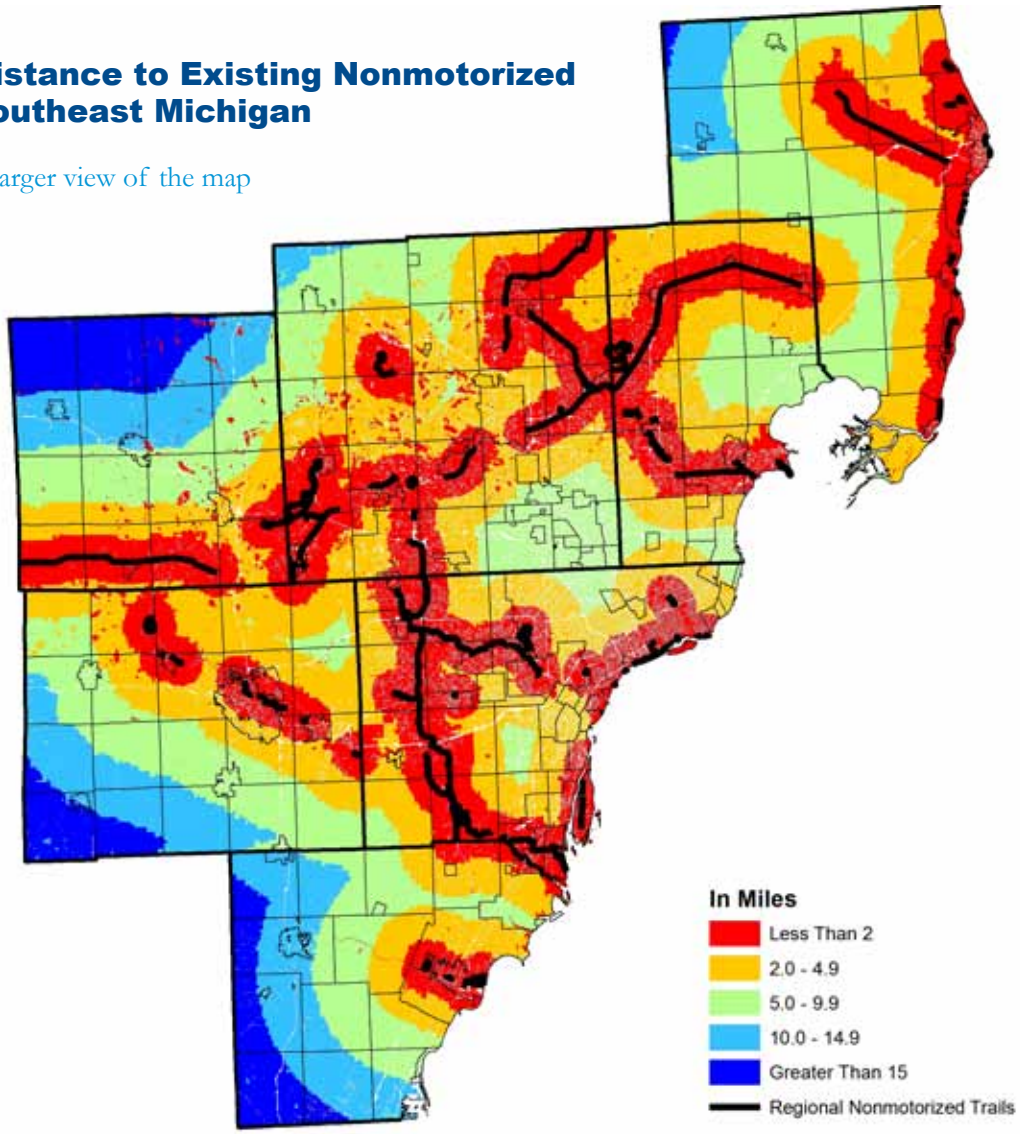
5.5 miles of publicly accessible riverfront property, from the Ambassador Bridge to Gabriel Richard Park, just east of the Belle Isle Bridge, and will include construction of a continuous RiverWalk, along with plazas, pavilions, and green spaces.

Currently, there is not enough public access along the Great Lakes and connecting channels in Southeast Michigan. The Michigan Department of Natural Resources released a report, *Department of Natural Resources Managed Public Land Strategy*, which recommends public access to the

Figure 8

Parcel Distance to Existing Nonmotorized Trails, Southeast Michigan

Go to a larger view of the map

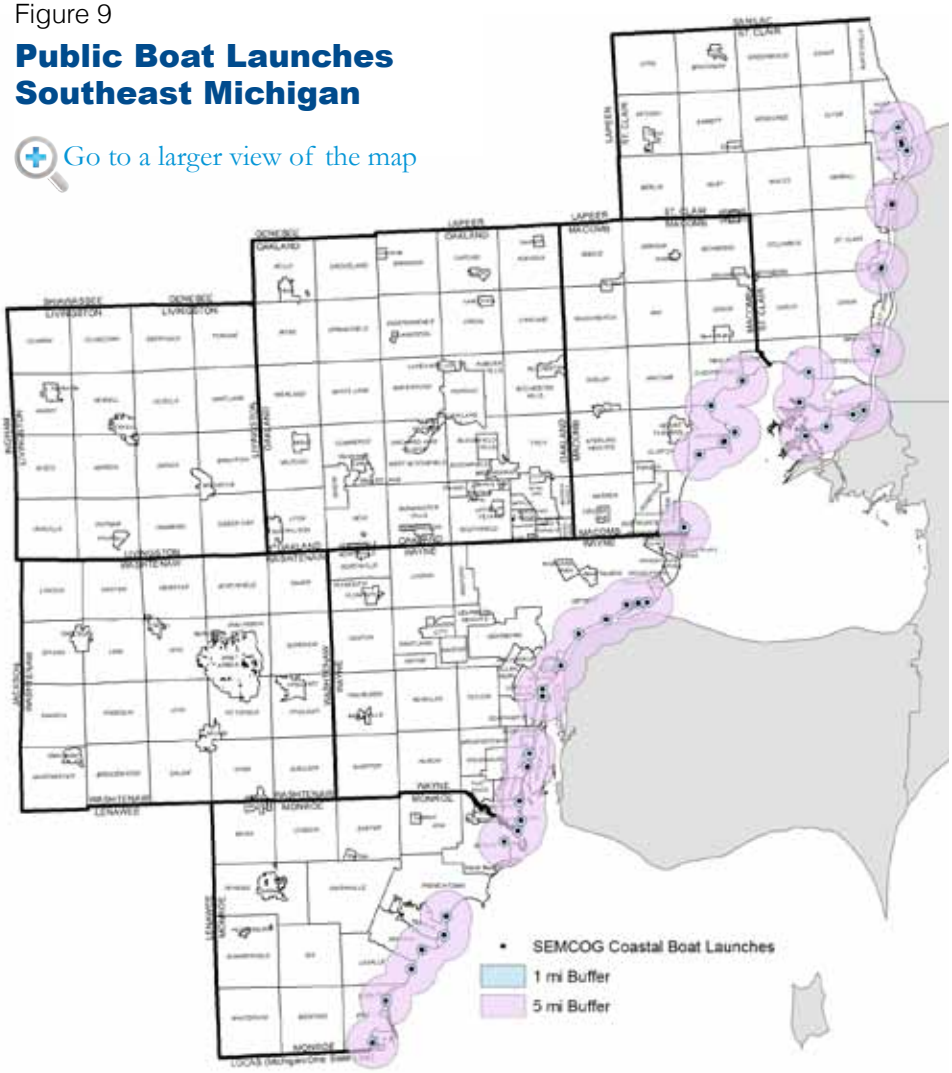


Great Lakes every five miles and every one mile within the Southeast Michigan region. Figure 9 illustrates the locations of public boat launches on SEMCOG's coastal region for both five miles and one mile. There are numerous locations throughout the coastline that do not meet the five-mile goal and no part of Southeast Michigan meets the one-mile recommendation. Also, anecdotally, this is illustrated by long lines of boaters trying to access Lake St. Clair and the Detroit River every spring and summer. Public access was also noted as a top priority by Macomb County in their Blue Economy Strategic Development Implementation Plan.

Figure 9

Public Boat Launches Southeast Michigan

Go to a larger view of the map



Regional Policies

Increase public access along the Great Lakes and connecting channels (Detroit River, St. Clair River, Lake St. Clair) to meet the recommendation of public boat access every five miles, with the long-term goal of moving toward access every one mile. In addition to public boat access, seek opportunities to enhance other public access for fishing, nonmotorized boats, swimming, and visual access.

Assess the need for additional public access on inland lakes and rivers in Southeast Michigan, including traditional boat launches, kayak launches, swimming, and visual access.

Michigan Department of Natural Resources a Leader in Accessibility and Universal Design

At a recent Universal Design Conference in Marquette, Michigan, the Michigan Department of Natural Resources (MDNR) Grants Section was awarded an "Above and Beyond ADA Award" for funding projects that make recreational facilities not only compliant with the Americans with Disabilities Act, but take accessibility to another level.

This is by no means the first time the MDNR has been lauded for its efforts to include people with disabilities in its programs. Fact is, the Michigan Natural Resources Trust Fund – the MDNR's main source of funding the purchase and development of recreational facilities – has long added bonus points for projects that incorporate accessibility elements when scoring proposals for funding.

For example, recently the MDNR added an EZ Launch Accessible Transfer System for canoes and kayaks on Bishop Lake at Brighton State Recreation Area. The transfer system allows wheelchair users to access a bench, from which they can drop into their boats unassisted.

Access to Trails

Access to trails continues to rate high with the public in both local and statewide polling. SEMCOG is currently learning more about the region's system and preferences via our regional nonmotorized planning effort, which has identified existing and proposed trails, shared-use sidepaths (along roads), and on-road bike facilities. The plan will also include a snapshot of nonmotorized user preferences via an in-depth survey and public workshops.

While some bicyclists prefer either on-road bike facilities or independent trails, most people want to use both and desire more connections between them so they can be used both for recreational purposes, but also commuting and other transportation-related trips. Almost all cyclists ride to residential and recreation areas (70 percent), but a good number ride to downtowns, employment centers, and neighborhood retail, too.

Since green infrastructure can coexist with nonmotorized facilities along roadways and in parks, there is great opportunity for the two efforts to work together for mutual benefit. The nonmotorized trail network helps connect various elements of green infrastructure, such as parks, community gardens, beaches, and other tourist attractions.

Therefore, it is important that everyone has access to the nonmotorized network. As a region, the average residential parcel is 3.38 miles away from a regional nonmotorized trail. However, this number varies from the heavily urban areas, such as Detroit residents are on average 2.85 miles away from a trail, and Monroe, whose residents are on average 7.30 miles away. In addition, there are sections of urban areas where average access is over five miles away. These disparities and gaps in the network will be included in SEMCOG's Regional Nonmotorized Transportation Plan.

Regional Policy

Prioritize funding for trail improvements to fill gaps within the Southeast Michigan trail network, focusing on reducing the time traveled for accessing nonmotorized trails for local residents.

Universal Design

Universal design involves designing spaces that can be used by the widest range of people possible. Universal design takes into account the full range of human diversity, including physical, perceptual, and cognitive abilities, as well as different body sizes and shapes. By designing for this diversity, we can create things that are more functional and more user-friendly for everyone. For instance, curb cuts at sidewalks were initially designed for people who use wheelchairs, but they are now also used by pedestrians with strollers or rolling luggage.[3]

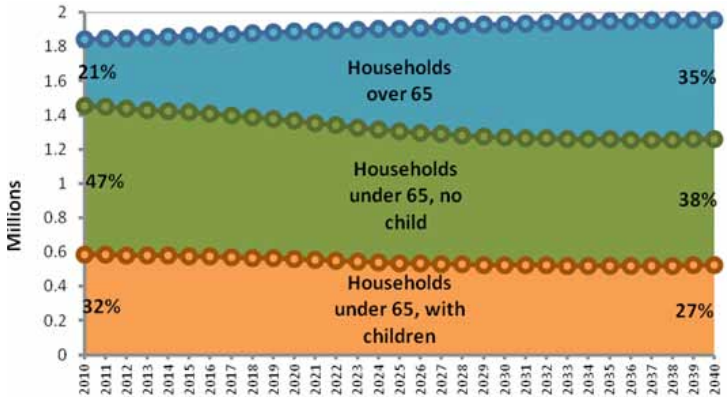
Between 2010 and 2040, households over 65 will increase by 300,000, or 77 percent. By 2040, 35 percent of all households in the region will be headed by a person over age 65 (Table 11). This demographic shift will increase demand for spaces that are accessible for all people. SEMCOG's Regional Housing Strategy adopted policy that encourages communities to provide housing choices that enable people to remain in the community as they age. In addition to housing choices, spaces that promote leisure activities, including park design, should meet the needs of the shifting demographics in the region.

Regional Policy

Work with state and local governments to include universal design – which focuses on designing spaces that can be used by the widest range of people possible – in development of the green infrastructure network.

Table 11

Households by Type, 2010-2040



Regional Policy

Green infrastructure should be designed so that it can be used by the widest range of people possible.

Connectivity of the Green Infrastructure Network

Aristotle stated, *The whole is greater than the sum of its parts.* Nowhere is that more true than with green infrastructure. Throughout this vision, we discuss the green infrastructure network. That's because the connection of different green infrastructure elements – parks, preserves, riparian corridors, wetlands – is critical to maintaining the ecological processes (e.g., filtering stormwater, cleaning water and urban air); maintaining the health and biodiversity of wildlife populations and reducing habitat fragmentation; and providing recreation opportunities for residents and visitors to Southeast Michigan.

Stakeholders attending the Green Infrastructure Visioning Sessions, as well as those participating in the public poll, also noted the importance of connectivity. Both stakeholders and the public said bike/hike trails are the green infrastructure element they want to see increased; stakeholders noted the top place they want to see more green infrastructure is along rivers and lakes.

The public stated that who owns the network is not as important as coordinated recreational use. In Southeast Michigan, local communities, land conservancies, utility companies, counties, regional entities (such as Huron Clinton Metropolitan Authority), the state, and federal agencies all own pieces of the green infrastructure network. Partnerships among these organizations can result in more integrated management of the system as a whole.

This chapter looks at the important role green infrastructure connectivity plays in Southeast Michigan's vision, specifically,

- Riparian corridors as a mechanism for connectivity,
- Connecting green infrastructure through restoration,
- Trails providing opportunities for linkages and enjoyment, and
- Southeast Michigan as a major pathway for migration.

Regional Policies

Connect natural areas, recreation areas, and riparian corridors to the extent possible as a mechanism to reduce habitat fragmentation, enhance wildlife passage, and encourage recreation opportunities.

The green infrastructure network should be approached as a system, regardless of ownership. Local, regional, state, federal, and private owners of the network should coordinate activities in order to provide an efficient, systems-based approach.

Table 12

Riparian Corridors on Public Land

County	Riparian acres within 50 foot buffer	Public riparian acres within 50 foot buffer	Percent public riparian buffer
Livingston	8,135	1,145	18%
Macomb	6,406	1,890	29%
Monroe	6,387	364	6%
Oakland	8,549	2,542	30%
St. Clair	9,798	1,055	11%
Washtenaw	8,502	1,590	19%
Wayne	5,657	3,183	56%
Out Wayne	5,143	2,823	55%
Detroit	514	360	70%
Region	53,434	12,068	23%

Riparian Corridors as a Mechanism for Connectivity

Riparian corridors provide one of the best opportunities to link public green infrastructure in Southeast Michigan. Using riparian corridors has numerous benefits, including:

- Protecting water quality by shading rivers and lakes,
- Providing access to water for fishing and canoe/kayak launches,
- Reducing the potential of streambank erosion,
- Reducing habitat fragmentation,
- Providing recreational opportunities for trails, and
- Connecting to upland areas, allowing wildlife to use upland and riparian areas.

In Southeast Michigan, approximately 23 percent of the 50-foot riparian corridor is in public ownership. That leaves multiple opportunities for strategic investment to increase recreational greenways and long-term wildlife corridors. Table 11 summarizes the stream buffers on public land.

Regional Policies

Riparian corridors should be protected and restored as a mechanism to connect green infrastructure.

Riparian corridors should be linked with upland areas to allow for connections for human and animal use.

Water trails should be integrated with public green infrastructure along riparian corridors to the extent possible, including canoe/kayak launch areas.

Connecting Green Infrastructure through Restoration

Linking the green infrastructure network can also be achieved by restoring historical wetland and woodland areas. Figure 4, in the Green Infrastructure Quality chapter, highlights the presettlement land cover that can be used to provide input into the areas for potential restoration. The Michigan Department of Environmental Quality, Wetland Division, has been actively working on mapping potential wetland restoration areas in Southeast Michigan.

Source: Huron River Watershed Council

Regional Policy

Work in partnership with recreation providers, the State of Michigan, local communities, and land conservancies to restore historical wetland and woodland areas as a way to connect green infrastructure.

Water trails: Cooperation at its best

Local, state, and federal agencies, along with the private sector and environmental organizations are partnering in implementing a comprehensive water trail program in Michigan. Water trails, or blueways, are marked routes on navigable waterways such as rivers, lakes, canals, and coastlines for people using small nonmotorized boats such as kayaks, canoes, rafts, or rowboats.

For more information on water trails in Michigan, visit www.michiganwatertrails.org.

Trails provide opportunities for linkages and enjoyment

Southeast Michigan's trail system provides opportunities to enjoy the surrounding green infrastructure network. These nonmotorized trails are a priority in local visioning as well as statewide trails planning. As such, green infrastructure and nonmotorized trails planning need to be coordinated in order to meet the public's desired outcome for connecting public green infrastructure elements and providing additional trail access. Figure 9 shows the location of the trail system and public parks.

Regional Policy

Coordinate nonmotorized trail planning with green infrastructure planning to assist in meeting the needs of a green infrastructure network that uses trails as a linkage.

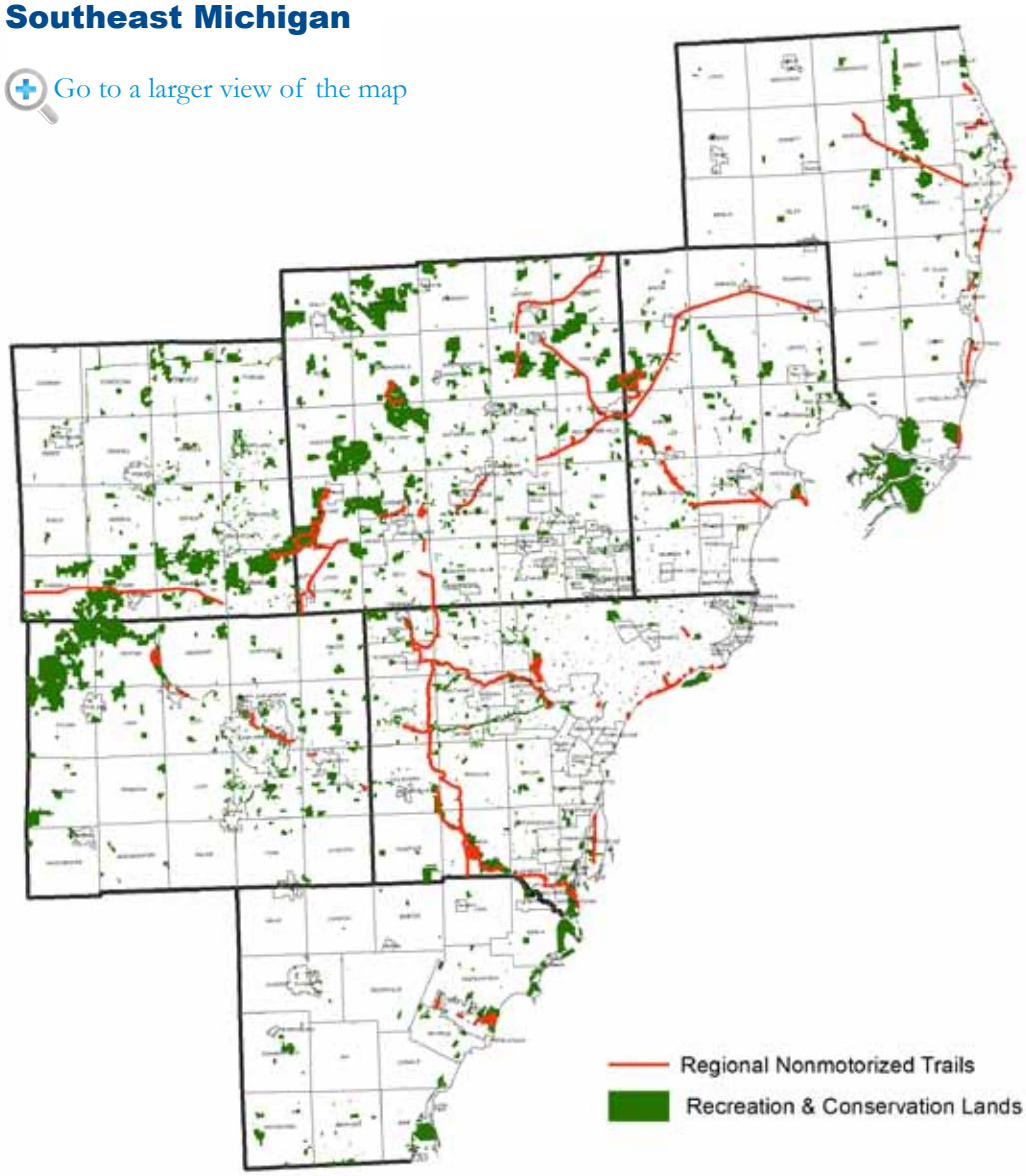
Southeast Michigan is a Major Pathway for Migration

Many bird species travel thousands of miles annually between their nesting and wintering areas. There are four general migratory flyways in North America. Southeast

Figure 10

Regional Trails and Public Green Infrastructure Southeast Michigan

Go to a larger view of the map



Michigan is located at the convergence of the Atlantic and Mississippi Flyways, and is an important flyway for more than 90 species of birds. Southeast Michigan provides important stopover sites for migrating birds. Some of the migratory animals include raptors, songbirds, shorebirds, waterfowl, and monarch butterflies. In fact, Southeast Michigan is noted as an area of greatest continental significance for North American waterfowl.[3] Figure 11 highlights likely areas for migrating land bird stopover sites.

Regional Policy

Protect high-quality green infrastructure that provides stopover sites for migratory birds.

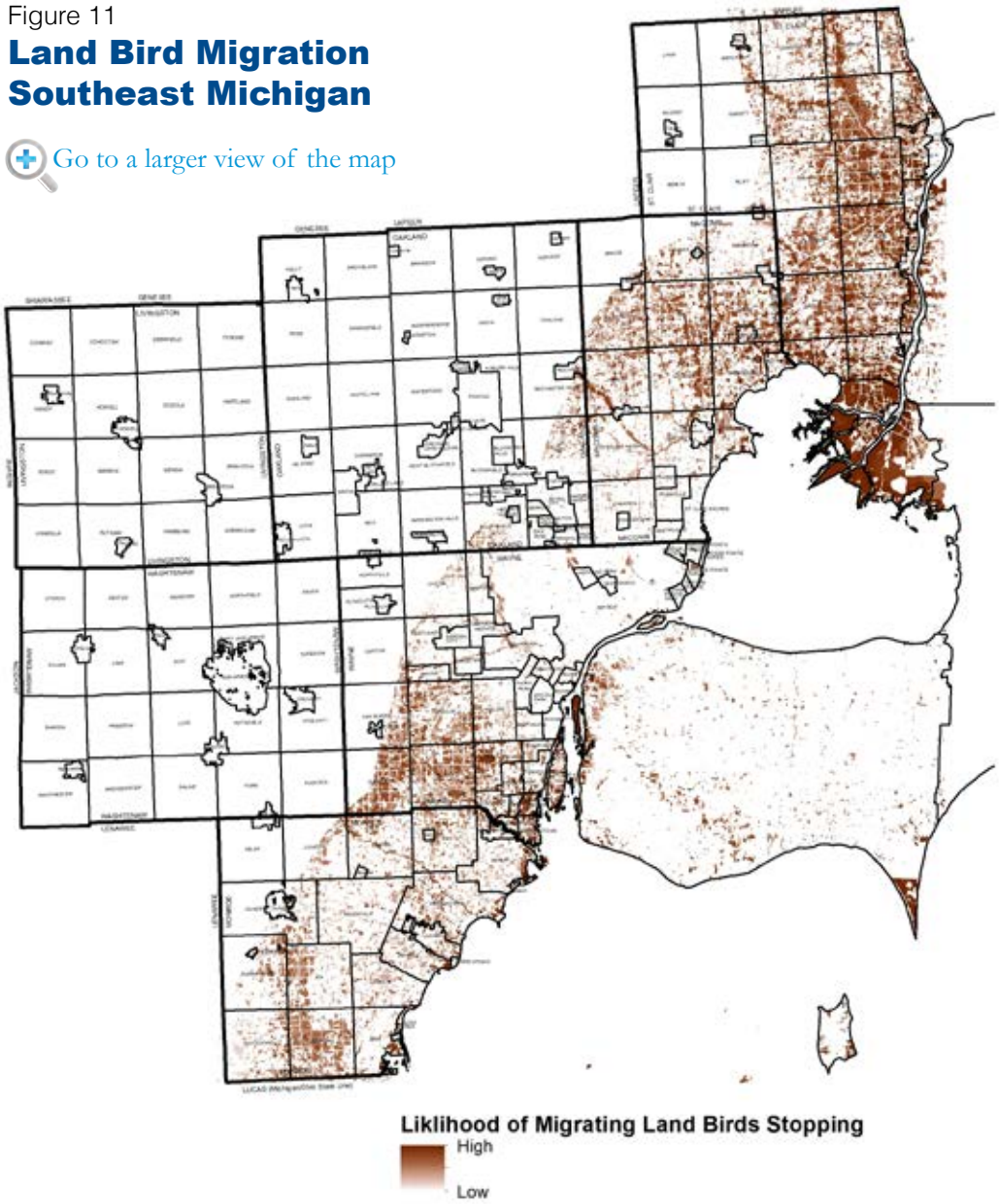
The Sandhill Crane brings economic opportunities in Chelsea

Green infrastructure connectivity and ensuring migratory stopover sites provides more than ecological benefits. It provides economic wins as well. The City of Chelsea takes advantage of the migration of Sandhill Cranes through their area. For two months every fall, over 7,000 Sandhill Cranes have been counted around Waterloo Recreation Area. The City of Chelsea celebrates the migration and encourages tourists through numerous events during the months of October and November, including the Festival of the Sandhill Cranes Gather and decorated metal Sandhill Cranes sculptures in and around Chelsea.

Figure 11

Land Bird Migration Southeast Michigan

Go to a larger view of the map



Source: The Nature Conservancy

Green Infrastructure and Water Quality

With over 43 percent of Great Lakes waters located in Michigan, in addition to the 11,000 lakes and 36,000 miles of rivers, Michigan is truly the Great Lakes State. Southeast Michigan is located next to the Lake Huron to Lake Erie Corridor, which is the connection between the upper, colder Great Lakes – Superior, Michigan, and Huron and the warmer, lower Great Lakes – Erie and Ontario. Within Southeast Michigan, there are almost 100,000 acres of water[1]. Table 13 summarizes the water by county.

Michigan is dependent on these rivers and lakes to provide drinking water and recreational opportunities to millions of residents, which provide significant benefits to Michigan's economy. For example, recreational fishing, hunting, and boating contribute more than $3 billion annually to Michigan's economy[2]. Additionally, the Detroit Water and Sewerage Department (DWSD) provides drinking water to the City of Detroit and 127 suburban communities which makes up 40 percent of the state's population[3]. Additionally, about 85 percent of the City of Ann Arbor's drinking water comes from the Huron River.

Within both the natural and built environments of green infrastructure, the connection to water quality is significant. Wetlands, woodlands, and prairies naturally capture, filter, and infiltrate rain water, while the constructed techniques replicate these types of natural systems. These systems work together to improve water quality in local lakes, streams, and rivers within Southeast Michigan and, subsequently, the Great Lakes. Results from the stakeholder visioning sessions and public survey supported the connection of green infrastructure to the region's water by identifying "protecting water quality" as the top rated green infrastructure benefit.

Table 13

Water Area in Southeast Michigan (acres)

	Livingston	Macomb	Monroe	Oakland	St. Clair	Washtenaw	Wayne	Region
Total Water	16,088	5,364	7,952	35,100	8,548	14,557	6,495	94,104
Lakes	12,238	2,477	3,811	28,785	963	9,431	2,524	60,229
Rivers, Streams	3,850	2,887	4,142	6,315	7,585	5,126	3,970	33,874

Coastal Wetlands: An Important Link with Our Water Resources

With approximately 3,921 miles of Great Lakes shore, Michigan has the longest coastline of any state in the continental U.S. Prior to European settlement, the shoreline area along the Lake Huron to Lake Erie corridor had extensive wetlands.

Great Lakes coastal wetlands are the most productive global natural systems, but are affected by Great Lakes water levels, development of shoreline areas, urban growth, industrialization, and agriculture. The Detroit River has lost approximately 97 percent of its coastal wetlands. Similar losses have occurred along the shorelines of Lake St. Clair and the St. Clair River. These near-shore water areas are also very susceptible to pollution and degradation from sources including polluted urban and agricultural stormwater runoff, industrial discharges and sewer overflows.[1]

Southeast Michigan Watersheds: The Link between Land and Water

Southeast Michigan is made up of watersheds that primarily drain to the Lake Huron-to-Lake Erie Corridor. The water quality of the rivers and lakes within the watersheds, as well as the Huron-to-Erie Corridor is directly connected to the activities on the land.

Both land use and land cover play significant roles in directly affecting, both positively and negatively, the quality of rivers and streams within local watersheds. Historic landscapes in Southeast Michigan all provide various functions and values that benefit water resources. Wetlands, woodlands, grasslands, prairies, and riparian corridors all play integral parts in the overall water cycle. They each help in their unique way to filter and reduce stormwater runoff entering local streams. As development has progressed across Southeast Michigan, the quantity of impervious cover and associated urban areas increased while these historic landscapes have decreased.

As impervious cover increased, the quantity of stormwater runoff also increased and the quality of local water resources has declined. The increase in stormwater runoff is generated when precipitation from rain and snowmelt events flows over land or impervious surfaces and does not percolate into the ground. The hard surfaces (paved streets, parking lots, and rooftops) prevent traditional percolation into the ground. As a result, an increase in the amount of polluted stormwater runoff enters local waterways.

Based on the impervious surfaces from the land cover data, approximately 900 billion gallons of stormwater runoff are annually generated. This includes over 800 tons of phosphorus and 140 thousand tons of sediment. While these estimates do not account for areas where runoff is treated, the estimates are intended to provide a perspective about how local water resources and the Great Lakes are affected by stormwater runoff.

Research from the Center for Watershed Protection proves that negative impacts to streams are evident at levels of five-to-10 percent impervious cover. Not only are the negative impacts felt by a reduction in stream quality, but recreational opportunities are also affected, which can range from beach closings to algae blooms to a reduction in fish populations and diversity.[5]

Using Green Infrastructure to Manage Stormwater Runoff

This Green Infrastructure Vision is intended to focus on solutions to addressing water quality challenges in the river systems. While the solutions include the entire network of green infrastructure, focusing on urban areas and the extent of impervious cover is a priority. Constructed green infrastructure techniques, such as bioswales, bioretention, tree planting, grow zones, porous pavement, and other unique features, can significantly reduce stormwater runoff and improve water quality.

[The Great Lakes] "define our region, providing precious drinking water, recreation, and are a founding pillar of our economy and our culture. With this shared resource so critical to our success as a state and region, we must foster a relationship of respect with our waters and with our neighbors. We must work together to develop economic opportunities – with an emphasis on sustainability."

– Michigan Governor Rick Snyder
Great Lakes Report (2013)[4]

With a focus on major areas of impervious surfaces and publicly owned properties, the following land use types rise to the top:

Institutional properties include publicly-owned property such as municipal facilities and complexes, libraries, parks, schools, and universities. The focus within these properties is to further assess opportunities to manage roof runoff and runoff from paved surfaces. Additionally, large open space areas managed as turf may present options for constructing native plant grow zones in areas not generally accessed by the public.

Major roadways are identified by their respective functional classification, but are generally represented by the major arterial roadways, including local, county, and state roads. Local residential streets are not defined as a primary area of opportunity. Within major roadways, constructing green infrastructure within the rights-of-way, either in existing open space or, where traffic data supports it, implementing road diets with green infrastructure are some of the opportunities. The Green Infrastructure and Transportation chapter describes these opportunities in more detail.

Parking lots, both publicly-owned and privately-owned, represent a major category of green infrastructure implementation opportunities. Publicly-owned parking lots are included as part of the impervious cover within the institutional properties. Privately-owned parking lots represent the larger commercial areas in the region. Constructing bioretention areas, bioswales, and porous pavement are techniques that can significantly reduce stormwater runoff. From a planning perspective, inverted parking lot islands can double as bioretention areas when coordinated with engineering design.

Riparian corridors are a consistent focus of opportunity throughout this vision. Expanding the forest and vegetated buffer adjacent to local streams improves the local stream corridor, leading to higher quality stream habitat and aquatic diversity.

Table 14

Green Infrastructure Opportunities (acres) within Southeast Michigan Subwatersheds over 10 percent impervious surfaces

Institutional Land Use (Publicly-Owned)			Major Roadways (Publicly-Owned)		Riparian Corridor		
Impervious Surfaces: Buildings	Impervious Surfaces: Parking Lots	Open Space (turf & trees)	Impervious Surfaces: Pavement	Open Space (turf & trees)	Privately-Owned Parking Lots	Tree Canopy Existing	Open Space
4,354	9,553	25,598	39,935	17,393	51,192	11,167	3,815

When analyzing watersheds in Southeast Michigan with over 10 percent impervious cover, the opportunities to implement green infrastructure are evident. For example, over 24,000 acres of open space in institutional land uses could be reviewed for the potential to convert managed turf areas to native plant grow zones and trees. Table 14 summarizes the areas of opportunity by land use type where constructed green infrastructure should be considered. The following section provides detailed information on opportunities by watershed and subwatershed in the region.

While the 10 percent impervious cover threshold helps to direct priorities, green infrastructure is an important element in managing runoff from all impervious surfaces and developed areas.

Regional Policies

Encourage policies to integrate constructed green infrastructure in publicly-funded projects, including institutional properties and major roadways. Focus implementation on roads, parking lots (public and private) and large managed turf areas.

Minimize mowing within riparian corridors and seek opportunities to increase tree canopy and native plant grow zones in open space areas (particularly public lands) along riparian corridors as a method to increase infiltration, prevent erosion, shade rivers and lakes, and improve habitat.

Work with communities and watershed groups to quantify the level of green infrastructure implementation that will lead to direct benefits in the region's water resources.

Watershed and Subwatershed Analysis of Green Infrastructure Opportunities

Detailed information highlighting areas of opportunity for constructed green infrastructure implementation is contained in the Appendix. Data is sorted by each of the major Southeast Michigan watersheds (Figure 12) that are tributary to the Lake Huron to Lake Erie corridor. The following major watersheds are included in this appendix: Alliance of Downriver Watersheds (Ecorse Creek/Combined Downriver/Lower Huron Watersheds), Belle/Black/Pine Watersheds, Clinton River Watershed, Huron River Watershed, Lake Huron to Lake Erie Direct Drainage Watersheds, Raisin River Watershed, Rouge River Watershed, and Stony Creek Watershed.

Southeast Michigan's Areas of Concern (AOCs)

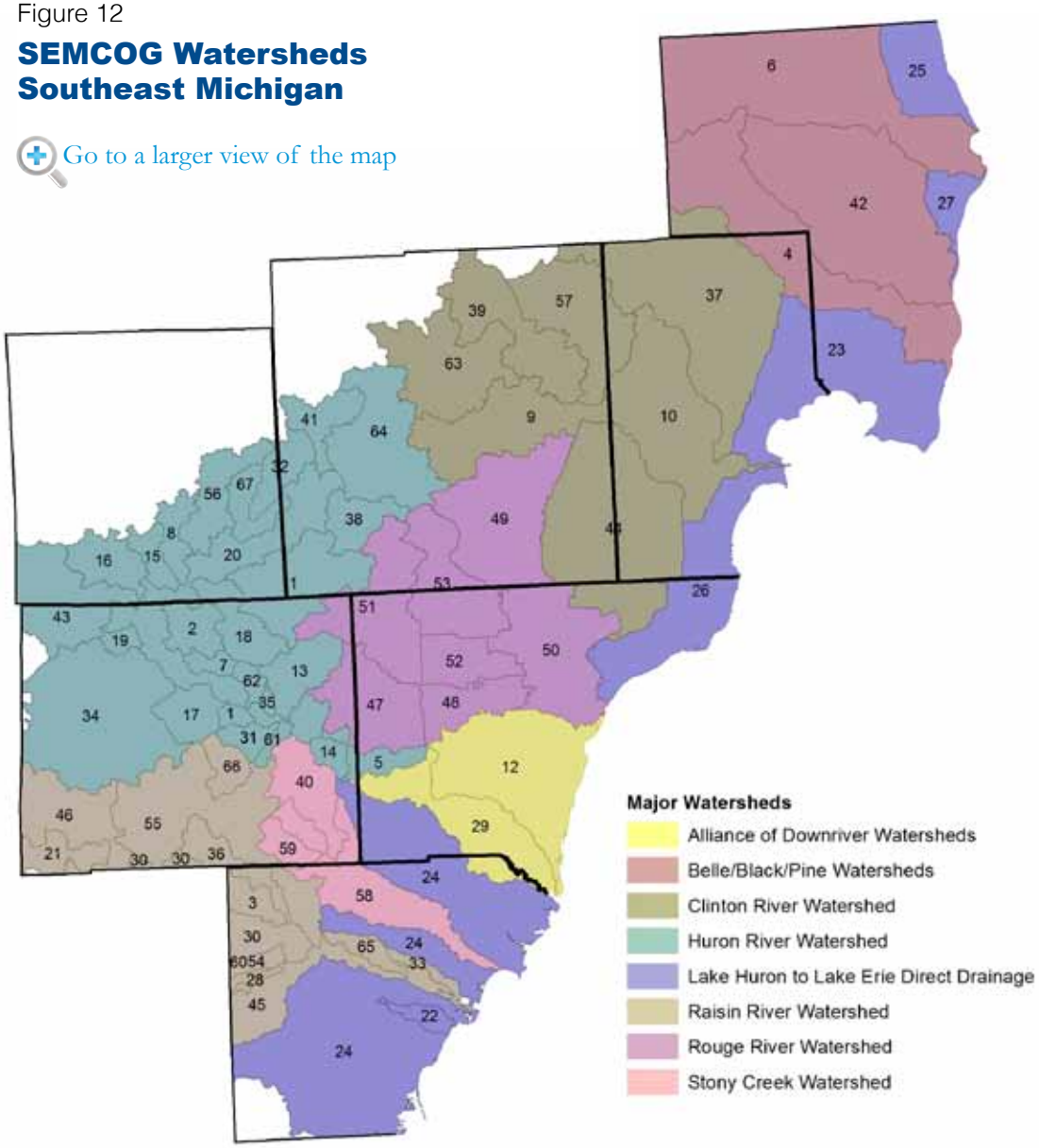
Michigan has 14 AOCs which are defined as areas on the Great Lakes that have beneficial use impairments (BUIs). The United States and Canada identified 43 AOCs on the Great Lakes as part of an amendment to the 1978 Great Lakes Water Quality Agreement. The complete list of BUIs includes 14 types of impairments; however, loss of fish and wildlife habitat, degradation of benthos and beach closing are common BUIs across all Southeast Michigan AOCs. The five AOCs in Southeast Michigan include the Clinton River, Detroit River, Raisin River, Rouge River and St. Clair River.

As previously described, stormwater runoff has a direct impact on water quality and subsequently, recreational opportunities such as fishing and swimming that are tied to these BUIs. Green infrastructure implementation will benefit removing BUIs in order to work towards delisting the local AOCs.

Figure 12

SEMCOG Watersheds Southeast Michigan

Go to a larger view of the map



What is a Watershed?

We all live in a watershed — the area that drains to a common waterway, such as a stream, lake, estuary, wetland, aquifer, or even the ocean — and our individual actions can directly affect it. Working together using a watershed approach will help protect our nation's water resources[6].

Subwatersheds

1 Allen Creek
2 Arms Creek
3 Bear Swamp Creek
4 Belle River
5 Belleville Lake
6 Black Watershed
7 Boyden Creek
8 Chilson Creek
9 Clinton Main
10 Clinton River East
11 Davis Creek
12 Ecorse Creek & Combined Downriver
13 Fleming Creek
14 Ford Lake
15 Hay Creek
16 Honey Creek (north)
17 Honey Creek (south)
18 Horseshoe Creek
19 Huron Creek
20 Huron River (upstream)
21 Iron Creek
22 La Plaisance Creek
23 Lake Drainage - Anchor Bay
24 Lake Drainage - Drains to Lake Erie
25 Lake Drainage - Lake Huron
26 Lake Drainage - Lake St. Clair
27 Lake Drainage - St. Clair River
28 Little River Raisin
29 Lower Huron
30 Macon Creek
31 Malletts Creek
32 Mann Creek
33 Mason Run
34 Mill Creek
35 Millers Creek
36 N Br Macon Creek
37 North Branch
38 Norton Creek
39 Paint Creek
40 Paint Creek - Washtenaw
41 Pettibone Creek
42 Pine Watershed
43 Portage Creek
44 Red Run
45 River Raisin - Monroe
46 River Raisin - Washtenaw
47 Rouge: LOWER 1
48 Rouge: LOWER 2
49 Rouge: MAIN 1-2
50 Rouge: MAIN 3-4
51 Rouge: MIDDLE 1
52 Rouge: MIDDLE 3
53 Rouge: UPPER
54 S Br Macon Creek
55 Saline River
56 South Ore Creek
57 Stony Creek
58 Stony Creek - Monroe
59 Sugar Creek
60 Swamp Raisin Creek
61 Swfit Run
62 Traver Creek
63 Upper Clinton
64 Upper Huron
65 Willow Run
66 Wood Outlet Drain
67 Woodruff Creek

Green Infrastructure and Air Quality

Air quality is important to the health of the region's residents. As the designated local air-quality planning agency under the federal Clean Air Act, SEMCOG works with the Michigan Department of Environmental Quality (MDEQ) to develop plans and programs that comply with federal Clean Air Act standards. Efforts are geared toward improving the quality of life in Southeast Michigan by attaining and maintaining air-quality standards in a cost-effective manner.

Within the region, there are numerous sources of air pollution including industrial factories, electric utility power plants, motor vehicle exhaust, gasoline vapors, chemical solvents, wood smoke, and fugitive dust from unpaved areas.

Studies have found that urban trees within the United States remove approximately 800,000 tons of air pollution on an annual basis with a single tree removing 10 pounds of air pollutants each year

In fact, air pollution is removed by most parts of a tree, including the soil, roots, leaves, trunk, and bark. Trees intercept particulate matter and can absorb ground-level ozone, sulfur dioxide, nitrogen dioxide, and carbon monoxide. Additionally, trees and forests absorb carbon dioxide and produce oxygen. Approximately 260 pounds of oxygen can be produced by a healthy, mature tree every year.

Criteria Air Pollutants

The EPA sets air quality standards for six common pollutants, called criteria air pollutants. Those are pollution, ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead. Of these, ozone and particle pollution are the most widespread. Permissible levels of these pollutants are based on human health criteria.

Presently, the Southeast Michigan region is in compliance with the standards for ozone, carbon monoxide, particulate matter, nitrogen dioxides, and lead. One heavily industrialized area of southeastern Wayne County is currently designated as nonattainment for sulfur dioxide.

A typical person consumes about 386 pounds of oxygen annually[1]. One large tree can supply enough oxygen for two people[2].

Not only do trees help capture air pollution and produce oxygen, they have also demonstrated economic benefits related to energy efficiency. By reducing localized air temperatures, trees shading around buildings reduce energy use and can result in cost savings on utility bills of 15 to 50 percent. Additionally, shading parking areas can benefit pavement life, as well as capture some evaporative emissions from parked cars during the summer. Finally, street trees not only provide an economic and aesthetic value to local communities, they can also intercept airborne particulate matter generated along roadways.

While these environmental and economic benefits can be realized through strategic increases in tree canopy across the region, it is important to note that the respective contributions to reducing air pollution are small in comparison to the overall emissions in the region. This is described further in the following sections.[1,2,3]

Benchmarking Air Quality Benefits from Green Infrastructure

Despite the rapid growth in the United States between 1980 and 2012, total emissions in the United States of the six air pollutants declined by 67 percent[1]. Table 16 further indicates that between 2002 and 2011, total emissions declined by about 25 percent. By comparison, Southeast Michigan has experienced a 51 percent reduction in annual pollutant emissions during the same time frame (Table 16[2]).

Table 15

Comparison of Growth Areas and Emissions in United States, 1980-2012

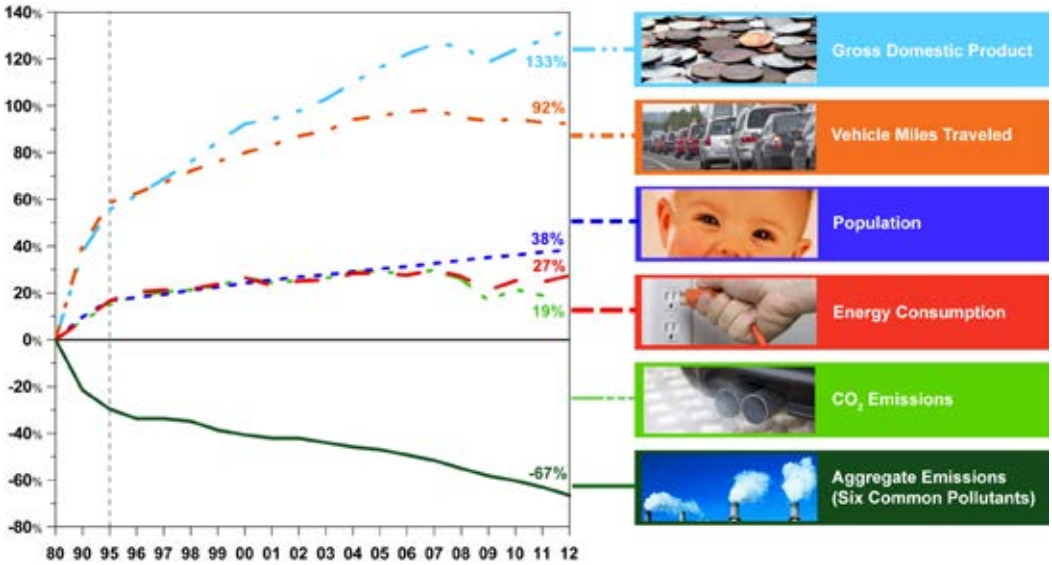


Table 16

Annual Pollutant Emissions in Southeast Michigan – All Sources

Pollutant (tons)								
Year	**CO**	**NO_x**	**VOC**	**SO_2**	**PM10**	**PM2.5**	**Combined PM**	**Total**
2002	1,705,816	316,263	234,322	281,443	100,695	29,072	129,767	2,667,611
2011	738,250	193,144	121,022	166,614	67,474	21,799	89,273	1,308,302
Percent change since 2002								
2011	-57%	-39%	-48%	-41%	-33%	-25%	-31%	-51%

Additionally, Table 16 summarizes the annual pollutant emissions in Southeast Michigan, along with the percent reduction in these emissions between 2002 and 2011.

While Southeast Michigan is currently meeting all but one national air quality standard, these standards are continuously being strengthened. Thus, identifying cost-effective strategies for further reducing pollutant emissions and improving the region's air quality is important.

Because trees can play a small role in improving air quality, benchmarking the potential pollution removal benefits will help guide future green infrastructure implementation in designated areas.

The methodology used to estimate air quality benefits of trees, based on the level of tree canopy in Southeast Michigan, uses an adaptation of the Urban Forests Effects (UFORE) model through the CITYgreen model[3]. The model is formulated on air quality data collected from 55 cities and estimates the removal of carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM10), and sulfur dioxide (SO_2). Pollution removal rates are a function of the tree canopy, growing season, climate, and humidity.

Environmental Mitigation and Climate Adaptation

Reducing air pollutants, such as carbon monoxide, ground-level ozone, particulate matter, nitrogen dioxide, and sulfur dioxide are provided in this analysis. Additionally, carbon storage in existing trees, along with the annual carbon sequestration are estimated purely on the level of tree canopy coverage.

Based on an existing tree canopy of 33 percent, Table 16 provides an estimate of annual emission reductions within the region. Additionally, increasing tree canopy coverage in the region to 40 percent results in additional pollutant removal and carbon benefits. It is important to note that the role of trees in removing air pollution is small in comparison to annual pollutant emissions as additionally shown in Table 16.

Table 17 highlights the 2011 pollutant emissions in Southeast Michigan and provides an indication as to the level of benefit tree canopy may provide.

Table 17

Estimated Pollutant Reduction from Tree Canopy

	CO	**NO_x**	**SO_2**	**Particulate Matter**
2011 Pollutant Emissions in Southeast Michigan (tons)	738,250	193,144	166,614	89,273
Pollutant Reduction with Current 33% Tree Canopy	900	4,800	3,900	15,000
(annual reduction in tons and % of total)	0.1%	2.5%	2.3%	16.8%
Pollutant Reduction with 40% Tree Canopy	1,000	5,800	4,700	17,800
(annual reduction in tons and % of total)	0.1%	3.0%	2.8%	19.9%

Table 18

Annual Pollutant Removal Due to Extent of Tree Canopy (tons)

Percent Tree Canopy in Southeast Michigan	Carbon Monoxide	Ozone	Nitrogen Dioxide	Particulate Matter	Sulfur Dioxide	Carbon Storage	Carbon Sequestered
33% Tree Canopy	900	13,600	4,800	15,000	3,900	36 million	282,000
40% Tree Canopy	1,000	16,300	5,800	17,800	4,700	50 million	395,000

Research studies estimate that urban trees within the United States store approximately 643 million tons of carbon with an annual carbon sequestration rate of approximately 25.6 million tons[2,3]. The extent of pollution reduction differs among cities according to the amount of air pollution, length of in-leaf season, precipitation, and other meteorological factors. Large healthy trees have a benefit over small healthy trees by about 70 times[4]. Strategically planting trees in the region will provide localized and regional environmental benefits.

Regional Policy

Southeast Michigan will strive to meet a 40 percent tree canopy for the region. Increases in tree canopy should be focused in urban areas with current low tree canopy, as well as specific land uses, including industrial and institutional properties, riparian corridors, central business districts, and along roadways and parking lots.

Industrial areas

Industrial land use makes up approximately 131,000 acres of Southeast Michigan. Within the industrial land, about 11,000 acres are bare ground. Planting trees in a portion of the bare and gravel areas located on industrial properties will help to mitigate airborne particulate matter and other airborne pollutants. While Southeast Michigan is in attainment of most air quality standards, particulate matter in the form of fugitive dust is a known problem in localized industrial areas.

Table 19

Land Cover in Transportation Corridors

Land Cover Type	Area (acres)
Imperious	55,371
Open Space	30,641
Tree Canopy	10,094
Bare Ground	270

While bare ground areas may be used for specific purposes on industrial property, setting an initial goal for greening a portion of these areas will facilitate further conversations to identify opportunities for increasing tree canopy. A goal of increasing tree canopy on bare and gravel areas by 10 percent on industrial parcels could potentially achieve additional pollutant removal. Table 18 shows the estimated benefits that could be achieved.

Regional Policy

Increase trees on industrial bare ground, with the goal of reducing localized air pollution, including fugitive dust in addition to enhancing aesthetics by buffering industrial land uses.

Roadways

There are approximately 96,000 acres of right-of-ways on major roadways in Southeast Michigan. Major roadways are identified by their respective functional classification, but are generally represented by the major arterial roadways, including local, county, and state roads. Within major roadways, constructing green infrastructure within the rights-of-way, either in existing open space or, where traffic data supports it, implementing road diets with green infrastructure are some of the opportunities that can incorporate additional tree planting. The land cover breakdown in transportation corridors is listed in Table 19.

Existing tree canopy represents approximately 10 percent of the entire major roadway right-of-way area. Increased greening of these roadsides could reduce fugitive dust generated by travel on these roadways. It could also serve as an effective noise buffer for residents and businesses located in the vicinity. Ideally, trees along roadways should be located to maximize shade on pavement and parked vehicles, while maintaining alignment with local, county, and state standards for landscaping within road rights-of-way. Additionally, trees

Table 20

Tree Canopy Benefits along Roadways (Existing and Future)

Tree Canopy within Major Roadways ROW (acres)	CO (t/yr)	O_3 (t/yr)	NO_2 (t/yr)	PM_{10} (t/yr)	SO_2 (t/yr)	C Storage (tons)	C Sequestered (t/yr)
Existing (10,094-ac)	9	139	49	153	40	434,000	651,000
Proposed Future (15,141-ac) (50% increase)	13	209	74	229	61	3,400	5,100

can also be incorporated into constructed green infrastructure techniques, such as bioretention and bioswales, that are designed to manage roadway and adjacent property runoff. Table 20 represents the environmental benefits realized with a potential 50 percent increase in tree canopy along roadways.

Finally, green infrastructure forest buffers have been identified as potential opportunities, particularly along major highways within the City of Detroit. Sometimes referred to as carbon forests, these 500-foot buffers between the highways and nearby residences help to capture pollutants from vehicles and serve as a buffer for noise. Studies have demonstrated that a 100-foot width of dense trees can reduce noise by 50 percent[5]. The extensive amount of vacant property within the city will facilitate future development of these carbon forests.

Regional Policy

Protect existing tree canopy along roadways and develop guidelines for increasing tree canopy within major road rights-of-way. Work to increase green infrastructure around high-volume roadways in the region as a mechanism to reduce fugitive dust and noise and improve aesthetics for the public.

Energy Efficiency

Planting trees along the west and south sides of buildings leads to lower cooling costs during the warmer seasons. Additionally, green roofs have demonstrated reduced utility costs in both the warm and cool seasons. Trees in the Midwest provide higher energy efficiency value than in milder climates of the United States due to their benefits in both the colder and warmer times of the year. In the summer, shading reduces cooling costs. In the winter, the structure of the trees can act as windbreaks leading to reduced outside windspeed and air infiltration to homes. This leads to lower heating costs. A computer simulation for Minneapolis, Minnesota, demonstrated that wind protection from three 25-foot tall trees, including two on the west side and one on the east side of a residential home, would lead to a three-percent reduction in annual heating costs and a 56-percent reduction in annual cooling costs[6].

In Southeast Michigan, there are approximately 99,000 acres of institutional property that includes 26,000 acres of tree canopy, 46,000 acres of open space, and 5,800 acres of building footprints. Of the building footprint area, only 70 acres are directly shaded by tree canopy. It is clear that the lack of shading around the building footprints, combined with available open space areas, present significant opportunities to increase tree canopy for energy efficiency purposes.

Regional Policy

Increase tree canopy in institutional property in conjunction with other green infrastructure techniques. Focus tree plantings along the west and south sides of buildings in order to increase energy efficiencies.

Urban Heat Island

Shaded parking lots significantly reduce the sun's heat and effects on parked cars, pavement condition, and stormwater runoff quality. Large parking lots on public properties and within commercial and industrial corridors have been identified as priority areas for increased tree canopy. Analysis focuses on identifying parking-lot acreage within publicly-owned and privately-owned property.

In Southeast Michigan, there are approximately 76,000 acres of parking lots, with 18 percent publicly-owned and 82 percent privately-owned. Within these parking lots, there are approximately 260 acres of tree canopy shading publicly-owned parking lots and 640 acres of tree canopy shading privately-owned lots. With only 260 acres of shading in the 13,500 acres of publicly-owned parking lots, tree planting is a large target of opportunity. These plantings can be installed individually or combined with other green infrastructure techniques to also manage parking lot runoff.

Regional Policy

Increase green infrastructure adjacent to and within parking lots to positively impact the urban heat island effect, in addition to reducing the amount of stormwater runoff and increasing the longevity of pavement condition.

Green Infrastructure and Transportation (Green Streets)

Southeast Michigan's transportation infrastructure, including roads, bridges, nonmotorized pathways, transit routes, and facilities, along with the people and vehicles that use it affect the physical landscape. The connection to green infrastructure ranges from providing connectivity to natural areas and features for recreational enjoyment, to representing the land use type with the highest levels of impervious cover directly impacting the region's water resources. Green infrastructure, both natural and constructed, can be strategically used along roadway corridors to provide recreational, social, and aesthetic amenities to surrounding communities in addition to providing local and regional environmental benefits.

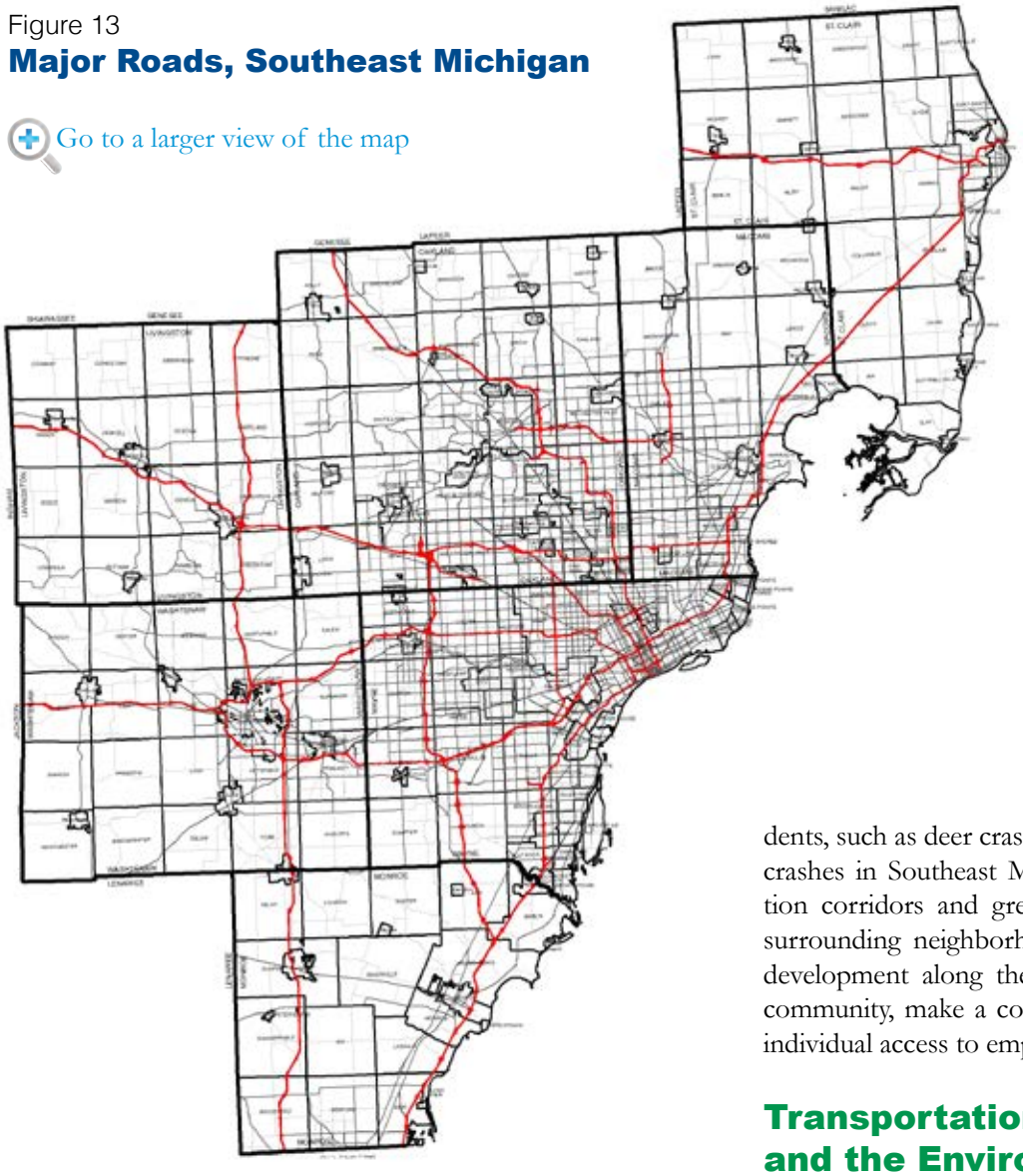
Typical major roadway and landcover

In Southeast Michigan, there are over 23,400 miles of roadways with approximately 245 square miles of impervious cover. This comprises approximately 36 percent of all impervious cover in Southeast Michigan.

Major roadways are identified by their respective functional classification, but generally include the major arterial and collector roads, including local, county, and state roads (Figure 13). Major roads comprise about 150 square miles in the region, with approximately 87 square miles of impervious cover and 64 square miles of open space and tree canopy.

Figure 13
Major Roads, Southeast Michigan

Go to a larger view of the map



Transportation Corridors and Green Infrastructure Connectivity

Transportation corridors present opportunities to link local and regional green infrastructure throughout Southeast Michigan's trail system. Local visioning identified nonmotorized trails as a regional priority, which can be part of the actual transportation corridor or located within and through adjacent green infrastructure areas. Protecting and enhancing adjacent green infrastructure areas also reduces habitat fragmentation and can also lead to fewer traffic-related incidents, such as deer crashes. (In 2012, there were 5,206 deer crashes in Southeast Michigan.) Finally, using transportation corridors and green infrastructure to connect with surrounding neighborhoods can contribute to economic development along the corridor, help create a sense of community, make a community more livable, and further individual access to employment and needed services.

Transportation Corridors and the Environment

Green infrastructure provides a variety of opportunities to enhance local and regional environmental conditions. While tree canopy and adjacent forests can provide related air quality benefits as described in the Green Infrastructure and Air Quality chapter, constructed green infrastructure provides additional water quality benefits as described in the Green Infrastructure and Water Quality chapter. Regional policies from each of these chapters relate to protecting and enhancing green infrastructure along transportation corridors for the benefit of the environment.

Source: Onondaga County Save the Rain

Green Streets

Green streets are roadways that achieve multiple benefits, with a focus on managing stormwater runoff close to the source through the use of bioswales, bioretention, porous pavements, tree trenches, and unique streetscape designs. They reduce the amount of water piped directly to local streams, in addition to providing local temperature mitigation and air quality improvements.

Table 21

Land Cover within Major Road Rights-of-Way (acres)

	Impervious Surface	Open Space	Tree Canopy	Urban Bare	Water	Total
Livingston	2,946	2,371	1,000	3	8	6,327
Macomb	6,888	4,467	897	35	13	12,299
Monroe	3,303	3,021	592	7	11	6,933
Oakland	13,341	6,148	3,331	74	29	22,922
St. Clair	3,679	3,557	605	32	12	7,885
Washtenaw	5,132	4,077	1,590	16	14	10,828
Wayne	20,082	7,001	2,079	103	27	29,293
Total	55,371	30,642	10,094	270	114	96,487

Complete Streets are roadways that are designed for all users, including drivers, bicyclists, public transportation riders, and pedestrians. Designing for complete streets creates sustainability and achieves economic vitality while protecting the environment and providing a higher quality of life for residents.

The Green Infrastructure and Water Quality Chapter stressed that major roadways in watersheds with levels of impervious cover greater than 10 percent are priority areas for constructed green infrastructure. While the transportation network is a significant component of the region's infrastructure, it generates more than 100 billion gallons of stormwater runoff with more than 100 tons of phosphorus and 34,000 tons of sediment on an annual basis. Compared to other land uses and impervious surfaces, roadway runoff tends to have higher levels of sediment, metals, salts, and deicing materials. The excess runoff, combined with pollutants, directly impacts local water resources.

Traditionally, the focus of managing stormwater runoff from roadways has been to remove it as quickly as possible in order to ensure public safety and the integrity of the road system. Green infrastructure represents an opportunity to change the historic stormwater management paradigm for roads while still achieving public safety and roadway integrity.

Specific green streets opportunities include:

- Redirecting runoff to constructed green infrastructure within available road right-of-way spaces.
- Implementing road diets to reduce impervious surfaces and using the available space for nonmotorized improvements, on-street parking, and constructed green infrastructure where traffic conditions warrant.

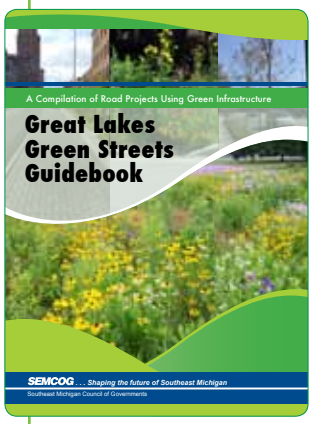
- Installing curb bump outs with constructed green infrastructure features at intersections which also achieve traffic calming or speed reduction.
- Constructing linear streetscape enhancements that include constructed green infrastructure for both aesthetic and environmental benefits.
- Aligning community goals related to reuse of vacant property to strategically integrate these types of properties into the green infrastructure network.
- Using nonmotorized features to make connections within the overall green infrastructure network.

One acre of roadway impervious surface can generate between 0.5 and 1 million gallons of stormwater runoff annually. Michigan Avenue in Lansing has 30 planter box bioretention areas that collect runoff from four acres of roadway and reduce the annual stormwater runoff by approximately 75 percent. While the planter boxes provide a direct benefit to water quality, they also enhance community aesthetics, traffic calming, and pedestrian safety.

Road diets represent opportunities in areas where there may be more traffic lanes than needed to accommodate current and future travel. Many roads in Southeast Michigan are operating well below maximum capacity. This is particularly true in some of the older urban areas that have experienced significant declines in population and employment over the last 50 years. Opportunities to repurpose lanes include:

- Construct green infrastructure to manage stormwater runoff from the roadway and increase the attractiveness of the street.
- Provide bike lanes and improve the connectivity of the region's bike route system.
- Provide on-street parking to help revitalize community downtowns.

Redeveloping of assets along transportation corridors can advance economic opportunity, improve social well-being, and strengthen the local tax base. Evaluating opportunities to repurpose buildings and parcels to using green infrastructure, creating public spaces, and greenway connections in combination with commercial development enhances the economic vitality of the region. A comprehensive approach is required to integrate corridor transportation planning, redevelopment, and green streets in a manner that supports economic development, considers community desires, creates quality of place, and promotes environmental and fiscal sustainability.



The Great Lakes Green Streets Guidebook contains a compilation of road projects across the Great Lakes states that have incorporated green infrastructure.

Additionally, collaborating across regional transportation assets and programs can open up opportunities to partner on green infrastructure implementation. Southeast Michigan has several local airports for various uses, including:

- Detroit Metropolitan Airport
- Detroit City Airport
- Willow Run Airport
- Selfridge Air National Guard
- Oakland County International Airport
- Ann Arbor Municipal Airport

With major state and county roadways providing access to these facilities, opportunities to improve local aesthetics and water resources can be achieved through partnerships in constructed green infrastructure. For example, Wayne County constructed low-growing native plant grow zones within the Ecorse Road medians adjacent to Willow Run Airport. MDOT is also exploring alternatives for enhancements to I-94 with Detroit Metropolitan Airport.

Coordinating development of complete and green streets with broader redevelopment of transportation corridors will provide multiple benefits for both new projects and retrofits within these corridors. Benefits include the following:

- Attractive streetscapes that connect business districts, residential, and recreation areas.
- Accommodating diverse traffic needs of cars, trucks, pedestrians, and bicyclists.

- Reducing stormwater runoff volume and improving local water quality.
- Improving air and water quality.
- Added traffic safety through various traffic calming features.
- Increasing efficiency of a community's overall infrastructure system.
- Working towards meeting newer federal stormwater requirements.
- Enhancing community livability and quality of life.
- Increasing economic vitality of the region.

Regional Policy

Promote use of complete and green streets as appropriate when planning transportation improvements to achieve multiple desired outcomes, including nonmotorized and water resource goals.

Analysis of Green Streets Opportunities

When analyzing transportation corridors for environmental benefit, the Green Infrastructure and Water Quality chapter focused on those subwatershed planning areas with levels of impervious cover greater than 10 percent. As described in that chapter, there are approximately 39,000 acres of roadway impervious cover across the region in these subwatershed planning areas. This also includes over 17,000 acres of open space and 7,000 acres of tree canopy all within the respective road rights-of-way. While these roadways are a subset of the major roadways shown on the Green Infrastructure Visioning maps, they represent priority areas of opportunity when specifically addressing stormwater runoff challenges.

In order to seek specific locations for potential green infrastructure implementation, local communities, watershed groups, and transportation agencies should collaborate and align respective outcomes. Opportunities to align goals include:

- Integrating stormwater management when adding capacity, paving gravel roads, reconstructing roads, and implementing road diets.
- Evaluating green infrastructure opportunities for all publicly-funded infrastructure projects, including roadways, water main replacement, and sanitary sewer rehabilitation projects.
- Collaborating on corridor redevelopment activities and using SEMCOG's Corridor Redevelopment Toolkit to focus on regionally important topics.
- Reviewing traffic models and traffic data to identify potential road diets that may occur with other local projects, such as recreational enhancements or other capital improvement programs.
- Identifying vacant property availability for strategic use in roadway projects.

Additionally, policy challenges with green streets should be addressed across programmatic levels of multiple agencies and jurisdictions. Transcending these inter-jurisdictions to create a cohesive approach across the region will realize a significant improvement in the water quality of local streams and rivers.

Regional Policies

Develop local, county, and state policies, standards, and guidelines to integrate green infrastructure into transportation infrastructure. Collaborate across transportation agencies to support consistent approaches for alternative street design standards.

Promote coordination between watershed planning groups and transportation agencies that leads to a process of incorporating stormwater management opportunities into transportation project planning.

Recognize and support actions by local communities and transportation agencies that seek to address the relationship between transportation and the environment.

Funding for Green Streets

Typically, stormwater management is an eligible cost under the federal system, but is often viewed as an "add on" by road agencies. When having to choose between spending limited road funding on resurfacing additional roads or adding stormwater management to their projects in revenue-starved circumstances, runoff management is often a lower priority. Transportation revenues have declined or remained constant over the past years, making this an even more difficult choice for transportation agencies. While current methods of funding transportation infrastructure are inadequate, largely outdated, and mostly out of alignment with current needs, it is important to evaluate opportunities to shift to an infrastructure funding mechanism that is more sustainable and equitable if the two programs are to be aligned.

Regional Policy

Advocate for a revised structure for transportation funding that provides adequate funding to design, construct, maintain, and replace transportation infrastructure in addition to necessary stormwater management infrastructure.

Green Infrastructure and Vacant Land

Throughout the *Green Infrastructure Vision*, vacant land has been identified as a potential opportunity to strategically invest in green infrastructure. Vacant land is defined as a land use that was commercial, industrial, or residential, but no longer has a structure on-site. Green infrastructure can be used on vacant land, both as a short-term holding strategy until it is ready to be redeveloped and as a long-term solution. Long-term solutions include:

- Access to public waterways and increasing riparian corridors,
- Buffering high-quality areas such as wetlands,
- Increasing connectivity of the green infrastructure network through linking public parks,
- Managing stormwater runoff from roadways by moving it into vacant lots,
- Greening individual vacant lots, and,
- Planning for large-scale green infrastructure that requires land assembly.

Opportunities around Parks, Wetlands, and Riparian Corridors

As discussed in the Quantity chapter, vacant land adjacent to parks, wetlands, and riparian areas are primary opportunities to link and protect the green infrastructure network. For example, Table 21 illustrates there are over 25,000 acres that provide opportunity to add to existing parks, link existing parks to each other, better enclose a park's geographic boundary, incorporate sensitive environmental resources, and allow for additional or new recreational uses. Table 21 also summarizes the amount of vacant land located adjacent to wetlands that can be used to expand existing wetlands, create buffers in upland areas adjacent to high quality or sensitive wetlands, and construct green infrastructure to reduce runoff to wetlands.

Table 22

Vacant Land Adjacent to Green Infrastructure

Area	Vacant Land Adjacent (Acres) to Wetlands	Vacant Land Adjacent to Parks (Acres)	Vacant Land Adjacent to Riparian Corridor (Acres)
Livingston	39,826	5,645	9,018
Macomb	27,906	2,164	3,120
Monroe	7,739	568	2,223
Oakland	51,450	7,942	9,929
St. Clair	29,050	3,571	4,714
Washtenaw	35,656	3,980	6,404
Wayne	25,233	2,082	1,857
Wayne (excluding Detroit)	25,232	1,952	1,845
Detroit	1	130	12
Total	216,860	25,952	37,265

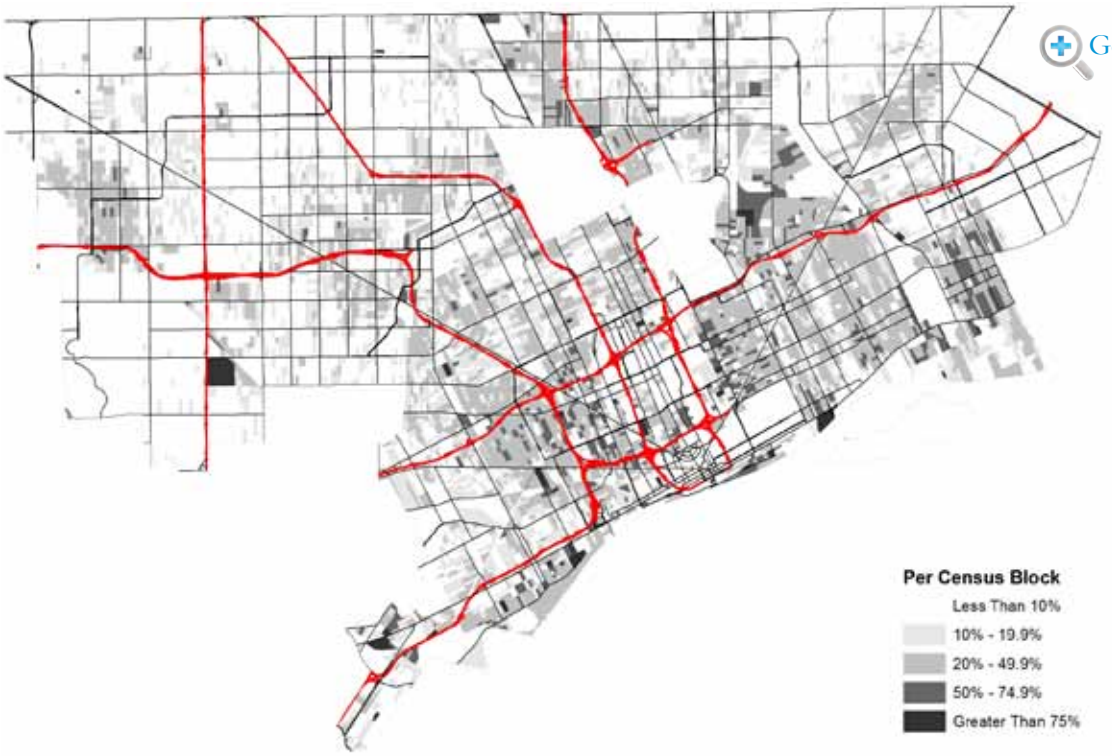
Finally, there is an additional 37,000 acres of vacant land in Southeast Michigan adjacent to rivers and lakes (Table 22). This vacant land provides additional opportunity for increasing public green infrastructure in order to increase public access to waterways, link protected riparian corridors together, and connect riparian corridors to upland parks and natural areas.

Regional Policy

Seek opportunities to use vacant land to increase protected green infrastructure around existing parks, natural areas, and riparian corridors.

Figure 14

Percent Vacant Land, City of Detroit



Go to a larger view of the map

Managing Stormwater Runoff from Roadways - Move It into Vacant Lots

As described in the Transportation and Green Infrastructure chapter, Southeast Michigan's major roads are a primary source of stormwater runoff into local waterways. Vacant lots located adjacent to these roads provide one opportunity for managing this runoff. These determinations should be made in conjunction with community and road agencies to ensure that long-term use of the vacant lot to manage runoff is consistent with local plans.

Regional Policy

Seek opportunities to use vacant lots adjacent to major roads to manage stormwater runoff when consistent with local plans.

Green Infrastructure on Vacant Lots

Vacant lots are also located in residential and commercial areas and can negatively impact the surrounding area. For example, the City of Detroit has over 105,000 vacant parcels totaling over 20 square miles[1]. Figure 14 shows the percent of vacant land in Detroit.

Green infrastructure can provide a short-term or long-term solution to vacant lots depending on the type of green infrastructure used. For example, tree nurseries are being used as a short-term solution on some vacant lots in Detroit. An example of a long-term solution is planting forests and woodlots on vacant lots that will eventually form a linked forest throughout the city.

37,000 acres of vacant land is adjacent to rivers and lakes

In areas of high vacancy, land assembly is needed to more efficiently implement green infrastructure on a larger scale. Multiple owners (at the local and state level) often are a challenge in assembling and implementing green infrastructure. In addition, in many urban areas, the lack of an organization such as a local land conservancy leads to concerns about long-term sustainability. To solve this issue, many land banks take on the role of land assembly and long-term holding of green infrastructure property.

Regional Policies

Implement green infrastructure on vacant properties as both a short-term and long-term solution to vacant properties.

Coordinate vacant land ownership to efficiently assemble property for green infrastructure implementation. Encourage long-term sustainability of green infrastructure properties through use of land trusts or land conservancies.

Detroit Water and Sewerage Department (DWSD) Transforming Vacant Lots

DWSD is transforming vacant lots into green infrastructure to reduce stormwater from entering the sewer system. As part of its agreement with the U.S. Environmental Protection Agency to protect the Rouge River, DWSD changed its traditional grey infrastructure control program to include a green infrastructure component.

In support of the Detroit Strategic Framework, one important component of the program – in partnership with Greening of Detroit – is transforming vacant lots into green infrastructure. DWSD and Greening of Detroit work with area residents to select specific lots and choose the green infrastructure treatment for each site.

Green Infrastructure and the Economy

The economic prosperity of the region is enhanced by the regional green infrastructure network. This chapter analyzes the economic benefits of green infrastructure, including natural and constructed green infrastructure. Economic benefits are tied to property values, tourism, agriculture, energy efficiency, and overall infrastructure savings.

Between 2007 and 2013, every county in Southeast Michigan lost both taxable value and state equalized value (SEV). In fact, every county in the region was among the top 10 largest losses in taxable value in the State of Michigan.

Green infrastructure alone cannot make up for the lost taxable value. However, it can benefit property values. At the Green Infrastructure visioning sessions, stakeholders were asked to identify the type of green infrastructure that provides the highest economic value. Stakeholders from the seven counties and the City of Detroit chose either "Publicly-owned Parks" or "Beach Access to Water" as providing the highest economic value. At the same time, they recognized that all elements of green infrastructure have a direct and indirect economic benefit to residents and local governments.

Property Values and Local Government Revenues

Increasing accessibility to public green infrastructure is an important element in this vision. One side effect of increasing green infrastructure accessibility is the premium that is applied to real estate value. For example, neighborhood parks and recreation land have been shown to increase

Table 23

Residential Property Value Premiums Near Parks

Location	Type of Park	Premium	Distance
Philadelphia, PA[2]	Large city parks	9%	Within 1,000 ft
City of Pittsburgh, PA[3]	All city parks	$23,900	Within 500 ft
Greenville, SC[2]	Small neighborhood parks	8.5%	Within 1,500 ft
Savannah, GA[2]	All city parks	14%	Across or adjacent to
Oakland County[2]	Recreation land	3.1%	Within 15 meters

residential property values within urban areas throughout the nation, including those areas in the Midwest and Michigan (Table 23).

Aside from parks, detention basins, community gardens, street tree planting programs, and natural features, such as wetlands and woodlands, have all been shown to increase home sales. These provide benefits to both homeowners and private developers. For example, a researcher from Wayne State University found that lots in conservation subdivisions that focus on preservation of natural features, carry premiums, are less expensive to build, and sell more quickly than lots in conventional subdivisions

The premiums associated with green infrastructure and residential values are also applicable to commercial property. Trees add to the aesthetics of commercial properties and can be associated with consumers spending more time and money in and returning more frequently to stores with higher amounts of tree canopy along their street frontages. In turn, rental rates have been shown to be up to seven percent higher in commercial areas with quality landscaping.

Regional Policies

Increase tree canopy in urban areas where tree canopy is below 20 percent to enhance local property values and local business revenues.

Support local community efforts to preserve natural features through ordinances and the site plan review process to positively affect property values and benefit local government resources.

Tourism

Recreational fishing, hunting, and boating contribute more than $4 billion annually to Michigan's economy. A recent survey found that in a single year, approximately 1.4 million Michigan residents and 350,000 nonresidents fished in state waters. This generated a direct economic benefit of approximately $2.4 billion to the state. In addition, according to the 2006 National Survey of Fishing, Hunting, and Wildlife, the average fishing, hunting, and wildlife watching participant spends $680 (Table 23). In addition, Michigan ranks first in number of registered boats and snowmobiles nationwide, contributing an estimated $2 billion to the state's economy.

Outdoor recreation tourism has also helped attract people to Southeast Michigan. In 2006, Oakland County attracted an estimated 394,514 pleasure trips, with more than 40 percent of visitors engaging in some outdoor activity, and 20 percent engaging in activities that directly depend on water resources. In addition, the park system in Washtenaw County creates an estimated $350 million in visitor spending each year resulting in 5,600 direct jobs and 6,700 indirect jobs.

Not only does the location of green infrastructure enhance property values, but the quality of green infrastructure is directly related to the level of local and state economic benefits. Research found that improving the water quality in 15 Lake Erie beaches in Ohio would increase consumer spending by $1.85 per person per trip. They estimated that the aggregate seasonal benefit of reducing an advisory at each beach was $3.2 to $3.4 million. These results are similar in Michigan, where Michigan State University estimated that if all 594 public Great Lakes beaches in Michigan closed for one seasonal day it would result in an aggregate loss of $24 million to the state's economy.

Regional Policies

Support efforts to protect, enhance, and restore the region's green infrastructure network to recognize and maintain the economic benefits and value of the tourism industry.

Coordinate with recreation providers to ensure that the green infrastructure network and programming maximizes tourism dollars to Southeast Michigan.

Use unique green infrastructure and wildlife associated with it as an opportunity to enhance local economic development opportunities.

Align regional tourism and water resource goals to strategically enhance and construct green infrastructure leading to improved water quality and fewer beach closings.

Table 24

Expenditures for Fishing, Hunting, and Wildlife Watching in Michigan

Activity	Michigan Participants	Expenditures	Expenditure/Person
Fishing	1,408,000	$1,623,042,000	$1,152.73
Hunting	756,000	$918,655,000	$1,215.15
Wildlife watching	3,846,000	$1,547,111,000	$402.26
Total	6,010,000	$4,088,808,000	$680.33

Infrastructure (Green vs. Conventional)

The economic benefits of using constructed green infrastructure compared to conventional stormwater management controls has been commonly described in literature and research through two main categories:

- Cost-effectiveness of constructed green infrastructure compared to conventional stormwater controls, and
- Cost-benefit analysis that evaluates the overall benefits of each alternative.

The cost-effectiveness approach looks exclusively at the costs of each alternative and does not consider the benefits derived from each alternative. For example, multiple studies have demonstrated reduced costs in new developments with the use of constructed green infrastructure, such as bioswales and bioretention, as opposed to the use of strictly conventional stormwater infrastructure, such as underground pipes and detention ponds. The cost reduction translates into lower expenditures incurred by residents and government agencies.

On the other hand, a cost-benefit analysis considers both a range of costs and benefits for the alternatives considered. It takes into account the environment, social, and public benefits of green infrastructure. While it requires greater data for the analysis, it is more comprehensive than a simple cost-effectiveness approach and can provide a more accurate economic outlook of the full range of benefits leading to a more complete basis for decision-making. These additional benefits can include:

- Increased amenities that enhance property values,
- Improved water quality and flood mitigation,
- Improved quality of local beaches by reducing the number of annual beach closures,
- Increased number of lots that can be developed,
- Expanded recreational opportunities and wildlife habitat improvements,
- Lower construction costs compared to traditional grey infrastructure,
- Reduced regulatory costs,
- Improved air quality,
- Reduced noise pollution,
- Decreased energy consumption, and
- Green jobs created.

Impervious surfaces, such as roads, buildings, and parking areas prevent rainfall from soaking into the ground. Instead, the increased quantities of stormwater runoff will enter local waterways or, in some cases, combined sewers leading to a wastewater treatment plant. Treating stormwater from combined systems at local wastewater treatment plants has both cost and regulatory implications. Managing that runoff in local decentralized green infrastructure techniques works towards reducing energy consumption and treatment costs, which are avoided costs that should be considered in a cost-benefit analysis. It also works towards achieving compliance obligations related to combined sewer overflows.

Examples of economic benefits realized through the use of constructed green infrastructure are numerous. Locally, Wayne County's multi-year grow zone initiative consists of establishing native plant grow zones within road rights-of-way and publicly-owned property in strategic locations across the entire county. The transition from managed turf to grow zones has resulted in direct economic benefits including reduced mowing and maintenance costs. Indirectly, grow zones filter and reduce localized stormwater runoff leading to in improved water quality in local streams.

Additionally, ECONorthwest analyzed nine green infrastructure projects (rain gardens, gravel wetlands, and stormwater wetlands) installed by the cities of Rochester and Rochester Hills. They estimated that the projects can potentially conserve 49-63 million gallons of runoff per year and provide $2,200-$3,100 per year in habitat-related benefits.

Finally, the City of Ann Arbor has implemented a variety of constructed green infrastructure techniques in order to reduce the costs associated with managing and treating stormwater. Using the calculation methods derived from the Center for Neighborhood Technology, ECONorthwest estimated that Ann Arbor and its residents will save between $53 and $185 million from decreased stormwater fees homeowners pay the city over 50 years.

Energy Efficiency Benefits

Whether it is avoidance from treating stormwater, or the heating and cooling benefits derived from natural vegetation, green infrastructure conserves energy in many ways. Green roofs, for example, provide an extra layer of insulation that can increase a building's temperature-regulation system. Ford Motor Company's Dearborn Truck Plant has a green roof covering 10.4 acres. Economic benefits include reduced heating and cooling demands by five percent, while also diminishing runoff and doubling the life of the roof.

When properly placed, street trees can also affect energy consumption by shading buildings, providing evaporative cooling, and blocking winter winds. For example, planting a tree on the west side of a home will reduce the home energy bill by three percent in the first five years and 12 percent in 15 years. A computer simulation for Minneapolis, Minnesota, demonstrated that wind protection from three 25-foot tall trees, including two on the west side and one on the east side of a residential home, would lead to a three percent reduction in annual heating costs and a 56 percent reduction in annual cooling costs.

An urban heat island occurs when natural land covers are replaced by a concentration of buildings, cement, and other surfaces that absorb and retain heat. Trees, green roofs, and other green infrastructure elements can cool urban areas by shading surfaces, deflecting sun radiation, and releasing moisture into the air. As of 2010, the City of Detroit had 48,580 acres of impervious surface (54.5 percent of all land cover) and 14,646 acres of tree canopy (16.4 percent). The lack of tree canopy is not unique to Detroit in Southeast Michigan. There are 56 communities that have less than 20 percent tree canopy land cover.

Regional Policies

Demonstrate and promote the economic benefits of using green infrastructure, including implementing constructed green infrastructure on institutional property and in publicly-funded projects.

Implement native plant grow zones in strategic areas on public property to reduce maintenance costs while improving local water resources.

Great Lakes Stormwater Management Institution

The Great Lakes Stormwater Management Institute at Lawrence Technological University showcases many low impact development examples throughout Southeast Michigan, in addition to the extensive green infrastructure network throughout the college campus.

Most notably, the Taubman Student Services Center at LTU features a 10,000-square-foot living green roof that supports nine different species of sedum ground cover. The green roof is expected to last approximately 40 years, more than twice the life span of traditional materials. With normal rainfall, the green roof retains between 60 and 90 percent of rainfall, while the remainder drains into a 10,000-gallon cistern to be used as "gray" water for flushing toilets.

Agriculture

The food and agriculture industry in Michigan contributes $91.4 billion annually to the state's economy and is responsible for 22 percent of the state's employment. Southeast Michigan counties are state leaders in many agricultural production categories (Table 25).

Agriculture is a piece of the green infrastructure picture that provides significant economic value to Michigan. In 2012, the Land Policy Institute at Michigan State University published a study looking at the role green infrastructure has on economic growth. They found that for each one-percent gain in agricultural land, there is an $18.20 increase in per capita income.

The recession from 2007-2009 significantly affected many Michigan economic sectors, but agriculture was one of the few recession-proof industries. According to an MSU study, the economic contribution of Michigan's farms rose 50 percent, from $7 billion to more than $14 billion, from 2004 to 2010.

Regional Policies

Preservation of high-valued agricultural lands and development of community gardens is encouraged as a tool to provide a high-quality local food network for Southeast Michigan and continue the economic viability of the agricultural industry.

Protect the economic viability of Southeast Michigan farms by implementing tools such as conservation easements. Additionally, implementing Generally Accepted Agricultural Management Practices, including vegetated buffer strips, reduces the adverse impacts of agricultural practices on local water resources and the Great Lakes.

Table 25

Agricultural Contributions by County

County	Top 10 Ranking in Michigan
Livingston	4th in revenue from horses and ponies ($1,030,000) 8th in number commercial feed manufacturing facilities (13) 9th in colonies of bees (2,730)
Macomb	2nd in meat processing plants (4) 3rd in direct-to-customer sales ($3,507,000) 3rd in number of aquaculture operations 4th in number of whole food processing plants (59) 6th in revenue from nursery, greenhouse, floriculture, and sod ($27,159,000) 8th in number of food warehouses (28)
Monroe	4th in revenue from vegetables ($18,563,000) 5th in revenue from nursery, greenhouse, floriculture, and sod ($34,866,000) 7th in acres of vegetables (6,707) and acres of corn, soy, and wheat (169,792) 8th in total crop sales ($122,058,000)
Oakland	1st in revenue from horses and ponies ($1,382,000) 3rd in number of food warehouses (61) and processing plants (82) 3rd in number of dairy processing plants (4) 3rd in number of commercial feed manufacturers (22)
St. Clair	6th in number of farms using organic production (19) 8th in acres of soybeans (64,224)
Washtenaw	1st in number of (146) and revenue from ($1,383,000) sheep and goat operations 1st in number of (468) and revenue from ($1,285,000) horse and pony operations 2nd in number of farms using organic production (26) 3rd in number of aquaculture operations (4) 7th in value direct-to-consumer sales ($1,859,000)
Wayne	1st in number of whole food (156), dairy (9), and meat (17) processing plants 2nd in number of aquaculture operations (5) 7th in revenue from nursery, greenhouse, floriculture, and sod ($23,446,000) 8th in value of direct-to-consumer sales ($1,781,000)

Green Infrastructure Vision for Southeast Michigan

Green Infrastructure and the Public Interest

Southeast Michigan's green infrastructure has major implications for a strong and robust economy, for improving water quality, saving on infrastructure costs, providing recreation opportunities in Southeast Michigan's varied natural landscapes and, as is further described in this chapter, achieving overall social benefits, such as reduced crime and stress, and improved health.

With these positive benefits, it is important that the public understands the value of green infrastructure to the quality of their life and to the region as a whole. Thus, there is a need to build public awareness of the benefits of green infrastructure as well as develop a marketing strategy that promotes specific sites and the recreational amenities they offer as a way to build support for the network.

Green Infrastructure and Crime Prevention

In areas with abandoned, vacant lots, blight can encourage crime. Research in Philadelphia supports greening vacant lots can reduce crime. Researchers found that areas with greened vacant lots were associated with consistent reduction in gun assaults in all parts of the city and reductions in vandalism and stress.[1] Other studies have found a relationship between crime and vegetation, including a Baltimore study that found a strong inverse association between crime rates and tree canopy cover.[2] Finally, a study of 98 apartment buildings with varying levels of nearby vegetation were compared in inner-city Chicago. Results indicate that the greener a building's surroundings, the fewer crimes were reported. The relationship of vegetation to crime held after the number of apartments per building, building height, vacancy rate, and number of occupied units per building were accounted for.[3]

Regional Policy

Seek opportunities when greening vacant lots and improving tree canopy to link activities to social benefits, including reducing crime.

Health Benefits of Green Infrastructure

Green infrastructure provides numerous health benefits, including improving access which can increase physical activity that can result in a decrease in obesity, diabetes, and heart disease. It also can provide psychological benefits such as reduced stress and increased happiness.

Green Infrastructure and Physical Activity

There has been a dramatic rise in recent years in the percentage of people who are overweight or obese; these conditions contribute to increases in chronic disease, such as diabetes, and traumatic diseases, such as cancer and heart disease.[4] According to the Centers for Disease Control and Prevention, only 25 percent of American adults achieve recommended levels of physical activity, 29 percent of adults engage in no physical activity during leisure time, and only 27 percent of students in 9th through 12th grades experience moderate-to-high physical activity.[5]

Evidence shows that when people have access to parks and trails, they are more likely to exercise, which can reduce obesity and its associated problems. A group of studies reviewed in the *American Journal of Preventive Medicine* showed that creation of or enhanced access to places for physical activity, combined with informational outreach, produced a 48.4 percent increase in the frequency of physical activity.[6] In a survey of trail users in southeastern Missouri, 55 percent of respondents said they were exercising more since the trail was built. In addition, Safe Routes to School programs provide walking and biking zones for children and teach them positive attitudes toward exercise.[7]

Green Infrastructure & Psychological and Social Health

A growing amount of research shows that contact with nature improves physical and psychological health. For example:

- In Pennsylvania, a review of 10 years of medical records showed that patients with tree views had shorter hospitalizations, less need for pain killers, and fewer negative comments in nurses notes, compared with patients with brick-wall views;
- Researchers found that residents with even limited views of trees or grass from their apartments reported less mental fatigue, less procrastination in dealing with life issues, and feeling that their problems were less severe, more solvable, and of shorter duration than residents with no views of nature.[8]
- A recent anxiety study from the Netherlands involving 345,000 people, found that people who resided in urban areas devoid of natural areas had a 44 percent higher rate of anxiety disorders than people who lived in communities with significant greenways, parks, and natural areas. The study also showed that time spent in natural surroundings reduced incidences of depression.[9]
- Researchers found that children with Attention Deficit Disorder (ADHD) can benefit significantly from regular access to parks and natural areas. The study found that children with ADHD who take 20-minute walks in urban parks received a concentration performance boost of at least as large as the performance boost from two widely prescribed medications.[10]

Regional Policies

Use green infrastructure, including parks and trails, as a mechanism for improved health in Southeast Michigan that includes communicating these benefits to the public.

Initiate partnerships between health-care providers and recreation providers in improving access and programming at parks and trails.

Public Education and Marketing

From understanding the benefits of native plants and bioswales, to promoting the rare ecological lands in Southeast Michigan, the need for public education and marketing of green infrastructure has never been higher. In fact, the stakeholder visioning sessions and SEMCOG public poll confirmed this when over 90 percent said they needed more education about green infrastructure.

Public Education

Educating the public, municipal officials, elected leaders, and others of the benefits of green infrastructure to the region and state is essential. There are numerous examples in the region and state where local projects to implement a built green infrastructure technique, such as a bioswale, were not successful due to lack of public or municipal support.

Educating the benefits of the entire green infrastructure network, including parks, open space, and riparian corridors, is also necessary. For example, Michigan is unique in offering a state funding source for park acquisition and development. The Michigan Natural Resources Trust Fund has provided over $240 million dollars in funding to our region, but in the recent past has been looked at to fill the gaps in other budget priorities.

Finally, public polls have shown that residents are interested in taking action on their own property to protect the environment and improve their property. Often, residents lack the information needed to implement these practices, such as how to install a rain garden, what is a native plant, and how to plant a tree to ensure its sustainability.

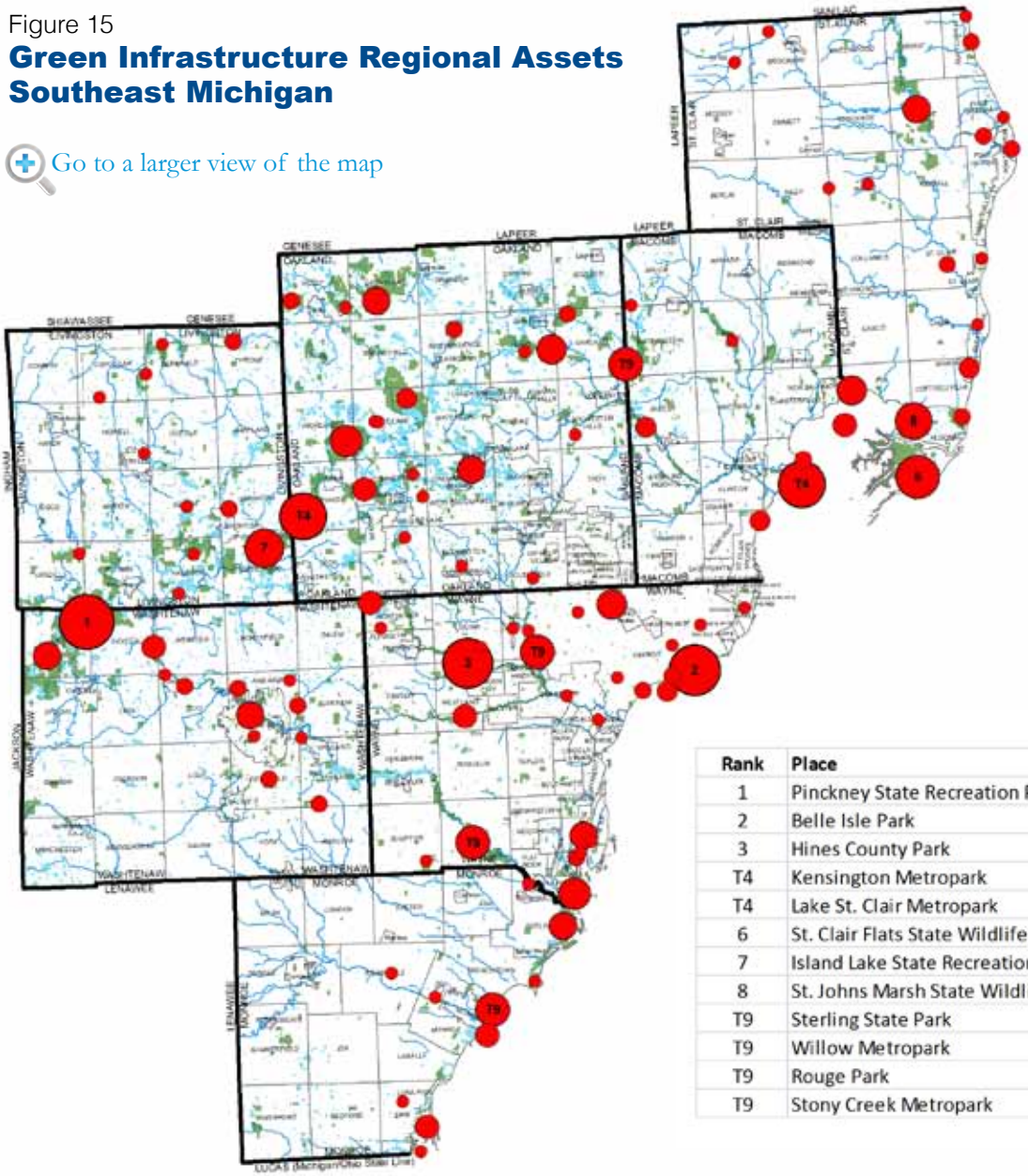
Marketing Green Infrastructure Resources

One of the best ways for the public and other stakeholders to embrace the green infrastructure network is to have them appreciate and use the resource. A strong marketing campaign is needed that highlights Southeast Michigan's green infrastructure assets.

Figure 15

Green Infrastructure Regional Assets Southeast Michigan

Go to a larger view of the map



Rank	Place
1	Pinckney State Recreation Park
2	Belle Isle Park
3	Hines County Park
T4	Kensington Metropark
T4	Lake St. Clair Metropark
6	St. Clair Flats State Wildlife Area
7	Island Lake State Recreation Area
8	St. Johns Marsh State Wildlife Area
T9	Sterling State Park
T9	Willow Metropark
T9	Rouge Park
T9	Stony Creek Metropark

One product from the green infrastructure visioning sessions was for stakeholders to identify green infrastructure areas of regional significance. Figure 14 highlights the areas stakeholders saw as the most regionally significant green infrastructure. Of note, is that most of the areas identified by stakeholders are parks that provide significant recreational opportunities. This helps illustrate that public support is often dictated by places where they visit and recreate. This is an important theme for a marketing campaign. While the region contains many globally-unique areas, the public might not recognize their full value them because they aren't close enough to become stewards of that resource.

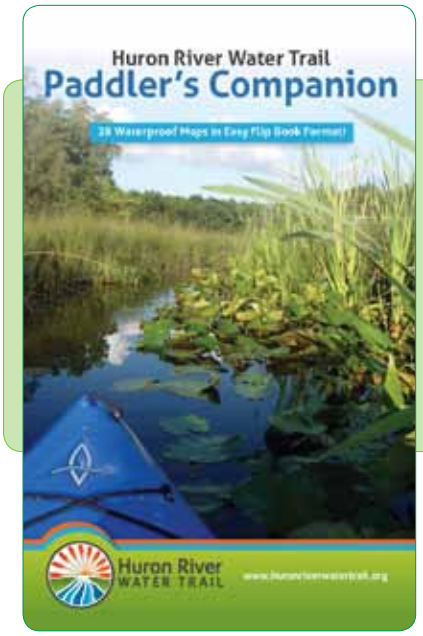
The Pure Michigan marketing campaign for the state has successfully branded tourism. However, the Pure Michigan campaign does not focus on the natural-resource base in Southeast Michigan; rather, the focus is on culture, stadiums, and shopping. As a result, local stakeholders have worked individually on marketing their specific assets.

Regional Policies

Educate the public, local and state government, business, and elected officials on the benefits of the green infrastructure network, including:

- Support and encourage the public's willingness to participate in greening their property and homes by providing information and education on how to implement the activities.
- Support programs that encourage use and stewardship of the green infrastructure network.

Initiate a coordinated marketing campaign highlighting Southeast Michigan's regional assets in partnership with state activities.



Marketing the Huron River

The Huron River Watershed Council is doing an excellent job of marketing recreational use of the Huron River. The Huron River is one of the most popular paddling and fly-fishing rivers in Michigan, and home to the state's busiest canoe and kayak livery. Recently, the Huron River Watershed Council developed The Paddler's Companion. This easy-to-read book is designed to be an essential guide for a trip on the river. In addition to the guide, a Huron River Water Trail logo and Web site have been developed – www.huronriverwatertrail.org.

Sustaining our Green Infrastructure Network: Maintenance, Financing, and Partnerships

Sustainability of the green infrastructure network is taking action to ensure the long-term viability of the network so that future generations can use and enjoy it. To accomplish this, the green infrastructure network must be both fiscally sustainable and properly maintained to ensure long-term sustainability of the system.

In Southeast Michigan, local communities, land conservancies, utility companies, counties, regional entities (such as Huron Clinton Metropolitan Authority), the state, and federal agencies all own pieces of the green infrastructure network. Partnerships among these organizations can result in more integrated management of the system as a whole, resulting in long-term sustainability of the network.

Maintaining the Green Infrastructure Network

Whether it is a park, natural area, trail, or built green infrastructure (e.g., bioswales and rain gardens), maintenance of green infrastructure is critical. Natural areas have been overrun with invasive species and rain gardens have failed due to lack of maintenance of the technique.

To ensure the sustainability of the system, maintenance requirements (both fiscal and staff time) need to be built into the green infrastructure network. Developing a maintenance plan that includes details about the types of maintenance that need to occur, along with timing and estimated costs should be provided for each site. This plan needs to recognize that various entities need to be included in order to holistically address maintenance, including those with expertise in invasive species, stormwater management, and landscape practices.

Innovative alternatives for maintaining green infrastructure can include using volunteers within the community (e.g., Boy Scouts, garden clubs), partnering with neighboring property owners to adopt green infrastructure, as well as forming a workforce development program. Innovative partnerships also include collaborating with business owners in commercial districts to integrate green infrastructure as part of a streetscape enhancement project in which the property owners participate in the long-term maintenance of the sites.

Putting Local Detroiters to Work on Green Infrastructure

The Greening of Detroit, founded in 1989, has planted more than 81,000 trees throughout the city. Workforce development (adult and youth), has been a core mission of the organization to assist in maintaining the green infrastructure that has been planted, as well as providing training for future jobs in the landscaping industry. More than 212 adult trainees have graduated from Greening's adult training programs. Greening of Detroit has placed more than 79 percent of trainees into full-time jobs that pay on average $11.75 an hour.

In 1998, Greening of Detroit created a summer youth employment program to assist in watering and maintaining newly planted trees. The Green Corps program has collectively employed more than 1,500 Detroit youth since its inception. By maintaining thousands of trees in 220 planting sites across the city, Corps members are investing energy and time in their communities.

Prescribed burns, such as this one by Six Rivers Regional Land Conservancy, is one method to reduce invasive species and maintain prairies

Funding for the implementation plan should be incorporated into the overall financial strategy. This should be carefully considered, because often funding sources (e.g., grants) will allow for acquiring or implementing green infrastructure, but not include the cost of long-term maintenance.

Regional Policies

Maintenance of the green infrastructure network is critical and should include development of a maintenance plan that includes both fiscal and staff resources needed to maintain the system.

Creative partnerships and programs should be pursued that maintain the network, including workforce development and community engagement opportunities.

Financing Public Green Infrastructure

Public green infrastructure, including parks, nature preserves, and trails, need to be treated just as other regional assets. To ensure the long-term sustainability of the green infrastructure network, fiscal sustainability is an important part of maintaining and enhancing the current system. Fiscal sustainability should also be at the forefront of discussions on additional strategic investment in the green infrastructure network.

Expanding the public green infrastructure network leads to additional costs relating to acquisition, development, and maintenance. For example, even expanding the size or programming of a park could lead to an increased cost related to staff time to manage the resource.

Numerous opportunities exist to fund acquiring, developing, and maintaining the green infrastructure network. Within the local government structure, understanding how green infrastructure benefits multiple departments within one community, as well as multiple governmental agencies opens up opportunities for cost-sharing, thereby reducing the financial burden based on traditional approaches. Financing green infrastructure should be structured in a manner that equally divides the costs associated with planning, design, construction, and long-term maintenance. Combining resources to work towards a community vision set by planning staff that includes a water resource goal set by public services opens up opportunities to demonstrate wise use of taxpayer funding.

Successful green infrastructure financing strategies include multiple funding sources depending on the type of green infrastructure to be implemented. For example, grants can be used to partially fund acquiring and developing parkland; user fees can implement built green infrastructure; and millages can be used to provide park programming. Typical financing options include:

- Stormwater utilities and taxing districts
- General fund
- Grant and loan programs
- Municipal bonds
- Fee in-lieu-of programs
- Developer funding
- Water/waste water revenues
- Millage

Regional Policies

Address fiscal sustainability of the green infrastructure network for both maintaining the current system and for any discussion of strategically increasing public green infrastructure.

Seek opportunities to fund green infrastructure through innovative methods, including public/private partnerships, stormwater utilities, and cost sharing within the local government.

Partnerships and Institutional Arrangements

Green infrastructure transcends multiple disciplines, agencies, and jurisdictions. Whether it is a single local community, a county, or the Southeast Michigan region, green infrastructure implementation requires cooperation and participation of a cross-section of entities. This integrated, decentralized approach should be reflected in local agency structures. For example, a public services department is generally responsible for stormwater management; however, parks and recreation departments are generally responsible for maintaining park areas. Aligning goals of departments and agencies to work towards the overall green infrastructure vision will ensure long-term sustainability of the green infrastructure network.

This transition from a historic, centralized approach to an approach with distributed roles and responsibilities will require training, program development, adaptive management, public outreach, inter-governmental coordination, and monitoring. While this transition is full of challenges, the benefits will include:

- Greater knowledge about green infrastructure and its multiple benefits;
- Support from team members and stakeholders on the green infrastructure program;
- Enhanced coordination across departments and agencies;
- Simplified approaches in the design and construction stages; and
- Long-term social, economic, aesthetic, and environmental benefits.

Regional Policies

Institute internal green infrastructure teams within government agencies to coordinate activities and meet multiple goals of the green infrastructure network.

Form partnerships among local, state, and federal agencies, as well as private business to provide a sustainable green infrastructure network in Southeast Michigan.

Michigan Natural Resources Trust Fund Provides Millions to Southeast Michigan for Green Infrastructure

Michigan communities have been engaged in natural resources protection and developing their green infrastructure assets since the mid 1970s. In 1976, the Michigan Natural Resources Trust Fund (MNRTF) was established to provide a source of funding for the public acquisition of lands for public outdoor recreation and resource protection. Funding was derived from royalties on the sale and lease of state-owned mineral rights. Since 1976, over 1,900 projects across Michigan, totaling approximately $1 billion, have been spent on resource protection and outdoor public recreation.

In Southeast Michigan, there have been approximately 415 projects dedicated to natural resource protection and outdoor public recreation development implemented between 1976 and 2012, totaling over $240 million.

County	Number of Projects	Total Awards
Livingston	17	$9,338,865
Macomb	40	$14,472,755
Monroe	17	$8,029,455
Oakland	143	$77,283,507
St. Clair	40	$17,115,449
Washtenaw	56	$24,301,314
Wayne	103	$89,539,133
Total	**416**	**$240,080,478**

Source: Michigan Department of Natural Resources

Visioning Green Infrastructure in Southeast Michigan

The regional vision ties all the components of green infrastructure together into an identified system and will, for the first time, benchmark the green infrastructure that we have, vision where we want to go, and give policy recommendations on how to get there. This chapter focuses on the process for visioning where we want to go.

The development of the vision included numerous stakeholder engagement sessions to gather input on priorities for Southeast Michigan's green infrastructure in the future, including:

- **Green Infrastructure Vision Task Force**. Established the Green Infrastructure Vision Task Force made up of representatives from over 70 local governments; state and federal agencies; environmental, transportation, and economic development groups. This task force met over a two-year period providing guidance throughout development of the vision.
- **Stakeholder Visioning Sessions**. Convened nine stakeholder visioning sessions throughout Southeast Michigan to provide input into regional policies and provide direct input into local green infrastructure opportunities. Over 300 stakeholders attended the visioning sessions.
- **Pulse of the Region Survey on Green Infrastructure Priorities**. 854 people from across Southeast Michigan completed this regional survey. The survey was available through SEMCOG and Metropolitan Affairs Coalition Web sites and ran from August-October, 2013.
- **October 2013 General Assembly**. More than 70 local elected officials were surveyed during a polling session at the General Assembly.

Results from Stakeholder and Public Polling

The voices of key stakeholder groups and the general public helped shape the direction of the vision. SEMCOG conducted eight in-person visioning sessions and an online public poll to identify important green infrastructure elements and desired outcomes for a regional vision. Key findings of the online survey include:

- The top four most important benefits of green infrastructure to Southeast Michigan residents are:
  1. Improving water quality (57%)
  2. Economic benefits [e.g., improved property values, neighborhood stabilization, green jobs, etc.] (46%)
  3. Improving air quality (38%)
  4. Adding to the quality of life with improved aesthetics (36%)

- The most important green infrastructure elements Southeast Michigan residents would like to see more of:
  1. Trees and rain gardens along roads, downtowns, and parking lots (70%)
  2. Bike/hike trails (56%)
  3. Natural areas [wetlands, woodlands, natural open space areas, etc.] (54%)
- Top places Southeast Michigan residents would like to see more green infrastructure:
  1. Along major roadways (50%)
  2. Near existing parks and fragile/protected areas (45%)
  3. On vacant property (43%)
  4. Along rivers and lakes (41%)

The results from the stakeholder polling at the visioning sessions were similar to these results and are reflected throughout the individual chapters of the vision. Appendix C contains the detailed results from the individual visioning sessions, the online survey, and the elected official poll at SEMCOG's October 2013 General Assembly meeting.

Key Themes for the Green Infrastructure Vision

Based on the visioning sessions, online public survey, task force input, and analysis of the land cover data, the following key themes were observed:

- While there are many different types of green infrastructure and owners, Southeast Michigan's green infrastructure is a network that needs to be managed as a system.
- Additional public green infrastructure should focus on connecting the public network together, focusing on riparian corridors and trails as part of the connectivity.
- Southeast Michigan has high quality, unique natural areas that need to be managed, preserved, and, in some cases, restored.
- Public accessibility to the green infrastructure network is paramount, including access to parks, trails, water, and ensuring public spaces are designed for all residents.
- Increasing tree canopy is a priority due to the numerous benefits, including water quality, property value enhancement, aesthetics, and connecting the green infrastructure network in urban areas.
- In urban areas, constructed green infrastructure should be focused on publicly-owned land such as roads and government property, as well as areas with large impervious surfaces such as private parking lots to improve the quality of local and regional water resources.
- The transportation network is a priority component of the regional green infrastructure network through development of green streets and complete streets in addition to connecting the green infrastructure network.
- Vacant property provides a unique opportunity to increase connectivity, buffer high-quality areas, improve public access to our waterways, and provide long-term solutions in high vacancy areas including providing a local food source.
- Educating elected officials and the public as well as promoting the environmental economic, and social benefits of the green infrastructure network is needed.
- Sustainability of the green infrastructure is essential, including maintenance, fiscal sustainability, and innovative partnerships.

Green Infrastructure Visioning Maps

These key themes are the basis for developing a regional map of green infrastructure. The regional map includes:

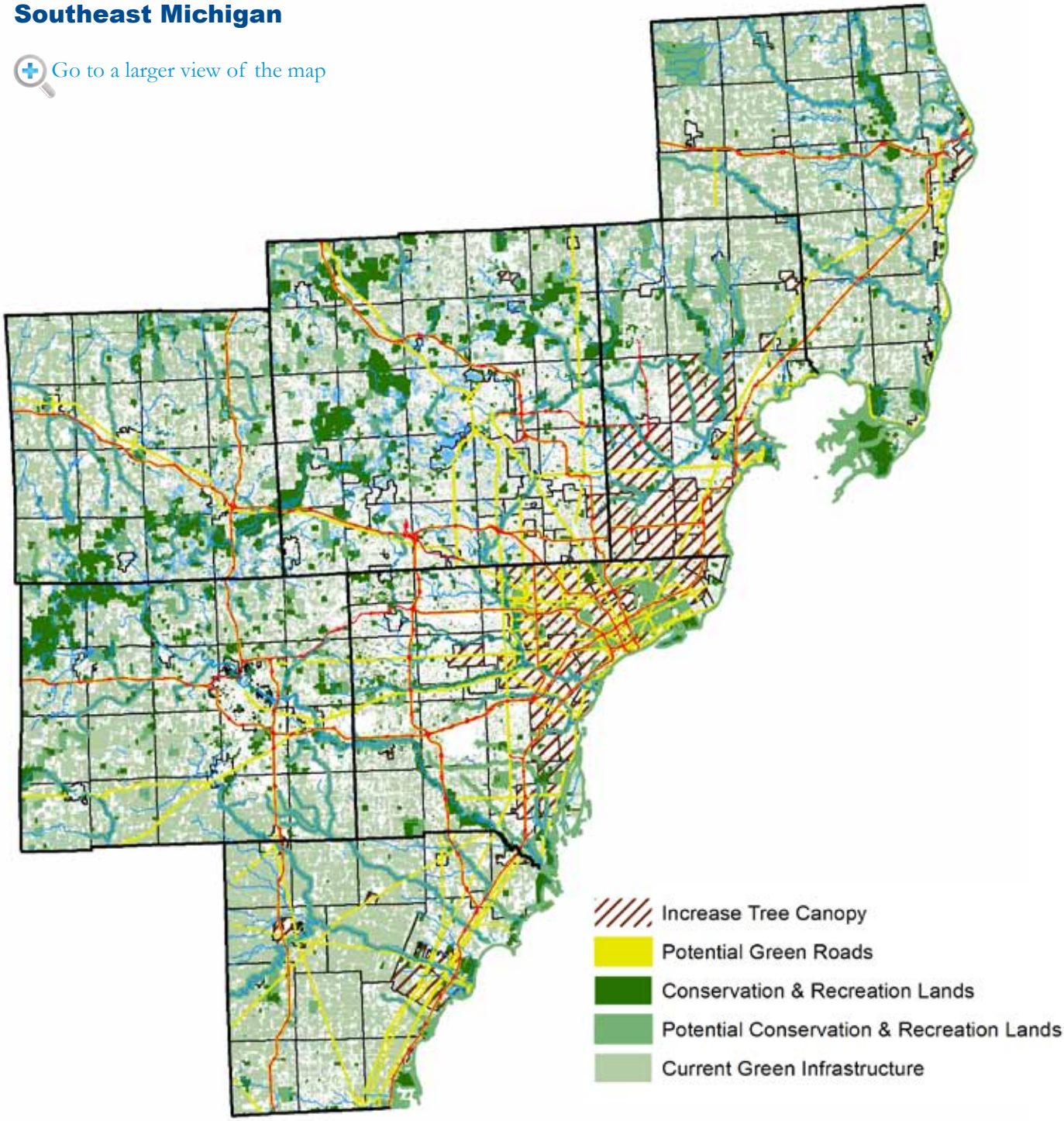
1. Current Green Infrastructure Network – This background shows the larger green infrastructure network of tree canopy (both private and public land), agricultural lands, and wetlands based on the 2010 land cover analysis for Southeast Michigan.
2. Recreation and Conservation Land – This highlights the region's public parks and conservation lands.
3. Potential Public Green Infrastructure – This highlights green infrastructure that could be added to the public green infrastructure network.
4. Potential Green Roads – This illustrates major roads that could either increase tree canopy or implement constructed green infrastructure (e.g., bioswales, rain gardens).
5. Increase Tree Canopy – Communities with less than 20 percent tree canopy are highlighted as a priority for increasing tree canopy.
6. Potential Constructed Green Infrastructure – The top 10 percent institutional properties in each county are included for potential constructed green infrastructure, such as grow zones and bioswales. The top one percent private parking lots are included for each county for potential rain gardens and bioswales.

Following the regional map, are maps of individual counties and the City of Detroit that include the above information, as well as additional county-level information.

Figure 16

Green Infrastructure Vision Southeast Michigan

Go to a larger view of the map



Livingston County

The Livingston County Parks and Open Space Advisory Committee (consisting of Livingston County Commissioners, multi-disciplinary county staff, and community leaders) manages approximately 500 acres of county park land that was bequeathed to Livingston County by two prominent agricultural land owners. Lutz County Park is located in rural Deerfield Township in north-east Livingston County. The park is comprised of 300 acres of varied natural features. Approximately 100 acres of the park land is currently developed with passive recreation. This county park is adjacent to the Oak Grove State Game Area, creating an impressive expanse of green infrastructure. Fillmore County Park is centrally located in Livingston County midway between the cities of Brighton and Howell in Genoa Charter Township. This 198-acre park is currently being designed; sports fields will be a prominent feature. It is the intention of the committee to begin developing this park in 2015.

Figure 17

Green Infrastructure Vision Livingston County

Go to a larger view of the map

- Top 1% Parking Lots by Size
- Top 10% Institutional Land Use Parcels by Size
- Potential Green Roads
- Conservation & Recreation Lands
- Potential Conservation & Recreation Lands
- Current Green Infrastructure

The Livingston County Planning Department published *Livingston County High Quality Natural Areas* that inventories high-quality natural areas throughout Livingston County using aerial photography. The high-quality natural areas were then prioritized by the Livingston Natural Features Coalition (comprised of local environmental representatives) using 10 criteria such as wetlands and proximity to other natural areas. The document also presents a number of personal behavior modifications and policy tools that can be used to protect the county's natural areas. This valuable resource tool is used by the local units of government in Livingston County developing Master Plans, and including natural features language in zoning ordinances. The prioritized land areas are also noted in each County Planning Department review of township zoning amendments.

In addition, the Huron River Watershed Council's (HRWC) Bioreserve Project has mapped and works to protect the watershed's remaining natural areas. The Bioreserve Map includes about 247,000 acres of forest, wetlands, and grasslands; publicly owned state, county, and metro parks as well as private lands – woodlots and wetlands farmers have not drained or plowed – and vacant land not yet developed. HRWC works with conservancies, property owners, and government preservation programs to direct their limited funds towards purchasing or permanently protecting the most ecologically important natural land. HRWC's Portage Creek Project is working with communities in that watershed to create green infrastructure plans that will be incorporated into local master plans.

HRWC is also working with municipalities in Livingston County to better understand how to use and plan for green infrastructure to capture and treat stormwater. HRWC conducted interviews and workshops to gather information about how local communities were using green infrastructure. The project has produced the products below to help municipalities use green infrastructure practices to reduce stormwater costs and improve the quality and volume of stormwater discharge to our natural water resources, including a report on barriers to green infrastructure, a project inventory, opportunities map, project designs, and Web resources.

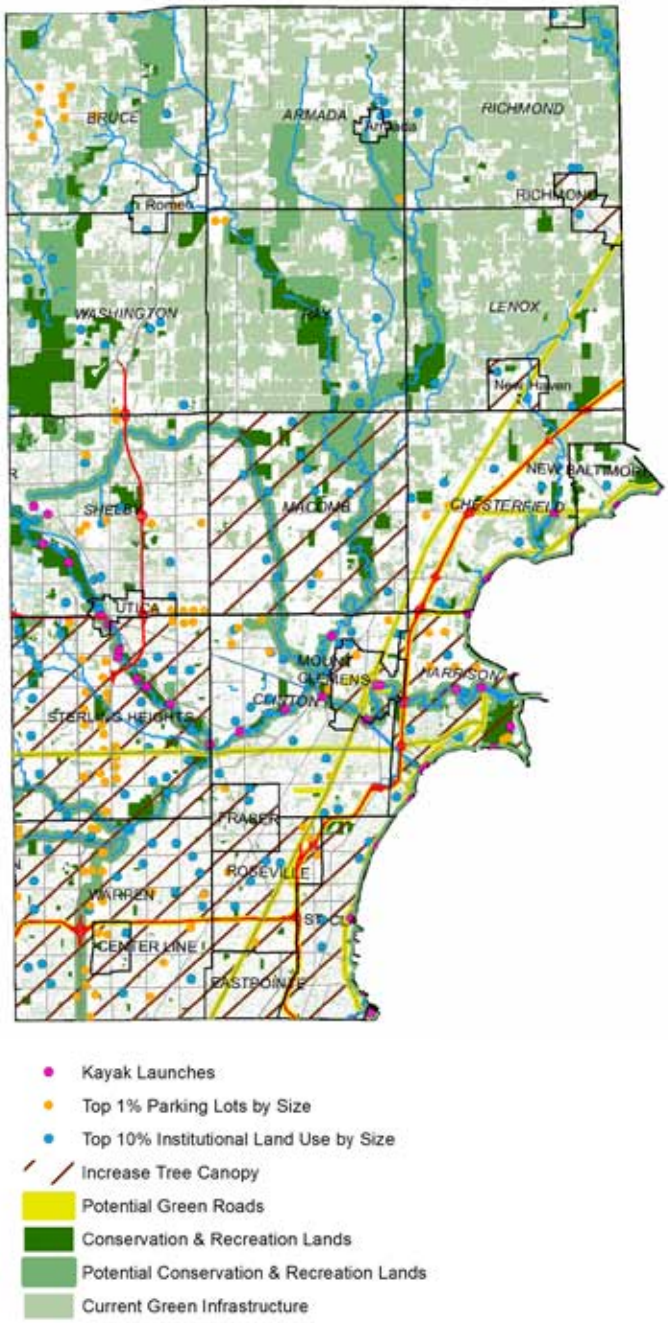
HRWC is actively involved in water trail planning and developed *The Paddler's Companion*. This easy-to-read book is designed to be an essential guide for a trip on the river. In addition to the guide, there is a Huron River Water Trail logo and Web site.

Macomb County

Macomb County is undertaking a new initiative to celebrate the many aspects that are known as the "Blue Economy." With over 60 active marinas, a world-class recreational boating and fishing industry, and numerous public and private access points providing many other ways to enjoy the water. Macomb County Department of Planning & Economic Development is playing a prominent role in expanding the understanding of this Blue Economy by integrating economic development, environmental stewardship, and quality of life.

Figure 18

Green Infrastructure Vision Macomb County



Go to a larger view of the map

Specifically, Macomb County developed the Blue Way Water Trail along the Clinton River, as well as the Coastal Paddling Trail along Lake St. Clair. They also developed a greenways vision that includes a floodplain greenway vision through the center of the county along the north branch of the Clinton River that would allow a long linear green space that could be used as a regional mountain biking trail and nature trails. Other parts of the vision call for large tracts of land for public use along Lake St. Clair and other areas to allow for development of a campground and another large tract for hunting. These issues and many others are also reflected in another effort being finalized – development of the county parks and recreation plan.

Macomb County is also actively involved in habitat restoration of the coastal wetlands at Lake St. Clair Metropark, and design and restoration of the Clinton River Spillway. Finally, the county has integrated green infrastructure on many of their own sites, including rain gardens at the administration building and bioswales, rain gardens, and porous pavers at the public works office.

In addition, Six Rivers Land Conservancy has been working with local governments, park systems, watershed councils, and other stakeholders to develop parcel-level conservation priorities throughout its five-county service area. The process has involved GIS mapping, natural feature analysis, community engagement, and volunteer site surveys. As priorities are identified, the land conservancy then moves into landowner contract and cultivation efforts to develop opportunities to protect identified priorities.

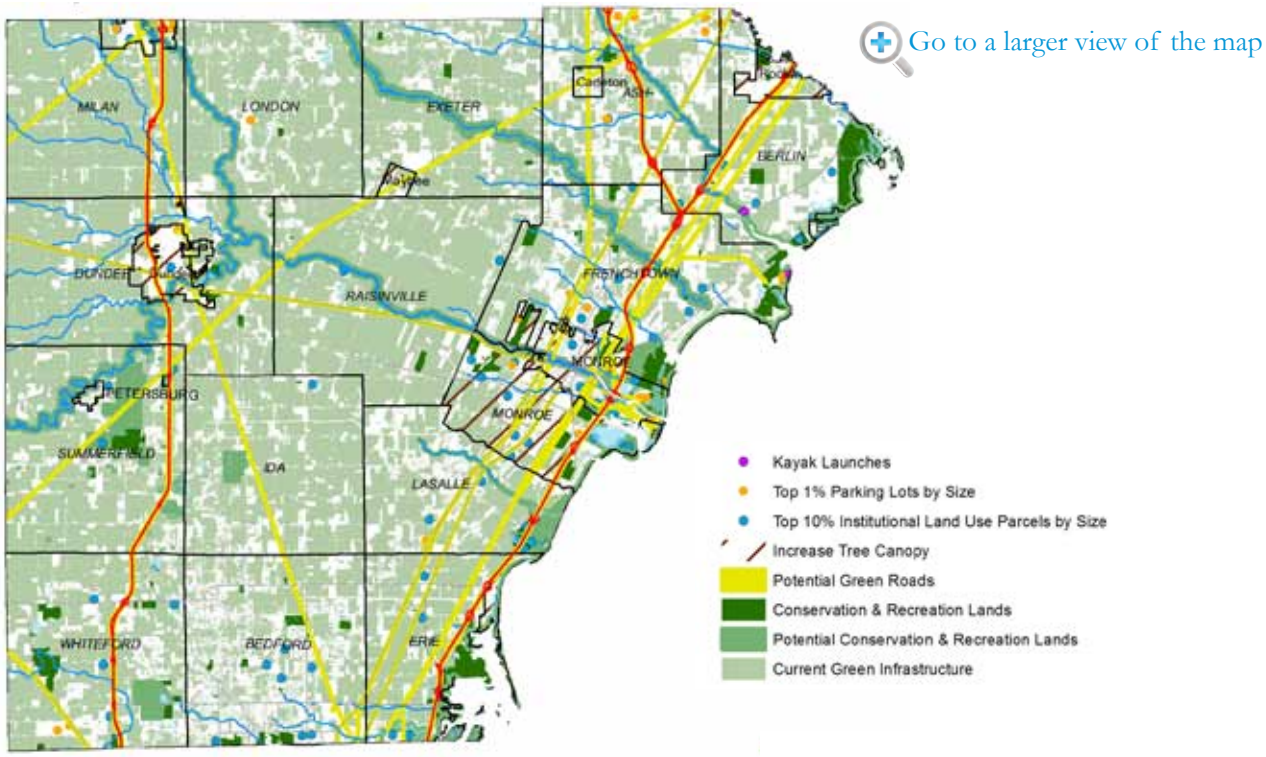
Finally, the Clinton River Watershed Council (CRWC) is working on developing waterhub vision plans to help connect people and waterways as part of its WaterTowns program in partnership with local communities. CRWC is also developing a water trail master plan for the Clinton River and Lake St. Clair.

Monroe County

Monroe County seeks to capitalize on, as well as preserve, its natural assets, in particular its shoreline on Lake Erie, the River Raisin corridor, its prime farmland, and its open space. The county's Comprehensive Plan, along with its Recreation Plan, emphasize lake and river access and open-space preservation. A recent water trail project seeks to promote the coastal zone as a premier recreational destination, as does a River Raisin corridor project focusing on the recently created National Battlefield Park. And the approximately 70 percent of Monroe County's land area dedicated to agricultural land use, along with woodlands and wetlands, serves as an important green infrastructure resource, with particular importance for flood control purposes, wildlife habitat, and rural landscape preservation.

Figure 19

Green Infrastructure Vision, Monroe County

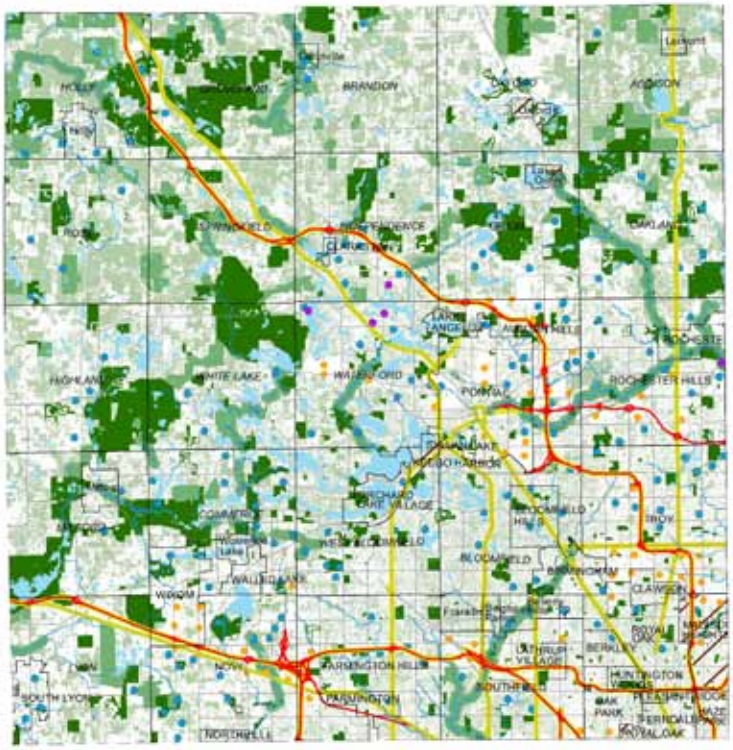


Oakland County

In 2009, Oakland County completed a nationally recognized Green Infrastructure Vision that identifies habitat "hubs," "sites," and "corridors" that are important to the sustainability of Oakland County's environmental quality, ecological diversity, and economy. The multi-scale vision not only provides a basis for the overall interconnected system of open spaces and recreation, but encourages integration of best land management practices into the local project design. The Conservation Fund, a national nonprofit dedicated to conservation, selected Oakland County's vision for its National Green Infrastructure Implementation Award in February 2011.

Figure 20

Green Infrastructure Vision Oakland County



- Kayak Launches
- Top 1% Parking Lots by Size
- Top 5% Institutional Land Use by Size
- Increase Tree Canopy
- Potential Green Roads
- Conservation & Recreation Lands
- Potential Conservation & Recreation Lands
- Existing Green Infrastructure

Go to a larger view of the map

Oakland County Economic Development and Community Affairs provides green infrastructure capacity building assistance to local governments, businesses, work groups, and individual citizens in both urban and rural areas.

Oakland County Parks offers more than 65 miles of park trails and natural landscapes for year-round recreation within its 13 county parks. The county park system also provides a variety of other recreation opportunities, including five golf courses, mobile recreation, three dog parks, two waterparks, a nature center, a BMX track, and the county market. Oakland County also has an Oak Routes County Trail Network vision. The emerging connections of trails, pathways, and blueways traverses much of the 910 square miles of the county, connecting neighborhoods to parks, schools, commercial districts, and town centers.

In addition, Six Rivers Land Conservancy has been working with local governments, park systems, watershed councils, and other stakeholders to develop parcel level conservation priorities throughout its five-county service area. The process has involved GIS mapping, natural feature analysis, community engagement, and volunteer site surveys. As priorities are identified, the land conservancy then moves into landowner contact and cultivation efforts to develop opportunities to protect identified priorities.

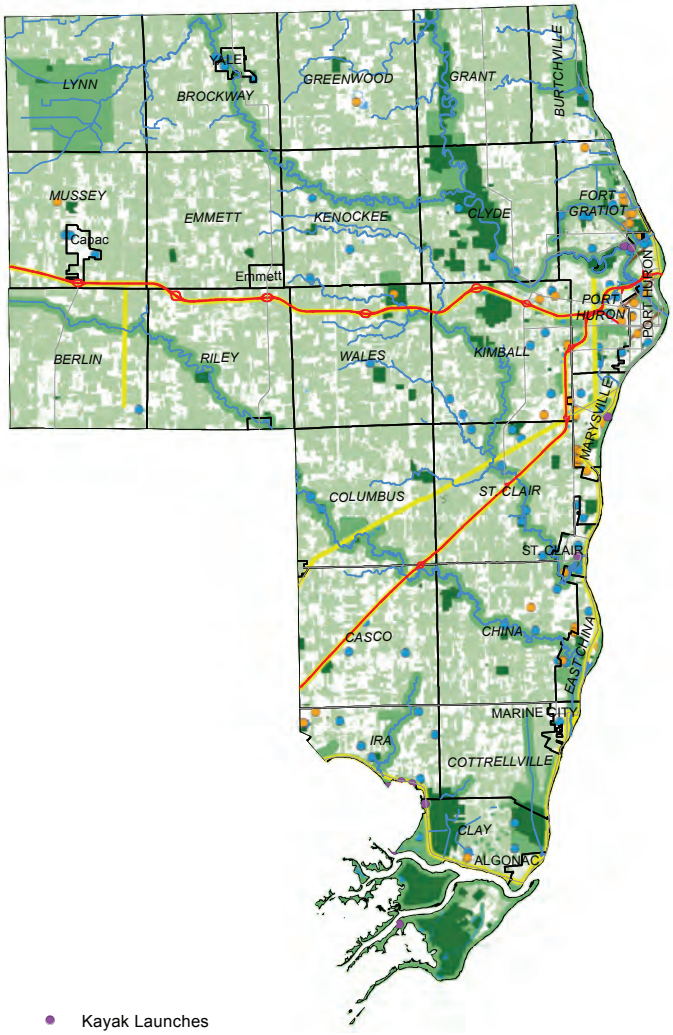
Finally, the Clinton River Watershed Council (CRWC) is working on developing waterhub vision plans to help connect people and waterways as part of its WaterTowns program in partnership with local communities. CRWC is also working to develop a water trail master plan for the Clinton River and Lake St. Clair.

St. Clair County

The water trails system in St. Clair County does an excellent job of combining green infrastructure connectivity, accessibility, economic development, and marketing into one holistic program. The program connects urban and rural areas with 16 water trails and achieves accessibility with 26 points of beaches, kayak/boat launches, or public access sites, including four handicapped-accessible kayak launches. St. Clair County is marketing its water trails through a hands-on Blueways of St. Clair Web site that highlights the different paddling routes and contains a database of places to camp, shop, eat, or learn about maritime history. Finally, the Island Loop Route in St. Clair County has earned National Water Trail status. This again enhances the visibility of their unique program.

Figure 21

Green Infrastructure Vision St. Clair County



- Kayak Launches
- Top 1% Parking Lots by Size
- Top 10% Institutional Land Use by Size
- Increase Tree Canopy
- Potential Green Streets
- Conservation & Recreation Lands
- Potential Conservation & Recreation Lands
- Current Green Infrastructure

Go to a larger view of the map

In 2011, the Belle River Watershed Advisory Group began work on the Belle River Watershed Management Plan. The goal is to assess current water quality conditions and identify grant projects that will help protect this important economic, recreational, and aesthetic resource. The completed plan will prioritize best management practices, recommend protection tools needed to support the goals and designated uses of the watershed, and develop a woody debris management plan.

The Blue Water River Walk project is almost one mile of St. Clair River shoreline immediately south of the mouth of the Black River in Port Huron, Michigan. Through an initial philanthropic land donation and a series of grants, the river walk is being developed in stages that will soon contain the restored Ferry Dock, habitat and shoreline restoration, an outdoor classroom, a pedestrian trail, and public art. The next phase will incorporate a County Wetlands Park, Fishing Pier, and First Peoples' Tribute.

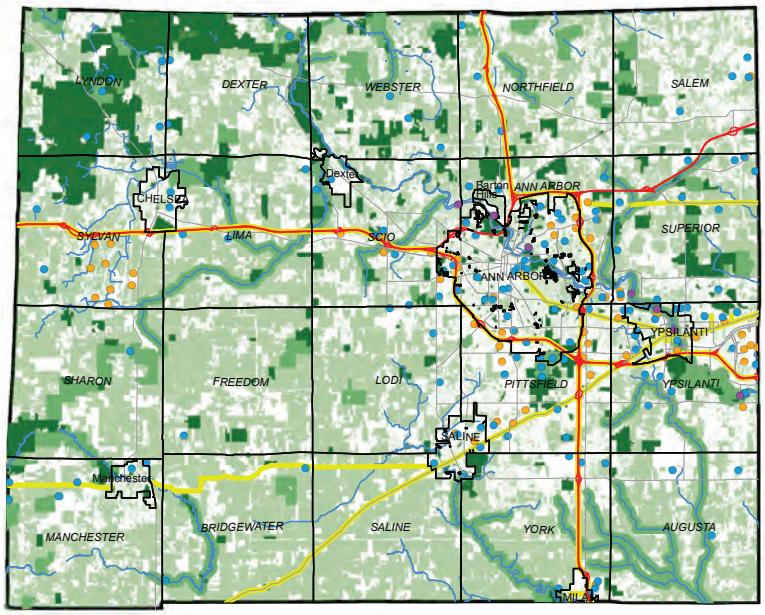
St. Clair County Parks and Recreation currently owns just under 1,000 acres of park land and operates five county parks and the 12.5 mile long Wadhams to Avoca Trail, all of which are located next to waterways. St. Clair County is partnering with 13 local units of government to develop the Bridge to Bay Trail along the county's coastline from Anchor Bay to Lake Huron. St. Clair County is working with Macomb County to connect the Bridge to Bay Trail to the Macomb Orchard Trail. The Parks and Recreation Commission financially assists local units of government to purchase waterfront properties for recreational use.

Washtenaw County

Since 1973, the Washtenaw County Parks and Recreation Commission (WCPARC) has strived to develop and enhance its park system, and now provides access to more than 5,000 acres of parks, preserves, open spaces, trails, rivers and lakes, and diverse ecosystems. In addition to the trail network in its parks and preserves, WCPARC has been instrumental in developing a nonmotorized trail system throughout Washtenaw County. WCPARC has also developed a broad range of recreational facilities and offers a diverse, entertaining, and educational array of programs for all ages.

Figure 22

Green Infrastructure Vision Washtenaw County



Go to a larger view of the map

- Kayak Launches
- Top 1% Parking Lots by Size
- Top 10% Institutional Land Use by Size
- Potential Green Streets
- Conservation & Recreation Lands
- Potential Conservation & Recreation Lands
- Current Green Infrastructure

Washtenaw County's Natural Areas Preservation Program (NAPP) purchases unique natural areas to ensure their preservation for the benefit of the county and its people, plants, and animals. Funding for the program is derived from a dedicated millage first approved in the November 2000 election. The goal of the NAPP is to identify lands which, through long-term preservation will: protect and preserve the natural and ecological diversity/heritage of Washtenaw County, complement the existing network of publicly and privately protected lands, and maximize the public benefit.

The Border-to-Border (B2B) Trail is a multi-agency, collaborative project to construct a multi-use trail traversing Washtenaw County, from Livingston County to Wayne County, along the Huron River. When completed, the 35-mile trail will permit nonmotorized travel through the linked open spaces encompassing Washtenaw County's most distinctive natural feature – the Huron River Corridor. Several segments of the trail have already been constructed.

The City of Ann Arbor has developed their first Urban and Community Forest Management Plan to provide a framework for effective management of the city's urban forest as an asset. Ann Arbor's city-managed urban forest (43,000 street trees and 6,600 park trees) provides $4.6 million in benefits each year to the city and its residents; the plan will help to maintain a sustainable urban forest that maximizes these benefits.

Since 2005, the city has planted nearly 9,000 trees along streets and in parks to replace both ash trees lost to the emerald ash borer and street trees that died or were removed. There has also been an effort to convert lawn areas to native species, and to create and maintain prairies as well as wetlands and rain gardens.

In 2013, Ann Arbor developed a city policy statement to provide guidelines for "Green Streets" as the standard for design of new and reconstructed city streets. The policy statement consisting of Stormwater Management Guidelines for Public Street Construction and Reconstruction was developed to set infiltration standards based on the ability of the project site to infiltrate stormwater. The Green Streets Policy Statement ensures that green infrastructure is incorporated into the design of all new and reconstructed city streets.

Natural Area Preservation (NAP) works to protect and restore Ann Arbor's natural areas and to foster an environmental ethic among its citizens. This involves conducting plant and animal inventories, ecological monitoring, and stewardship projects in Ann Arbor parks. These tasks are performed by both staff and volunteers. The city has over 1,200 acres of natural area set aside to preserve natural features and open spaces within Ann Arbor and create a green corridor for wildlife.

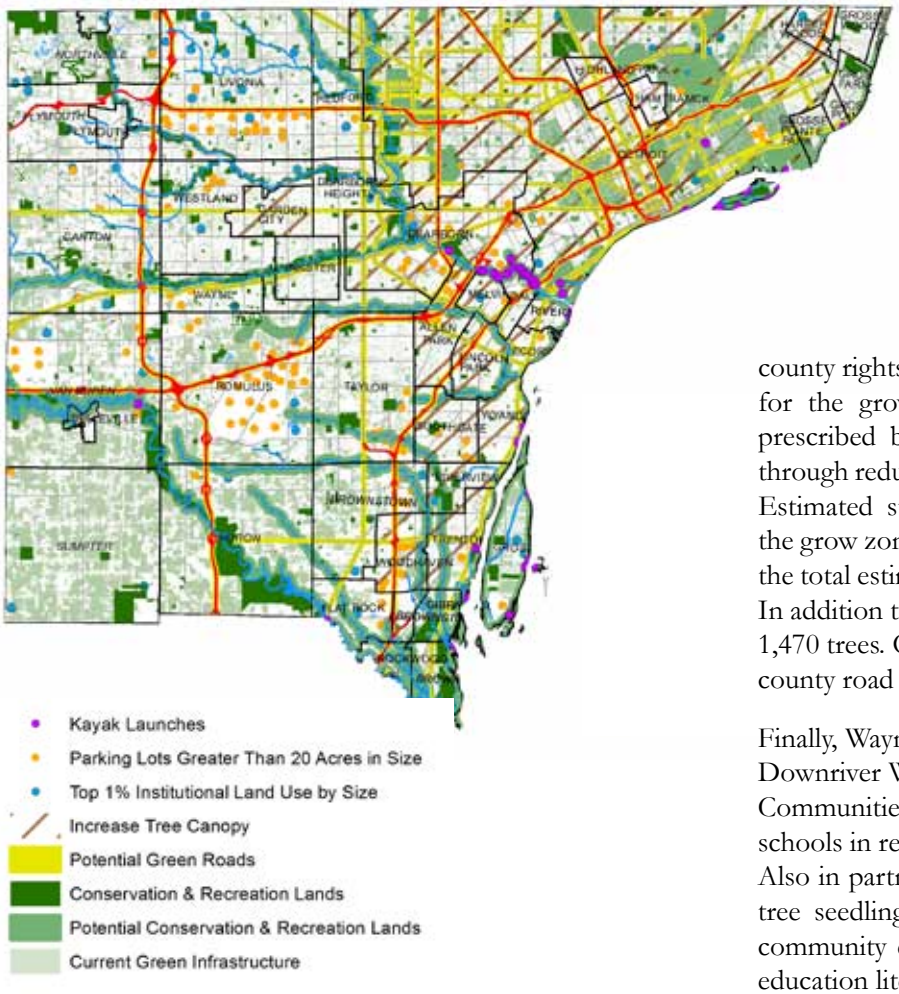
In addition, the Huron River Watershed Council's (HRWC) Bioreserve Project has mapped and works to protect the watershed's remaining natural areas. HRWC is also involved in planning for green infrastructure to capture and treat stormwater and plan water trails. More information on HRWC's programs can be found in the Livingston County description.

Wayne County

Wayne County is involved in numerous green infrastructure initiatives, including parks, grow zones, tree plantings, and public outreach. For example, Wayne County manages over 5,600 acres of parkland, the majority of which is wooded riparian corridor. This includes Hines Park (17+ miles/2,300-acre park along Middle Rouge River), the Lower Rouge Parkway (783-acre park along Lower Rouge River), Lola Valley Park (58-acre park along the Upper Rouge River), Bell Creek Park (64-acre park along Bell Creek), and the Holliday Nature Preserve (550 acres along Tonguish Creek).

Figure 23

Green Infrastructure Vision
Wayne County



Go to a larger view of the map

Wayne County also owns Elizabeth Park and Marina along the Detroit River; Crosswinds Marsh, a 1,056-acre park in Sumpter Twp; the Nankin Mills Interpretive Center; and Bennett Arboretum, as well as the Inkster Valley Golf Course (400 acres) and Warren Valley Golf Course (219 acres) within the Lower Rouge Parkway and Hines Park, respectively.

Over the past eight years, Wayne County has converted nearly 50 acres of turf to native plant grow zones. Forty acres is within Wayne County parks and seven acres is in county rights-of-way. There is also a maintenance program for the grow zones, which includes over 16 acres of prescribed burn. Since 2006, maintenance cost savings, through reduced mowing, is estimated to be over $456,000. Estimated stormwater detention financial benefits from the grow zones are estimated to be over $225,000, bringing the total estimated financial benefit to more than $681,000. In addition to grow zones, Wayne County has planted over 1,470 trees. Over 90 percent of these have been planted in county road right-of-way.

Finally, Wayne County, in partnership with the Alliance of Downriver Watersheds (ADW) and the Alliance of Rouge Communities (ARC), has distributed over 385 trees to schools in recognition for being a Michigan Green School. Also in partnership with the ADW and ARC, over 11,600 tree seedlings have been distributed to students and at community events along with green infrastructure public education literature.

Other organizations, such as the Downriver Linked Greenways, have completed over 50 miles of contiguous trails, from the City of Trenton, past the Detroit River International Wildlife Refuge, connecting four metroparks to I-275. Also, the Detroit Heritage River Water Trail has opened four public access sites to include a state-of-the-art adaptive kayak launch. HRWC is actively involved in water trail planning and developed *The Paddler's Companion*. This easy-to-read book is designed to be an essential guide for a trip on the river. In addition to the guide, there is a Huron River Water Trail logo and Web site.

City of Detroit

The City of Detroit recently completed a 24-month public process to develop a comprehensive strategic framework that guides decision-making around a shared vision that improves overall quality of life. While the framework contains many aspects of community planning, it strategically includes opportunities for green infrastructure throughout the city. These opportunities are both small- and large-scale. Smaller-scale techniques can be used on vacant property for neighborhood stabilization or to manage roadway runoff. Larger techniques include buffers along major highways, in addition to assembling large parcels of land to convert to natural green infrastructure, which includes reducing and eliminating the roadway network in areas of high vacancy.

Detroit Water and Sewerage Department (DWSD) is implementing green infrastructure through a number of projects, including tree planting, managing roadway runoff, and transforming vacant lots. As part of its agreement with the U.S. Environmental Protection Agency to protect the Rouge River, DWSD changed its traditional grey infrastructure control program to include a green infrastructure component.

Figure 24

Green Infrastructure Vision
City of Detroit

Go to a larger view of the map

Implementing the Green Infrastructure Vision

Creating green infrastructure success – who has a role?

The region's green infrastructure network consists of many pieces, and many people have different roles in moving the regional vision forward. As a result, integrating green infrastructure planning into a local community requires collaboration across multiple municipal departments and agencies. Successful implementation incorporates elements from local government planning, engineering and public works, recreation, public outreach, and finance departments, in addition to numerous outside agencies. The following list of roles provides a sense of how these different pieces can begin to come together.

Local government roles

Governing bodies/councils

- Adopt policies that promote green infrastructure in the community and showcase its use on public property and communicate benefits to the public.
- Establish a community-wide policy that all publicly-funded construction projects will consider green infrastructure at the concept stage.
- Educate citizens about the importance of green infrastructure in the community.

Planning and engineering

- Update zoning ordinances and land-use plans to encourage use of green infrastructure. At a minimum, include the use of green infrastructure in stormwater ordinances.

Community and economic development

- Evaluate vacant parcels for greening potential and/or opportunity to link or enhance parks.
- Partner with the business community to increase and/or maintain green infrastructure.
- Evaluate local natural assets to determine if ecotourism can be used or enhanced as an economic tool.
- Participate in state grant programs to increase tree canopy in residential neighborhoods.

Road agencies/Department of public services

- Review road, water, and sewer infrastructure projects to identify potential opportunities to incorporate green infrastructure.
- Participate in infrastructure collaboration opportunities between road, water, sewer, and stormwater activities at a local, regional, and state level for efficient use of limited resources.
- Evaluate public service yards for green infrastructure opportunities, such as installing bioswales near aggregate storage piles.
- Evaluate all community-owned properties, such as city hall, schools, and libraries for green infrastructure opportunities such as native plant grow zones and rain gardens/bioswales.

Recreation providers

- Review the local park system to enhance or link park and recreation opportunities.
- Identify tree canopy coverage across the community and determine targets of opportunity for potential enhancements.
- Identify ways to enhance public access to parks and waterways.
- As local recreation plans are updated, identify specific goals for green infrastructure.
- Participate in regional parks and recreation planning.
- Provide a regional assessment of recreational needs in concert with park assessments.

Downtown development authority

- Plan and work with road agencies for integrated techniques, such as street trees, tree infiltration trenches, and bioswales that manage stormwater runoff.
- Educate businesses on the wide range of benefits of green infrastructure.

Historic district commissions

- Consider using native plants that are historic to the region as a landscaping opportunity on historic sites.

State government

- Consider regional green infrastructure priorities when allocating grant resources.
- Prioritize green infrastructure implementation when making investments in state property.
- Emphasize the use of green infrastructure in state-regulated stormwater programs.
- Convene broader statewide and regional forums on green infrastructure.

Academia

- Increase research on performance levels, range of multiple benefits, and cost analyses of green infrastructure techniques.

Environmental groups

- Organize volunteers to implement green infrastructure.
- Identify funding opportunities for implementing green infrastructure.

Business community

- Incorporate green infrastructure on commercial/industrial property, such as planting trees, bioswales, and rain gardens.
- Support community-based green infrastructure initiatives.

Public

- At home, install rain gardens, or use rain barrels to reduce stormwater to local streams.
- Volunteer in local watershed activities, such as park cleanups, tree plantings, or water quality monitoring activities.
- Plant a tree to reduce stormwater to local streams; planting trees on west/south sides of homes increases the energy efficiency of the home.

Appendix A

Green Infrastructure Vision Regional Policies

Green Infrastructure Quantity

Tree Canopy
Strive to increase tree canopy to 40 percent in Southeast Michigan. Increases in tree canopy should be focused in urban areas where tree canopy is below 20 percent, as well as specific land use types such as around industrial property, within riparian corridors, central business districts, and along roadways and parking lots.

Wetlands
Protect existing high quality wetlands by using local land use regulations such as ordinances and continuing the State of Michigan's conservation easement and wetland protection program.

Protect highly sensitive wetland areas and restore areas contiguous to wetlands using available adjacent vacant land opportunities.

Use green infrastructure to manage stormwater runoff and protect existing high-quality wetlands and natural areas from pollution and runoff volume.

Parks
Focus increasing public green infrastructure along existing parks, natural areas, and riparian corridors in conjunction with improving public accessibility. Opportunities to increase green infrastructure in these areas should be focused around ecologically significant areas, as well as available vacant land.

Increase public green infrastructure through use of large tracts of land, which provide habitat value and allow for diverse recreational opportunities while minimizing conflicts resulting in increased regional prosperity.

Decisions on the type of green infrastructure added to an area should be implemented within a regional assessment of recreational needs for the region.

Agricultural Land and Community Gardens
Encourage preservation of high-valued agricultural lands and development of community gardens as tools to provide a high-quality local food network for Southeast Michigan and continue the economic viability of the agricultural industry.

Agricultural land management should include the use of Generally Accepted Agricultural Management Practices, including vegetated buffer strips, to reduce the adverse impacts of agricultural practices on local water resources and the Great Lakes.

Riparian Corridor
Increase public green infrastructure along existing parks, natural areas, and riparian corridors. Opportunities should focus around ecological significant areas as well as available vacant lots and large lots.

Minimize mowing within riparian corridors and seek opportunities to increase tree canopy and native plant grow zones in open space areas (particularly public lands) along riparian corridors as a method to increase infiltration , prevent erosion, shade rivers and lakes, and improve habitat.

Connect riparian corridors to natural areas and parks using available vacant properties to enhance wildlife and recreational corridors.

Constructed Green Infrastructure
Seek opportunities to construct green infrastructure in priority areas including roadways, institutional properties, parking lots, riparian corridors and downtown areas.

Demonstrate the benefits of green infrastructure by implementing constructed green infrastructure on local government property.

Encourage constructed green infrastructure opportunities in local government plans and ordinances.

Quality of the Green Infrastructure Network

Southeast Michigan's Unique Places
Seek opportunities to protect and restore unique natural areas in Southeast Michigan, including buffering high quality and rare natural areas to enhance protection of these resources. Work strategically with the Michigan Department of Natural Resources, the Nature Conservancy, and local land conservancies to coordinate activities.

Use restoration of historical wetlands and woodlands as an opportunity to link the green infrastructure network.

Preserve and restore smaller wetlands and woodlots within urban environments to provide local environmental, social, and economic benefits.

Managing Our Natural Areas
Ensure that protected areas include maintenance plans for constructed green infrastructure, as well as maintaining the quality of natural areas such as managing invasive species (e.g., invasive Phragmites).

Incorporate conservation planning into the development process, including local ordinances and engineering standards to reduce the impacts of fragmenting the green infrastructure network.

Seek opportunities to reconnect green infrastructure areas that are currently fragmented.

Use constructed green infrastructure to manage the impacts of stormwater runoff to natural areas.

Accessibility to the Green Infrastructure Network

Access to Public Parks
Seek opportunities to increase access to public parks within the City of Detroit and in small towns within rural areas to meet the recommendation of an average public access of .25- .5 mile.

Incorporate access to public green infrastructure as part of local planning, including downtown /commercial revitalization, health care facilities, and government buildings.

Partner with recreation providers to determine and address gaps between public recreational needs and the recreational opportunities provided within the existing large park system.

Access to Attract and Retain Young Professionals
Use green infrastructure as a mechanism to attract and retain the knowledge-based workforce.

Access to Water
Increase public access along the Great Lakes and connecting channels (Detroit River, St. Clair River, Lake St. Clair) to meet the recommendation of public boat access every five miles, with the long-term goal of moving toward access every one mile. In addition to public boat access, seek opportunities to enhance other public access for fishing, nonmotorized boats, swimming, and visual access.

Assess the need for additional public access on inland lakes and rivers in Southeast Michigan, including traditional boat launches, kayak launches, swimming, and visual access.

Access to Trails
Prioritize funding for trail improvements to fill gaps within the Southeast Michigan trail network, focusing on reducing the time traveled for accessing nonmotorized trails for local residents.

Universal Design
Work with state and local governments to include universal design – which focuses on designing spaces that can be used by the widest range of people possible – in development of the green infrastructure network.

Connectivity of the Green Infrastructure Network

Connect natural areas, recreation areas, and riparian corridors to the extent possible as a Connect natural areas, recreation areas, and riparian corridors to the extent possible as a mechanism to reduce habitat fragmentation, enhance wildlife passage and encourage recreation opportunities.

The green infrastructure network should be approached as a system, regardless of ownership. Local, regional, state, federal, and private owners of the network should coordinate activities in order to provide an efficient, systems-based approach.

Riparian Corridors as a Mechanism for Connectivity
Protect and restore riparian corridors as a mechanism to connect green infrastructure.

Link riparian corridors with upland areas to allow for connection for human and animal use.

Integrate water trails with public green infrastructure along riparian corridors to the extent possible, including canoe/kayak launch areas.

Connecting Green Infrastructure through Restoration
Work in partnership with recreation providers, the State of Michigan, local communities, and land conservancies to restore historical wetland and woodland areas as a way to connect green infrastructure.

Trails Provide Opportunities for Linkages and Enjoyment
Coordinate nonmotorized trail planning with green infrastructure planning to assist in meeting the needs of a green infrastructure network that uses trails as a linkage.

Migration Pathways
Protect high-quality green infrastructure that provides stopover sites for migratory birds

Green Infrastructure and Water Quality

Encourage policies to integrate constructed green infrastructure in publicly-funded projects, including institutional properties and major roadways. Focus implementation on roads, parking lots (public & private) and large managed turf areas.

Minimize mowing within riparian corridors and seek opportunities to increase tree canopy and native plant grow zones in open space areas (particularly public lands) along riparian corridors as a method to increase infiltration , prevent erosion, shade rivers and lakes, and improve habitat.

Work with communities and watershed groups to quantify the level of green infrastructure implementation that will lead to direct benefits in the region's water resources.

Green Infrastructure and Air Quality

Strive to increase tree canopy to 40 percent in Southeast Michigan. Increases in tree canopy should be focused in urban areas with current low tree canopy, as well as specific land uses, including industrial and institutional properties, riparian corridors, central business districts, and along roadways and parking lots.

Increase trees on industrial bare ground, with the goal of reducing localized air pollution , including fugitive dust in addition to enhancing aesthetics by buffering industrial land uses.

Protect existing tree canopy along roadways and develop guidelines for increasing tree canopy within major road rights-of-way. Work to increase green infrastructure around high-volume roadways in the region as a mechanism to reduce fugitive dust and noise and improve aesthetics for the public.

Increase tree canopy in institutional property in conjunction with other green infrastructure techniques. Focus tree plantings along the west and south sides of buildings in order to increase energy efficiencies.

Increase green infrastructure adjacent to and within parking lots to positively impact the urban heat island effect in addition to reducing the amount of stormwater runoff and increasing the longevity of pavement condition.

Green Infrastructure and Transportation

Promote use of complete and green streets as appropriate when planning transportation improvements to achieve multiple desired outcomes, including nonmotorized and water resource goals.

Develop local, county and state policies, standards, and guidelines to integrate green infrastructure into transportation infrastructure. Collaborate across transportation agencies to support consistent approaches for alternative street design standards.

Promote coordination between watershed planning groups and transportation agencies that leads to a process of incorporating stormwater management opportunities into transportation project planning.

Recognize and support actions by local communities and transportation agencies that seek to address the relationship between transportation and the environment.

Advocate for a revised structure for transportation funding that provides for adequate funding to design, construction, maintain, and replace transportation infrastructure in addition to necessary stormwater management infrastructure.

Green Infrastructure and Vacant Land

Seek opportunities to use vacant land to increase protected green infrastructure around existing parks, natural areas, and riparian corridors.

Seek opportunities to use vacant lots adjacent to major roads to manage stormwater runoff when consistent with local plans.

Implement green infrastructure on vacant properties as both a short-term and long-term solution to vacant properties.

Coordinate vacant land ownership to efficiently assemble property for green infrastructure implementation. Encourage long-term sustainability of green infrastructure properties through use of land trusts or land conservancies.

Green Infrastructure and the Economy

Property Values and Local Government Revenues

Increase tree canopy in urban areas where tree canopy is below 20 percent to enhance local property values and local business revenues.

Support local community efforts to preserve natural features through ordinances and the site plan review process to positively affect property values and benefit local government resources.

Tourism

Support efforts to protect, enhance and restore the region's green infrastructure network to recognize and maintain the economic benefits and value of the tourism industry.

Coordinate with recreation providers to ensure that the green infrastructure network and programming maximizes the tourism dollars to Southeast Michigan.

Use unique green infrastructure and wildlife associated with it as an opportunity to enhance local economic development opportunities.

Align regional tourism and water resource goals to strategically enhance and construct green infrastructure leading to improved water quality and fewer beach closings.

Infrastructure (Green vs. Conventional) & Energy Efficiency

Demonstrate and promote the economic benefits of utilizing green infrastructure, including implementing constructed green infrastructure on institutional property and in publicly-funded projects.

Implement native plant grow zones on in strategic areas on public property to reduce maintenance costs while improving local water resources.

Agriculture
Encourage preservation of high-valued agricultural lands and development of community gardens as tools to provide a high-quality local food network for Southeast Michigan and continue the economic viability of the agricultural industry.

Protect the economic viability of Southeast Michigan farms by implementing tools such as conservation easements. Additionally, implementing Generally Accepted Agricultural Management Practices, including vegetated buffer strips, reduces the adverse impacts of agricultural practices on local water resources and the Great Lakes.

Green Infrastructure and the Public Interest

Green Infrastructure and Crime Prevention
Seek opportunities when greening vacant lots and improving tree canopy to link activities to social benefits, including reducing crime.

Health Benefits of Green Infrastructure
Use green infrastructure, including parks and trails, as a mechanism for improved health in Southeast Michigan that includes communicating these benefits to the public.

Initiate partnerships between health-care providers and recreation providers in improving access and programming at parks and trails.

Public Education and Marketing
Educate the public, local and state government, business, and elected officials on the benefits of the green infrastructure network, including:

- Support and encourage the public's willingness to participate in greening their property and homes by providing information and education on how to implement the activities.
- Support programs that encourage use and stewardship of the green infrastructure network.

Initiate a coordinated marketing campaign highlighting Southeast Michigan's regional assets in partnership with state activities.

Sustaining Our Green Infrastructure Network: Maintenance, Financing, and Partnerships

Maintaining the Green Infrastructure Network
Maintenance of the green infrastructure network is critical and should include development of a maintenance plan that includes both fiscal and staff resources needed to maintain the system.

Creative partnerships and programs should be pursued that maintain the network, including workforce development and community engagement opportunities.

Financing Green Infrastructure
Address fiscal sustainability of the green infrastructure network for both maintaining the current system and for any discussion strategically increasing public green infrastructure.

Seek opportunities to fund green infrastructure through innovative methods, including public/private partnerships, stormwater utilities, and cost sharing within the local government.

Partnerships and Institutional Arrangements
Institute internal green infrastructure teams within government agencies to coordinate activities and meet multiple goals of the green infrastructure network.

Form partnerships among local, state, and federal agencies, as well as private business to provide a sustainable green infrastructure network in Southeast Michigan.

Appendix B

Watershed Data Areas of Opportunity Detail

This part of the appendix contains data highlighting areas of opportunity for constructed green infrastructure implementation within each of the major Southeast Michigan watersheds that are tributary to the Lake Huron to Lake Erie corridor. The following major watersheds are included in this appendix:

- Alliance of Downriver Watersheds (Ecorse Creek/Combined Downriver/Lower Huron Watersheds)
- Belle/Black/Pine Watersheds
- Clinton River Watershed
- Huron River Watershed
- Lake Huron to Lake Erie Direct Drainage Watersheds
- Raisin River Watershed
- Rouge River Watershed
- Stony Creek Watershed

Each watershed section quantifies the land cover data by subwatershed planning area. Additionally, for those planning areas with impervious cover greater than 10 percent, the areas of opportunity are listed in a separate table.

It is important to note that this analysis did not include field assessments of specific properties, but rather used both land use and land cover data to identify the types of properties that local communities, counties, and planning agencies should consider for constructed green infrastructure implementation. This data is intended to complement existing subwatershed planning efforts in order to refine long-term implementation and aid in developing partnerships for successful planning and implementation.

Alliance of Downriver Watersheds (Ecorse Creek/Combined Downriver/Lower Huron)

Alliance of Downriver Watersheds Land Cover by Planning Area

Subwatershed	Acres	Percent Impervious	Impervious Surfaces: Buildings	Impervious Surfaces: Pavement	Open Space	Tree Canopy	Urban Bare	Water Area
Ecorse Creek & Combined Downriver	83,313	37%	7,622	23,591	28,723	20,036	2,258	1,084
Lower Huron	47,264	15%	1,509	5,517	21,022	17,443	635	1,138
Total Area	130,577	26%	9,131	29,108	49,745	37,479	2,892	2,222

Land cover data in acres.

Alliance of Downriver Watersheds Areas of Opportunity for subwatersheds over 10 percent

Subwatershed	Institutional Land Use (Publicly-Owned)			Major Roadways (Publicly-Owned)		Privately-Owned Parking Lots	Riparian Corridor	
	Impervious Surfaces: Buildings	Impervious Surfaces: Parking Lots	Open Space	Impervious Surfaces: Pavement	Open Space		Tree Canopy Existing	Open Space
Ecorse Creek & Combined Downriver	365	538	2,189	3,223	1,410	6,713	483	193
Lower Huron	69	69	907	888	540	1,004	824	171
Total Area	433	607	3,097	4,111	1,950	7,718	1,307	364

Belle, Black and Pine Watersheds

Belle, Black and Pine Watersheds Land Cover by Planning Area

Subwatershed	Acres	Percent Impervious	Impervious Surfaces: Buildings	Impervious Surfaces: Pavement	Open Space	Tree Canopy	Urban Bare	Water Area
Belle River	95,617	4%	853	2,985	63,720	26,046	842	1,170
Pine River	28,289	17%	959	3,863	17,440	3,660	925	1,442
Black Watershed	131,945	4%	1,258	4,106	83,183	41,220	518	1,661
Total Area	255,851	8%	3,070	10,955	164,344	70,926	2,285	4,273

Pine River Watershed Areas of Opportunity

Watershed	Institutional Land Use (Publicly-Owned)			Major Roadways (Publicly-Owned)		Privately-Owned Parking Lots	Riparian Corridor	
	Impervious Surfaces: Buildings	Impervious Surfaces: Parking Lots	Open Space	Impervious Surfaces: Pavement	Open Space		Tree Canopy Existing	Open Space
Pine River	24	149	744	907	974	380	1,728	312

Clinton River Watershed

Clinton River Watershed Land Cover by Planning Area

Subwatershed	Acres	Percent Impervious	Impervious Surfaces: Buildings	Impervious Surfaces: Pavement	Open Space	Tree Canopy	Urban Bare	Water Area
Paint Creek	45,592	12%	1,536	3,976	16,245	21,002	404	2,429
Stony Creek	46,867	4%	372	1,371	29,672	14,371	528	553
North Branch	116,936	5%	1,413	4,484	72,608	35,953	830	1,648
Upper Clinton	50,235	15%	2,104	5,267	14,621	22,850	438	4,954
Clinton Main	49,975	29%	3,802	10,821	14,270	15,872	825	4,385
Clinton East	74,029	30%	6,811	15,100	30,322	19,456	1,075	1,266
Red Run	104,794	47%	14,832	34,157	30,838	26,946	1,380	696

Land cover data in acres.

Clinton River Watershed Areas of Opportunity

Subwatershed	Institutional Land Use (Publicly-Owned)			Major Roadways (Publicly-Owned)		Privately-Owned Parking Lots	Riparian Corridor	
	Impervious Surfaces: Buildings	Impervious Surfaces: Parking Lots	Open Space	Impervious Surfaces: Pavement	Open Space		Tree Canopy Existing	Open Space
Clinton East	277	600	1,673	2,161	1,431	3,358	1,047	326
Clinton Main	269	766	1,933	1,882	827	3,382	608	250
Paint Creek	54	181	578	519	331	467	523	112
Red Run	852	1,637	3,332	5,820	2,114	9,122	445	478
Upper Clinton	101	271	832	905	477	1,082	365	110
Total Area	1,552	3,455	8,347	11,286	5,180	17,411	2,987	1,276

Areas of opportunity in acres.

Huron River Watershed Land Cover by Subwatershed

Subwatershed	Acres	Percent Impervious	Impervious Surfaces: Buildings	Impervious Surfaces: Pavement	Open Space	Tree Canopy	Urban Bare	Water Area
Allen Creek	3,300	44%	440	1,003	534	1,295	22	6
Arms Creek	13,729	3%	89	294	6,981	5,974	43	349
Belleville Lake	10,808	21%	557	1,747	4,189	2,670	219	1,426
Boyden Creek	4,731	3%	41	124	2,966	1,528	10	62
Chilson Creek	10,847	7%	180	550	3,277	5,663	19	1,159
Davis Creek	43,661	10%	1,063	3,291	20,407	16,656	497	1,747
Fleming Creek	19,745	7%	289	1,132	9,249	8,539	157	378
Ford Lake	5,415	26%	359	1,053	1,377	1,464	21	1,142
Hay Creek	8,557	6%	146	393	2,694	4,706	13	605
Honey Creek (north)	17,418	4%	149	530	6,815	9,234	188	503
Honey Creek (south)	14,839	12%	437	1,353	6,960	5,570	305	213
Horseshoe Creek	19,505	7%	281	1,050	8,954	7,954	110	1,155
Huron Creek	4,152	3%	22	91	2,414	1,566	2	56
Huron River (upstream)	68,301	9%	1,422	4,612	22,243	33,892	506	5,625
Malletts Creek	6,855	34%	640	1,713	2,077	2,282	30	113
Mann Creek	14,099	12%	286	1,354	6,168	5,605	184	502
Mill Creek - Huron	91,869	4%	712	2,787	53,387	31,804	400	2,778
Millers Creek	1,531	30%	128	339	334	706	6	18
Norton Creek	15,478	21%	919	2,327	5,504	5,588	258	883
Pettibone Creek	15,707	10%	424	1,094	5,334	6,689	209	1,957
Portage Creek	41,080	2%	205	797	15,926	21,219	36	2,897
South Ore Creek	21,543	11%	581	1,811	6,980	10,384	157	1,630
Swfit Run	3,240	22%	164	559	1,293	1,111	26	86
Traver Creek	4,506	13%	135	451	2,353	1,489	6	72
Upper Huron	53,007	11%	1,641	3,965	14,295	27,010	409	5,688
Woodruff Creek	12,379	11%	288	1,014	4,145	5,863	266	804
Total Area	526,303	13%	11,597	35,434	216,859	226,460	4,099	31,853

Land cover data in acres.

Huron River Watershed Areas of Opportunity

Subwatershed	Institutional Land Use (Publicly-Owned)			Major Roadways (Publicly-Owned)		Privately-Owned Parking Lots	Riparian Corridor	
	Impervious Surfaces: Buildings	Impervious Surfaces: Parking Lots	Open Space	Impervious Surfaces: Pavement	Open Space		Tree Canopy Existing	Open Space
Allen Creek	131	110	100	243	60	154	1	1
Belleville Lake	34	111	313	479	285	434	66	22
Ford Lake	33	41	133	280	125	178	31	11
Honey Creek (south)	14	45	161	305	222	357	134	70
Malletts Creek	50	116	244	319	144	517	13	2
Mann Creek	14	41	146	106	114	299	51	42
Millers Creek	28	39	91	50	25	84	0	0
Norton Creek	31	128	232	279	167	811	135	117
South Ore Creek	34	104	320	312	170	411	149	94
Swift Run	36	106	422	129	73	107	35	12
Traver Creek	15	19	80	118	72	49	39	26
Upper Huron	65	214	665	635	403	543	552	206
Woodruff Creek	12	58	138	237	145	165	79	51
Total Area	497	1,133	3,047	3,490	2,005	4,109	1,286	652

Areas of opportunity in acres.

Lake Huron to Lake Erie Direct Drainage

Subwatershed	Acres	Percent Impervious	Impervious Surfaces: Buildings	Impervious Surfaces: Pavement	Open Space	Tree Canopy	Urban Bare	Water Area
Lake Huron	30,861	4%	338	1,007	20,902	8,254	138	222
St. Clair River	15,479	23%	954	2,571	5,677	5,671	336	269
Anchor Bay	113,596	9%	2,820	7,683	64,011	33,320	1,488	4,275
Lake St. Clair	68,281	48%	9,567	22,969	19,713	14,654	828	549
Lake Erie	237,181	7%	3,429	11,646	158,613	57,205	2,212	4,076
Total Area	465,398	18%	17,108	45,876	268,917	119,104	5,002	9,391

Land cover data in acres.

Subwatershed	Institutional Land Use (Publicly-Owned)			Major Roadways (Publicly-Owned)		Privately-Owned Parking Lots	Riparian Corridor	
	Impervious Surfaces: Buildings	Impervious Surfaces: Parking Lots	Open Space	Impervious Surfaces: Pavement	Open Space		Tree Canopy Existing	Open Space
La Plaisance Creek-Lake Erie	0	18	53	85	53	118	0	0
Lake St. Clair	191	911	1,651	5,413	1,651	3,577	57	83
St. Clair River	5	125	341	452	341	501	31	21
Total Area	196	1,053	2,046	5,950	2,046	4,196	88	104

Areas of opportunity in acres.

Raisin River Watershed

Subwatershed	Acres	Percent Impervious	Impervious Surfaces: Buildings	Impervious Surfaces: Pavement	Open Space	Tree Canopy	Urban Bare	Water Area
Bear Swamp Creek	8,915	2%	25	162	8,202	509	11	6
Iron Creek	13,012	2%	43	201	6,900	5,341	92	435
Little River Raisin	1,800	2%	6	28	1,571	190	1	4
Macon Creek	18,346	4%	139	585	14,710	2,338	394	180
Mason Run	4,378	14%	172	438	2,933	790	39	8
N Br Macon Creek	14,836	3%	71	338	12,347	2,010	44	27
S Br Macon Creek	4,726	4%	27	170	4,125	377	8	19
Swamp Raisin Creek	1,634	2%	5	22	1,528	75	1	4
Willow Run	7,009	2%	28	106	5,758	1,096	5	15
Wood Outlet Drain	9,727	16%	433	1,109	5,366	2,541	75	204
Saline River	73,142	4%	719	2,547	52,264	16,491	336	785
River Raisin - Washtenaw	34,540	3%	204	769	21,549	11,315	92	609
River Raisin - Monroe	28,922	6%	478	1,392	20,302	5,951	117	682
Total Area	220,987	5%	2,350	7,867	157,554	49,021	1,215	2,979

Land cover data in acres.

Subwatershed	Institutional Land Use (Publicly-Owned)			Major Roadways (Publicly-Owned)		Privately-Owned Parking Lots	Riparian Corridor	
	Impervious Surfaces: Buildings	Impervious Surfaces: Parking Lots	Open Space	Impervious Surfaces: Pavement	Open Space		Tree Canopy Existing	Open Space
Mason Run	11	22	138	59	37	138	32	64
Wood Outlet	27	66	283	133	152	301	88	58
Total Area	38	88	421	192	188	439	120	122

Areas of opportunity in acres.

Rouge River Watershed

Rouge River Watershed Land Cover by Subwatershed Planning Area

Subwatershed	Acres	Percent Impervious	Impervious Surfaces: Buildings	Impervious Surfaces: Pavement	Open Space	Tree Canopy	Urban Bare	Water Area
Lower 1	39,785	20%	1,864	6,105	19,703	11,065	548	500
Lower 2	21,341	43%	2,467	6,708	5,887	5,933	233	114
Main 1-2	65,786	31%	5,253	15,242	15,470	27,573	310	1,937
Main 3-4	58,475	52%	7,863	22,401	12,903	13,393	1,504	410
Middle 1	51,589	28%	3,709	10,918	18,432	16,139	693	1,697
Middle 3	20,727	49%	2,824	7,379	4,661	5,546	134	184
Upper	40,768	38%	3,993	11,450	10,883	13,823	260	360
Total Area	298,471	37%	27,973	80,203	87,938	93,472	3,682	5,203

Land cover data indicated in acres.

Rouge River Watershed Areas of Opportunity

Subwatershed	Institutional Land Use (Publicly-Owned)			Major Roadways (Publicly-Owned)		Privately-Owned Parking Lots	Riparian Corridor	
	Impervious Surfaces: Buildings	Impervious Surfaces: Parking Lots	Open Space	Impervious Surfaces: Pavement	Open Space		Tree Canopy Existing	Open Space
Lower 1	41	228	783	899	608	1,313	386	168
Lower 2	145	227	625	973	313	1,228	257	31
Main 1-2	333	725	1,342	2,564	850	2,760	883	146
Main 3-4	541	623	1,155	4,417	1,107	4,163	370	105
Middle 1	165	450	1,770	1,788	855	2,619	390	149
Middle 3	104	194	386	1,067	340	1,995	353	45
Upper	237	520	1,213	1,830	622	2,478	667	190
Total Area	1,568	2,967	7,274	13,537	4,694	16,556	3,307	835

Areas of opportunity in acres.

Stony Creek Watershed

Subwatershed	Acres	Percent Impervious	Impervious Surfaces: Buildings	Impervious Surfaces: Pavement	Open Space	Tree Canopy	Urban Bare	Water Area
Sugar Creek	8,639	6%	100	410	6,238	1,753	74	64
Paint Creek - Washtenaw	23,998	12%	749	2,209	12,681	8,039	104	216
Stony Creek	48,344	7%	810	2,358	16,334	25,289	631	2,923
Total Area	80,981	8%	1,659	4,977	35,252	35,080	809	3,203

Land cover data in acres.

Subwatershed	Institutional Land Use (Publicly-Owned)			Major Roadways (Publicly-Owned)		Privately-Owned Parking Lots	Riparian Corridor	
	Impervious Surfaces: Buildings	Impervious Surfaces: Parking Lots	Open Space	Impervious Surfaces: Pavement	Open Space		Tree Canopy Existing	Open Space
Paint Creek	46	101	623	462	356	382	344	149

Areas of opportunity in acres.

Appendix C

Green Infrastructure Survey Questions	Livingston County		St. Clair County		Macomb County		Oakland County	
	# of responses	% of total	# of responses	% of total	# of responses	% of total	# of responses	% of total
1. What benefits of green infrastructure are most important to you?								
A. Improving our water quality	11	44.0%	6	27.3%	6	33.3%	7	15.9%
B. Improving our air quality	2	8.0%	1	4.5%	0	0.0%	0	0.0%
C. Providing increased recreational opportunities	3	12.0%	6	27.3%	3	16.7%	10	22.7%
D. Adding to the quality of life with improved aesthetics	2	8.0%	3	13.6%	3	16.7%	9	20.5%
E. Economic benefits (improved property values, neighborhood stablization, green jobs)	4	16.0%	4	18.2%	2	11.1%	4	9.1%
F. Improving the use of vacant property	0	0.0%	1	4.5%	0	0.0%	2	4.5%
G. Increasing habitat areas	1	4.0%	0	0.0%	4	22.2%	3	6.8%
H. Energy savings	0	0.0%	0	0.0%	0	0.0%	2	4.5%
I. Climate change mitigation	2	8.0%	1	4.5%	0	0.0%	7	15.9%
	25	100%	22	100%	18	100%	44	100%
2. What is the most important green infrastructure element you would like to see more of in your area?								
A. Trees along roads, downtowns	3	12.5%	3	12.5%	3	16.7%	5	11.4%
B. Bike/hike trails	11	45.8%	3	12.5%	2	11.1%	15	34.1%
C. Kayak/canoe/boat access	0	0.0%	7	29.2%	3	16.7%	4	9.1%
D. Parks	3	12.5%	4	16.7%	1	5.6%	4	9.1%
E. Community gardens	2	8.3%	4	16.7%	2	11.1%	4	9.1%
F. Natural areas (wetlands, woodlands)	5	20.8%	3	12.5%	7	38.9%	12	27.3%
	24	100%	24	100%	18	100%	44	100%
3. Where is the most important place you'd like to see more green infarstructure?								
A. Within 1/2 mile of my home	1	4.2%	1	4.2%	2	10.0%	2	4.5%
B. Along rivers and lakes	6	25.0%	10	41.7%	5	25.0%	10	22.7%
C. Along major roadways	7	29.2%	0	0.0%	5	25.0%	11	25.0%
D. Near existing parks and rare areas	4	16.7%	4	16.7%	6	30.0%	7	15.9%
E. Inside parks	0	0.0%	0	0.0%	0	0.0%	1	2.3%
F. On vacant property	0	0.0%	3	12.5%	0	0.0%	9	20.5%
G. On local government property	0	0.0%	0	0.0%	0	0.0%	3	6.8%
H. Within commercial industrial corridors	6	25.0%	6	25.0%	2	10.0%	1	2.3%
4. In your area, how important is it to use green infrastructure to reduce pollution to our rivers, lakes and streams? AVERAGE SCORE =	7.9		8.3		8.5		8.2	
5. In your area, how important of a role does green infrastructure play in retaining and attracting knowledge based workers? AVERAGE SCORE =	5.7		7.2		7.2		7.1	
6. In your area, how important of a role could green infrastructure play in creating semi-skilled green jobs for lower-income workers? AVERAGE SCORE =	4.9		6.6		6.1		6.7	
7. What green infrastructure provides the highest economic value in your area?	# of responses	% of total	# of responses	% of total	# of responses	% of total	# of responses	% of total
A. Publicly-owned parks	10	40.0%	4	16.7%	5	27.8%	25	56.8%
B. Privately-owned parks/common areas	1	4.0%	0	0.0%	0	0.0%	4	9.1%
C. Beach access to water	11	44.0%	15	62.5%	10	55.6%	3	6.8%
D. Natural areas	2	8.0%	2	8.3%	1	5.6%	9	20.5%
E. Land trails	1	4.0%	3	12.5%	2	11.1%	3	6.8%
8. In your area, how important is it to have public green infrastructure within 1/2 mile of residential population? AVERAGE SCORE =	7.5		6.7		8.3		8.3	
9. In your area, how important is it to have public access for boats (canoe, kayak, fishing) to local waterways? AVERAGE SCORE =	6.6		8.0		7.6		7.0	

Wayne County		Monroe County		Washtenaw County		City of Detroit		Visioning Sessions Total		Fall General Assembly		Public Poll
# of responses	% of total	# of responses	% of total	# of responses	% of total	# of resposes	% of total	# of responses	% of total	# of responses	% of total	38% Oakland; 30% Wayne; 17%
11	23.9%	2	11.8%	11	39.3%	12	22.2%	66	25.9%	13	21.7%	55%
1	2.2%	0	0.0%	0	0.0%	4	7.4%	8	3.1%	2	3.3%	38%
6	13.0%	0	0.0%	5	17.9%	3	5.5%	36	14.1%	5	8.3%	27%
8	17.4%	7	41.2%	2	7.1%	7	13.0%	41	16.1%	9	15.0%	36%
12	26.1%	1	5.9%	1	3.6%	12	22.2%	40	15.7%	21	35.0%	47%
2	4.3%	0	0.0%	0	0.0%	8	14.8%	13	5.1%	3	5.0%	24%
3	6.5%	5	29.4%	5	17.9%	2	3.7%	23	9.0%	1	1.7%	25%
0	0.0%	1	5.9%	0	0.0%	3	5.5%	6	2.4%	3	5.0%	14%
3	6.5%	1	5.9%	4	14.3%	4	7.4%	22	8.6%	3	5.0%	17%
46	100%	17	100%	28	100%	55	102%	255	100%	60	100.0%	NA
8	16.7%	0	0.0%	6	20.7%	9	16.6%	37	14.1%	16	28.6%	71%
16	33.3%	8	40.0%	7	24.1%	11	20.4%	73	27.9%	20	35.7%	55%
0	0.0%	2	10.0%	0	0.0%	2	3.7%	18	6.9%	4	7.1%	17%
4	8.3%	2	10.0%	2	6.9%	6	11.1%	26	9.9%	5	8.9%	39%
2	4.2%	0	0.0%	0	0.0%	12	22.2%	26	9.9%	2	3.6%	33%
18	37.5%	8	40.0%	14	48.3%	15	27.8%	82	31.3%	9	16.1%	54%
48	100%	20	100%	29	100%	55	102%	262	100%	56	100.0%	NA
1	2.1%	0	0.0%	0	0.0%	5	9.2%	12	4.6%	8	14.8%	36%
13	27.7%	10	52.6%	7	24.1%	6	11.1%	67	25.8%	16	29.6%	41%
5	10.6%	2	10.5%	6	20.7%	9	16.6%	45	17.3%	16	29.6%	51%
5	10.6%	2	10.5%	9	31.0%	5	9.2%	42	16.2%	3	5.6%	44%
0	0.0%	1	5.3%	0	0.0%	2	3.7%	4	1.5%	1	1.9%	14%
13	27.7%	2	10.5%	0	0.0%	14	26.0%	41	15.8%	5	9.3%	42%
1	2.1%	0	0.0%	2	6.9%	5	9.2%	11	4.2%	2	3.7%	18%
9	19.1%	2	10.5%	5	17.2%	7	13.0%	38	14.6%	3	5.6%	35%
								260		54	100.0%	NA
8.3		8.8		8.8		7.90		8.3		7.5		
7.3		7.1		7.0		6.90		7.0		5.9		
7.0		6.9		6.4		7.65		6.4		5.8		
# of responses	% of total	# of responses	% of total	# of responses	% of total	# of responses	% of total	# of responses	% of total			
29	58.0%	3	15.0%	18	62.1%	30	55.5%	124	46.8%	28	47.5%	
1	2.0%	0	0.0%	0	0.0%	15	27.8%	21	7.9%	4	6.8%	
11	22.0%	13	65.0%	3	10.3%	3	5.5%	69	26.0%	19	32.2%	
3	6.0%	2	10.0%	4	13.8%	6	11.1%	29	10.9%	3	5.1%	
6	12.0%	2	10.0%	4	13.8%	1	1.8%	22	8.3%	5	8.5%	
								265		59	100.0%	
8.2		7.9		8.6		8.43		8.0		7.0		
7.1		8.5		8.0		6.26		7.4		6.8		

Green Infrastructure Survey Questions	Livingston County		St. Clair County		Macomb County		Oakland County	
	# of responses	% of total	# of responses	% of total	# of responses	% of total	# of responses	% of total
10. In your area, how important is it to increase green infrastructure around industrial areas to reduce dust, improve air quality and enhance your area? AVERAGE SCORE =	6.9		7.5		7.6		7.5	
11. In your area, how important is it to increase green infrastructure through stream buffers around local waterways? AVERAGE SCORE =	7.8		7.9		8.4		7.8	
12. In your area, how important is it to utilize green infrastructure as a mechanism to enhance vacant lots? AVERAGE SCORE =	5.7		6.6		6.7		6.6	
13. In your area, how important is it to increase green infrastructure along roadways to reduce stormwater pollution, enhance commercial and residential areas, and integrate into trails planning? AVERAGE SCORE =	7.7		8.4		8.3		8.3	
14. In your opinion, how important is it to increase green infrastructure to increase energy efficiency and/or reduce the impacts of climate change? AVERAGE SCORE =	5.4		7.2		7.0		7.4	
15. Looking at the Southeast Michigan region as a whole, is it important to you to increase and protect green infrastructure throughout the whole region as a mechanism to have a successful region?	# of responses	% of total	# of responses	% of total	# of responses	% of total	# of responses	% of total
1. Yes. I understand the benefits the importance of increasing green infrastructure across the whole Southeast Michigan region	21	91.3%	20	87.0%	17	89.5%	43	97.7%
16. In your opinion, does there need to be more education of green infrastructure benefits and marketing of our green infrastructure?	# of responses	% of total	# of responses	% of total	# of responses	% of total	# of responses	% of total
1. Yes	24	96.0%	21	95.5%	18	100.0%	44	100.0%
17. How likely are you to install green infrastructure (rain gardens, trees, rain barrels) on your property?	7.8		7.8		7.1		8.2	

Wayne County		Monroe County		Washtenaw County		City of Detroit		Visioning Sessions Total		Fall General Assembly		Public Poll
# of responses	% of total	# of responses	% of total	# of responses	% of total	# of resposes	% of total	# of responses	% of total	# of responses	% of total	38% Oakland; 30% Wayne; 17%
8.5		8.1		7.4		8.17		7.7		6.9		
8.3		8.5		8.3		7.19		8.1		6.5		
7.9		7.8		5.7		8.61		6.8		5.8		
8.3		8.7		8.4		8.35		8.3		7.6		
7.8		8.0		7.6		8.22		7.3		6.3		
# of responses	% of total	# of responses	% of total	# of responses	% of total	# of responses	% of total	# of responses	% of total	# of responses	% of total	
50	100.0%	19	95.0%	27	96.4%	51	94.0%	197	95.2%			
# of responses	% of total	# of responses	% of total			# of responses	% of total	# of responses	% of total	# of responses	% of total	% of total
49	98.0%	20	100.0%			53	98.0%	176	98.3%	52.0%	90.0%	93%
7.3		6.7		8.6		7.78		7.7		5.6		8.0

Appendix D

Footnotes

Green Infrastructure Quantity

1 American Forests. www.americanforests.org

2 National Parks and Recreation Association. PRORAGIS. www.nrpa.org/PRORAGIS/

3 Indiana Department of Natural Resources. Chapter 3: Supply of Outdoor Recreation Acreage in Indiana. http://www.in.gov/dnr/outdoor/files/chap3.pdf

4 U.S. Department of Agriculture 2007 Census. www.agcensus.usda.gov/index.php/

5 The Center for Neighborhood Technology. Green Values Stormwater Toolbox. www.greenvalues.cnt.org

6 American Forests. www.americanforests.org

Green Infrastructure Quality

1 Wildlife Habitat Council. Explore our Natural World. A Biodiversity Atlas of the Lake Huron to Lake Erie Corridor. 2002.

2 Ibid.

3 Michigan Natural Features Inventory. Meeting the Challenge of Invasive Plants: A Framework for Action. 2009.

4 Wildlife Habitat Council. Explore our Natural World. A Biodiversity Atlas of the Lake Huron to Lake Erie Corridor. 2002.

5 Ibid.

6 Michigan Department of Natural Resources. http://www.michigan.gov/dnr/0,4570,7-153-10370_59996-268154--,00.html

7 Emerald Ashborer State Coalition. www.emeraldashborer.info

Accessibility to the Green Infrastructure Network

1 American Planning Association. How Cities Use Parks for Economic Development. 2002.

2 Michigan Office of the Great Lakes. Michigan State of the Great Lakes 2013.

3 UniversalDesign.Com. www.universaldesign.com/about-universal-design.html

4 Frank, L, Kerr, J, Chapman, J & Sallis, J. Urban Form Relationships with Walk Frequency and Distance Among Youth. American Journal of Health Promotion. 2007.

Connectivity of the Green Infrastructure Network

1 Benedict, Mark and Edward McMahon, Green Infrastructure: Smart Conservation for the 21st Century. 2001.

2 Explore our Natural World: A Biodiversity Atlas of the Lake Huron to Lake Erie Corridor.

3 U.S. Fish and Wildlife Service. North American Waterfowl Management Plan. 2012.

Green Infrastructure and Water Quality

1 Appel, Lisa M. Julie A. Craves, Mary Kehoe Smith, et. al.; Explore Our Natural World: A Biodiversity Atlas of the Lake Huron to Lake Erie Corridor. US Environmental Protection Agency Great Lakes National Program Office to the Wildlife Habitat Council. 2002.

2 http://www.michigan.gov/som/0,4669,7-192-45414---,00.html

3 www.dwsd.org

4 Sweeney, Brian. Editor. Office of the Great Lakes, Michigan Department of Environmental Quality. Michigan State of the Great Lakes 2013.

5 http://chesapeakestormwater.net/2009/11/the-reformulated-impervious-cover-model/#download-48

6 www.epa.gov

Green Infrastructure and Air Quality

1 Nowak, D.J.; Crane, D.E.; and Stevens, J.C. "Air Pollution Removal by Urban Trees and Shrubs in the United States." Urban Forestry and Urban Greening. 2006, 4, 115-123.

2 Urban Forest Research, Center for Urban Forest Research, March 2001.

3 http://www.sciencedirect.com/science/article/pii/S1618866706000173

4 http://www.fs.fed.us/psw/publications/documents/psw_gtr202/psw_gtr202.pdf

5 U.S. Department of Agriculture. U.S. Forest Service. Pacific Southwest Research Station. Northeast Community Tree Guide: Benefits, Costs and Strategic Planting. (accessed Oct. 15, 2012).

6 Scott, K.I., Simpson, J.R., and McPherson, E.G. 1999. Effects of tree cover on parking lot microclimate and vehicle emissions. J. Arboric. 25(3):129-142.

7 http://www.epa.gov/airtrends/aqtrends.html#comparison

8 U.S. EPA National Emissions Inventories for 2002, 2008 and 2011

9 American Forests. CITYgreen for ArcGIS. American Forests, Washington DC. 2004.

10 Nowak, D.J.; Eric J. Greenfield, Robert E. Hoehn, Elizabeth Lapoint. Carbon storage and sequestration by trees in urban and community areas of the United States. Environmental Pollution 178 (2013) 229-236.

11 Nowak, D.J. and Crane, D.E. 2000. The Urban Forest Effects (UFORE) Model: quantifying urban forest structure and functions. In: Hansen, M. and T. Burk (Eds.) Integrated Tools for Natural Resources Inventories in the 21st Century. USDA Forest Service General Technical Report NC-212. St. Paul, MN. pp. 714-720.

12 Nowak, D.J. 1994d. Air pollution removal by Chicago's urban forest. In: McPherson, E.G, D.J. Nowak and R.A. Rowntree. Chicago's Urban Forest Ecosystem: Results of the Chicago Urban Forest Climate Project. USDA Forest Service General Technical Report NE-186. pp. 63-81.

13 Nowak, David J. Susan M. Stein, Paula B. Randler, et.al. Sustaining America's Urban Trees and Forests. U.S. Department of Agriculture Forest Service. General Technical Report NRS-62. 2010.

14 McPherson, Gregory E.; James R. Simpson; Paula J. Peper, et.al. Midwest Community Tree Guide: Benefits, Costs and Strategic Planting. U.S. Department of Agriculture Forest Service. General Technical Report PSW-GTR-199. 2006.

15 U.S. Department of Agriculture. U.S. Forest Service. Pacific Southwest Research Station. Northeast Community Tree Guide: Benefits, Costs and Strategic Planting. (accessed Oct. 15, 2012).

16 http://www.epa.gov/airtrends/aqtrends.html#comparison

Green Infrastructure and Vacant Land

1 Detroit Future City. Detroit Strategic Framework Plan. 2012.

Green Infrastructure and the Economy

1 SEMCOG (2013). State and Local Government Revenue: State Disinvestment in Local Government. SEMCOG University Webinar.

2 Hammer, T. R., Coughlin, R. E., & ET, A. (1974). THE EFFECT OF A LARGE URBAN PARK ON REAL-ESTATE VALUE. American Institute of Planners.Journal of the American Institute of Planners, 40(4), 274.

3 The Urban Redevelopment Authority of Pittsburgh. (2010). Measuring the Economic Impact of Green Space in Pittsburgh. Retrieved from: cloud.tpl.org/pubs/ccpe-econvalueparks-rpt.pd

4 Espey, M., & Owusu-Edusei, K. (2001). Neighborhood parks and residential property values in greenville, south carolina. Journal of Agricultural and Applied Economics, 33(3), 487-492.

5 Cebula, R. J. (2009). The hedonic pricing model applied to the housing market of the city of savannah and its savannah historic landmark district. Review of Regional Studies, 39(1), 9-22.

6 Land Policy Institute. Economic Valuation of Natural Resource Amenities: A Hedonic Analysis of Hillsdale and Oakland
Counties.

7 Braden, J. B., & Johnston, D. M. (2004). Downstream economic benefits from storm-water management. Journal of Water Resources Planning and Management, 130(6), 498-505.

8 Voicu, I., & Been, V. (2008). The effect of community gardens on neighboring property values. Real Estate Economics, 36(2), 241.

9 Watcher, S. & Wonger, G. (2006). What is a Tree Worth? Green-City Strategies and Housing Prices. Real Estate Economics, 36 (2).

10 Mohamed, R. (2006). The economics of conservation subdivisions: Price premiums, improvement costs, and absorption rates. Urban Affairs Review, 41(3), 376-399.

11 Wolf, Kathleen. Business District Streetscapes, Trees, and Consumer Response

12 Laverne, R. J., & Winson-Geideman, K. (2003). The influence of trees and landscaping on rental rates at office buildings. Journal of Arboriculture, 29(5), 281-290.

13 U.S. Fish & Wildlife Services (2008). 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation – Michigan

14 Land Policy Institute (2007). Economic Impact of Michigan's State Parks: A Case Study of Rifle River Recreation Area.

15 Oakland County Planning and Economic Development. http://www.advantageoakland.com/ResearchPortal/Documents/
gi_econ_impact_sum.pdf

16 Stynes, Daniel & Warzecha (2002). Washtenaw County: Summary of Tourism Impacts 1999-2001

17 Murray, C., B. Sohngen, and L. Pendleton (2001). Valuing Water Quality Advisories and Beach Amenities in the Great Lakes. Water Resour. Res., 37, 2583-2590

18 Song, F., Lupi, F., Kaplowitz (2010). Valuing Great Lakes Beaches. Retrived from:

19 http://water.epa.gov/infrastructure/greeninfrastructure/gi_costbenefits.cfm

20 Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices, EPA publication number 841-F-07-006, December 2007.

21 SEMCOG (2008). Low Impact Development Manual for Michigan.

22 http://water.epa.gov/infrastructure/greeninfrastructure/gi_regulatory.cfm

23 ECONorthwest (2012). Economic value of green infrastructure projects in Rochester and Rochester Hills, Michigan.

24 Carpenter, Donald, Ph.D., A case study on the use of LEED, LID, and BMPs in the redevelopment of a Midwestern urban campus. http://www.ltu.edu/water/low_impact_development_publication.asp.

25 Reliableplanet. Rouge goes green: Ford plant creates sustainable solutions. Retrieved January 13, 2013 from: http://www.
reliableplant.com/Read/12523/rouge-ford-sustainable

26 Center for Urban Forest Research (2001). Save Dollars With Shade. Retrieved from: http://www.fs.fed.us/psw/programs/ uesd/uep/products/3/cufr_149.pdf

27 McPherson, Gregory E.; James R. Simpson; Paula J. Peper, et.al. Midwest Community Tree Guide: Benefits, Costs and Strategic Planting. U.S. Department of Agriculture Forest Service. General Technical Report PSW-GTR-199. 2006.

28 EPA (2013). Why Green Infrastructure? Retrived Janaury 13, 2014 from: http://water.epa.gov/infrastructure/greeninfrastructure/gi_why.cfm#EnergyClimateChange

29 http://www.michigan.gov/mdard/0,4610,7-125-1572-7775--,00.html

30 Michigan Department of Agriculture. Michigan Food and Agricultural Systems Profile. Retrieved from: http://www.michigan.gov/documents/mda/County_Food_System_Profiles_292923_7.pdf

31 Land Policy Institute (2012). Drivers of Economics Performance in Michigan.

32 MDARD. MSU study: food and agriculture contributions to Michigan economy top $90 billion. Retrieved from: http://www.michigan.gov/mdard/0,4610,7-125-1572_3628-275583--,00.html

Green Infrastructure and the Public Interest

1 Branas, Charles, et. al., A Difference-in-Differences Analysis of Health, Safety, and Greening Vacant Urban Space. 2011.

2 Troy, Austin, et.al., The Relationship Between Tree Canopy and Crime Rates Across and Urban-Rural Gradient in Greater Baltimore Region. 2011.

3 Kuo, Frances and William Sullivan. Environment and Crime in the Inner City: Does Vegetation Reduce Crime? Environment and Behavior. 2001.

4 Wolf, K. Civic Nature: Valuation: Assessments of Human Functioning and Well Being in Cities. Proceedings of the 3rd Biennial Conference of the U. S. Society of Ecological Economics.

5 Trust for Public Land. The Health Benefits of Parks. 2006.

6 Ibid.

7 Ibid.

8 Ibid.

9 Ibid.

10 Ibid.

SEMCOG Officers
2013-2014

Joan Gebhardt
Chairperson
Treasurer,
Schoolcraft College

Kathy D. Vosburg
First Vice Chair
Commissioner,
Macomb County

Robert Clark
Vice Chairperson
Mayor,
City of Monroe

Rodrick Green
Vice Chairperson
Trustee,
Superior Township

Jeffrey Jenks
Vice Chairperson
Commissioner,
Huntington Woods

Phil LaJoy
Vice Chairperson
Supervisor,
Canton Township

Michael Sedlak
Immediate Past Chair
Clerk,
Green Oak Township

Paul E. Tait
Executive Director