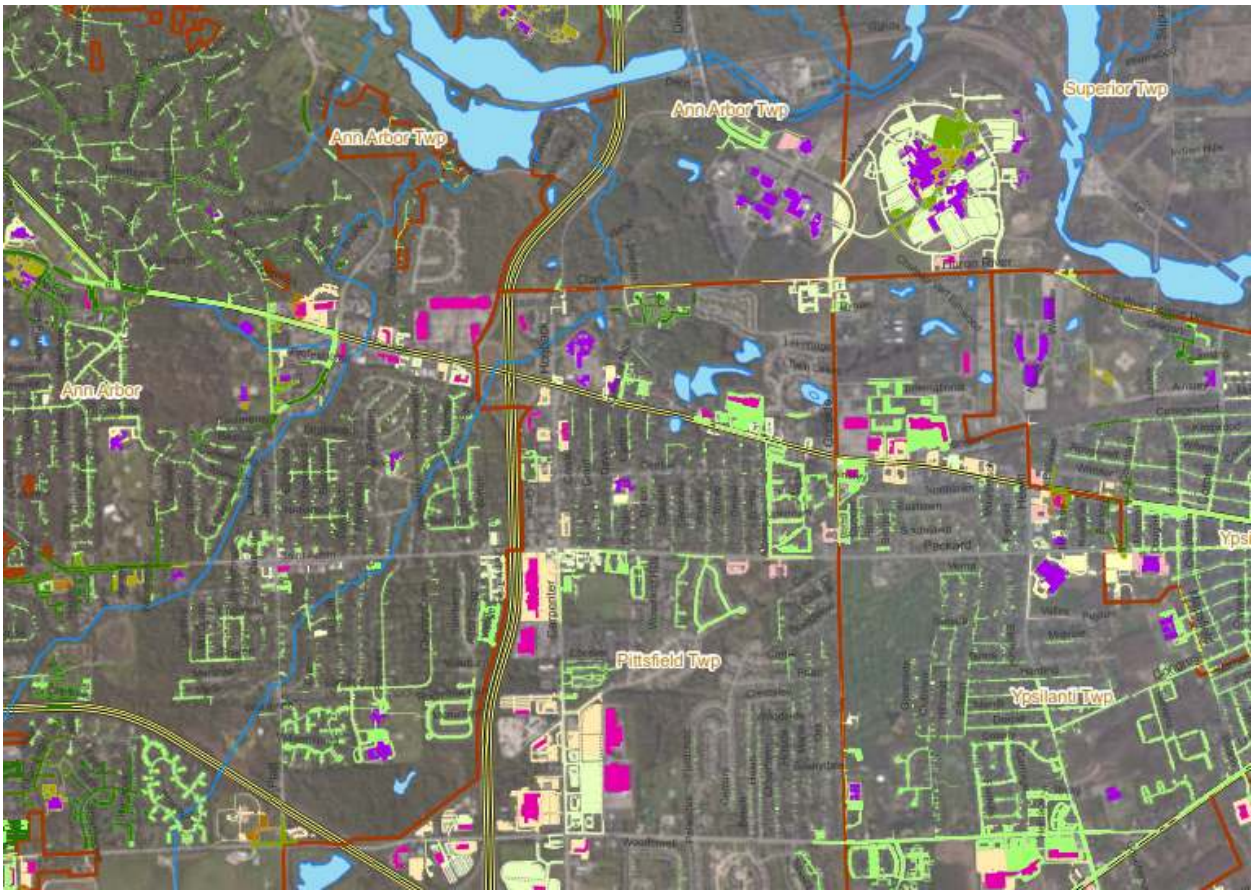
Guide to Green Infrastructure Opportunity Maps for Washtenaw County



Produced by the Huron River Watershed Council
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Purpose

The Green Infrastructure (GI) Opportunity Maps were developed by the Huron River Watershed Council (HRWC), working in consultation with municipal partners in Washtenaw County. The maps were developed with the intent of identifying targets for stormwater treatment Green Infrastructure projects. HRWC utilized available aerial and geographic information across Washtenaw County to identify areas with a greater likelihood of success for establishing Green Infrastructure projects.

The development of the GI Opportunity Maps was an important part of an effort to plan for GI development in Washtenaw County – a project that was funded by a grant from the Michigan Department of Environmental Quality. The project purpose was to move GI project development forward to capture, treat and infiltrate stormwater reducing the impacts from altered hydrology due to urban development. As such, the maps identify and prioritize GI opportunities that would capture runoff from impervious surfaces that are not otherwise treated. The maps were also designed to suggest alternatives to reduce the need for or size of conventional "grey infrastructure" such as gutters, pipes and underground storage facilities. This is in contrast to GI projects developed for other purposes such as natural resource conservation, habitat protection, or aesthetic benefits.

How to Obtain GI Opportunity Maps

A single map was developed for Washtenaw County. This map was segmented into a set of sub-county maps covering all the target areas in the county. Any or all desired maps can be obtained from HRWC's Green Infrastructure website. On that website, a link is provided to a list of maps available in pdf format. Those include the following area maps:

- Downtown Ann Arbor
- Northern Ann Arbor Area
- Western Ann Arbor
- Arbor-Ypsi Cooridor
- Chelsea
- Dexter
- Manchester
- Milan
- Pittsfield Township
- Salem Township
- Saline
- Scio Township
- South US-23 Cooridor
- Whitmore Lake
- Ypsilanti and Augusta Townships
- City of Ypsilanti

In addition to static pdf maps, a database of GIS files can also be downloaded. Finally, custom maps can be produced at the request of project partners by contacting Ric Lawson (rlawson@hrwc.org; 734-769-5123).

Production Process

Identifying Target Zones

The base layer for analysis was SEMCOG's 2010 Impervious Composite layer from their land cover dataset that was classified based on aerial imagery from 2009. That layer classifies several types of impervious cover: buildings, paved surfaces draining to storm systems, and tree cover with impervious surface underneath.

In the first step, HRWC sought to identify areas within Washtenaw County that are impacted most from altered hydrology due to urban development. HRWC reclassified the Impervious Composite layer into

two classes: impervious or pervious and conducted a rough cluster analysis to identify areas with generally higher proportions of impervious cover. The resulting pattern can be seen in Figure 1.

Visual inspection of impervious densities reveals that much of the county has little to modest impervious cover density, and several areas have very high densities. HRWC (with advice from partners) reasoned that areas with lower impervious cover densities would gain less benefit from additional GI projects. In fact, the impervious cover in the lower density areas mostly comes in the form of county roads, which usually send runoff to existing GI such as roadside swales that gain some stormwater infiltration, with remaining stormwater runoff being directed to wetlands or streams.

HRWC then identified and classified the areas with higher impervious densities as "GI target zones." The resulting zones (overlaid on top of the impervious surface density image) can be seen in Figure 2. Several small areas that initially appeared to be impervious were actually gravel or other mining operations and were eliminated as targets for stormwater GI. All further analysis was conducted on areas within these zones as these would be the areas that would benefit most from GI project implementation.

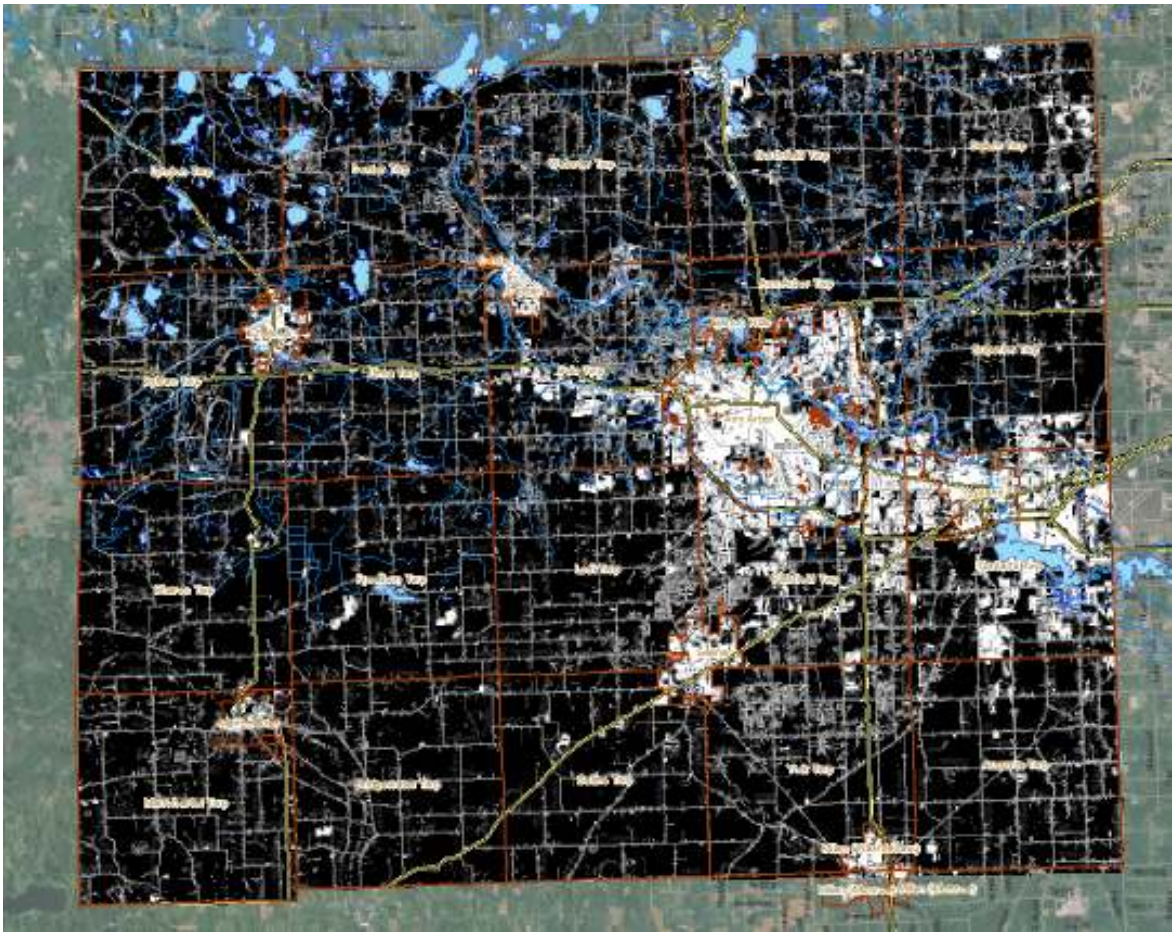

FIGURE 1. IMAGE SHOWING IMPERVIOUS COVER DENSITY IN WASHTENAW COUNTY. AREAS WITH HIGHER DENSITIES OF IMPERVIOUS COVER APPEAR WHITE, WHILE THOSE WITH LOWER DENSITIES APPEAR BLACK.

Identifying Targets by Type

Three general types of GI target strategies were selected for classification: green streets, large lots and green roofs. Since around 50% of an urban area's runoff can be generated by roads and right-of-ways, identifying target roads for green street applications and other projects on proximate properties was deemed important. Similar to green streets, large parking lots and other non-building surfaces were considered to be good targets for GI applications as they can contribute concentrated doses of stormwater runoff. Finally, the last feature to identify is the buildings themselves. Building roofs can be targets for green roof applications or downspout disconnect programs.

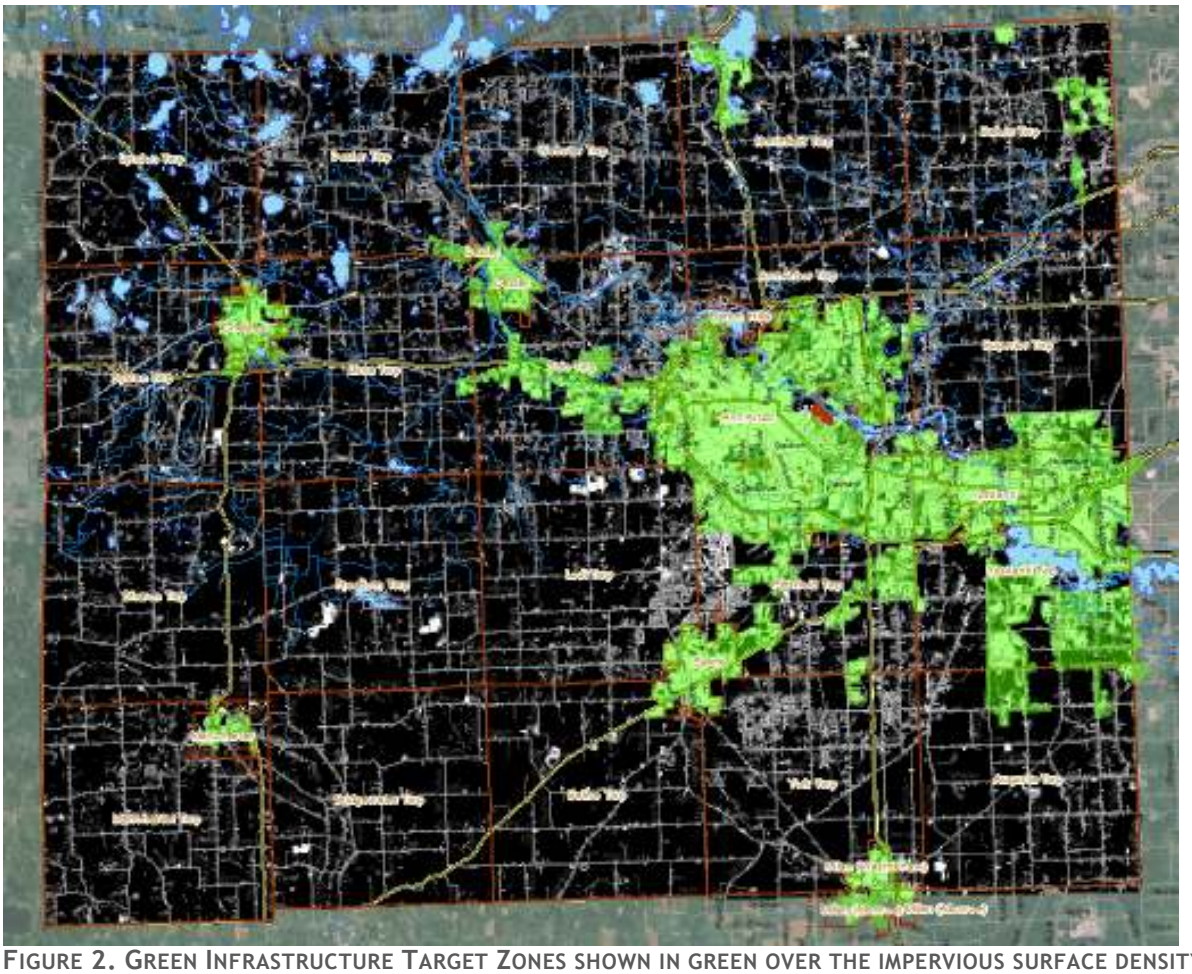

FIGURE 2. GREEN INFRASTRUCTURE TARGET ZONES SHOWN IN GREEN OVER THE IMPERVIOUS SURFACE DENSITY IMAGE FROM FIGURE 1.

Roofs were the easiest to identify. All buildings were classified in the SEMCOG Impervious Composite layer. In order to prioritize green roof targets, HRWC simply selected those with an area of ½ acre or more, as green roof applications are more cost effective to install on larger roofs.

Green streets were identified by first selecting all non-building impervious cover. Since many of these impervious polygons were contiguous (roads are all interconnected), the impervious cover was intersected with the county parcel ownership layer. From there, all impervious polygons that intersected with county or residential road lines (separate layers) were selected as green street targets. This was a fairly effective strategy to separate roads from lots, but there was some degree of misclassification (i.e. streets classified as lots and vice versa).

To identify large lots, the remaining non-building impervious areas (i.e. those that were not identified as roads) were considered lots. Those polygons with an area greater than 1 acre were selected as *large* lots to eliminate smaller areas such as residential driveways.

Segmenting by Ownership

In order to develop an effective GI development strategy, the type of ownership of each property is needed. After discussion with county partners, four classes of ownership were determined to be useful

for seeking different types of GI projects: public lands (government owned), properties owned by public institutions like schools and universities, properties owned by private commercial or industrial businesses and residential properties. HRWC used SEMCOG's 2008 Land Use layer developed from parcel records to identify ownership classes. That layer included a combined classification for government or institutional ownership, so three ownership classes were used. The three GI strategy types (green streets, large lots and green roofs) were then segmented by each of the three ownership classes to result in nine GI target groups.

Establishing Priorities

GI projects need to meet a number of criteria to be successful, depending on the type of GI project under consideration. Many resources are available that describe these criteria across a range of GI or Low Impact Design (LID) applications. For green roofs, the main criteria is that the existing roof must not exceed a certain pitch slope. Roof pitch cannot be discerned from available data, so no further criteria beyond roof size was considered.

For street and lot projects, three criteria were considered that would make some GI project locations better than others. These three were selected because they could be useful for site selection, but also because information could be obtained or implied from available GIS layers. The priority criteria used included good draining soils, gentle slopes, and no pre-existing stormwater capture and treatment.

To determine areas of good draining soils where infiltration projects would be more likely to be successful, the hydrologic soil classification within the national soils layers from the National Resource Conservation Service was used. Areas with soils in groups A and B were selected for prioritization.

To eliminate areas where slopes are too steep to allow for effective infiltration of runoff, a digitial elevation model was used. Elevations were processed to generate percent slopes across the region. Areas with slopes less than 6% were included in the priority selection layer.

Finally, to find more recent residential and commercial developments that were built with storm systems connected to detention ponds, the water classification in SEMCOG's impervious composite layer was used. The logic of using this criteria for prioritization is that areas connected to detention/retention ponds are receiving at least some amount of stormwater capture and treatment. Such areas would be better evaluated for detention pond retrofit projects, rather than new GI. For this criteria, known developments with detention ponds were examined to identify a minimum area of a detention pond. A size of 4,000 square feet was used. All water bodies smaller than this were removed from the analysis, since they were not likely stormwater treatment ponds. Larger natural water bodies were also eliminated. The remaining ponds were then buffered by 200 feet to provide a distance for connection to the detention ponds. This distance did a reasonable job of selecting subdivision areas with ponds as opposed to areas that happened to be close to natural water bodies. Any target areas that intersected detention pond buffers were removed from the priority layer.

Using the combined layer, a new set of prioritized areas was generated. Each resulting map, therefore, shows prioritized and unprioritized areas for three GI types across three ownership classes. A total of 12 Green Infrastructure Opportunity classes were generated for the target zones in Washtenaw County. It should be noted that, at the time of analysis, HRWC only possessed soils and elevation layers for the Huron River Watershed boundary, so these criteria were not applied to areas outside the watershed.

How to Use the Opportunity Maps

The GI Opportunity Maps highlight a range of project opportunity areas for municipalities and agencies in Washtenaw County. As described in the process section, three types of GI area types are identified and each of those area subdivided by three property ownership classes. Priority areas within each of the combined classes are also identified to help focus target site identification further. Each of the different GI opportunity types were developed to highlight a range of possible GI projects. Details on project types complete with design, installation and maintenance specifications can be found in a number of other resources. Two comprehensive local resources include the *Lid Manual for Michigan* (SEMCOG, 2008) and *The Washtenaw County Water Resources Commissioner Rule and Guidelines* (Washtenaw County Water Resources Commissioner, 2014 (in publication)).

Residential Green Streets

A number of GI practices can be employed in and around residential streets. The most obvious applications would address runoff from the streets themselves. Municipalities could review the residential green street opportunities in their jurisdiction and compare the list against a list of residential streets up for reconstruction or other major repair. At minimum, the high priority streets should be considered for direct applications including: pervious paving, subsurface infiltration beds, or infiltration trenches; or indirect applications to be developed in road right-of-ways including: bioretention, rain gardens, bioswales, vegetated filter strips, planter boxes or broad tree planting.

In addition to practices to capture, store, treat and infiltrate runoff from the road themselves, GI practices to capture and treat runoff from neighboring residential properties can also be sought through residential programs. These practices could include: downspout disconnections, rain gardens, other bioretention or reuse practices such as rain barrels or cisterns. Tree planting programs could also be targeted to priority GI opportunity streets in right-of-ways or on residential properties. Resident practices could be encouraged through incentive programs, stormwater or water bill rebates, technical assistance or direct grants. Combining direct street runoff projects with targeted resident programs can be particularly powerful at reducing runoff from a priority target area, such as those highlighted on the map.

The GI Opportunity Map should be used for prioritizing projects at a planning level. Additional information on target properties, such as soil borings, slope calculations, storm system inventory, etc. should be collected prior to moving forward with a project design. While the priority residential green street opportunity areas are the best places to start, many of the practices listed above can be implemented under less-than-ideal conditions. Rain gardens and bioretention can be successful even in poor draining soils if given enough time for root penetration, for example.

Government/Institutional Green Streets

Most of the GI practices described for residential streets can also be applied to streets owned by government agencies or institutions (e.g. schools and universities). Access streets to government buildings may even be easier opportunities as there would be reduced owner conflicts. However, government street opportunities are limited in scale. Partnerships with universities and school districts could be developed to address major priority areas under those ownerships. Grant-funded demonstration projects could be developed to start such initiatives.

Commercial/Industrial Green Streets

Target streets next to privately owned commercial or industrial properties again offer opportunities to apply the street runoff practices listed under residential green streets. Additional projects extending onto these properties may need to be developed opportunistically as these properties are proposed for redevelopment. Like with residential streets, connecting street projects with large private property projects may provide combined opportunities that would exceed the benefits of individual projects. When private properties are proposed for redevelopment, the GI Opportunity Map should be consulted for priority designation and opportunity for GI development.

Government/Institutional Large Lots

Government-owned lots may be the best set of areas to start with GI project planning. A large area of impervious surface can be treated with more flexibility than streets given the wider area. No property owner conflicts will delay development. Government properties also tend to have high public visibility and so offer the added benefit of offering educational opportunities. Highlighting a working example of GI on a visible government property can serve to illustrate a municipality's commitment to water resource protection and illustrate the benefits offered by GI approaches.

Practices to address runoff from large lots can include many of the same practices used for green streets: pervious paving, subsurface infiltration beds, or infiltration trenches, bioretention, rain gardens, bioswales, or vegetated filter strips. Practices can include regarding to larger downslope treatment areas with well-draining soils or distributed across the lot. Large lots in dense urban areas can also be treated with underground detention and infiltration. While not a GI solution, deeper excavation may provide access to better draining soils.

Commercial/Industrial Large Lots

As with privately owned streets, projects on private lots will likely need to be undertaken opportunistically as redevelopment is proposed. At such time, the GI Opportunity Map should be reviewed for opportunities to encourage GI design and connection to green street development. The Water Resource Commissioner's new stormwater rules (Washtenaw County Water Resources Commissioner, 2014 (in publication)) will help to require or encourage GI projects. Further incentives or stricter requirements could be established for priority GI lots.

Green Roofs

Green roofs are an innovative way to slow and treat runoff from large roofs. While their ability to store runoff is limited, they can significantly delay the runoff and remove a range of pollutants. Additionally, green roofs have subsidiary benefits such as reducing building heating and cooling costs, providing rooftop garden space, and reducing the heat island effect found in urban centers. Green roofs are best employed in concert with additional GI practices on the surrounding property. Government owned buildings are the best targets for their community benefit and for the allowance for a longer payback. However, unless roof access is encouraged, green roofs lack the visibility impact that other GI practices provide. Incentives could be provided for private green roofs. Cost considerations are greater with green roofs and should therefore be considered after other GI opportunities are developed on target properties.

Future Improvements

The GI Opportunity Map for Washtenaw County is the first effort to systematically identify the best areas for GI development in the county. While it is a good start and should help to narrow the targets to provide assistance with GI planning for municipal and agency stakeholders, future efforts to refine the map could improve its usefulness.

1. *Reduce misclassifications.* Due to the large scale of the county, the geographic data used in map production resulted in a number of type misclassifications. Some large lots were identified as streets and vice versa, and some green street opportunities were missed altogether. Individual misclassifications could be identified and corrected, given sufficient time.
2. *Develop priority areas outside the Huron River Watershed.* Some geographic data such as soil types were only available for the Huron River Watershed at the time of analysis. Obtaining this data for the other watersheds in Washtenaw County would extend priority area refinement.
3. *Refine current stormwater treatment information.* Municipal staff may possess information for their jurisdictions about stormwater treatment such as directly connected downspout areas, detention pond locations and connections, and street age and reconstruction schedules. This data could be incorporated to refine the project type definitions and priority designations.
4. *Develop additional project criteria information*. Additional criteria could be developed to highlight areas with a greater likelihood for successful GI project development. HRWC began an effort that included greater context analysis for the Dexter area (see appendix for process description). This effort could be completed, refined and then applied to the entire county region.
5. *Capture direct input from municipal users.* Finally, following the distribution of the GI Opportunity Map, municipal and agency staff will likely identify additional suggestions for improving the map and prioritization scheme. This feedback should be captured and incorporated where possible.

References

SEMCOG. (2008). *Low Impact Development Manual for Michigan*. Detroit, MI.

Washtenaw County Water Resources Commissioner. (2014 (in publication)). *Rules and Guidelines: Procedures and Design Criteria for Stormwater Management Systems*. Washtenaw County, MI.