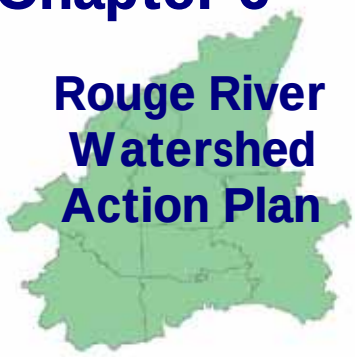
Chapter 6



Rouge River Watershed Action Plan

Action Plan Development

Prior to determining what actions are needed to restore and preserve the watershed, areas with the greatest amount of impairments, based on the primary pollutants of concern, were determined. Areas needing protection from degradation were also determined based on macroinvertebrate, fisheries, and frog and toad populations, and habitat quality.

This management plan is built upon documented successes and is focused on observed problems. The approach for restoration has evolved from merely improving water quality to maximizing ecological integrity. Watershed-wide there are issues with flow, impaired biota and pathogens as illustrated by the TMDLs for *E. coli* and biota. The entire watershed is designated an Area of Concern (AOC) under the Great Lakes Quality Agreement. Impervious surfaces, altered hydrology, loss of pervious surfaces and the resultant increase in polluted storm water has been identified as the root cause of all these problems. Consequently, the philosophy of the ARC involves attacking this root cause at each and every opportunity. Nonetheless, Critical and Protection Areas were determined to help focus restoration and preservation efforts.

"Treatment train" refers to the application of a series of physical storm water best management practices to achieve improved drainage water quality.

Structural best management practices seem to be most effective when they can be combined in a treatment train. However, BMPs will fail if improperly located within the treatment train or not properly maintained.

The ARC's overall action strategy is to protect and maintain what is healthy, restore what is degraded and keep working collaboratively to continuously improve environmental conditions and the efficiency of activities. The ARC is creating a Collaborative Action Plan to address the priority pollutants, realize AOC delisting, and expand on the volume reduction BMP scenarios developed by the subwatershed groups. Within this action plan the ARC is essentially combining the U.S. EPA's *Managing Wet Weather with Green Infrastructure Action Strategy* and the Water Environment Federation's *Water is Life and Infrastructure Makes it Happen* campaigns to achieve storm water runoff volume reduction and pollutant loading reductions. The basic components of the ARC's Collaborative Action Plan are:

- Wastewater Treatment System Improvements
- Collaborative IDEP Activities
- Collaborative PEP Activities
- Green Infrastructure/Low Impact Development (LID)[1] Projects and Retrofits
- Fish Passage and Habitat Projects
- Progress Evaluation
- Collaborative Planning, Financing and Reporting

[1]Green infrastructure (GI) is an approach to storm water management that uses natural systems (or engineered systems that mimic natural processes) to enhance environmental quality. In general, GI techniques use soils and vegetation to infiltrate, evapotranspire, and/or recycle stormwater runoff. Low impact development (LID) is synonymous with green infrastructure practices (Odefey 2012).

Critical Areas

A critical area is defined as the geographic portion of the watershed that is contributing a majority of the pollutants and is having a significant impact on the water body. The concept behind identifying a critical area is to reduce the geographic scope of the watershed project and focus attention on the part of the watershed that is contributing the most pollutants.

Critical areas within the Rouge River Watershed have been identified and include areas with known high bacterial concentrations from past sampling results, areas with high sediment and nutrient loads from modeling results, subwatersheds with significant storm water runoff volume and high bankfull frequencies, and using existing knowledge from ARC members and consultants

Critical Areas

Pathogens

In an urbanized watershed, such as the Rouge River Watershed, wet weather bacterial exceedences are not uncommon. However, bacterial indicators, such as *E. coli*, present during dry weather conditions suggest an area in which further study is warranted and actions are required to eliminate sources. Johnson Creek, Franklin Branch and Pebble Creek all experience rare exceedences in bacteria standards during dry weather, while the Lower Rouge River, Tonquish Creek and the sampled tributaries in the Upper Subwatershed experience frequent violations. Using existing *E. coli* data and local knowledge, pathogen critical areas were determined for the watershed. Some of these areas require intensive illicit discharge elimination investigations, while others require actions to reduce CSOs and SSOs. These areas were divided into three priority work areas.

IDEP/PEP 1st Priority Work Areas

Three areas were identified by the ARC Technical Committee as Pathogen 1st Priority Work Areas (Figure 6-1). Two of these areas are within the Upper Rouge Subwatershed and one is in the Middle 1 Subwatershed. The criteria used to identify them as a priority included:

- Upstream of known CSO/SSO areas
- Highest *E. coli* concentrations ("Poor" rating per 2006 RREMAR)
- Dry weather Human *E. coli* (based on 2005 & 2006 BST studies)
- Grant funds awarded to focus on these areas

Within these 1st Priority Areas the local communities, counties and the ARC are focusing staff and resources to aggressively implement collaboration of IDEP and PEP activities to identify and eliminate the sources of human sewage and elevated bacteria concentrations in these subwatershed areas as quickly as possible. The IDEP activities include intensive sampling to narrow down areas with elevated *E. coli*, then smoke testing, dye testing and/or storm sewer inspections to narrow down sources of human sewage. PEP activities include advertising the pollution hotline numbers and

distributing storm sewer awareness information. This intensified IDEP and PEP implementation will be focused in these areas through 2015.

IDEP/PEP 2nd Priority Work Areas

Significant portions of the Upper, Lower and Main 1-2 Subwatersheds have been identified by the ARC as IDEP/PEP 2nd Priority Work Areas (Figure 6-1). The criteria used to identify them as IDEP/PEP 2nd Priority Work Areas included:

- Upstream of known CSO areas
- High *E. coli* concentrations ("Poor" rating per 2006 RREMAR)
- Dry weather Human *E. coli* (based on 2005 & 2006 BST studies)
- Grant funding applied for to investigate and isolate problem areas.

Within these 2nd Priority Areas the local communities, counties and ARC staff recognize the need to aggressively implement collaborative IDEP and PEP activities. Upon conclusion of efforts in the 1st Priority Areas, intensified IDEP and PEP activities will shift to these subwatershed areas between 2015 and 2020. The activities will be the same as those specified for the 1st Priority Areas.

CSO/SSO Priority Work Areas

The Main 3-4 and significant portions of the Upper, Middle 3 and Lower 2 subwatersheds have been identified by the ARC as CSO/SSO Priority Areas (Figure 6-1). The criteria used to identify these areas included:

- Known uncontrolled CSOs remain
- Known SSO areas

Within these CSO/SSO Priority Work Areas the local communities, Wayne County and the ARC are spending millions of dollars on CSO, sanitary sewer and/or wastewater treatment system maintenance and capital improvements. While these investments are underway routine storm water IDEP and PEP efforts will be implemented. Based on the City of Detroit's draft 2011 NPDES permit, uncontrolled CSOs will be eliminated by 2035. It is anticipated that any documented SSOs will also be controlled by that date.

Areas outside the 1st, 2nd and CSO/SSO priority areas identified above including significant portions of the Middle 1 and Main 1-2 will be subject to routine IDEP, PEP, and sanitary sewer system operation and maintenance activities as implemented by the local communities and counties without focused support from the ARC. Table 6-1 provides a summary of the priority pollutants, sources, causes, critical areas and best management practices that will work towards reducing the pollutant loads and/or eliminating direct sources of pollution.

Figure 6-1: Critical Areas Targeting Pathogens

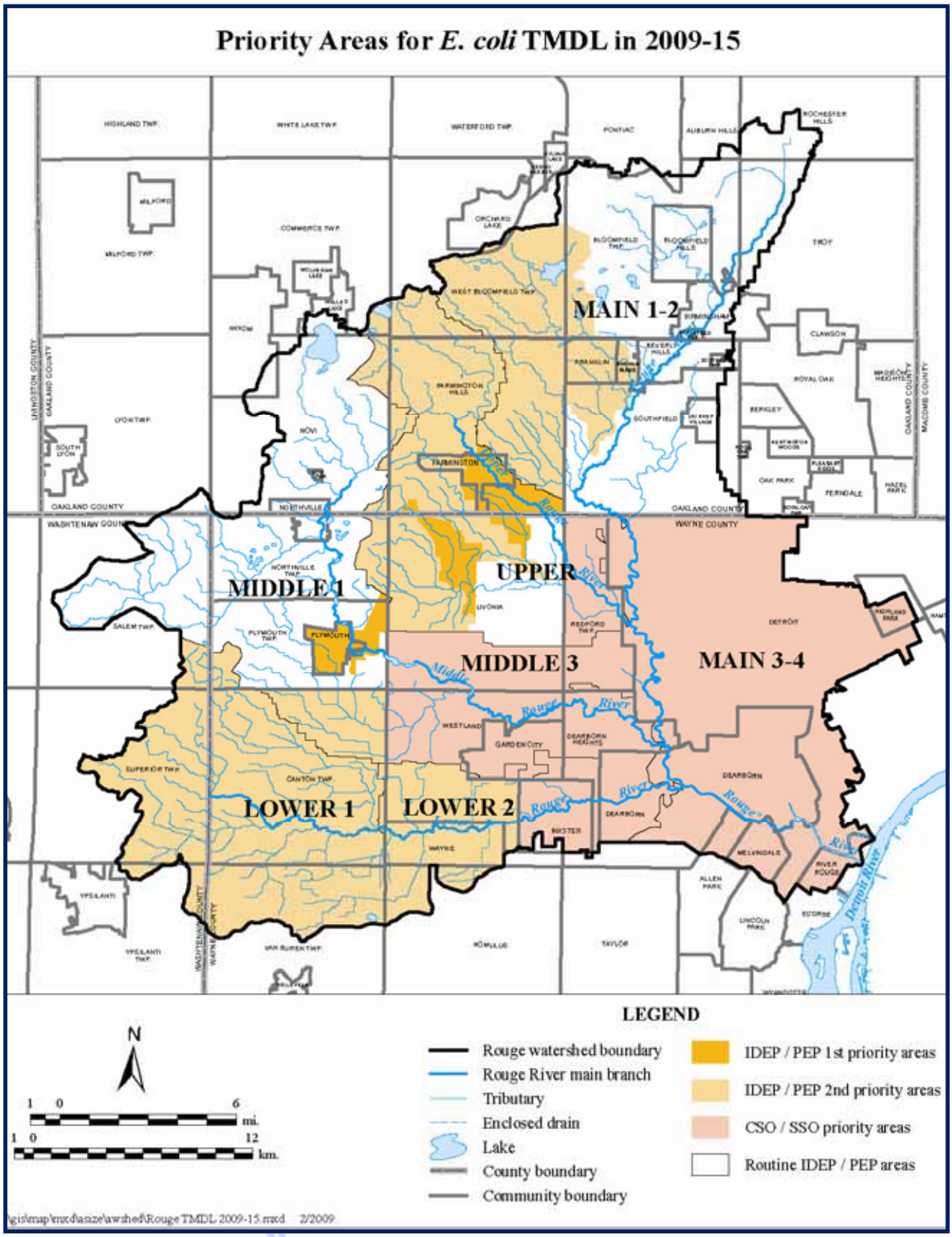


Table 6-1: Summary of Pathogen 1st Priority Pollutant Sources, Causes, and Best Management Practices

Sources		Causes	Critical Areas CSO and SSO Priority	Action Plan Activities
Combined Sewer Overflows (CSOs)		• Insufficient sewer capacity. • Loss of pervious areas via urban development.	Communities w/Uncontrolled Overflows: Dearborn, Dearborn Heights, Detroit, Highland Park, Inkster, Redford Township	• Sewer retrofitting/updates to system • Flow reduction • Green infrastructure
Sanitary Sewer Overflows (SSOs)		• Excess wet weather infiltration/Inflow • Insufficient sewer capacity.	Evergreen-Farmington System which covers portions of Farmington Hills, Beverly Hills, Auburn Hills, West Bloomfield Township, and Troy. Rouge Valley System which covers portions of Allen Park, Canton Township, Dearborn, Dearborn Heights, Garden City, Inkster, Livonia, Melvindale, Northville, Northville Township, Plymouth, Plymouth Township, Redford Township, Romulus, Van Buren Township, Wayne, and Westland. Western Townships Utility Authority which covers portions of Canton ,Northville and Plymouth townships	• Sewer lining, inspections • Regular maintenance of system • Building capacity
Sources		**Causes**	**Critical Areas 1st Priority/2nd Priority**	**Action Plan Activities**
Illicit Connections &Discharges	Failing Septic Systems (OSDS)	• Historical lack of septic system maintenance, education, inspection and correction. • Undetected or uncorrected illicit discharges.	Portions of Southfield, Farmington Hills, Plymouth Township, Livonia Portions of Bloomfield and Canton, Farmington Hills, Franklin, Livonia, Northville Township, Novi, Plymouth Township, Salem Township, Southfield, Superior, Van Buren , West Bloomfield and Ypsilanti townships and Westland,	• Septic system maintenance education • Septic system inspection programs • Pre-sale Septic system inspection ordinance
	Illicit Sanitary Connections to a Storm System	• Undetected or uncorrected illicit discharges. • Inadequate construction inspection for new and existing sanitary sewer connections.	Portions of Farmington Hills, Southfield, Plymouth, Livonia Portions of Bingham Farms, Bloomfield, Canton and, Commerce townships, Farmington, Farmington Hills, Franklin, Livonia, Northville Township, Novi, Plymouth Township, Romulus, Salem Twp, Southfield, Superior Twp, Van Buren Twp, Wayne, West Bloomfield Twp. Westland, Ypsilanti Twp	• Continued IDEP activities (dye testing, etc.) • Sewer televising and inspections

Contaminated Storm Water Runoff	Pet Waste/Urban Animal Waste	• Little knowledge of the importance of pet waste /urban animal waste management. • Loss of pervious areas via urban development.	Watershed-wide[1]	• Education • Signage at waterways • Pet waste stations
			Watershed-wide[1]	
	Agricultural Animal Waste	• Poor manure management. • Lack of Buffer Strips	Not applicable	• Manure Management Education • Increase Buffer Zone along waterways. • Education on Good Housekeeping Procedures
			Superior and Salem townships	
	Re-suspended Sediment	• Excessive peak discharges • Unsatisfactory infrastructure maintenance.	Watershed-wide[1]	• Good housekeeping measures • Reduction of impervious surfaces
			Watershed-wide[1]	
Wastewater Treatment Plants (Ypsilanti Community Utility Authority (YCUA), Walled Lake, Commerce and Salem townships)		N/A		

[1]Watershed-wide = There are no known critical areas, but the source is suspected to be contributing to the pollutant problem.

Sediment

Sediment is a contributing factor to many water quality issues within the watershed. Prioritized critical areas are the areas according to the WMM model with the highest total suspended solids loading (>500,000 lbs/yr). In addition, based on the Johnson Creek DO TMDL, sediment is impacting Johnson Creek. Therefore, the sediment critical areas include portions of the Upper, Main 1-2, Middle, Middle 3 and Lower 2 SWMAs as described below and shown in Figure 6-2.

Based on the WMM:

- City of Livonia (portions of)
- City of Westland (portions of)
- City of Wayne (portions of)
- City of Southfield (SE portion of)
- City of Farmington Hills (NW portion of)
- City of Allen Park (portions of)
- City of Melvindale (portions of)

Based on the Johnson Creek TMDL:

- Northville (portions of)
- Northville Twp (portions of)
- Salem Twp (portions of)

Since the WMM model is based on land use characteristics rather than field conditions, these critical areas are best associated with Infrastructure sources. The critical areas for the Streambank source are based on the streambank erosion surveys conducted in the Main 1-2 and in portions of the Upper SWMAs. There are no known field conditions that suggest critical areas for the Construction Site source; therefore, this source should be considered throughout the watershed. The Johnson Creek TMDL cited runoff (construction site, agricultural and urban storm water) as sources of the sediment load (MDEQ 2007). Table 6-2 provides a summary of the sediment sources, causes, critical areas and best management practices that will work towards reducing the pollutant loads and/or eliminating direct sources of pollution.

Figure 6-2: Critical Areas Targeting Sediment

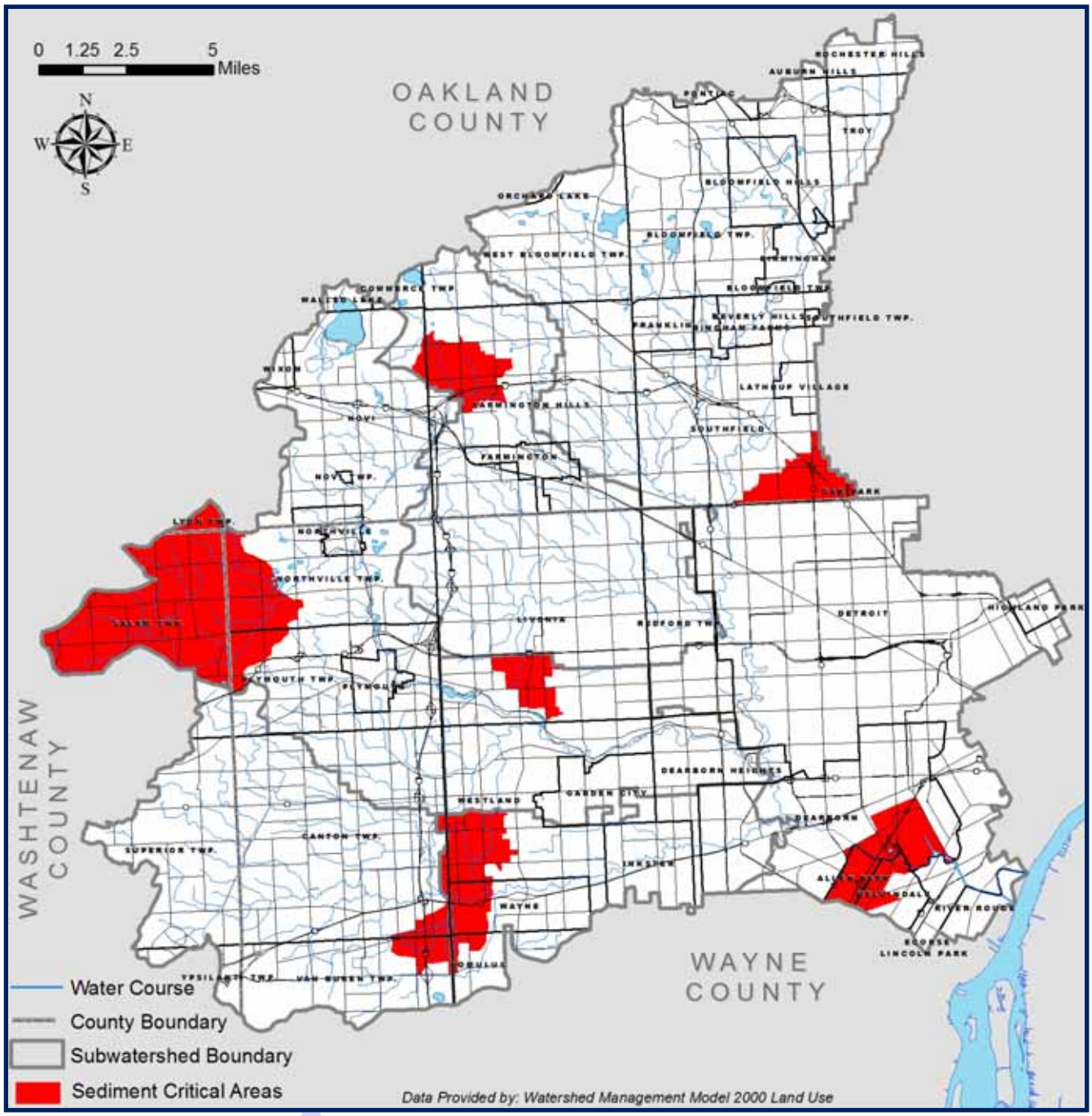


Table 6-2 Summary of Sediment Priority Pollutant Sources, Causes, and Best Management Practices

Sources	Causes	Critical Areas	Action Plan Activities
Construction sites	• Lack of a viable soil erosion & sedimentation control program. • Absence of effective education regarding riparian corridor management and storm water BMP maintenance. • Poor construction practices	Johnson Creek Drainage Area: portions of Northville, Northville and Salem townships.	• Construction site education • Contractor education • Soil erosion ordinances and enforcement
Streambanks	• Loss of green infrastructure via urban development. • High wet weather flows. • Absence of effective education regarding riparian corridor management and storm water BMP maintenance. • Loss of tree canopy	Main 1-2 priority sites[1] Upper priority sites[2] Other SWMAs not evaluated	• Woody debris management • Streambank Stabilization • Buffers • Riparian Corridor Education • Tree Planting
Infrastructure: Roads/Highways/ Bridges and Related Infrastructure Municipal properties (including DPW facilities, public parks, library properties, unimproved properties)	• Loss of pervious areas via urban development. • Insufficient storm water infrastructure maintenance	Portions of Livonia, Westland, Wayne, Allen Park, Melvindale, Southfield, Farmington Hills Johnson Creek Drainage Area: portions of Northville, Northville and Salem townships.	• Green infrastructure installation • Storm water BMPs • Grow zone installation
Agricultural runoff	• Uncontrolled runoff • Lack of buffer strips	Johnson Creek Drainage Area: portions of Northville and Salem townships.	• Increase Buffer Zones along waterways.

[1]Main 1-2 – Streambank Stabilization Priority Sites (Limno-Tech, 2004):

1. Evans Drain, Southfield
2. Rouge River, immediately downstream from a grade control structure, Troy
3. Rouge River, several hundred feet upstream from Beach Road, Troy
4. Pebble Creek, immediately east of Danvers Drive and north of Twelve Mile Road, Farmington Hills
5. Trib. A – Main Ravines Drain, Farmington Hills
6. Main Ravines Drain, Farmington Hills (a)
7. Main Ravines Drain, Farmington Hills (b)
8. Unnamed Tributary near Bingham Lane, Bingham Farms
9. Unnamed Tributary immediately west of Bell Road, Southfield
10. Pebble Creek meander adjacent to Holy Sepulchre Cemetery, Southfield
11. Upstream of Nine Mile Road Bridge, Southfield
12. Broad meander, downstream of the confluence of Pernick Creek, Southfield.

[2]Upper Priority sites (based on SWAG input):

1. East side of crossing of Farmington Road at the Minnow Pond Drain, Farmington Hills
2. West side of crossing of Farmington Road at the Minnow Pond Drain, Farmington Hills
3. On Seeley Drain approximately 620ft downstream from Halsted Road, Farmington Hills
4. Bell Creek near Bell Creek Court, Livonia
5. Rennolds' Ravine, South of 5 Mile Road, East of Levan Road, Livonia
6. Tarabusi Creek south of 8 Mile Road, Livonia
7. West Bell Branch at Newburgh Road crossing just south of 8 Mile Road, Livonia
8. On the North Bell Branch near Myrna Avenue and Hubbard, Livonia
9. Idyl Wyld Golf Course, Livonia
10. I-275 and Hix Road, Livonia
11. Tarabusi Creek and North Bell Branch intersection, Livonia
12. On Tarabusi Creek located northeast of intersection of Gary Lane and Riverside Drive, Livonia
13. 6 Mile Road and Francavilla Drive, Livonia
14. Bell Creek Court, Livonia

Nutrients

Nutrients are a contributing factor to many water quality issues within the watershed including algal blooms, DO reduction and lake eutrophication. Prioritized critical areas are the areas according to the WMM model with the highest total phosphorus loading (> 1,600 lbs/year). Figure 6-3 shows that this occurs in select portions of the Upper, Main 1-2, Middle 3 and Lower 2 Subwatersheds. More specifically, these areas include:

- Redford Township (portions of)
- West Bloomfield Township (portions of)
- City of Westland (portions of)
- City of Wayne (portions of)
- City of Southfield (SE portion of)
- City of Farmington Hills (NW portion of)
- City of Allen Park (portions of)
- City of Melvindale (portions of)
- Lathrup Village (portions of)

Since the WMM model is based on land use characteristics rather than field conditions, these critical areas are best associated with Impervious Area, Infrastructure, and Storm Water sources. There are no known field conditions that suggest critical areas for the Waterfowl/Animal Waste source, therefore this source should be considered throughout the watershed. Table 6-3 provides a summary of the nutrient sources, causes, critical areas and best management practices that will work towards reducing the pollutant loads and/or eliminating direct sources of pollution.

Figure 6-3: Critical Areas Targeting Nutrients

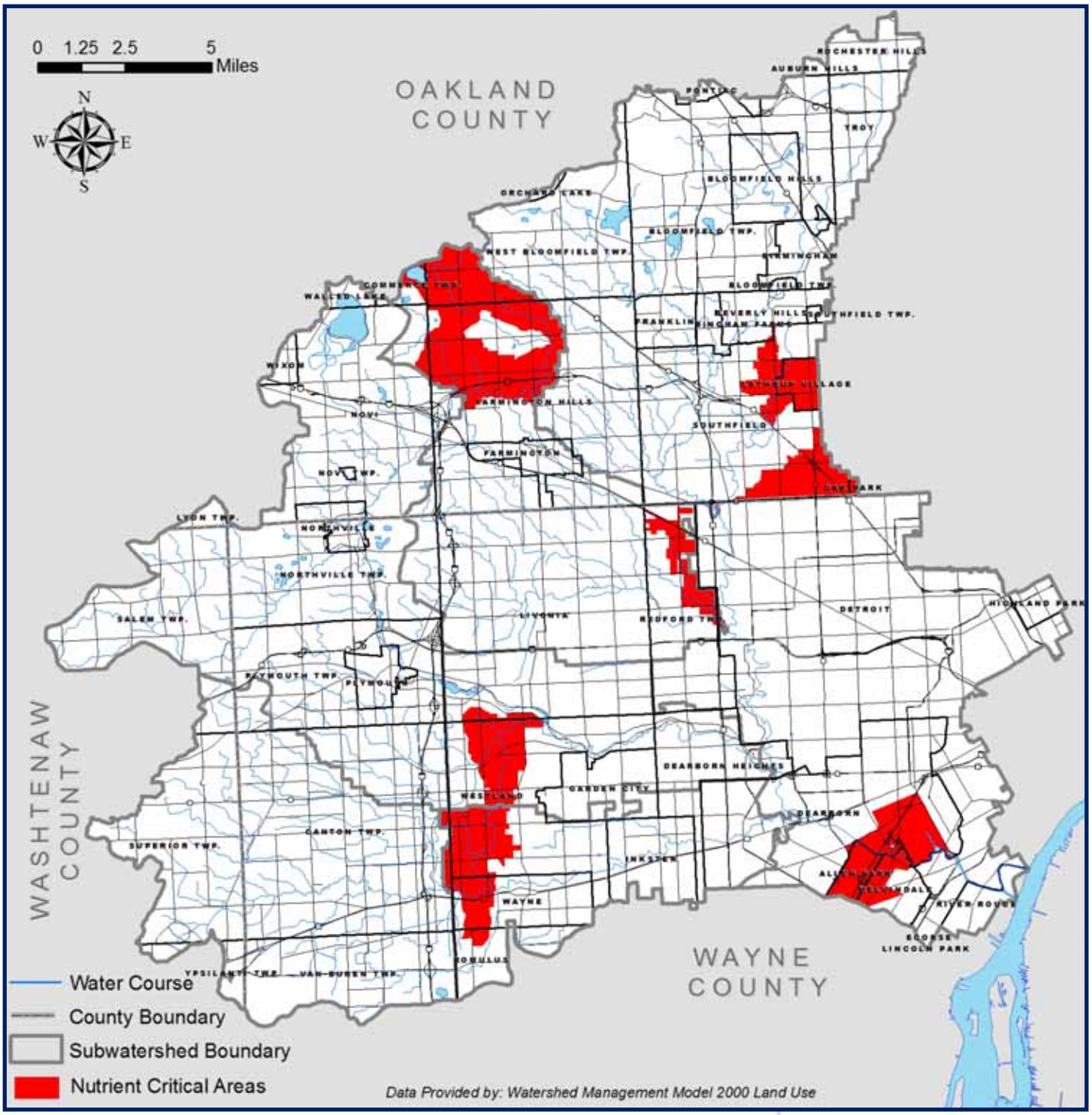


Table 6-3: Summary of Nutrient Priority Pollutant Sources, Causes, and Best Management Practices

Sources	Causes	Critical Areas	Action Plan Activities
High percentage of impervious surfaces (Gray Infrastructure) and lack of natural features (Green Infrastructure).	• Loss of pervious areas via urban development.	Portions of: Allen Park, Farmington Hills, Lathrup Village, Melvindale, Redford Twp, Southfield, Wayne, West Bloomfield Twp, Westland	• Pervious pavement • Green Infrastructure
Urban/Rural Storm Water	• Loss of pervious areas via urban development. • Historic lack of education about proper fertilization and soil testing practices for property owners and property managers. • Insufficient storm water infrastructure maintenance.	Portions of: Allen Park, Farmington Hills, Lathrup Village, Melvindale, Redford Twp, Southfield, Wayne, West Bloomfield Twp, Westland	• Storm Water BMPs • Green Infrastructure • Fertilizer Education
Failing Septic Systems	• Historical lack of septic system maintenance, education, inspection and correction. • Undetected or uncorrected illicit discharges.	Portions of: Farmington Hills, Redford Twp, Southfield, West Bloomfield Twp, Westland	• Septic System Maintenance Education • Septic System Ordinances
Roads/Highways/Bridges and Related Infrastructure	• Loss of pervious areas via urban development. • Insufficient storm water infrastructure maintenance.	Portions of: Allen Park, Farmington Hills, Lathrup Village, Melvindale, Redford Twp, Southfield, Wayne, West Bloomfield Twp, Westland	• Green Infrastructure Improvements • Municipal Good Housekeeping Practices • Storm water BMPs
Nuisance Waterfowl/Urban Animal Waste	• Lack of education regarding pet waste/urban animal waste management.	Watershed-wide[1]	• Signage • Pet Waste Stations • Education

[1]Watershed-wide = There are no known critical areas, but the source is suspected to be contributing to the pollutant problem.

Stream Hydrology

The hydrologic analysis of the Rouge River was previously outlined in Chapter 3. Results of this analysis indicate that the bankfull or overbank flooding is occurring on average between 0.6 and 10 times per year with the most impacted sites being the Upper Rouge at Telegraph Road in Detroit and Lower Rouge at Wayne Road (Table 6-4).

Table 6-4: Average Annual Bankfull Frequency

USGS Stream Gage	Gage ID	Bankfull Flow Rate (cfs)	Average Annual Bankfull Frequency	Stream Indicator based on Overbank Frequency[1]
Main Rouge at Birmingham (Maple Rd.)	US4	495	1.4	Impacted[2]
Main Rouge at Southfield (Beech Rd.)	US5	664	5.5	Non-Supporting
Evans Ditch at Southfield (9 Mile Rd.)	US6	357	4.3	Non-Supporting
Upper Rouge at Farmington (Shiawassee)	US3	478	0.6	Impacted[2]
Upper Rouge at Detroit (Telegraph)	U05	314	9.2	Urban Drainage
Main Rouge at Detroit (Plymouth Rd.)	US7	1309	3.4	Non-Supporting
Middle Rouge near Garden City (Inkster Rd.)	US2	525	5.5	Non-Supporting
Middle Rouge at Dearborn Heights (Hines/Ford)	D06	550	5	Non-Supporting
Lower Rouge at Wayne (Wayne Rd.)	L06	321	10	Urban Drainage
Lower Rouge at Inkster (John Daly)	US1	1047	1.7	Impacted

[1]Stream Hydrology Indicator: Overbank Occurs as follows: Supporting (<1.5 times/year); Impacted (1.5 – 3 times per year); Non-Supporting (3 – 7 times per year); Urban Drainage (> 7 times per year)
[2]This stream is considered impacted because of its flashiness based on 15 day and 1 month flows

The Technical Committee and the SWAGs discussed recommendations for targeting storm water runoff volume. Interim and long-term milestones were established based on achieving 1% and 100% of the storm water volume reduction targets needed to attain stable streams (Table 6-5). These targets are correlated to inches of storage across the watershed based on reducing the frequency of the statistical 30-day event by 50%. The quantity of inches over the subwatershed takes into account the size of the subwatershed. This indicates that the Lower 1, Main 1-2, and the Upper subwatersheds and Evans Ditch require the largest amount of reduction per acre.

Table 6-5: Volume Reduction Targets

Subwatershed	Area (ac)	Inches over Subwatershed[1]	Short-Term Volume Target (cf)	Long-Term Volume Target (cf)
Lower 1	39,785	0.362	522,800	52,280,081
Lower 2	21,312	0.284	219,710	21,971,053
Main 1-2	65,891	0.336	803,662	80,366,249
Evans Ditch	5,757	0.319	66,664	6,666,459
Main 3-4	58,451	0.209	443,451	44,345,193
Middle 1	51,589	0.216	404,500	40,450,061
Middle 3	20,727	0.216	162,516	16,251,690
Upper	40,768	0.318	470,603	47,060,317
Total Rouge River Watershed Volume Control Target			**3,093,911**	**309,391,103**

[1]Storage required to halve the frequency of the 30-day event.

Based on the average annual bankfull frequency[2] and the amount of volume reduction needed by subwatershed, the following critical areas were established to address storm water volume in the Rouge:

- Lower 1 SWMA,
- Main 1-2 SWMA, and
- Upper SWMA.

However, with over 309 million cubic feet of storm water reduction needed, reductions in volume and rate of delivery are needed across the entire watershed. As such, green infrastructure installation is a high priority activity for restoring the watershed and every opportunity for green infrastructure utilization/LID should be taken advantage of regardless of its location in the watershed.

As volume control is addressed across the watershed, non-point source pollutants such as sediment, nutrients and, to some extent, fecal coliform are also expected to be reduced. Meeting the long-term volume reduction targets is expected to reduce the coliform, nutrient and sediment loads by 44%, 36% and 39%, respectively. Tables 6-6, 6-7 and 6-8 show the pollutant load reduction associated with the short and long-term volume reduction based on the WMM model.

[2] It is recognized that floods are not necessarily a negative characteristic when there is sufficient floodplain available. Nonetheless, bankfull frequency was used to determine critical areas for flow reduction.

Table 6-6: Estimated Fecal Coliform Pollutant Load Reductions with Volume BMP Achievement

	Current Load from Storm Water	Short-term Volume Reduction	Long-term Volume Reduction	
Subwatershed	(trillion counts/yr)	(trillion counts/yr)	(trillion counts/yr)	% Reduction
Lower 1	1,830	11.27	1,127	62%
Lower 2	1,480	6.33	633	43%
Main 1-2	4,250	19.3	1,930	45%
Main 3-4	677	1.89	189	28%
Middle 1	2,740	12	1,200	44%
Middle 3	2,370	7.5	750	32%
Upper	5,750	25.6	2,560	45%
Watershed Total	**19,097**	**83.89**	**8,389**	**44%**

[1]As compared to current loads.

Table 6-7: Estimated Total Phosphorus Pollutant Load Reductions with Volume BMP Achievement

	Current Load from Storm Water	Short-term Volume Reduction	Long-term Volume Reduction	
Subwatershed	Total (lbs/yr)	Total (lbs/yr)	Total (lbs/yr)	% Reduction
Lower 1	13,868	63	6,284	45%
Lower 2	9,597	36	3,619	38%
Main 1-2	29,286	113	11,341	39%
Main 3-4	13,377	35	3,501	26%
Middle 1	20,653	74	7,380	36%
Middle 3	17,131	48	4,756	28%
Upper	33,773	131	13,146	39%
Watershed Total	**137,685**	**500**	**50,027**	**36%**

[1]As compared to current loads.

Table 6-8: Estimated Total Suspended Solids Pollutant Load Reductions with Volume BMP Achievement

	Current Load from Storm Water	Short-term Volume Reduction	Long-term Volume Reduction	
Subwatershed	(million lbs/yr)	Total (lbs/yr)	(million lbs/yr)	% Reduction
Lower 1	3.50	15,792	1.58	45%
Lower 2	2.09	8,792	0.88	42%
Main 1-2	6.03	26,398	2.64	44%
Main 3-4	4.67	13,660	1.37	29%
Middle 1	5.15	19,945	1.99	39%
Middle 3	4.11	13,110	1.31	32%
Upper	6.48	27,821	2.78	43%
Watershed Total	**32.03**	**125,518**	**12.55**	**39%**

[1]As compared to current loads.

Conclusion

The critical areas were established based on actual bacteria indicator results, the hydraulic modeling within each subwatershed and the non-point source pollutant loading estimates. The modeling demonstrates that a reduction in volume of storm water can result in a significant improvement in water quality. The anticipated volume reductions will move the

watershed towards meeting the desired designated beneficial uses and water quality while meeting the objectives of the TMDLs.

Priority Protection Areas

Priority Protection Areas (PPAs) are those areas of the watershed in which actions are recommended to preserve current conditions or enhance the river. Priority Areas were selected based on contiguous riparian corridors, stream studies, benthic macroinvertebrate sampling, in-stream sampling, and frog and toad surveys. Table 6-9 summarizes the number of PPAs by SWMA, while more detail descriptions follow. The Main 1-2 has the most PPAs at 11. Green infrastructure installation/LID is a high priority activity needed to preserve the PPAs.

The larger PPAs have been mapped in Figure 6-4 along with the critical areas to indicate the areas that should be initially targeted by watershed restoration and preservation efforts.

Table 6-9: Priority Protection Area Summary

	Number of Priority Protection Areas				
SWMA	**Macros**	**Fish**	**Frog/Toad**	**Habitat**	**SWMA Total**
Lower 1	1	0	2	4	**7**
Lower 2	0	0	3	1	**4**
Main 1-2	3	3	1	4	**11**
Main 3-4	0	1	0	2	**3**
Middle 1	2	1	0	3	**6**
Middle 3	1	1	2	2	**6**
Upper	2	2	0	2	**6**
Watershed Total	**9**	**8**	**8**	**18**	**43**

Streambank stabilization at Ford Field in Dearborn

Protection Areas based on Benthic Macroinvertebrates

Historical studies were reviewed, including the Friends of the Rouge Bug Hunt reports, MDEQ benthic studies and known areas with high diversity of benthic macroinvertebrate to compile a list of areas that should be addressed to protect the high quality of the stream in that area (See Chapter 3 for in-depth analysis). The PPAs are as follows:

- Lower 1 Subwatershed:
  - Headwaters of Fowler
- Main 1-2 Subwatershed:
  - Main Branch in the City of Troy
  - Pebble Creek in the City of Southfield
  - Fairway Park in the City of Birmingham
- Middle 1 Subwatershed:
  - Johnson Creek, specifically near Ridge Road
  - Middle Branch between Newburgh Lake and Nankin Lake
- Middle 3 Subwatershed:
  - Downstream of the dam at Newburgh Lake

- Upper Subwatershed:
  - Tarabusi Creek at Eight Mile Road in Livonia
  - Minnow Pond Drain near Farmington Road

Protection Areas based on Fisheries

Historical fisheries studies were reviewed, including MDEQ fish biology studies and known areas with diverse fish populations to compile a list of areas that should be addressed to protect the high quality of the stream in that area (See Chapter 3 for in-depth analysis). The PPAs are as follows:

- Main 1-2 Subwatershed:
  - Franklin Branch
  - Cranbrook Creek
  - Main Branch at Beach Road in Troy
- Main 3-4 Subwatershed:
  - Within the main channel, there are species found here that are found nowhere else in the watershed. The flat, low valley itself provides the conditions necessary for extensive flooding and floodplain development. Indeed most of the riparian land in this district is in public ownership due to its propensity for flooding.
- Middle 1 Subwatershed:
  - Johnson Creek (Coldwater Fishery)
- Middle 3 Subwatershed:
  - Newburgh Lake
- Upper Subwatershed:
  - Minnow Pond Drain
  - Seeley Creek

Protection Areas based on Frog and Toad Monitoring

Historical studies were reviewed, including the Friends of the Rouge Frog and Toad monitoring reports and known areas with high quality wetland habitat to compile a list of areas that should be addressed to protect the high quality of the stream in that area (See Chapter 3 for in-depth analysis). The PPAs are as follows:

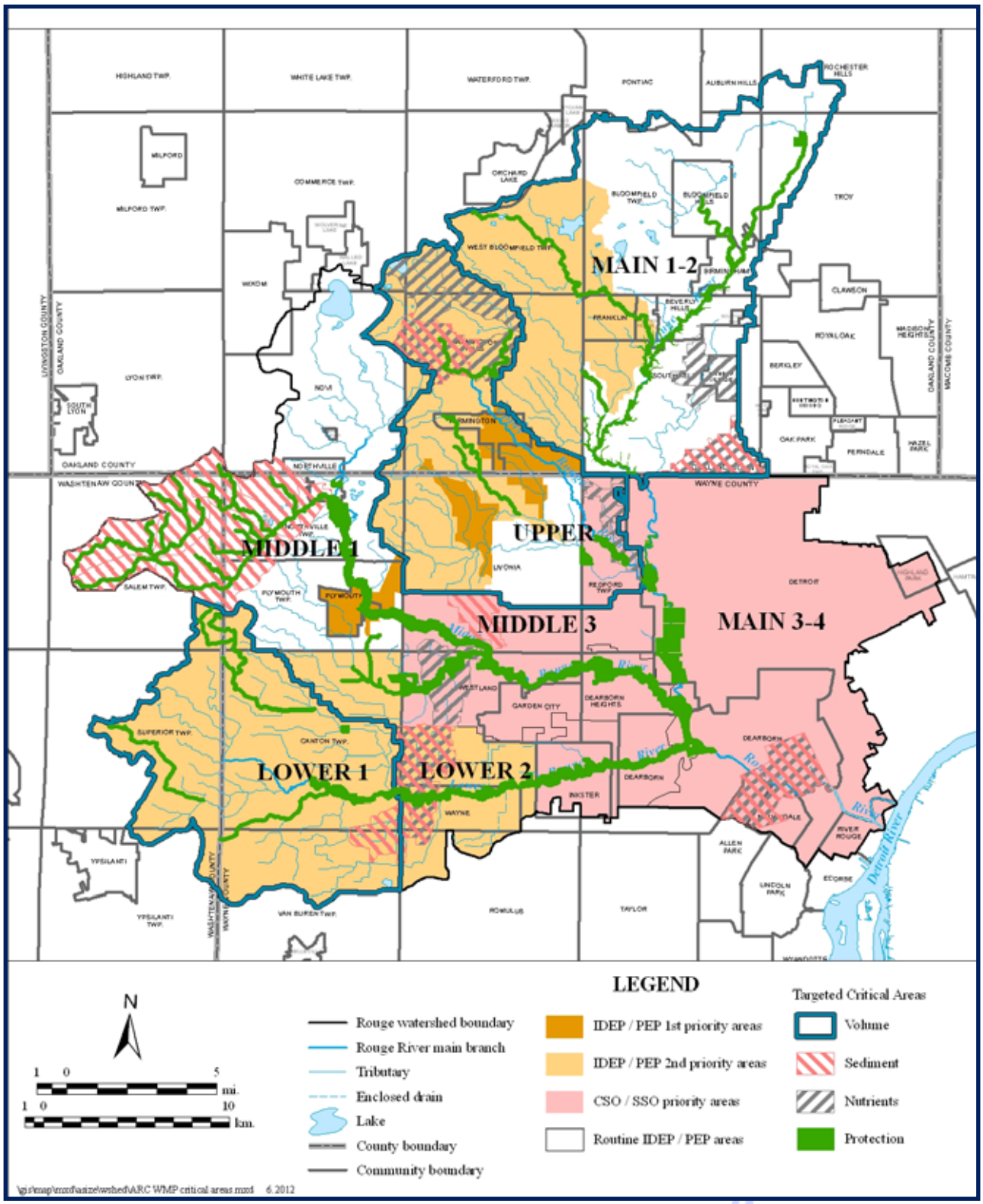
- Lower 1 Subwatershed:
  - Flodin Park
  - Fellows Creek
- Lower 2 Subwatershed:
  - Inkster Wetlands
  - Ford Field Park in Dearborn
  - Dearborn Hills Golf Course
- Main 1-2 Subwatershed:
  - Firefighters Park in Troy
- Middle 3 Subwatershed:
  - Hines Parkway
  - Holliday Nature Preserve

Protection Areas based on Habitat Quality

Historical studies were reviewed, including MDNR/MDEQ reports, Rouge Project studies and known areas with high quality wetland habitat to compile a list of areas that should be addressed to protect the high quality of the stream in that area (See Chapter 3 for in-depth analysis). Due to the importance of the riparian corridor, the contiguous riparian corridors along the primary branches also should be protected. The PPAs are as follows:

- Lower 1 Subwatershed:
  - Fellows Creek upstream of Canton Center Road
  - Fowler Creek
  - Sines Drain
  - Lower Rouge Parkway
- Lower 2 Subwatershed:
  - Lower Rouge Parkway
- Main 1-2 Subwatershed:
  - Franklin Branch
  - Pebble Creek
  - Main Branch of the Rouge
  - Rouge Green Corridor
- Main 3-4 Subwatershed:
  - Eliza Howell Park in Detroit
  - Rouge Park in Detroit
- Middle 1 Subwatershed:
  - Johnson Creek, between Six Mile Road and Beck Road
  - Johnson Creek, the section approximately 1,000 feet upstream of Pickford Avenue to Edenberry Road
  - Hines Drive – Middle Rouge Parkway
- Middle 3 Subwatershed:
  - Tonquish Creek
  - Hines Drive – Middle Rouge Parkway
- Upper Subwatershed:
  - Lola Valley Park
  - Bell Creek Park

Figure 6-4: Priority Protection and Critical Areas for Watershed Actions



Implementation Roadmap

An implementation roadmap helps the users of this plan to understand the general approach with which to implement various best management practices and actions to work towards achieving identified targets in critical areas.

Implementation Sequence & Timeline

This management plan is built upon past successes and the focus for this restoration has evolved towards volume control with targeted areas for reduction and elimination of pathogens. By controlling the rate and amount of storm water reaching the local waterways, non-point source pollution will be reduced dramatically. In addition, by eliminating illicit connections, pathogen conditions will improve.

Below are general categories of BMPs that will help address not only storm water volume and rate control, but also the other pollutants and sources identified in Chapter 4. There are also general and individual projects that will work towards meeting the designated, desired and beneficial uses of the watershed and meet water quality standards. The individual actions, noted below, are broken into short and long timeframes. Short term timeline is considered from 2009-2015 and long term is considered to be from 2015-2035.

Volume Reduction – Subwatershed BMP Scenarios

Since volume reduction is so critical to pollutant load reduction, the ARC developed various scenarios for reducing volume in each SWMA. Each SWAG was given a list of BMPs to choose from as shown in Table 6-10. It should be noted that this list of BMPs is a relatively small subset of the various BMPs that can be implemented. This seemed appropriate for SWAG-level planning. Each subwatershed developed an implementation plan to reduce 1% of the targeted volume (short-term target) within the next three to five years and the long-term target as shown in Tables 6-11 through 6-17.

Table 6-10: Assumptions for each BMP

BMP	Design Assumptions	Storage (cf)		Units
Rain Barrel	55-gallon	7.35	/barrel	55 gal RB
Grow Zone Open Space–GZ	Convert open space to grow zone[1]	453	/ac	Acres
Grow Zone Urban– GZ	Convert urban to grow zone[1]	585	/ac	Acres
Tree Canopy	Canopy interception, 1/2-inch rain[2]	0.02	/sf canopy	Trees (ea)
Rain Garden[3]	6" ponding, 18" planting media, 6" sand	0.98	/sf	Res. RG
Wetland	3" ponding	0.49	/sf	Acres
Vegetated Swale	2' bottom, 1% bottom slope	6,160	/mile	Miles
	6" dam at 75' spacing, both sides			

[1] Per CITYGREEN, with 0.5-inch rainfall
[2] Based on 36% interception rate
[3] Residential Rain Garden Typically 150 sq. ft.

Table 6-11: Lower 1 Subwatershed (Overall goals of 1% and 100%)

		Target Reduction Volume (cf)			
		1% - 522,800		100% - 52.2 Million	
BMP	Units	Quantity	Storage	Quantity	Storage
Rain Barrel	55 gal RB	800	5,880	8,000	58,800
Grow Zone Open Space–GZ	Acres	50	22,650	2,000	906,000
Grow Zone Urban– GZ	Acres	2	1,170	50	29,250
Tree Canopy	Trees (ea)	15,000	6,750	30,000	13,500
Rain Garden[3]	Res. RG	300	44,100	500	73,500
Wetland	Acres	15	320,166	2,300	49,092,120
Vegetated Swale	Miles	20	123,200	500	3,080,000
Total Volume Control (cf)			523,916		53,253,170

Table 6-12: Lower 2 Subwatershed (Overall goals of 1% and 100%)

		Target Reduction Volume (cf)			
		1% - 219,700		100% - 21.9 Million	
BMP	Units	Quantity	Storage	Quantity	Storage
Rain Barrel	55 gal RB	200	1,470	8,000	58,800
Grow Zone Open Space–GZ	Acres	10	4,530	2,000	906,000
Grow Zone Urban– GZ	Acres	0	0	100	58,500
Tree Canopy	Trees (ea)	2,500	1,125	60,000	27,000
Rain Garden[3]	Res. RG	50	7,350	2,000	294,000
Wetland	Acres	10	213,444	700	14,941,080
Vegetated Swale	Miles	2	12,320	1,000	6,160,000
Total Volume Control (cf)			240,239		22,445,380

Table 6-13: Main 1-2 Subwatershed (Overall goals of 1% and 100%)

		Target Reduction Volume (cf)			
		1% - 870,400		100% - 87.1 Million	
BMP	Units	Quantity	Storage	Quantity	Storage
Rain Barrel	55 gal RB	3,000	22,050	10,000	73,500
Grow Zone Open Space–GZ	Acres	250	113,250	5,000	2,265,000
Grow Zone Urban– GZ	Acres	5	2,925	50	29,250
Tree Canopy	Trees (ea)	10,000	4,500	200,000	90,000
Rain Garden[3]	Res. RG	300	44,100	5,000	735,000
Wetland	Acres	28	597,643	3,500	74,705,400
Vegetated Swale	Miles	15	92,400	1,500	9,240,000
Total Volume Control (cf)			876,868		87,138,150

Table 6-14: Main 3-4 Subwatershed (Overall goals of 1% and 100%)

		Target Reduction Volume (cf)			
		1% - 443,350		100% - 44.4 Million	
BMP	Units	Quantity	Storage	Quantity	Storage
Rain Barrel	55 gal RB	500	3,675	10,000	73,500
Grow Zone Open Space–GZ	Acres	100	45,300	3,000	1,359,000
Grow Zone Urban– GZ	Acres	50	29,250	500	292,500
Tree Canopy	Trees (ea)	8,000	3,600	200,000	90,000
Rain Garden[3]	Res. RG	150	22,050	500	73,500
Wetland	Acres	14	298,822	1,800	38,419,920
Vegetated Swale	Miles	10	61,600	1,000	6,160,000
Total Volume Control (cf)			464,297		46,468,420

Table 6-15: Middle 1 Subwatershed (Overall goals of 1% and 100%)

		Target Reduction Volume (cf)			
		1% - 404,500		100% - 40.5 Million	
BMP	Units	Quantity	Storage	Quantity	Storage
Rain Barrel	55 gal RB	500	3,675	8,000	58,800
Grow Zone Open Space–GZ	Acres	50	22,650	1,000	453,000
Grow Zone Urban– GZ	Acres	2	1,170	50	29,250
Tree Canopy	Trees (ea)	8,000	3,600	20,000	9,000
Rain Garden[3]	Res. RG	150	22,050	500	73,500
Wetland	Acres	14	298,822	1,800	38,419,920
Vegetated Swale	Miles	10	61,600	500	3,080,000
Total Volume Control (cf)			413,567		42,123,470

Table 6-16: Middle 3 Subwatershed (Overall goals of 1% and 100%)

		Target Reduction Volume (cf)			
		1% - 162,500		100% - 16.3 Million	
BMP	Units	Quantity	Storage	Quantity	Storage
Rain Barrel	55 gal RB	300	2,205	8,000	58,800
Grow Zone Open Space–GZ	Acres	10	4,530	1,000	453,000
Grow Zone Urban– GZ	Acres	0	0	50	29,250
Tree Canopy	Trees (ea)	1,500	675	30,000	13,500
Rain Garden[3]	Res. RG	150	22,050	1,000	147,000
Wetland	Acres	5	106,722	450	9,604,980
Vegetated Swale	Miles	5	30,800	1,000	6,160,000
Total Volume Control (cf)			166,982		16,466,530

Table 6-17: Upper Subwatershed (Overall goals of 1% and 100%)

		Target Reduction Volume (cf)			
		1% - 470,600		100% - 47.1 Million	
BMP	Units	Quantity	Storage	Quantity	Storage
Rain Barrel	55 gal RB	1,000	7,350	5,000	36,750
Grow Zone Open Space–GZ	Acres	100	45,300	1,000	453,000
Grow Zone Urban– GZ	Acres	5	2,925	50	29,250
Tree Canopy	Trees (ea)	10,000	4,500	100,000	45,000
Rain Garden[3]	Res. RG	200	29,400	2,500	367,500
Wetland	Acres	15	320,166	2,000	42,688,800
Vegetated Swale	Miles	10	61,600	600	3,696,000
Total Volume Control (cf)			471,241		47,316,300

Best Management Practices (BMPs)

Best Management Practices (BMPs) are "structural devices or non-structural practices designed to prevent pollutants from entering into storm water flows, to direct the flow of storm water, or to treat polluted storm water flows" (MDEQ NPDES Wastewater General Permit # MIG610000). According to the Center for Watershed Protection there are over 130 different BMPs that can potentially be used to restore urban subwatersheds. No single BMP addresses all storm water problems and a treatment train is usually the best approach. Each BMP has certain limitations but can be applied effectively based on drainage area served, available land space, cost, pollutant removal efficiency, as well as a variety of site specific factors such as soil types, slopes, depth of groundwater table, etc.

Utilizing the best management practices and potential actions detailed below will help improve water quality and continue progress toward achieving state-designated standards in the Rouge River and its tributaries.

Structural Practices

Structural storm water practices are physical systems that are constructed for a new or existing development that reduce the storm water impact of development. Such systems can range from underground, in-line storage vaults to manage peak flows, to slightly graded swales vegetated with native plants to slow flows as well as treat pollutants. Maintenance is a vital part of continued effectiveness of structural BMPs and each BMP has individual requirements and costs which should be addressed as a part of the planning process. The effect of these physical systems can often be quantitatively measured by monitoring inflow and outflow parameters. Recent studies have suggested certain pollutant removal efficiencies of various BMPs (Table 6-18).

Maintenance is a vital part of continued effectiveness of structural BMPs and each BMP has individual requirements and costs which should be addressed as a part of the planning process.

Table 6-18: Pollutant Removal Efficiencies of Various BMPs (Schueler, 2005)

Storm water Treatment Option	Storm water Pollutant						
	TSS	TP	TN	Metals	Bacteria	Organic Carbon	Oil & Grease
Bioretention/Rain Gardens	⊙	×	○	●	●	⊙	●
Constructed Wetlands	⊙	⊙	○	○	⊙	×	●
Green Roofs	●	⊙	○	⊙	⊙	⊙	●
Grow Zones	●	⊙	○	⊙	⊙	⊙	●
Pervious Pavement	●	⊙	○	●	?	●	●
Vegetated /Bio Swales	●	×	○	⊙	×	⊙	●
Other	Varies						

● Excellent Removal (76-100%) × Low Removal (0-25%) ○ Fair Removal (26-51%)
⊙ Good Removal (51-75%) ? Unknown Removal

Rain garden in Lathrup Village

Table 6-19 uses stream indicators to evaluate the effectiveness of structural BMPs in restoration and improvement efforts.

Table 6-19: Stream Indicators to Evaluate the Effectiveness of Structural BMPs

Structural BMPs	Stream Indicators				
	Stream Hydrology	Physical Alteration of the Stream Corridor	Water Quality	Stream habitat	Aquatic Diversity
Bioretention/Rain Gardens	x		x		
Capture & Reuse	x		x		
Constructed Wetlands/Retention	x	x	x	x	x

Structural BMPs	Stream Indicators				
	Stream Hydrology	Physical Alteration of the Stream Corridor	Water Quality	Stream habitat	Aquatic Diversity
Dam Modification				x	x
Green Roofs	x		x		
Grow Zones	x	x	x		
Habitat Creation & Enhancement		x		x	x
Pervious Pavement	x		x		
Storm Water Retrofit Practices	x		x		
Stream Repair & Protection		x	x	x	x
Tree Planting	x	x	x	x	x
Vegetated/Bio Swales	x		x		

Bioretention/Rain Gardens

Bioretention areas or rain gardens are shallow surface depressions planted with specifically selected native vegetation to capture and treat storm water runoff from rooftops, streets and parking lots. Bioretention areas can be used to manage a small amount of storm water runoff from a residential roof or large area such as a parking lot. This BMP has many benefits including volume control through vegetative transpiration (uptake) and infiltration. Other benefits include water quality improvements from filtration through the vegetation and soil, habitat creation, and site aesthetics enhancement.

Cistern in Livonia

Capture & Reuse (Rain Barrels/Cisterns)

Rain barrels, cisterns, and storage tanks are all structures that capture storm water for the purpose of reuse. Rain barrels are well suited for residential lots, while cisterns and other large storage tanks are more appropriate for commercial/industrial sites. Captured water can be re-used for a variety of applications including irrigation and gray water uses in buildings. Additional uses may be appropriate with proper treatment. Capture and reuse of storm water greatly improves water quality through reducing the amount of volume and pollution entering the waterways. Additionally, reuse of storm water reduces use of potable water.

Oxbow at The Henry Ford

Constructed Wetlands/Retention

A constructed wetland is a manmade wetland with over 50% of its surface area covered by wetland vegetation. It is ideal for large, regional tributary areas where volume control is needed. Wetlands provide hydrological restoration benefits. Volume reductions are primarily achieved through evapotranspiration. Constructed wetlands are designed to remove contaminants from storm water such as oils, pesticides, nutrients, fertilizers, or animal wastes. Constructed wetlands also provide an opportunity to

Green roof at Ford Rouge Plant

create or restore valuable wetland habitat for wildlife and environmental enhancement.

Dam Modification or Removal

Dams can cause a number of negative impairments to the watershed including increased water temperatures, reduced or zero flows during dry periods and limited access to upstream habitat for fish species. A number of dam modifications can be implemented to mitigate and/or eliminate the negative impact. These improvements include dam removal, construction of suitable fish passageways, operational adjustments during periods of low flow and modification of the dam to allow for a cool water discharge (bottom draw).

Green Roofs

Green roofs are rooftops that are partially or completely covered with vegetation and soil or a growing media, planted over a waterproof membrane, thus allowing the roof to function more like a vegetated surface providing transpiration, filtration, etc. Green roofs are not common for residential homes; however, schools, libraries, and commercial or industrial buildings are perfect candidates for installation. Flat roofs are preferred, but green roofs can be installed on pitched roofs when designed accordingly. In addition to storm water volume control, green roofs have many other environmental benefits including reduced heating and cooling costs, increased roof lifespan, heat island reduction and habitat enhancement. Green roofs can also be used as an educational tool or sightseeing attraction.

Grow zone at Bennett Arboretum in Northville Township

Grow Zones

A grow zone is an upland and/or riparian native planting area implemented to reduce storm water volume, improve water quality and enhance wildlife habitat. Grow zones can be implemented in a variety of areas but ideal locations are in parks, riparian corridors and other areas that are currently maintained as mowed lawn but not used. Grow zones help reduce storm water volume runoff through enhanced infiltration associated with deep-rooted native vegetation and transpiration (uptake) of the plants. Conversion of traditional turf grass or impervious surfaces to grow zones provides a noticeable reduction in storm water runoff. Water quality is further improved because fertilizers and herbicides are not needed to maintain a native grow zone, thus reducing pollutant loading to the watershed. Native grow zones also create habitat, food and shelter for wildlife that live on the land or in the water.

Swirl concentrator at Dearborn DPW yard

Habitat Creation & Enhancement

Wildlife and habitat enhancement can be implemented in many areas such as uplands, riparian areas or in streams, lakes and rivers. It can be implemented on any size parcel of land whether it is acres in the country, an average-sized suburban yard, or a tiny plot in the city. Enhancement projects protect the environment, add beauty to the surroundings. Any

manipulation of habitat that improves its value and ability to meet specified requirements of one or more species is a benefit to the watershed.

Pervious Pavement

Pervious pavements, including concrete, asphalt and pavers, promote storm water infiltration and ground water recharge. Pervious pavement is well suited for parking lots, walking paths, sidewalks, playgrounds, plazas, tennis courts, and parking lanes. Storm water drains through the permeable surface where it is temporarily held in the voids of a stone bed or other storage reservoir and then slowly infiltrates into the underlying substrate or soil.

Storm Water Retrofit Practices

Storm water retrofits are structural practices that can remove and/or treat storm water pollutants, minimize channel erosion, and help restore stream hydrology. Typical storm water retrofits include updating detention basins to promote infiltration, filtration and potential habitat enhancement, installing catch basins inserts/ proprietary storm water quality enhancement structures/oil-water separators to help treat storm water and general updating of existing storm water practices. Storm water retrofit practices that specifically address volume control are those that promote infiltration and/or retention. Other practices would be considered Quality Control BMPs.

Goal of Hydrologic Analysis assess watershed and stream stability so that proposed solutions will:

- ***address the cause (improve flow regime),***
- ***not move the problem to another location, and***
- ***be permanent***

(Fongers, MDEQ)

Stream Repair & Protection Practices

Stream repair practices include a large group of techniques used to enhance the appearance, structure and/or function of streams. These practices range from simple stream cleanups and basic stream repairs to extremely sophisticated stream restoration techniques. Stream cleanups such as removal of trash, litter or rubble are often cosmetic and temporary, however, they are extremely effective tools for involving and educating the public. Stream repair techniques, such as hard/soft bank stabilization, grade control, flow deflection, habitat enhancement, or fish barrier removal, are typically limited by their in-stream location, and may treat the immediate problem but not the underlying cause of the problem. In some cases, streambank erosion is a natural stream process that is not caused by human influence and is not causing stream impairment. Unnatural or excessive erosion is often the result of changes in the flow regime of a river associated with increases in storm water runoff from the contributing watershed. Attempts to correct excessive erosion without addressing the underlying cause will not be successful in the long run. Prior to implementing significant streambank restoration projects an analysis of hydrology/morphology, including a site-specific analysis of the cause and magnitude of the problems should be completed.

Tree Planting

Tree canopy and forest cover has been shown to reduce storm water runoff through interception and reduced surface runoff rates compared to un-

wooded areas. In addition to storm water volume reduction, trees improve air and water quality, provide habitat and enhance aesthetics. While planting additional trees improves the environment, preserving trees is equally or more important as they are already established and in the case of trees . . . the bigger the better.

Vegetated/Bioswales

A vegetative or bioswale is a shallow storm water channel that is densely planted with a variety of grasses, shrubs, and/or trees designed to slow, filter, and infiltrate storm water runoff. Check dams can be used to improve performance and maximize infiltration, especially in steeper areas. Vegetated swales typically treat runoff from highly impervious surfaces such as roadways and parking lots. There are many benefits to a vegetated swale including storm water filtration and infiltration, and reduction of traditional curb/gutter costs.

Non-Structural Practices

Non-structural practices include managerial, educational, regulatory and vegetative practices designed to prevent pollutants from entering storm water runoff or reduce the volume of storm water requiring management. These practices include education programs, public involvement programs, land use planning, natural resource protection, regulations, operation and maintenance or any other initiative that does not involve designing and building a physical storm water management mechanism. Although most of these non-structural practices are difficult to measure quantitatively in terms of overall pollutant reduction and other storm water parameters, research demonstrates that these practices have a large impact on changing policy, enforcing protection standards, improving operating procedures and changing public awareness and behaviors to improve water quality and quantity in a watershed over the long term.

Animal Waste Management

Animal waste in urbanized watersheds is caused by wildlife such as raccoons, geese and deer, to domestic pets such as dogs and cats, to agricultural animals such as horses, cows and pigs. There are a variety of activities that can help reduce urbanized animal waste including dog waste stations, vegetative barriers around detention ponds and adjacent to streams, signs that dissuade the public from feeding waterfowl and educational pamphlets.

Discharge Prevention Practices

Discharge prevention practices prevent sewage and other pollutants from entering the stream from illicit discharges, illicit connections, sewer overflows, failing septic systems and industrial/transport spills. These practices can include, but are not limited to, outfall inspection, environmental hotline and citizen reporting, equalization basins, sanitary sewer inspection/maintenance, failing septic system identification and repair.

Financial Programs

Integrating storm water management programs into the daily procedures of a community can incur new costs. In many cases, communities and agencies will need to explore creative solutions to finance new staff, new programs, or new commitments. Grants may be available, often with a local match involved, but these are short term solutions for one-time projects. Long terms solutions that have been tested in other areas include the following: implementing a storm water utility fee incurred by users of the storm water system; assess fees for impervious cover; give credits to fees if private detention/retention practices exist; assess a one-time septic system installation fee and/or establish forest and wetland mitigation banking system.

Regional Relationships

Local government, non-profit organizations, educational institutions and others can work together to reduce the individual costs of restoring the resource. Such relationships include:

- Participation in a watershed alliance comprised of local and county governments working to improve a local watershed.
- Committees comprised of a variety of stakeholders, such as government, non-profit organizations, stewardship groups, educational institutions, consultants, and others focused on a specific initiative, such as education, to address storm water pollution.
- Partnerships between neighboring communities, between local government and residents or local and county governments that reduce costs of programs or initiatives.
- Committees or commissions that serve in an advisory capacity to local governments, educational institutions, stewardship groups or other organizations and work to publicize water resource activities or initiatives.

ARC meeting

Municipal Good Housekeeping Practices and Programs

The Center for Watershed Protection Manual 9 – Municipal Pollution Prevention identifies ten main practice areas and programs to improve the health of the watershed (Novotney and Winer, 2008) as:

1. Management of Facilities such as composting/recycling facilities, public works yards, or wastewater treatment plants (i.e. Hotspots)
2. Construction Project Management
3. Street Repair and Maintenance
4. Street Sweeping
5. Storm Drain Maintenance
6. Storm Water Hotline Response
7. Park and Landscape Maintenance
8. Residential Stewardship
9. Storm Water Management Practice Maintenance
10. Employee Training

Street sweeping in Livonia

Table 6-20 associates these practice areas and programs with storm water pollutant removal.

Table 6-20: Storm Water Pollutant Removal Associated with Municipal Operations

Municipal Operation	Sediment	Nutrients	Hydro-Carbons
Hotspot Facility Management	●	●	●
Construction Project Management	●	⊙	⊙
Street Repair and Maintenance	●	⊙	●
Street Sweeping	●	○	⊙
Storm Drain Maintenance	⊙	○	○
Storm Water Hotline Response	●	○	●
Park and Landscape Maintenance	⊙	●	○
Residential Stewardship	○	●	⊙
Storm Water Management Practice Maintenance	⊙	⊙	○
Employee Training	●	⊙	●

●Frequently associated with operation ⊙ infrequently associated with operation
○ rarely associated with operation

These practice areas and programs are also captured under the State of Michigan Department of Environmental Quality National Pollutant Discharge Elimination System Wastewater Discharge General Permit MIG610000 Storm Water Discharges From Municipal Separate Storm Sewer Systems (MS4s).

Non-Point Source Education

Non-point source education programs educate stakeholders about river-friendly practices that reduce or prevent storm water pollution from entering local rivers and streams. Focus audiences for these BMPs are: homeowners, local governments, riparian landowners, lake and home associations, commercial lawn care businesses, business and industry, and educational institutions, such as schools and universities. Preventing pollutants from reaching the river system is far more cost-effective than waiting until restoration or clean-up is required. Public education and involvement activities are meant to teach people about the watershed, promote partnerships focused on restoring the resource, or highlight practices that improve the waterway. Public education and involvement programs can include the following activities:

- Stream stewardship programs: trained citizen volunteers conduct benthic macroinvertebrate sampling, frog and toad surveys, invasive plant removal, woody debris management, river clean-ups, and/or planting native buffers or grow zones.
- Public education materials: newsletters, fact sheets, brochures and posters that target specific practices or activities.
- Residential programs: storm drain stenciling or marking; healthy lawn and garden techniques, rain barrel installation and/or grow zone planting, household hazardous waste collection programs.
- Presentations: displays, workshops, ongoing programming at nature centers, participation in established community events

- Schools education: water sampling programs, poster or calendar contests, water festivals, water resource-related curriculum, schoolyard habitats, facility tours.
- Targeted advertising: public service announcements, newspaper advertising, local cable/radio advertising, placemats.
- Giveaways: magnets, bags, tip cards.

Ordinance Updates

Local ordinances, including storm water management ordinances, natural features ordinances, wetland ordinances, woodland ordinances and/or landscaping and zoning ordinances can easily be updated to promote the goals of the watershed management plan. Storm water ordinances can be updated to require volume control (infiltration) for new and redevelopments. Wetland, woodland and natural features ordinances can be created and/or updated to provide protection for existing wetlands, woodlands, riparian buffers and other valuable natural features. Landscaping ordinances can be updated to allow for and/or promote planting of native vegetation. Zoning ordinances can be updated to allow for cluster developments, reduced setbacks, reduced parking and road widths and other low impact development techniques.

Visteon trail in Van Buren Township

Recreational Enhancement & Access

In order to encourage public awareness and concern for rivers, streams and wetlands, it is important to increase opportunities for people to access these water resources. If provided with aesthetically pleasing, accessible and well-advertised recreational areas - be it a canoe livery, a fishing pier, or a trail system – the public will be able to experience the benefits that the waterway offers and in turn, may want to work to protect the resource.

Riparian & Upland Management

A riparian buffer is the area of land that exists between low, aquatic areas such as rivers, streams, lakes, ponds, and wetlands and upland areas that are the higher, dry areas such as forests, farms, cities, and suburbs. Unaltered riparian buffers may exist as various types of floodplain forest or wetland ecosystems. A riparian buffer can be designed to intercept surface runoff and subsurface flow from upland sources for the purpose of removing or buffering the effects of associated nutrients, sediment, organic matter, pesticides, and other pollutants prior to entry into surface waters and groundwater recharge areas.

Riparian and upland management practices not only include preserving and planting buffers with native vegetations but also the removal/prevention of dumping, invasive species control, and habitat enhancement areas. Each management project should be designed to address the unique stresses and disturbances that occur within the urban watershed and maximize storm water infiltration and subsequent pollutant removal. Center for Watershed Protection Manual 5 – Riparian Management Practices offer detailed guidance on these techniques.

Rouge Rescue volunteers in Redford Township

Storm Water Retrofit Analysis

A storm water retrofit analysis allows a subwatershed and/or community to identify and prioritize opportunities for meeting storm water volume reduction goals. The Center for Watershed Protection's *Urban Subwatershed Restoration Manual 3:Urban Storm water Retrofit Practices* outlines a procedure for completing a comprehensive storm water retrofit analysis. Opportunities for improvements to existing storm water management facilities construction of new facilities are considered for both larger regional storage facilities and smaller, on-site facilities. The analysis includes a retrofit scoping to confirm the local restoration objectives; a desktop analysis to identify potential retrofit sites; an investigation of the feasibility retrofit sites in the field; development of initial concepts for feasible retrofits; evaluation and ranking of the feasible retrofits; and a subwatershed treatment analysis to determine how implementation of the selected retrofits meet the restoration objectives. Table 6-21 identifies which BMPs directly address the approved watershed TMDLs.

Table 6-21: Best Management Practices Correlated to Approved TMDLs

	BMP	*E. coli* (Watershed-wide)	Biota (Watershed-wide)	DO (Watershed-wide)
Structural BMPs	Bioretention/Rain Gardens	X	X	X
	Capture & Reuse (Rain Barrels/Cisterns)		X	X
	Constructed Wetlands/Retention	X	X	X
	Dam Modification			
	Green Roofs		X	
	Grow Zones	X	X	X
	Habitat Creation & Enhancement		X	X
	Pervious Pavement	X	X	X
	Storm Water Retrofit Practices	X	X	X
	Stream Repair & Protection Practices		X	X
	Tree Planting	X	X	X
	Vegetated/Bioswales	X	X	X
Non-Structural BMPs	Animal Waste Management	X		
	Discharge Prevention Practices (ARC IDEP/TMDL Plan)	X		
	Financial Programs	X	X	X
	Institutional Relationships	X	X	X
	Municipal Good Housekeeping Practices and Programs	X	X	X
	Non-Point Source Education	X	X	X
	Ordinance Updates	X	X	X
	Recreational Enhancement & Access			
	Riparian & Upland Management	X	X	X
	Storm Water Retrofit Analysis	X	X	X

Table 6-22 presents a compilation of recommended BMPS corresponding to the applicable watershed goals and objectives.

Table 6-22 Best Management Practices Correlated to Goals and Objectives

Goal 1 – Reduce sources of pollutions that threaten public health.
This goal strives to continue to address sources of pathogens and bacteria in the river and its tributaries while also supporting actions to the Rouge River E. *coli* TMDL (MDEQ, 2007).

a. Continue to address remaining SSOs & CSOs. (Middle 1/Lower 1 – N/A)
b. Continue to prevent, identify and eliminate illicit discharges & illicit connections
c. Work to reduce non-point source pollution.
d. Improve water quality

	BMP	1a. SSO/CSO	1b. Illicit Discharge/ Connections	1c. Reduce NPS	1d. Improve Water Quality
Structural BMPs	Bioretention/Rain Gardens	X		X	X
	Capture & Reuse (Rain Barrels/Cisterns)	X		X	X
	Constructed Wetlands/Retention	X		X	X
	Dam Modification				X
	Green Roofs	X		X	X
	Grow Zones	X		X	X
	Habitat Creation & Enhancement				X
	Pervious Pavement	X		X	X
	Storm Water Retrofit Practices	X		X	X
	Stream Repair & Protection Practices				X
	Tree Planting	X		X	X
	Vegetated/Bio Swales	X		X	X
Non-Structural BMPs	Animal Waste Management			X	X
	Discharge Prevention Practices (ARC IDEP/TMDL Plan)	X	X		X
	Financial Programs	X	X	X	X
	Institutional Relationships				X
	Municipal Good Housekeeping Practices and Programs			X	X
	Non-Point Source Education			X	X
	Ordinance Updates			X	X
	Recreational Enhancement & Access				X
	Riparian & Upland Management			X	X
	Storm Water Retrofit Analysis			X	X

Goal 2 - Reduce runoff impacts through sustainable storm water management strategies and programs.

A primary focus for watershed planning is to address impacts from non-point source pollution. The amount or volume of urban storm water runoff, combined with storm water flow rates and non-point source pollution comprise the focus of this goal.

a. Implement measures to effectively manage storm water volume and flow rates.
b. Work to reduce water quality impacts from urban storm water runoff.

	BMP	2a. Manage storm water volume & flows	2b. Improve storm water quality
Structural BMPs	Bioretention/Rain Gardens	X	X
	Capture & Reuse (Rain Barrels/Cisterns)	X	X
	Constructed Wetlands/Retention	X	X
	Dam Modification		
	Green Roofs	X	X
	Grow Zones	X	X
	Habitat Creation & Enhancement		
	Pervious Pavement	X	X
	Storm Water Retrofit Practices	X	X
	Stream Repair & Protection Practices		X
	Tree Planting	X	X
	Vegetated/Bio Swales	X	X
Non-Structural BMPs	Animal Waste Management		X
	Discharge Prevention Practices (ARC IDEP/TMDL Plan)		X
	Financial Programs	X	X
	Institutional Relationships	X	X
	Municipal Good Housekeeping Practices and Programs	X	X
	Non-Point Source Education	X	X
	Ordinance Updates	X	X
	Recreational Enhancement & Access		
	Riparian & Upland Management		X
	Storm Water Retrofit Analysis	X	X

Goal 3 - Inform and educate the public to become watershed stewards.
Improving the public's understanding of their role as watershed stewards is critical to long-term watershed restoration. The previous goal focuses on storm water pollution, storm water volume and storm water flow rates. Restoration and water quality improvements will not be realized without participation from watershed residents and business owners. Thus the objectives are further defined as follows:

a. Continue to conduct public education and participation programs.
b. Collaborate with Rouge River watershed stakeholder groups on stewardship activities.

	BMP	3a. Public education & participation	3b. Collaborative stewardship
Structural BMPs	Bioretention/Rain Gardens	X	X
	Capture & Reuse (Rain Barrels/Cisterns)	X	
	Constructed Wetlands/Retention	X	
	Dam Modification		
	Green Roofs		
	Grow Zones	X	X
	Habitat Creation & Enhancement		
	Pervious Pavement		
	Storm Water Retrofit Practices		
	Stream Repair & Protection Practices		
	Tree Planting	X	X
	Vegetated/Bio Swales		
Non-Structural BMPs	Animal Waste Management	X	
	Discharge Prevention Practices (ARC IDEP/TMDL Plan)		
	Financial Programs	X	X
	Institutional Relationships	X	X
	Municipal Good Housekeeping Practices and Programs		
	Non-Point Source Education	X	X
	Ordinance Updates		
	Recreational Enhancement & Access	X	X
	Riparian & Upland Management	X	X
	Storm Water Retrofit Analysis		

Goal 4 - Protect, restore and/or enhance natural features to maintain/improve river and watershed ecosystems.

While addressing storm water quality, volume and flow rates is a primary goal, minimizing these impacts can be realized by maintaining and enhancing natural features, such as wetlands, woodlands and riparian corridors to improve the urban stream indicators. These indicators were described at length in the previous chapters, including stream hydrology, water quality, stream habitat, aquatic and fish diversity and stream corridor conditions. Objective associated with this goal include the following:

a. Implement measures to protect natural features and watershed ecosystems.
b. Work to enhance or restore green infrastructure and watershed ecosystems
c. Restore or maintain aesthetically appealing conditions.

	BMP	4a. Implement protection measures	4b. Enhance or restore ecosystems	4c. Improve aesthetics
Structural BMPs	Bioretention/Rain Gardens	X	X	X
	Capture & Reuse (Rain Barrels/Cisterns)	X		
	Constructed Wetlands/Retention	X	X	X
	Dam Modification		X	
	Green Roofs	X	X	
	Grow Zones	X	X	X
	Habitat Creation & Enhancement	X	X	X
	Pervious Pavement	X		
	Storm Water Retrofit Practices	X	X	X
	Stream Repair & Protection Practices		X	X
	Tree Planting	X	X	X
	Vegetated/Bio Swales	X	X	
Non-Structural BMPs	Animal Waste Management	X		X
	Discharge Prevention Practices (ARC IDEP/TMDL Plan)			
	Financial Programs	X	X	X
	Institutional Relationships	X		
	Municipal Good Housekeeping Practices and Programs			
	Non-Point Source Education	X		
	Ordinance Updates	X		
	Recreational Enhancement & Access	X	X	X
	Riparian & Upland Management	X	X	X
	Storm Water Retrofit Analysis		X	X

Goal 5 - Maximize community assets related to the watershed.
Community assets are commonly referred to as recreational opportunities, both active and passive, but which are connected to the environment and the Rouge River. As the ARC and watershed stewards strive for improvements across the watershed, it's the connection to the river that attracts residents and visitors to the river and other natural features. Objectives include the following:

a. Promote and enhance the amount and quality of recreational opportunities.
b. Educate the public about the connection between river stewardship and recreational opportunities.

	BMP	5a. Promote, enhance and increase recreational opportunities	5b. River stewardship education
Structural BMPs	Bioretention/Rain Gardens		X
	Capture & Reuse (Rain Barrels/Cisterns)		
	Constructed Wetlands/Retention		
	Dam Modification		
	Green Roofs		
	Grow Zones	X	X
	Habitat Creation & Enhancement		
	Pervious Pavement		
	Storm Water Retrofit Practices		
	Stream Repair & Protection Practices		
	Tree Planting	X	X
	Vegetated/Bio Swales		
Non-Structural BMPs	Animal Waste Management		
	Discharge Prevention Practices (ARC IDEP/TMDL Plan)		
	Financial Programs		
	Institutional Relationships	X	X
	Municipal Good Housekeeping Practices and Programs		
	Non-Point Source Education		X
	Ordinance Updates		
	Recreational Enhancement & Access	X	X
	Riparian & Upland Management	X	X
	Storm Water Retrofit Analysis		

Goal 6 - Support institutional relationships for the implementation of the management plan.
This goal is representative of the ongoing institutional arrangement of the Alliance of Rouge Communities. Objectives supporting these ongoing relationships include the following:

a. Investigate financing and incentive programs to support local storm water management.
b. Maximize the use of resources through a collaborative effort so that standards, ideas, and programs are shared.
c. Educate the public about the connection between watershed health and economic sustainability.

	BMP	6a. Investigate financing and incentives	6b. Collaboration	6c. Public Education
Structural BMPs	Bioretention/Rain Gardens			
	Capture & Reuse (Rain Barrels/Cisterns)			
	Constructed Wetlands/Retention			
	Dam Modification			
	Green Roofs			
	Grow Zones			
	Habitat Creation & Enhancement			
	Pervious Pavement			
	Storm Water Retrofit Practices			
	Stream Repair & Protection Practices			
	Tree Planting			
	Vegetated/Bio Swales			
Non-Structural BMPs	Animal Waste Management			
	Discharge Prevention Practices (ARC IDEP/TMDL Plan)			
	Financial Programs	X	X	X
	Institutional Relationships	X	X	X
	Municipal Good Housekeeping Practices and Programs			
	Non-Point Source Education		X	X
	Ordinance Updates			
	Recreational Enhancement & Access			
	Riparian & Upland Management			
	Storm Water Retrofit Analysis			

Recommended Implementation Actions

In addition to volume reduction initiatives already discussed, specific actions designed to work towards achieving the identified pollutant targets across the Rouge River Watershed are presented in Table 6-23 through 6-31. This table identifies watershed-wide collaborative approaches and actions as well as subwatershed and community specific priorities. These actions are intended to represent the types of BMPs previously described, but with specific areas identified as the initial priorities for the watershed. A priority ranking is based on the project readiness, critical areas and pollutant priority (bacteria, flow/volume, sediment, and nutrients) of the watershed. All actions identified in the table represent potential projects towards achieving the goals and objectives of this plan and are not commitments by any community for implementation. The studies/plans already completed and referenced in the below actions may be found in Appendix D.

Table 6-23: Overall Rouge River Watershed Actions

Overall Rouge River Watershed Action	Goal	Cost (if available)	Stakeholders	Timeline	Priority	Indicator
SSO Corrective Action Plans & Permits						
CSO Corrective Actions & Permits						
County-Based Complaint Response			ARC, Communities, counties			
Rouge Collaborative IDEP & Toxic Material Collections		1.2 Million	ARC, Communities, Counties			
County-Based Advanced Investigations			ARC, Communities, Counties			
Staff Training			ARC, Communities, Counties			
Minimize Seepage from Sanitary Sewers			ARC, Communities, Counties			
Minimize OSDS			ARC, Communities, Counties			
Inspection of ARC Member Owned Facilities			ARC, Communities, Counties			
Visual Inspection During Routine Field Investigations			ARC, Communities, Counties			
Point of Storm Water Discharge - Dry Weather Survey			ARC, Communities, Counties			
Map of Storm Water Discharge Points to Waters of the State			ARC, Communities, Counties			
Unique Method to Evaluate IDEP Effectiveness			ARC, Communities, Counties			
IDEP Volunteer Training	1	$150,000/year	ARC, Communities, Counties	Short	High	Number of volunteers trained
Distribute pollution prevention literature (coordinated procurement)	1-4	$20,000/year	ARC, Communities, Counties, Stewardship Groups	Short	High	Number of pieces distributed
Rouge GI/LID Education Campaign	1-5	1.0 Million	ARC, Communities, Counties	Short	High	Number of education events, Number of projects
Coordinated Community Newsletter Articles & Ads (Graphics)	1-6	$5,000 (annual)	ARC, Communities, Counties, Stewardship Groups	Short	High	Number of articles
Displays - Events & Static	1-6	$10,000	ARC, Communities, Counties, Stewardship Groups	Short	High	Content of display and locations used
Environmental Hotline Promotion	1-6	$110,000	ARC, Communities, Counties, Stewardship Groups	Short	High	Number of brochures
Advertisements	1-6	$150,000/year	ARC, Communities, Counties, Stewardship Groups	Medium	High	Ads and locations
Fertilizer Point of Sale	1-4	$50,000/year	ARC, Communities, Counties, Stewardship Groups	Short	High	Number of stores participating
Workshops & Projects - GZ Sites	2-5	$100,000/year	ARC, Communities, Counties, Stewardship Groups	Ongoing	High	Number of workshops; number of participants

Rain Barrel Sales	2-4	$2,000/event	ARC, Communities, Counties, Stewardship Groups	Ongoing	High	Number of rain barrels sold
Green Schools Activities	1-4	$75,000/year	ARC, Communities, Counties, Stewardship Groups	Ongoing	High	Number of participating schools
Value of Trees Campaign	1-5	$5,000/year	ARC, Communities, Counties, Stewardship Groups	Ongoing	High	Number of flyers; Number of seedlings/trees distributed
Technical Advisory Committees	1-4, 6	$18,000/year	ARC, Communities, Counties, Stewardship Groups	Ongoing	High	Number of meetings
Volunteer Monitoring - Benthics	1-5	$80,000/year	ARC, Communities, Counties, Stewardship Groups	Ongoing	High	Number of sites; number of Exc.-Good scores
Volunteer Monitoring - Frog & Toad	1-5	$40,000 a year	ARC, Communities, Counties, Stewardship Groups	Ongoing	High	Number of volunteers trained; number of species
System Labeling/Signage	1-6	$40 a sign	ARC, Communities, Counties, Stewardship Groups	Ongoing	High	Number of signs
ARC Public Involvement and Education Committee Coordination	3,6	$17,000/year	ARC, Communities, Counties, Stewardship Groups	Ongoing	High	Number of participants
SE Michigan Partners Coordination	1-6	$20,000	ARC, Communities, Counties, Stewardship Groups	Ongoing	High	Number of participants
Green Infrastructure Implementation Projects	1-6	50 Million	ARC, Communities, Counties	Ongoing	High	Number of sites; amount of storm water treated
Animal Waste Management	1-5	$500 - $15,000	Communities, Counties, Stewardship Groups, Public/Private Stakeholders	Short	Medium / High	No. of pet waste stations; signage
Green infrastructure assessment/visioning and implementation to address volume storage.	1-6	$5,000-5 Million	ARC, Communities, Counties, Stewardship Groups	Short	High	Preliminary GI plan
Storm Water Retrofit Analysis	1-4	$200,000	ARC, Communities, Counties	Short	Medium	Preliminary plan
Storm Water Retrofit Practices	1-4	$5,000 - $500,000	Communities, Counties	Mid	Medium	Number and type of retrofits
Rouge Green Corridor Networking/Initiative	1-6	$250,000	Communities, Counties, Stewardship Groups, Public/Private Stakeholders	Long	Medium	Number of participants and projects
Riparian & Upland Management	1-5	$3,000 - $50,000	Communities, Counties, Stewardship Groups, Public/Private Stakeholders	Short	High	Number of sites
Stream Repair & Protection	1-5	$3,000 – 2 Million	Communities, Counties, Stewardship Groups	Long	Low / Medium	Number of sites
General Facilitation	6	$160,000	ARC	Ongoing	High	Number of participants
Website maintenance	1-6	$7,000/year	ARC	Ongoing	High	Number of hits
Watershed Data maintenance	1-6	$10,000	ARC	Ongoing	High	N/A
Annual Report Development System & Sections	1-6	$10,000	ARC	Annually	High	Final report

Grant Writing	1-6	$20,000/year	ARC	Ongoing	High	Number of grants written; number of grants received
Collaborative Action Plan	1-6	$100,000	ARC	Short	High	Final plan
Regional Relationships	6	Various	All	Short	High	Number of participants and projects
Financial Programs	6	Various	All	Short	Medium / High	Report
Ordinance Update	1-6	$5,000-$50,000	Communities, Counties	Short	Medium / High	Updated Ordinances
Recreational Enhancement & Access	4	$5,000 – 5 Million	Communities, Counties, Stewardship Groups, Public/Private Stakeholders	Mid	Medium	Report
Planning & Reporting	6	$20,000	ARC	Ongoing	High	Report
Physical Monitoring	1-6	$77,000	ARC	Ongoing	High	WQ results
Biological Monitoring	1-6	$100,000	ARC	Ongoing	High	Numbers of bugs, frogs and toads
Water Quality/Chemistry Monitoring	1-6	$77,000	ARC	Ongoing	High	WQ results
Public Education/Involvement	1-6	$150,000/year	ARC	Ongoing	High	Report of activities
Pollution Prevention/Restoration Projects	1-6	Various	ARC	Ongoing	High	No. of projects
Monitoring Activities (FOTR, RPO, Green Infrastructure & Impervious Mapping)	1-6	$150,000	ARC	Short	High	Report of activities
Formally Assess Removal - Fish Consumption Advisory	1-5	Unknown	MDNRE	Short	High	Advisory updates
Formally Assess Removal - Fish Deformities BUI	1-5	Unknown	MDNRE	Short	High	BUI Delisted
Formally Assess Removal - Restrictions on Dredging BUI	1-5	Unknown	MDNRE	Short	High	BUI Delisted
Assess Aesthetic BUI Removal Criteria	1-5	Unknown	MDNRE	Short	High	BUI Delisting Criteria
Rouge Fish Community Assessment	1-5	Unknown	MDNRE	Short	High	Completed assessment
Rouge Green Corridor Land Acquisition Planning	4,5	1 Million	ARC, Communities, Counties	Medium	Medium	Acres acquired
Rouge Green Corridor Maintenance Planning and Programs	4,5	200,000	ARC, Communities, Counties	Medium	Medium	Maintenance Plan and program
Flow Monitoring at Lake Level Structures	1-6	$270,000	ARC, Communities, Counties	Medium	Medium	Results
Rouge River Supplemental Watershed Study (USACE, 2008)	1-6	$400,000	USACE, Communities, Counties	Short	Medium	Completed study
Rouge River Clean-Up/ Rouge Rescue	1-6	$100,000/annual	ARC, Communities, Counties, Private Stakeholders, Stewardship Groups	Short	High	Number of volunteers and sites; list of activities
Develop and enact a Fertilizer Ordinance to require or maximize the use of no-phosphorus fertilizers by commercial applicators.	1-6	Various	ARC Communities	Medium	High	Ordinances
Sustainable Watershed Management Funding	6	Unknown	ARC, Communities, Counties, FOTR, Universities	High	High	Funding plan

Table 6-24: Lower 1 Subwatershed Actions

Lower 1 Action	Goal	Cost (if available)	Stakeholders	Timeline	Priority	Indicator
Grow Zone Implementation at Barchester Park, Griffin Park, Freedom Park, Heritage Park & Patriot Park.	1-4	$3,000 - $80,000	Canton Township	Short	High*	Number of acres planted
Wayne County Lower Rouge Parkway Grow Zones and Signage	1-5	$100,000	Wayne County	Short	High*	Number of acres converted and educational signs placed
Pheasant Run Golf Course wetland and floodplain creation, expansion, enhancement.	1-4	$100,000-$800,000	Canton Township	Long	Medium *	Number of acres/sq. ft. created
Implement Driveway Closures and Consolidations Consistent with the Ford Road Access Mgt Plan (Canton Township) (8 driveway closures @ 1,000 SF = 8,000 SF)	1-4	$300,000	MDOT, Canton Township, Canton DDA	Short	High*	Amount of storm water treated
Green Infrastructure Assessment/visioning and implementation to address 10% (522,800 CF) of volume storage	1-4	$5,000 - 5 Million	ARC, Communities, Counties, Stewardship Groups	Short	High*	USGS gage and number of measures implemented
Ford/Lotz Road Intersection Improvements with GI	1-4	$350,000	MDOT, Canton Township, Canton DDA	Short	High*	Amount of storm water treated
I-275 Northbound Off-Ramp to Ford Road Improvements with GI	1-4	$250,000	MDOT, Canton Township, Canton DDA	Short	High*	Amount of storm water treated
Ford/Sheldon Roads- Add northbound through lane and an exclusive northbound right-turn lane on Sheldon Road with GI	1-4	$300,000	MDOT, Canton Township, Canton DDA	Short	High*	Amount of storm water treated
Ford/Canton Center Roads- Add exclusive right-turn lane on Ford Road with GI	1-4	$150,000	MDOT, Canton Township, Canton DDA	Short	High*	Amount of storm water treated
Ford/Haggerty Roads- Provide exclusive right-turn lanes in each direction on Ford Road. Convert continuous right-turn lane into shared and through lane in WB direction. Add new through lane in EB direction (halfway to Lilley to I-275) with GI	1-4	$1 million	MDOT, Canton Township, Canton DDA	Mid	High*	Amount of storm water treated
Provide exclusive right-turn lanes in each direction on Ford Road. Extend continuous right-turn lane into shared/through lane to west of Lilley in WB direction. Add new through lane in EB direction (west of Lilley to halfway to Haggerty) with GI	1-4	$1 million	MDOT, Canton Township, Canton DDA	Mid	High*	Amount of storm water treated
Implement Driveway Closures and Consolidations Consistent with the Ford Road Access Mgt Plan with GI (Canton Township) (8 driveway closures @ 1,000 SF = 8,000 SF)	1-4	$300,000	MDOT, Canton Township, Canton DDA	Short	High*	Amount of storm water treated

*Actions associated with critical areas/priority protection areas and priority pollutants.

Table 6-25: Lower 2 Subwatershed Actions

Lower 2 Action	Goal	Cost (if available)	Stakeholders	Timeline	Priority	Indicator
Lower Rouge DOE, Road & Park Maintenance Yard Impervious & GI Assessments and Capital Improvement Recommendations	1-5	$10,000	Wayne County	Short	High*	Assessment report and improvements report
DOE LID/LEED Offices – Green Roof, Pervious Pavement & Green Infrastructure Demonstration Facility	1-5	$1,000,000	Wayne County	Mid	High*	Capital improvements and benefits assessment
Municipal Parking Lot No. 1 (Michigan Ave & Wayne Rd) storm water improvements.	1-3	$1.5 Million	City of Wayne	Short	Medium*	Number of acres / square feet of storm water treated
Lower Rouge Grow Zones, Tree Planting and Signage	1-6	$100,000	Wayne County	Short	High*	Number of acres converted, numbers of trees planted and educational signs placed
Lower Rouge Road & Park Maintenance Yard GI and Impervious Reduction Retrofits	1-5	$1,000,000	Wayne County	Long	Medium*	Retrofits and benefits assessment
Ford Field Streambank Stabilization	2-4	$80,000	City of Dearborn	Long	Low	Linear feet of streambank stabilized
Implementation of restoration activities based on City of Wayne streambank erosion inventory.	3, 4	$15,000 - $500,000	City of Wayne	Long	Low*	Linear feet of streambank stabilized/restored, project completion
Wayne Rd Dam Modification	4	$3 Million	Wayne County, FOTR, Communities	Mid	Medium	Project Completion and fish survey
Implement Driveway Closures and Consolidations Consistent with the Ford Road Access Mgt Plan (Westland, Garden City, Dearborn, Dearborn Heights) (30 driveway closures @ 44,000 SF of Impervious Surface) with GI	1,2,6	$500,000	MDOT, Westland, Garden City, Dearborn, Dearborn Heights	Short	High*	Amount of storm water treated.
Canfield Recreation Center Storm Water Enhancements	1-4	$100,000	Dearborn Heights, Wayne County, Non-profit Groups	Short	High	Amount of storm water treated
Green Infrastructure Assessment/visioning and implementation to address 5% (219,710 CF) of volume storage	1-4	$5,000 - 5 Million	ARC, Communities, Wayne County, Stewardship	Short	High*	USGS gage and number of measures implemented
Storm water Retrofit Analysis	2	$200,000	ARC, Communities, Wayne County	Short	Medium*	Completed analysis

*Actions associated with critical areas/priority protection areas and priority pollutants.

Table 6-26: Main 1-2 Subwatershed Actions

Main 1-2 Action	ioal	Cost (if available)	Stakeholders	Timeline	ority	Indicator
Regional storm water facilities in southeast section of City.		$500,000	City of Farmington Hills	Mid	High*	Amount of storm water treated
Orchard Lake Road Corridor Storm Water Enhancement Projects.		$250,000	City of Farmington Hills	ong	Medium*	Amount of storm water treated
Beverly Elementary School Rain Garden	2-4	$30,000	Beverly Hills, School System, Private Stakeholders, SOCWA	Short	High*	Amount of storm water treated
Implement projects from the RGC Riparian and Aquatic Habitat Inventory and Mgmt. Plan	1-6	$35,000	Birmingham, Beverly Hills, Southfield, Oakland County, Six Rivers Land Conservancy	Mid	Medium*	Completed projects
Bioswale implementation Bloomfield Hills right-of-way, on the south side of Long Lake Road, off of Barden Road, west of Woodward	1, 2	$70,000	Bloomfield Hills	Short	High*	Number of acres / square feet of water treated
Franklin Historical Museum and Village Wide Storm Water & Ecological Enhancements	2-4	$50,000	Franklin Historical Museum, Franklin, Private Stakeholders	Short	High*	Amount of storm water treated
Franklin Community Rain Garden Installation	2-4	$80,000	Franklin, Private Stakeholders	Long	High*	Amount of storm water treated
Lathrup Village Rain Garden Installation and Education	2-4	$20,000	Lathrup Village, SOCWA, Private Stakeholders	Short	High*	Number of rain gardens installed
Southfield Adler School Rain Garden	2-4	$15,000	Southfield, Alder School, SOCWA	Short	High*	Amount of storm water treated
Implement native vegetative buffer along the river at Beech Woods Park Golf Course	2,4,5	$50,000	Southfield	Short	High*	Type of plants; linear feet installed
Restore area near Bridge Street to mesic wet meadow at Valley Woods Nature Preserve South	1-5	$25,000	Southfield, SRRLC	Short	High	Completed project
Beech Woods Storm Water Enhancement & Greening Project	1-4	$2 Million	City of Southfield	Short	High*	Amount of storm water treated
Storm Water Enhancements on public and private property (i.e. porous pavements, green roofs, cisterns, bioswales, grow zones, rain gardens, tree planting, etc.).	1-5	$2 Million	City of Southfield, Private Stakeholders, Corporate Stakeholders, Stewardship Groups	Short	High*	Types of projects; amount of storm water treated
Washington Heights Drainage Improvements – regional storage or onsite BMPs.	1-4	$3 Million	City of Southfield, Private Stakeholders	Short	High*	Amount of storm water treated
Holy Sepulchre Storm Water Retention Project – lake improvements to alleviate flooding and erosion downstream.	1-4	$2 Million	City of Southfield	Long	Medium*	Project Completion
Bioretention along Parking Lot- LID implementation on Lawrence Tech	1-4	$80,000	Lawrence Tech University	Long	High*	Project completion
West Bloomfield Township private storm water enhancements (i.e. rain gardens, grow zones, etc.)	1-5	Various	West Bloomfield Township, Private Stakeholders	Long	High*	Amount of storm water treated

Main 1-2 Action	Goal	Cost (if available)	Stakeholders	Timeline	Priority	Indicator
dentify where direct connections and outfalls can be daylighted	1-5	Unknown	Beverly Hills, Birmingham, Southfield	Long	Low	Map of areas
Conservation Easement at Sisters of Mercy Property	5	$50,000	Farmington Hills	Short	High	Acres of property in conservation easement
Lathrup Village Tree Planting	2-4	$10,000	Lathrup Village, Private Stakeholders, Non-Profits	Short	High*	Number of trees planted
Purchase Berberian Property to preserve natural habitat and rare plant species.	2-5	Unknown	City Southfield, Private Stakeholders, Corporate	Short	High	Successful purchase
Tree canopy enhancement program.	2-4	$500,000	City of Southfield	Short	High*	Number of trees planted
MDOT Tamarack Basin Storm Water Enhancements	1-4	$2-$4 Million	City of Southfield, MDOT, Private Stakeholders	Short	High*	Amount of storm water treated
City of Southfield Detention Ponds Storm Water Enhancements	1-5	$5 Million	City of Southfield, Private Stakeholders	Short	High*	Amount of storm water treated
Develop and implement woodland protection ordinances in Birmingham and Beverly Hills	2-6	Various	Birmingham, Beverly Hills	Medium	High	Revised ordinances
Booth Park Streambank Stabilization Project & Floodplain Enhancements	2-4	$600,000	Birmingham	Long	Medium*	Linear feet of streambank stabilized and restored, and acres of floodplain enhanced
Streambank Erosion at Douglas Evans	1-5	$100,000	Beverly Hills	Long	Medium*	Linear feet stabilized and restored
City Wide Streambank Stabilization	1-5	$300,000	Birmingham	Long	Medium*	Linear feet stabilized and restored
Franklin Branch Streambank Stabilization	1-5	$300,000	Bloomfield Township	Long	Medium*	Linear feet stabilized and restored
City of Southfield Streambank Erosion Projects - 75 identified severe erosion sites that need attention to avoid failure of infrastructure and major slopes.	1-5	$75,000 - $150,000 per site	Southfield	Short	High*	Linear feet of streambank stabilized
Continue streambank stabilization for high priority sites identified in the Franklin Branch Erosion Inventory.	1-5	Various	Southfield	Medium	Medium*	Linear feet stabilized and restored
Birmingham City Wide Woody Debris Management	1-5	$50,000	Birmingham	Long	Low	Woody Debris management sites
Graves Drain Sediment Removal and Streambank Stabilization	1-5	$400,000	West Bloomfield Township	Medium	Medium*	Sediment removed and streambank stabilized
Evans Creek Constructed Wetland *LID implementation on Lawrence Tech*	2-4	$600,000	Lawrence Tech University & Southfield	Short	High*	Acres of wetland created and amount of storm water treated
Using MDEQ wetland/hydric soils maps restore 85 acres wetlands in Valley Woods Nature Preserve South	1-5	$250,000	Southfield	Mid	High	Amount of acres restored

Main 1-2 Action	ioal	Cost (if available)	Stakeholders	Timeline	ority	Indicator
Restore capacity of wetlands to store and detain storm water by removing or blocking existing culverts and shallow ditches and placing rock armored inlets within spoil banks and upstream and downstream ends of Valley Woods Nature Preserve at Civic Center	1-5	$280,000	Southfield	Short	Medium*	Acres restored
Invasive Species Removal	5	$60,000	SRRLC, Beverly Hills	Short	Medium	Amount of invasives pulled
Danvers Pond dam removal and riparian restoration.	1-4	$500,000	City of Farmington Hills	Short	High	Dam removal and amount of riparian restoration
City Wide Bike Trail	5	$100,000	Birmingham, Oakland County	Short	Medium	Miles of path installed
Septic Program – low interest loan or funding for residents to connect to sanitary sewer when septic system fails.	1	$2-$4 Million	City of Southfield	Short	High*	Number of septic systems eliminated
Vacuum sweeper to maintain porous pavement and provide additional sediment removal.	2	$150,000	City of Southfield	Long	Medium*	Project Completion
Carpenter Lake Nature Center and Program Development to include a 'green building' and public education.	3, 5	$2 Million	City of Southfield	Long	High	LEED Certified building and educational areas
Bloomfield Township Sewer and Water Improvements	1	$3,720,000	Bloomfield Township	Medium	Medium*	Completed project
Lathrup Village Sanitary Sewer Rehabilitation	1	$2,344,000	Lathrup Village	Medium	Medium	Completed project
Provide pet-waste bags, trash cans and educational signage regarding proper disposal.	1-5	Various	Birmingham, Beverly Hills, Southfield (RGC)	Medium	Medium*	Number of signs; pet waste stations
Develop downspout disconnection programs/rain barrel use		Unknown	Rouge Green Corridor	Mid	Medium*	
LID implementation on Lawrence Tech University	1-4	$200,000 - 1.5 Million	Lawrence Tech University	Long	High*	Number of acres/sq. ft. of storm water treated
Implementation of actions based on the Main 1-2 Subwatershed Detention Basin Inventory	1,2	$50,000 - 300,000	Main 1-2 Communities, Oakland County	Short	Medium*	Number of detention basins updated and type of additional storm water treatment
Implementation of actions based on the Main 1-2 Streambank Erosion Inventory	4	$20,000- $150,000	Main 1-2 Communities, Oakland County	Long	Low*	Linear feet of streambank stabilized/restored
Implement Rouge Green Corridor Master Plan	5	$2.5 Million	Main 1-2 Communities, Oakland County	Short	High	Project Implemented and benefits

*Actions associated with critical areas/priority protection areas and priority pollutants.

Table 6-27: Main 3-4 Subwatershed Actions

Main 3-4 Action	Goal	Cost (if available)	Stakeholders	Timeline	Priority	Indicator
Wayne County Main 3/4 Rouge DOE, Road & Park Maintenance Yard Impervious & GI Assessments and Capital Improvement Recommendations	1-5	$10,000	Wayne County	Short	High*	Retrofits and benefits assessment
Implement Green Streets projects via construction of green infrastructure along roadways and parking lots.	1-4	$30 Million	City of Detroit	Mid	High*	Map of installed projects
Increase tree canopy along roadways, municipal properties and open spaces.	1-5	$15 Million	City of Detroit	Short	High*	Number of trees planted
Implement downspout disconnection in Residential, Commercial and Industrial areas and replace with green infrastructure techniques where feasible.	1-4	$10 Million	City of Detroit	Mid	High*	Number of downspouts disconnected
Wayne County Main 3/4 Rouge Grow Zones, Tree Planting and Signage	1-5	$100,000	Wayne County	Short	High*	Number of acres converted, numbers of trees planted and educational signs placed
Wayne County Main 3/4 Rouge DOE, Road & Park Maintenance Yard GI and Impervious Reduction Retrofits	1-5	$1,000,000	Wayne County	Long	Medium *	Retrofits and benefits assessment
Michigan Avenue /Evergreen Road storm water treatment and habitat restoration. (USACE –Rouge River 905(B), 2003)	1-4, 6	2.5 Million	Wayne County, ARC, USACE, Rouge Gateway Partnership Members, other local communities and groups.	Long	High*	Number of acres of habitat cleared, and amount of storm water treated
Rouge Park Master Plan & Implementation Activities	2-5	$100,000	City of Detroit Recreation Dept, Friends of Rouge Park	Mid	High	Completed master plan
Rouge Park Natural Areas Management	2-6	$200,000	City of Detroit Recreation Dept, Friends of Rouge Park	Short	High	Number of acres of habitat protected/enhanced
Demolish and remove vacant structures and replace with pervious land cover.	1-5	$84 Million	City of Detroit	Short / Long	High*	Number of homes demolished and acres of pervious land cover installed
Tournament Players Golf Course storm water treatment and wetland restoration (USACE –Rouge River 905(B), 2003)	1-4, 6	5.5 Million	Wayne County, ARC, USACE, Rouge Gateway Partnership Members, other local communities and groups.	Long	Low*	Number of acres created and amount of storm water treated
Henry Ford Estate Dam Modification for Fish Passage (USACE –Rouge River 905(B), 2003)	4, 6	3 Million	Wayne County, local communities, FOTR, ARC, U.S. Army Corps of Engineers (USACE)	Long	High	Project Completion and fish survey
Fordson Island Habitat Restoration (USACE –Rouge River 905(B), 2003)	2, 4, 6	1 Million	Wayne County, Marathon Ashland Petroleum, USACE, ARC and other local communities or groups	Long	High	Acres restored
Concrete Channel Modifications/Enhancements-For Habitat And Fish Populations (USACE, 2003)	3, 4, 6	15 Million	Wayne County, ARC, USACE, Rouge Gateway Partnership Members, other local communities and groups.	Long	High	Type of habitat created and fish survey

Main 3-4 Action	Goal	Cost (if available)	Stakeholders	Timeline	Priority	Indicator
Oakwood Commons Oxbow Restoration (USACE, 2003)	2-4, 6	20 Million	Wayne County, ARC, USACE, Rouge Gateway Partnership Members, other local communities and groups.	Long	High	Acres of storm water
Rouge River Gateway Project (USACE, 2008)	2, 4, 5	5 Million	Wayne County, ARC, USACE, Rouge Gateway Partnership Members, other local communities & groups	Long	High	Acres of greenway established
Rouge River Oxbow – Phase 3 (USACE, 2008) – Reconnect oxbow segment at The Henry Ford	2-5	6.8 Million	Wayne County, ARC, USACE, Rouge Gateway Partnership Members, other local communities & groups	Long	High	Completion of reconnection
Great Lakes Legacy Act Projects	1	Various	USEPA	Mid	High	Number of projects completed

*Actions associated with critical areas/priority protection areas and priority pollutants.

Table 6-28: Middle 1 Subwatershed Actions

Middle 1 Action	Goal	Cost (if available)	Stakeholders	Timeline	Priority	Indicator
Johnson Creek TSS Load Assessment to verify TMDL modeling results	4	$100,000	ARC, Northville Twp, Salem Twp	Short	High*	Completion of study
Johnson Creek Hydrological Analysis to mitigate low base flow conditions	4	$80,000	ARC, Northville Twp, Salem Twp	Short	High*	Completion of study
Colony Estates Subdivision Footing Drain disconnection (from sanitary)	1	$25,000	Northville Twp	Short	Low*	Number of drains disconnected / approximate amount flow removed from system
Rain barrel program for local businesses located within the historic lakefront district and possibly promote it for homeowners. Probably 50 to 100 rain barrels would be needed.	2, 3	$5,000 - $10,000	Walled Lake	Short	High	Number of rain barrels
Pervious pavement installation (Riley Park parking lot, E. V. Mercer Beach parking area, possibly city-owned road in subdivisions, and sidewalks in the historic lakefront district)	1-3	$5,000-$50,000	Walled Lake	Long	Medium	Number of acres/sq. ft. of storm water treated
Community Park Storm Water Enhancements (Pervious Pavement, Grow Zones, Tree Planting, etc.)	1-4	$250,000	Northville Twp	Short	High*	Acres of grow zones installed
Millennium Park Storm Water Enhancements (Grow Zones, Detention Pond Retrofit, etc.)	1-4	$200,000	Northville Twp	Mid	High*	Amount of storm water treated
Dept of Public Works Storm Water Enhancements (Rain Gardens, Green Roof, Grow Zones, Pervious Pavement, etc.)	1-4	$300,000	Northville Twp	Mid	High*	Amount of storm water treated

Middle 1 Action	Goal	Cost (if available)	Stakeholders	Timeline	Priority	Indicator
Ridge Pond Grow Zone	1-4	$35,000	Northville Township	Mid	High*	Area of grow zones planted
City Hall Grow Zone	1-4	$50,000	Northville Township	Long	High*	Area of grow zones planted
Thayer's Corner Habitat Enhancement (Grow Zones, Native Plantings, Rain Gardens, Pervious Pavement, etc.)	1-4	$300,000	Northville Twp	Long	Medium *	Acres of enhancements implemented
Rain garden/bioretention implementation on public property (E. V. Mercer Beach parking area and possibly at Veterans' Memorial at S. Pontiac Trail and W. Walled Lake Drive, in curbed area along W. Walled Lake Drive, and in Riley Park.	1-3	$5,000-$25,000	Walled Lake	Short	High	Number of acres/sq. ft. of storm water treated
Storm water implementation projects (rain gardens, tree planting, pervious pavement, grow zones, etc.) at Riley Park	2-4	$5,000-$100,000	Walled Lake	Short	High	Number of acres/sq. ft. of storm water treated
Rain garden/bioretention implementation in residential neighborhoods (Virginia Park Subdivision, Jenny Park Subdivision, Philipskis Walled Lake Subdivision, Hillcroft Subdivision, Clutz Lakeview Subdivision, and Welfare Lakeview Subdivision)	1-4	$2,000-$25,000	Walled Lake	Long	Medium	Number of acres/sq. ft. of storm water treated
Middle Rouge Grow Zones, Tree Planting and Signage	1-5	$100,000	Wayne County	Short	High	Assessment report and improvements report
Middle Rouge Road & Park Maintenance Yard Impervious & GI Assessments and Capital Improvement Recommendations	1-5	$10,000	Wayne County	Mid	High	Assessment report and improvements report
Middle Rouge Road & Park Maintenance Yard GI and Impervious Reduction Retrofits	1-5	$1,000,000	Wayne County	Long	Medium	Amount of storm water treated
Cedar Springs Basin Storm Water Enhancements (Water Quality Improvements, Habitat Enhancements, Native Plant Buffer	1-4	$100,000	City of Novi	Short	High	Amount of storm water treated
Civic Center Basin Storm Water Enhancements (Water Quality Improvements, Habitat Enhancements, Native Plant Buffer)	1-4	$160,000	City of Novi	Mid	Medium	Amount of storm water treated
Meadowbrook Glens Basin Storm Water Enhancements (Water Quality Improvements, Habitat Enhancements, Native Plant Buffer)	1-4	$100,000	City of Novi	Mid	Medium	Amount of storm water treated
Ingersol Basin Storm Water Enhancements (Water Quality Improvements, Habitat Enhancements, Native Plant Buffer)	1-4	$15,000	City of Novi, MDOT	Mid	Medium	Amount of storm water treated
Jamestown Green Basin Storm Water Enhancements (Water Quality Improvements, Habitat Enhancements, Native Plant Buffer)	1-4	$70,000	City of Novi	Mid	Medium	Amount of storm water treated

Middle 1 Action	Goal	Cost (if available)	Stakeholders	Timeline	Priority	Indicator
Leavenworth Basin Storm Water Enhancements (Water Quality Improvements, Habitat Enhancements, Native Plant Buffer)	1-4	$100,000	City of Novi	Long	Low	Amount of storm water treated
Lexington Green Basin Storm Water Enhancements (Water Quality Improvements, Habitat Enhancements, Native Plant Buffer)	1-4	$40,000	City of Novi	Long	Low	Amount of storm water treated
Thornton Basin Storm Water Enhancements (Water Quality Improvements, Habitat Enhancements, Native Plant Buffer)	1-4	$140,000	City of Novi	Long	Low	Amount of storm water treated
East Bay Village Condominiums Detention Basin Enhancements	2-4	$50,000	Walled Lake, Private Stakeholders	Mid	Medium	Amount of storm water treated
C&O Basin Storm Water Enhancements (Water Quality Improvements, Habitat Enhancements, Native Plant Buffer)	1-4	$300,000	City of Novi	Short	High	Amount of storm water treated
Brookfarm Park Streambank Stabilization	2, 4, 5	$115,000	City of Novi	Long	Low	Linear feet of streambank stabilized
Rotary Park Streambank Stabilization	2, 4, 5	$165,000	City of Novi	Long	Low	Linear feet of streambank stabilized
Ford/Beck Roads- Add eastbound and westbound through lanes on Ford Road with GI	1	$2 million	MDOT, Canton Township, Canton DDA	Mid	High*	Storm water retrofits
Implement Boulevard Recommendations with Green Infrastructure Design on Ford Road between I-275 and Lilley Road with GI	1-4	$3 million	MDOT, Canton Township, Canton DDA	Mid	High*	Amount of storm water treated
Woods of Edenderry Wetland Enhancement	2, 4	$30,000	Northville Twp	Short	Medium	Acres of wetland enhanced
Meadowbrook Lake Dam Improvements (Peak flow attenuations and downstream protection)	2-4	$350,000	City of Novi	Short	High	Water quality improvements
Educational workshops on lake friendly lawn care.	3, 4	$5,000	Walled Lake	Short	High	Number of participants
Walled Lake educational display and activities at their Market Day and Beach Party	3	$15,000	Walled Lake	Short	High	Number of participants
City of Novi West Oaks Basin Storm Water Enhancements (Water Quality Improvements, Habitat Enhancements, Native Plant Buffer)	1-4	$100,000	City of Novi	Short	High	Amount of storm water treated

*Actions associated with critical areas/priority protection areas and priority pollutants.

Table 6-29: Middle 3 Subwatershed Actions

Middle 3 Action	Goal	Cost (if available)	Stakeholders	Timeline	Priority	Indicator
City Hall Storm Water Enhancements	2-4	$80,000	Dearborn Heights, Wayne County, Non-profit Groups	Short	High*	Amount of storm water treated
Middle Rouge DOE, Road & Park Maintenance Yard Impervious & GI Assessments and Capital Improvement Recommendations	1-5	$10,000	Wayne County	Mid	High*	Assessment report and improvements report
Newburgh Lake Floating Islands Project for Eutrophication mitigation and fish spawning	5	Unknown	Wayne County, Middle Rouge Communities	Long	Low*	Completed project
Nankin Impoundment Dredging for Fisheries Enhancement	5	Unknown	Wayne County, Middle Rouge Communities	Long	Medium	Completed project

*Actions associated with critical areas/priority protection areas and priority pollutants.

Table 6-30: Upper Subwatershed Actions

Upper Action	Goal	Cost (if available)	Stakeholders	Timeline	Priority	Indicator
Shiawassee Park Storm Water Improvements (rain gardens/bioretention)	2, 3	$30,000	City of Farmington	Short	High*	Number of acres / amount of storm water treated
Rain Garden Installation and Municipal Offices	1-4	$50,000	Redford Township	Short	High*	Number of acres of storm water treated
West Bell Branch Regional Storm Water Storage Basins from *City of Livonia Storm Water Management Plan*	1-4	$700,000	City of Livonia	Mid	High*	Amount of storm water treated
Whispering Willows Regional Storm Water Storage Basins from *City of Livonia Storm Water Management Plan*	1-4	$400,000	City of Livonia	Mid	Medium*	Amount of storm water treated
Shamrock Village Retention Basin Retrofit	1-4	$120,000	Redford Township	Long	Low*	Amount of storm water treated
Minnow Pond Drain (Farmington Rd) Farmington Hills Streambank Erosion Inventory	1-4	$15,000	Farmington Hills	Long	Low*	Linear feet of streambank stabilized
Seeley Drain – 620' (Halsted Rd)- Farmington Hills Streambank Erosion Inventory - Sediment removal and streambank stabilization	1-4	$500,000	Farmington Hills	Long	Low*	Linear feet of streambank stabilized
Bell Branch @ 5 Mile & Levan - Streambank Stabilization from *City of Livonia Storm Water Management Plan*	1-4	$110,000	City of Livonia	Long	Low*	Linear feet of streambank stabilized
Bell Creek near Bell Creek Court - Streambank Stabilization from *City of Livonia Storm Water Management Plan*	1-4	$531,000	City of Livonia	Mid	High*	Linear feet of streambank stabilized

Upper Action	Goal	Cost (if available)	Stakeholders	Timeline	Priority	Indicator
5 Mile Road and Levan Road - Streambank Stabilization from *City of Livonia Storm Water Management Plan*	1-4	$450,000	City of Livonia	Mid	Medium*	Linear feet of streambank stabilized
Tarabusi Creek and North Bell Branch Intersection - Streambank Stabilization from *City of Livonia Storm Water Management Plan*	1-4	$900,000	City of Livonia	Mid	High*	Linear feet of streambank stabilized
Tarabusi Creek South of 8 Mile - Streambank Stabilization from *City of Livonia Storm Water Management Plan*	1-4	$2.1 Million	City of Livonia	Long	Low*	Linear feet of streambank stabilized
Upper River Rouge Streambank Erosion Inventory Report Site No. 5158- Downstream of Farmington Road Crossing Minnow Pond Drain, Farmington Hills	1-4	$5,100	Farmington Hills	Long	Medium*	linear feet of streambank stabilized
Upper River Rouge Streambank Erosion Inventory Report Site No. 5423 Seeley Drain, Farmington Hills	1-4	$6,780	Farmington Hills	Long	Medium*	Linear feet of streambank stabilized
I-275 and Hix Road Streambank Stabilization	1-4	$1,100,000	MDOT, Livonia	Mid	Low	Linear feet of streambank stabilized

*Actions associated with critical areas/priority protection areas and priority pollutants.

Table 6-31: Multiple Subwatershed Actions

Lower 1 and 2 Action	Goal	Cost (if available)	Stakeholders	Timeline	Priority	Indicator
Lower Rouge River WDM Management Project - Fisheries and Recreation	5	Unknown	Wayne County, Lower Rouge Communities	Long	Medium	Completed study
Middle 1 and 3 Action	**Goal**	**Cost (if available)**	**Stakeholders**	**Timeline**	**Priority**	**Indicator**
Lakes and Impoundments- Feasibility Studies and Restoration	1-5	30 Million	ARC, Communities, Counties	Long	Medium	Completed study
Middle 1, Upper and Main 1-2 Action	**Goal**	**Cost (if available)**	**Stakeholders**	**Timeline**	**Priority**	**Indicator**
Complete City-wide BMP analysis.	1-4	$150,000	City of Farmington Hills	Short	High*	Project Completed
Update Storm Drainage Master Plan and incorporate BMP solutions.	2	$250,000	City of Farmington Hills	Short	High*	Updated Storm Drainage Master Plan
City Hall Storm Water Enhancement Project (i.e. porous pavement, green roofs, cisterns, bioswales, public education, etc.)	1-2	$500,000	City of Farmington Hills	Short	High*	Amount of storm water treated
Native vegetation demonstration areas on City-owned properties, including Natural Beauty roads, fire stations and City projects.	1-4	$25,000	City of Farmington Hills	Short	High	Number of sq. ft. acres planted with native vegetation
Porous pavement installation at City facilities (i.e. Costick Center, Ice Arena, Founders Sports Park, City Hall, DPW, Fire Stations, etc.)	1-5	$2 Million	City of Farmington Hills	Short	High*	Amount of porous pavement installed

Public and private storm water enhancements on various land uses (i.e. grow zones, riparian buffers, rain gardens, etc.).	1-4	$300,000	City of Farmington Hills, Private Stakeholders	Short	High*	Amount of storm water treated
Grow zone implementation on City-owned property that are currently turf grass or other non-native plants and covered by impervious surfaces.	1-4	$250,000	City of Farmington Hills	Short	High*	Amount of grow zones implemented
Storm water enhancements on commercial property owners in Community Development Block Grant.	1-4	$1 Million	City of Farmington Hills, Private Stakeholders	Short	Medium*	Amount of storm water treated
Implementation of City-wide BMP analysis.	1-5	$3 Million	City of Farmington Hills	Mid	High*	Number / type of project completed and benefit
Tree canopy enhancement program.	1-4	$500,000	City of Farmington Hills	Short	High*	Number of trees planted
Public and private Detention Basin Storm Water Enhancements (i.e. Founders Sport Park, Cass Road, Farmington Hills Golf Club, Fire Stations, etc.)	1-4	$1 Million	City of Farmington Hills, Private Stakeholders	Short	High*	Amount of storm water treated
Acquisition of riparian lands, develop trails, connecting pathways and other City-owned properties.	1-4	$2 Million	City of Farmington Hills	Long	Medium	Amount of land acquired, property connected, linear feet of paths
Public and private riparian property improvements (i.e. erosion control, natural vegetation, etc.)	1-4	$500,000	City of Farmington Hills, Private Stakeholders	Mid	Medium*	Type of riparian property improvements
Invasive species removal program throughout City-owned properties (i.e. heritage Park, Woodland Hills Park, Memorial Park, Founders Sport Park, Farmington Hills Golf Club, etc.).	1-4	$150,000	City of Farmington Hills	Short	High*	Amount of invasive species removed
Implementation of Turfgrass Stewardship Program on City-owned golf courses and parks.	1-4	$150,000	City of Farmington Hills	Short	High	Number of properties implementing programs
Jet cleaning unit for storm sewer system sediment removal.	1-4	$200,000	City of Farmington Hills	Short	High*	Amount of sediment removed
Vactor spoils processing area	1-4	$80,000	City of Farmington Hills	Short	High*	Amount of spoils treated
Acquire hazardous material equipment for fire department	1-4	$300,000	City of Farmington Hills	Short	High	Amount of potential pollution prevention and mitigation
Storm water enhancements from roof (i.e. cisterns, rain gardens, etc.)	1-4	$60,000	City of Farmington Hills	Short	High*	Amount of storm water treated.

*Actions associated with critical areas/priority protection areas and priority pollutants.

Technical & Financial Assistance

Best Management Practice Implementation & Maintenance Costs

Costs for BMP implementation and maintenance can vary greatly based on many factors, including but not limited to, the area of construction, size of practice, new development or a redevelopment/retrofitting construction, etc. Table 6-32 shows some costs based on the 2006 Upper Grand River Watershed Management Plan, 2004 Bear Creek Watershed Management Plan and 2007 Center for Watershed Protection Urban Storm water Retrofit Practices Manual #3 and #8.

Table 6-32: BMP Implementation & Maintenance Costs

BMP	Estimated Implementation Cost	Estimated Annual/Maintenance Cost
Agricultural Vegetated Filter Strips	$200 per acre installed	$4/ac
ARC Participation	various	Various
Bioretention Retrofit -large	$10.50 per cubic foot treated	4% construction costs
Bioretention Retrofit – small	$30.00 per cubic foot treated	
Bioretention – new	$25,400 per acre treated	
Catch Basin Cleaning	$25/ea	n/a
Catch Basin Inserts	$800 per device	$3/inspection
Cisterns	$15 per cubic foot treated	
Constructed Wetland	$2,900 per acre treated	2%-4% construction costs
Curbside Leaf Pick-Up	$11.60 per household	
Dog Waste Station	$250-$300 per station	
Educational Brochures	$1.50/ea	$10,000 for the watershed
Extended Detention – new	$3,800 per acre treated	
Filtering Practices – new	$58,100 per acre treated	
Greenroof – Extensive	$225 per cubic foot treated	
Greenroof – Intensive	$360 per cubic foot treated	
High Efficiency Street Sweeping	$100,000-$200,000/vehicle	$15-$30/curb mile
Household Hazardous Waste Collection	$1.75-$8.09 per household	
Infiltration Retrofits	$15 per cubic foot treated	4% construction cost
Infiltration – new	$25,400 per acre treated	4% construction cost
Invasive Species Control	$400/ac	$400/ac
Native Vegetation Restoration Program	$800/ac installation	$200/ac
New Storage Retrofit	$5.00 per cubic foot $19,400 per acre treated	
Ordinance Creation/Adoption	$13,000-$15,000	Enforcement
Permeable Pavers	$120 per cubic foot treated	
Pond Retrofit	$3 per cubic foot $11,100 per acre treated	4% construction cost
Porous Asphalt Pavement	$0.50-$1.00 /ft2	$200/acre
Rain Barrels	$25 per cubic foot	n/a
RainGarden	$4 per cubic foot	4% construction cost
Riparian Buffer	$350/ac	2% installation cost
Sand Filter - structural	$20 per cubic foot treated	

BMP	Estimated Implementation Cost	Estimated Annual/Maintenance Cost
Sand Filter – underground	$65 per cubic foot treated	
Septic System Inspections	$150-$260 per household	
Signage	$20-$50 per sign	
Soil Testing	$12-$15 per sample	
Streambank Stabilization	$300/linear ft (one side for design & construction)	$1.80/ linear ft
SWAG Participation	Various	various
Tree Plantings	$3.25-$19 per tree	
Tree Pit – storm water	$70 per cubic foot treated	
Watershed Water Quality Monitoring	$50,000/year	n/a
Water Quality Swales Retrofit	$12.50 per cubic foot treated	$60/acre of drainage area
Water Quality Swales - new	$18,150 per acre treated	$60/acre of drainage area
Wet Ponds – new	$8,350 per acre treated	

(Note: costs are based on construction and do not include D&E which range from 5%-40%)

Available Technical Resources from Partner Organizations

There are many local resources to help further understand and implement the more than 130 different BMPs that can potentially be used to restore urban subwatersheds. Below are a few of the organizations currently working within the Rouge River Watershed:

- Alliance of Rouge Communities (www.allianceofrougecommunities.com/)
- Friends of the Rouge (www.therouge.org)
- Rouge River Remedial Action Committee (www.epa.gov/grtlakes/aoc/rougriv.html)
- Southeastern Oakland County Water Authority (www.socwa.org)
- Southeast Michigan Council of Governments (www.semcog.org)
- Rouge River National Wet Weather Demonstration Program (www.rougeriver.com)
- Michigan Department of Environment (www.michigan.gov/deq)
- Michigan Department of Natural Resources (www.michigan.gov/dnr)
- Rouge River Gateway Project
- Wayne County Department of Environment (www.waynecounty.com/doe)
- Washtenaw County Drain Commissioner's Office (www.ewashtenaw.org/government/drain_commissioner/index_html?qlink)
- Oakland County Water Resources Commissioner's Office (www.oakgov.com/drain/)
- Oakland County Planning & Environment (www.oakgov.com/peds/info_pub/planning_and_enviromental_infoandpubs.html)
- University of Michigan-Dearborn Environmental Interpretive Center (www.umd.umich.edu/eic/)

- Cranbrook Institute of Science (http://science.cranbrook.edu/educational watershed)
- United States Environmental Protection Agency – Region 5 (www.epa.gov/region5/)
- United State Army Corp of Engineers Great Lakes & Ohio River Division (www.lrd.usace.army.mil/)

Potential Funding Sources

The following are some of the possible funding sources such as grants, loans, and cost share programs, available to stakeholder agencies and non-governmental organizations for watershed management. This list is not exhaustive. Information on these funding sources can be found on the Internet or by contacting the agency.

Agricultural

- Agriculture in Concert with the Environmental Program (USDA)
- Watershed Protection and Flood Prevention Program (USDA)
- Conservation Reserve Program (NRCS)
- Wetlands Reserve Program (NRCS)
- Wildlife Habitat Incentive Program (NRCS)
- Forestry Incentives Program (NRCS)
- Environmental Quality Incentives Program (NRCS)
- Farmland Protection Program (USDA)
- Debt for Nature (Farm Service Agency)
- SARE Producer Grant Program (USDA)

Storm, waste and drinking water improvements and management

- MDEQ Clean Water State Revolving Fund Loans
- MDEQ Drinking Water Revolving Fund Loans
- Rural Business Enterprise Grants (water, wastewater, storm water) (USDA)
- Rural Development Water & Wastewater Disposal Program Grants & Loans (USDA)

Habitat restoration and creation

- Partners for Fish & Wildlife (US Dept Fish & Wildlife)
- North American Wetland Conservation Act Grant Program (US Dept of Interior)
- National Fish & Wildlife Foundation (US Dept of Interior)
- US EPA Five Star Restoration Grant Program
- Great Lakes Aquatic Habitat Network and Fund
- Natural Heritage Grant Program (MDNR)
- Inland Fisheries Grant Program (MDNR)
- Private Stewardship Grant Program (US Dept of Interior, US Fish & Wildlife, Endangered Species)
- Aquatic Ecosystems Restoration Grants (US Army Corps of Engineers)
- Great Lakes Fishery Trust
- DTE Energy Tree Planting Grants

- NOAA: Open Rivers Initiative
- NOAA Community-based Restoration Program - Project Grants
- Sustain Our Great Lakes

Education

- US EPA Environmental Education Program
- US EPA Five Star Restoration Grant Program
- ARC Public Education Activities
- Friends of the Rouge programs
- Southeastern Oakland County Water Authority/Southeastern Oakland County Resource Recovery Authority
- Green Schools Program
- Rouge River Water Festivals

Watershed planning and implementation

- Clean Water Act Section 319 Non-point Source Pollution Management Grants (MDEQ)
- Clean Michigan Initiative Grants
- Great Lakes Restoration Initiative

General

- Non-point Source Pollution Management Grant (MDEQ)
- US National Research Initiative Competitive Grants Program (USEPA)
- Community Forestry Grant Program (MDNR)
- Great Lakes Basin Program for Soil Erosion and Sediment Control (Great Lakes Commission)
- The Joyce Foundation
- Wal-Mart Environmental Grants
- Michigan Gateway Community Foundation
- Great Lakes Commission Grants
- Great Lakes Protection Fund
- Small Watershed Program (NRCS)
- Community Foundation for Southeast Michigan
- Plant Conservation Alliance: NFWF Native Plant Conservation Initiative
- Paul H. Young Trout Unlimited

Water quality monitoring

- Clean Water Corps grant program (MDEQ)
- Great Lakes Aquatic Habitat Network and Fund