



5.0 Causes/Sources of Impairment & Reduction Targets

5.1 Causes & Sources of Impairment

According to WDNR's 2012 Water Quality Report and Section 303d List (WDNR, 2012), none of the tributary streams in Wind Point watershed are listed as impaired for any of their "Designated Uses" because they have not been assessed by WDNR. However, the findings of this report combined with water quality sampling results suggest moderate impairment of the tributary streams caused by channelization, streambank erosion, draining of wetlands, and high nutrient and *E. coli* in agricultural and urban stormwater runoff.

Wind Point watershed also has six beaches: North Beach, Zoo Beach, Shoop Park Beach, Parkway Beach, Wind Point Beach, and Bender Park Beach. Many beaches along Lake Michigan are routinely monitored for *E. coli* according to federal criteria set for open waters of the Great Lakes. None of the beaches sampled along Wind Point watershed are listed as impaired. However, recent sampling by the Racine Health Department in 2013 of the beaches along Wind Point watershed found *E. coli* levels that were nearly double the standard.

Causes and sources of water quality impairment are typically derived from WDNR's 303(d) impaired waters information. However,

WDNR does not list any of the water bodies in Wind Point watershed as impaired. Hence, impairment information was obtained via the watershed characteristics inventory, water quality monitoring, and input from watershed stakeholders during Phase I and Phase II meetings

with specific comments originating from the “Wind Point Watershed Environmental Issues Identification Survey” conducted by UW Extension (Appendix G). It is also important to note that there are also non-water quality related impairments in the watershed such as habitat

degradation, loss of open space, hydrologic and flow changes, and reduced groundwater infiltration. Many different causes and sources are related to these impairments. Table 32 summarizes all *known* or *potential* causes and sources of watershed impairments.

Table 32. *Known* and *potential* causes and sources of watershed impairment.

Impairment	Cause of Impairment	Known or Potential Source of Impairment
Wind Point Watershed Tributaries & Outfalls		
Water Quality/Fish & Aquatic Life	Nutrients- <i>known impairment</i> : (Phosphorus)	Streambank & ravine erosion Agricultural row crop runoff Residential, Ag, and commercial lawn fertilizer Failing septic systems Livestock & horse farm operations (manure) Pet waste Wastewater Treatment Plants
Water Quality/Fish & Aquatic Life	Sediment- <i>known impairment</i> : (Total Suspended Solids/ turbidity)	Streambank & ravine erosion and headcutting Construction site runoff Urban runoff (roads, parking lots, building, homes, etc.) Agricultural row crop runoff Discharges from municipal storm sewer systems (MS4)
Water Quality: Contact	Bacteria - <i>known impairment</i> : (<i>E.coli</i>)	Waterfowl/animal waste Urban stormwater runoff Septic system failures Illicit sewage discharges
Water Quality/Fish & Aquatic Life	Nutrients- <i>potential impairment</i> : (Nitrogen)	Streambank & ravine erosion Agricultural row crop runoff Residential, Ag, and commercial lawn fertilizer Failing septic systems Livestock & horse farm operations (manure) Pet waste
Water Quality/Fish & Aquatic Life	Chlorides (salinity)- <i>potential impairment</i>	Deicing operations on roads & other pavement;
Water Quality/Fish & Aquatic Life	Low dissolved oxygen- <i>potential impairment</i>	Heated stormwater runoff from urban areas Lack of natural riffles in tributaries
Water Quality: Contact	Petroleum hydrocarbons (oil & grease)- <i>potential impairment</i>	Railway derailments; Trucking cargo spills along major roads; General gas station, urban, and highway runoff; Illicit dumping Industry
Habitat Degradation	Invasive/non-native plant species in riparian and other natural areas- <i>known impairment</i> Recreational or Social Use Constraints- <i>Known impairment</i>	Spread from existing and introduced populations Off road vehicles Hiking off designated trails Dogs of leash Loss of wildlife habitat

Impairment	Cause of Impairment	Known or Potential Source of Impairment
Habitat Degradation	Loss and fragmentation of open space/natural habitat due to development & groundwater changes- <i>known impairment</i>	Inadequate protection policy Traditional development design Streambank, channel, and riparian area modification Lack of needed natural land management Lack of restoration and maintenance funds Wetland loss
Hydrologic and Flow Changes	Impervious surfaces- <i>known impairment</i>	Existing & future urban runoff Wetland loss Agricultural drain tiles
Aquifer Drawdown	Reduced infiltration & human use- <i>known impairment</i>	Groundwater wells Traditional development design Existing and future urban impervious surfaces Inadequate protection policy Wetland loss
Wind Point Watershed Beaches		
Recreational Restrictions	<i>E. coli</i> <i>Known impairment</i>	Waterfowl/animal waste Urban stormwater runoff Wastewater treatment plants Septic system failures Illicit sewage discharges

5.2 Critical Areas, Management Measures & Estimated Impairment Reductions

For this watershed plan a “Critical Area” is best described as a location in the watershed where existing of potential future causes and sources of an impairment or existing function are significantly worse than other areas of the watershed. Seven Critical Area types were identified in Wind Point watershed and include: 1) poorly designed/functional detention basins; 2) large drained wetland complexes; 3) highly degraded stream and/or ravine reaches; 4) highly degraded riparian areas; 5) green infrastructure protection areas; 6) large row crop agricultural areas; 7) other potential sites not fitting the categories above. Short descriptions of each Critical Area type are included below. Table 33 includes summaries of the current condition at each Critical Area (by type) and recommended Management Measures with estimated nutrient and sediment load reductions expected. The list of Critical Areas is derived from a comprehensive list of measures found in the Action Plan section

of this report. Figure 56 maps the location of each Critical Area.

Pollutant load reduction is evaluated for the majority of the Critical Area Management Measures based on efficiency calculations developed for the USEPA's Region 5 Model. This model uses “Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual” (MDEQ 1999) to provide estimates nutrient and sediment load reductions from the implementation of *agricultural* Management Measures. Estimate of nutrient and sediment load reduction from implementation of *urban* Management Measures is based on efficiency calculations developed by the EPA. EPA pollutant load reduction worksheets for each Critical Area Management Measure are located in Appendix E.

Critical Detention Basins

Critical detention basins are generally defined as existing basins that do not provide adequate ecological and water quality benefits in areas where these attributes are needed. By retrofitting these basins with native vegetation and other measures,

stormwater can be improved while at the same time improving wildlife habitat and extending or creating green infrastructure. There are 8 critical detention basin retrofit opportunities. A summary covering specifics about detention basins in the watershed is included in Section 3.14.2.

Critical Wetland Restoration Sites

Critical wetlands restoration sites are generally associated with areas that where historically wetland prior to European settlement in the 1830s but were drained for agricultural or residential purposes. Many of these historic wetlands can be restored by breaking existing drain tiles and planting with native vegetation. Wetland restorations are among the most recommended projects to improve water quality, reduce flooding, and improve wildlife habitat. Critical Area status was assigned based on location, size, and restoration potential. There are 9 critical wetland restoration areas totaling 270 acres. A detailed summary of the extent of drained wetlands and potential wetland restoration opportunities in the watershed is included in Section 3.14.3.

Critical Stream and Ravine Reaches

Critical stream and ravine reaches are those with highly eroded banks and/or highly degraded channel conditions that are a major source of total suspended solids (sediment) carrying attached phosphorus and nitrogen. Bank stabilization using bioengineering and installation of artificial riffles in Critical Area areas will greatly reduce sediment and nutrient transport downstream while improving habitat and increasing oxygen levels. Four stream and/or ravine reaches (Trib B Reach 2, Trib D Reach 2, Trib E Reach 3, and Trib F Reach 4 totaling 8,685 linear feet were identified as Critical Areas. Section 3.14.1 includes a complete summary of streams and ravines in the watershed.

Critical Riparian Areas

Critical riparian areas are select locations adjacent to tributary reaches that are in poor ecological condition or areas lacking a buffer but with excellent ecological restoration and remediation potential to improve water quality and habitat conditions. Two riparian areas along Trib E Reach 1 and Trib G Reach 5 totaling 14,541 linear feet are

considered Critical Areas. Section 3.14.1 includes a full summary of the riparian areas in the watershed.

Critical Green Infrastructure Protection Areas

Information obtained from predicted future land use data and green infrastructure sections of this plan led to identification of 11 critical green infrastructure protection areas totaling 1,403 acres. The significance is that these areas are situated in environmentally sensitive or important green infrastructure areas where protecting and restoring or developing using "Conservation Design" or "Low Impact" design standards would best benefit watershed health.

Critical Agricultural Land

It is well documented that agricultural land is a significant contributor of nutrients and sediment in watersheds. According to modeling, agricultural areas contribute 32% of the nitrogen loading, 16% of the phosphorus load, and 14.5% of the sediment load in the watershed. There are currently about 1,111 acres of crop land or 9% of Wind Point watershed.

Seven agricultural areas totaling 975 acres were identified as Critical Areas based on their size and/or location in the watershed. Critical agricultural lands are those for which application of agricultural measures would reduce pollutant loading. Practices explored in this plan include conservation tillage (no till) for crop land.

Other Management Measure Sites

One site, that does not fit into the management measure categories above, is considered a Critical Areas. There is significant bluff erosion along 4,500 linear feet of the Lake Michigan coast from Fitzsimmons Rd. (within Bender Park) south to Elm Rd. (We Energies owned land). However, it remains unknown at this time how much of this erosion is natural versus accelerated erosion due to human influences. Therefore, it is recommended that a feasibility study be conducted to determine the need for and cost of stabilizing the eroded bluff using approaches similar to the bluff stabilization used on the north portion of the bluff at Bender Park.

Table 33. Critical Areas, existing conditions, Management Measures, & estimated nutrient, sediment, and bacteria load reductions.

Critical Area	Existing Condition/Description	Recommended Critical Area Management Measure	Nutrient & Sediment Load Reduction
Detention Basins			
4B	Series of existing linear dry bottom detention features with mown turf grass slopes and concrete channels on MMSD South Shore WWTP property.	Design and implement project to retrofit existing detention features to create linear bioinfiltration swales planted with native vegetation. Project would enhance and expand on existing green infrastructure to along Lake Michigan.	TSS = 423 tons/yr TN = 336 lbs/yr TP = 42 lbs/yr Bacteria = 78%
20D	Existing wetland bottom detention basin servicing Baywood Estates Subdivision. Basin is dominated by invasive species and a 400 lf low flow concrete channel with turf grass slopes enters the basin from the south.	Design and implement project to alter low flow concrete channel and plant side slopes with native vegetation. Replant detention area with native wetland vegetation.	TSS =6.5 tons/yr TN =33 lbs/yr TP =10 lbs/yr Bacteria = 78%
21A	Existing dry bottom basin with mown turf grass servicing adjacent subdivision. Basin is located adjacent to Tributary G Reach 3.	Design and implement project to naturalize detention basin by replacing turf grass with native vegetation to improve water quality, wildlife habitat, and green infrastructure connection.	TSS = 5 tons/yr TN = 52 lbs/yr TP = 6 lbs/yr Bacteria = 88%
21A	Existing dry bottom basin with mown turf grass servicing adjacent subdivision. Basin is located at headwaters of Tributary G Reach 6.	Design and implement project to naturalize detention basin by replacing turf grass with native vegetation to improve water quality, wildlife habitat, and green infrastructure connection.	TSS = 5 tons/yr TN = 52 lbs/yr TP = 6 lbs/yr Bacteria = 88%
31A	Large dry bottom regional detention basin servicing over 500 acres of surrounding development. Basin consists of low flow concrete channels and mown turf grass. Basin is also located at headwaters of Tributary J.	Design, permit, and install project to retrofit exiting detention basin by altering low flow channels and creating wetland and prairie storage areas that would provide water quality benefits, wildlife habitat and, green infrastructure.	TSS=136 tons/yr TN=996 lbs/yr TP=260 lbs/yr Bacteria=78%
37C	Large excavated pond used as detention for Prairie School and other surrounding development. Pond buffer is prairie north of Prairie School and generally weedy old field vegetation in other areas. Some moderate erosion is occurring around portions of the shoreline.	Design and implement project to alter outlet structure and concrete channel then naturalize entire pond shoreline and emergent zone to create wetland detention for water quality, wildlife, and green infrastructure benefits.	TSS=55 tons/yr TN=328 lbs/yr TP=87 lbs/yr Bacteria=78%
39B	Existing dry bottom detention basin within Vidian Chelsak Park along the south side of 3 Mile Rd. Vegetation in the basin consists of mown turf grass.	Design and implement project to replace turf grass and revegetate with native vegetation to improve water quality, wildlife, and green infrastructure benefits while reducing long term maintenance costs. Project would also be good demonstration for public.	TSS = 22 tons/yr TN = 148 lbs/yr TP = 32 lbs/yr Bacteria = 88%
43A	Existing regional storage area that has been naturalized in part with native prairie and wetland vegetation. Several invasive species are common on the site.	Implement a monitoring and management program to keep invasive species under control and to ensure the storage area performs as designed.	TSS=280 tons/yr TN=1,800 lbs/yr TP=456 lbs/yr Bacteria=78%

Critical Area	Existing Condition/Description	Recommended Critical Area Management Measure	Nutrient & Sediment Load Reduction
Wetland Restoration Sites			
W9	3 acre turf grass swale in Shoop Park Golf Course that drains adjacent course areas and residential area north south to wetland swale complex that flows east to Lake Michigan.	Restore wetland swale within golf course. A restored wetland would help filter pollutants, provide wildlife habitat, green infrastructure, and be a good demonstration project for the public to see.	TSS=7 tons/yr TN=36 lbs/yr TP=12 lbs/yr Bacteria=78%
W10	Approximately 7 acres of shallow ponds created via earthen dams along a historic wetland swale on land owned by the Johnson Foundation.	Remove earthen dams and restore wetland hydrology and native wetland plants to benefit water quality, wildlife habitat, and other green infrastructure benefits.	TSS=20 tons/yr TN=127 lbs/yr TP=39 lbs/yr Bacteria=78%
W14	9 acres of drained wetlands along the south side of Tributary I on private agricultural land that is slated for future residential development.	Incorporate wetland restoration in future conservation or low impact residential development plans by using most feasible areas as wetland detention and/or mitigation	TSS=2.5 tons/yr TN=24 lbs/yr TP=7 lbs/yr Bacteria=78%
W15	30 acres of drained wetlands adjacent to Crawford Park on private agricultural land that is slated for future residential development.	Incorporate wetland restoration in future conservation or low impact residential development plans by using most feasible areas as wetland detention and/or mitigation	TSS=8 tons/yr TN=49 lbs/yr TP=15 lbs/yr Bacteria=78%
W16	12 acres of drained wetlands on 20+ acre agricultural parcel that is adjacent to Tributary G. Parcel is slated for future residential development.	Incorporate wetland restoration in future conservation or low impact residential development plans by using most feasible areas as wetland detention and/or mitigation	TSS=4 tons/yr TN=27 lbs/yr TP=8 lbs/yr Bacteria=78%
W19	Primary agricultural land along Tributary G and abutting uncompleted Audubon Arboretum residential subdivision. Land is slated for future residential development.	Incorporate wetland restoration along Tributary G into future conservation development plans where feasible. Restored wetlands can be used as detention and/or wetland mitigation.	TSS=25 tons/yr TN=24 lbs/yr TP=37 lbs/yr Bacteria=78%
W20	Primary agricultural land along Tributary G on east end of parcel. Land is slated for future residential development. Area is also adjacent to SEWRPC Environmental Corridor.	Incorporate wetland restoration along Tributary G into future conservation development plans where feasible. Restored wetlands can be used as detention and/or wetland mitigation.	TSS=10 tons/yr TN=64 lbs/yr TP=24 lbs/yr Bacteria=78%
W21	16.5 acres of drained wetlands along Tributary G Reach 3. Land is currently agricultural and slated for future residential development. Area is also adjacent to SEWRPC Environmental Corridor.	Incorporate wetland restoration in future conservation or low impact residential development plans by using drained wetlands along Tributary G as wetland/floodplain detention and/or mitigation.	TSS=7 tons/yr TN=43 lbs/yr TP=13 lbs/yr Bacteria=78%
W22	46.5 acres of drained wetland within Cliffside Park abutting Tributary F. The majority of the existing vegetation here is comprised of old field species.	Investigate possibility to restore hydrology and native vegetation as part of a potential wetland mitigation bank.	TSS=3 tons/yr TN=10 lbs/yr TP=7 lbs/yr Bacteria=78%

Critical Area	Existing Condition/Description	Recommended Critical Area Management Measure	Nutrient & Sediment Load Reduction
Stream & Ravine Stabilization			
Tributary B Reach 2 (TRB2)	1,497 lf of stream within Bender Park that is naturally meandering but with moderately to highly eroded streambanks resulting from a headcut. Reach is bordered immediately by young mesic woodland.	Design, permit, and implement project to stabilize headcut and selectively stabilize highly eroded areas using bioengineering techniques. In addition, install up to five artificial riffles/grade controls within the stream channel.	TSS = 69 tons/yr TN = 137 lbs/yr TP = 69 lbs/yr Bacteria = n/a
Tributary D Reach 2 (TRD2)	1,537 lf of tributary (to Lake Michigan) on land owned by We Energies. Upper portion of reach is naturally meandering but exhibits highly eroded streambanks. About 500 lf along the downstream portion of the reach is a deep ravine with severe erosion prior to joining Lake Michigan.	Design, permit, and implement project to stabilize highly eroded stream and ravine slopes using a combination of bioengineering and hard armoring approaches. Grade controls will also be needed within the channel to control flow velocities.	TSS=1,753 t/yr TN =3,506 lbs/yr TP =1,753 lbs/yr Bacteria = n/a
Tributary E Reach 3 (TRE3)	3,201 lf of tributary/ravine (to Lake Michigan) on land owned by We Energies (Rifle Range Ravine). A headcut is located at upper portions of reach followed by a deeply incised ravine exhibiting severely eroded slopes.	Design, permit, and implement project to stabilize headcut and highly eroded ravine slopes using a combination of bioengineering and hard armoring approaches. Grade controls will also be needed within the channel to control flow velocities.	TSS=5,510 tons/yr TN=11,019 lbs/yr TP =5,510 lbs/yr Bacteria = n/a
Tributary F Reach 4 (TRF4)	2,450 lf of tributary/ravine (to Lake Michigan) on land owned by Racine County (Cliffside Park Ravine). Two headcuts are located at upper portions of reach where it meets Reaches 2 & 3. This is followed by a moderately incised ravine exhibiting highly eroded slopes.	Design, permit, and implement project to stabilize headcuts and highly eroded ravine slopes using a combination of bioengineering and hard armoring approaches. Grade controls will also be needed within the channel to control flow velocities.	TSS=906 tons/yr TN=1,812 lbs/yr TP =906 lbs/yr Bacteria = n/a
Riparian Areas			
Tributary E Reach 1 (TRE1)	3,468 lf of tributary with a narrow degraded riparian buffer of invasive shrubs and trees in most agricultural areas.	Achieve SEWRPC recommended Goals of 75 whereby 75% minimum of the total stream length should be naturally vegetated and 75 foot wide minimum riparian buffer established.	TSS =5.5 tons/yr TN = 103 lbs/yr TP = 11 lbs/yr Bacteria = 37%
Tributary G Reach 5 (TRG5)	8,073 lf of tributary between Crawford Park and Novak Rd. within a human created drainage ditch with concrete low flow channel. Side slopes are mown turf grass.	Design and implement project to restore native prairie and wetland vegetation along buffer areas to create green infrastructure connection benefits. A bike or walking trail could also be constructed.	TSS =75 tons/yr TN = 984 lbs/yr TP = 154 lbs/yr Bacteria = 37%

Critical Area	Existing Condition/Description	Recommended Critical Area Management Measure	Nutrient & Sediment Load Reduction
Green Infrastructure Protection Areas			
G11	18 acres on public land that is currently a USEPA Superfund Site along the Lake Michigan coast. This parcel is slated for future residential development.	Incorporate Conservation Design or Low Impact design standards into future development plans to preserve green infrastructure benefits along Lake Michigan.	Pollutant reduction cannot be assessed via modeling
G12	90 acres on private parcels at headwaters of Tributary A & also including SEWRPC Environmental Corridors. Parcels are slated to become residential development in the future.	Incorporate Conservation or Low Impact design standards into future development plans.	Pollutant reduction cannot be assessed via modeling
G13	250 acres of mostly vacant brownfields within Oak Creek know as the Lakefront Redevelopment Area. In 2011 the City produced and adopted a redevelopment plan for the site that includes redevelopment incorporating green infrastructure.	Implement development concepts outlined in the City Redevelopment Plan and stabilize shoreline to prevent bluff erosion.	Pollutant reduction cannot be assessed via modeling
G14	95 acres of private agricultural and vacant land adjacent to Bender Park and slated for future residential development.	Milwaukee County Department of Parks consider purchasing and restoring parcels to increase open space/green infrastructure adjacent to Bender Park.	Pollutant reduction cannot be assessed via modeling
G15	36 acres of land currently owned by We Energies but slated for future residential/mixed use development. Parcels also include SEWRPC Environmental Corridors.	Incorporate Conservation or Low Impact design standards into future development plans.	Pollutant reduction cannot be assessed via modeling
G16	334 acres on private agricultural and vacant parcels along surrounding Tributary E Reach 1 and abutting Cliffside Park to the southeast. Parcels are slated for future residential development and also contain SEWRPC Environmental Corridors.	Incorporate Conservation or Low Impact design standards into future development plans.	Pollutant reduction cannot be assessed via modeling
G17	85 acres on private agricultural land and woodland at headwaters of Tributary G Reach 2. SEWRPC Environmental Corridors are also included on these parcels. Parcels are slated for future residential development.	Incorporate Conservation or Low Impact design standards into future development plans.	Pollutant reduction cannot be assessed via modeling
G18	228 acres of land on parcels that are primarily agricultural and slated for future residential development along Tributary G Reaches 5 & 6. The unfinished "Arboretum" subdivision and SEWRPC Environmental Corridors are also located within this area.	Incorporate Conservation or Low Impact design standards into future development plans.	Pollutant reduction cannot be assessed via modeling

Critical Area	Existing Condition/Description	Recommended Critical Area Management Measure	Nutrient & Sediment Load Reduction
G19	96 acres of land on parcels that are primarily agricultural and slated for future residential development and cemetery expansion at headwaters of Tributary G Reach 4.	Incorporate Conservation or Low Impact standards into future residential development plans and incorporate stormwater best management practices into cemetery expansion where feasible.	Pollutant reduction cannot be assessed via modeling
G110	115 acres of land owned by Vulcan that is mostly agricultural and slated for future residential development.	Incorporate Conservation or Low Impact design standards into future residential development plans.	Pollutant reduction cannot be assessed via modeling
G111	56 acres of land owned by Vulcan that is mostly vacant and slated for future residential development.	Incorporate Conservation or Low Impact design standards into future residential development plans.	Pollutant reduction cannot be assessed via modeling
Agricultural Land			
AG1	109 acres of agricultural land in row crop production	Implement conservation tillage (no till) with filter strips	TN= 507 lbs/yr TP= 272 lbs/yr TSS= 177 tons/yr
AG2	115 acres of agricultural land in row crop production	Implement conservation tillage (no till) with filter strips	TN= 548 lbs/yr TP= 294 lbs/yr TSS= 192 tons/yr
AG3	259 acres of agricultural land in row crop production	Implement conservation tillage (no till) with filter strips	TN= 1,138 lbs/yr TP= 610 lbs/yr TSS= 391 tons/yr
AG4	113 acres of agricultural land in row crop production at headwaters of Tributary G	Implement conservation tillage (no till) with filter strips	TN= 539 lbs/yr TP= 289 lbs/yr TSS= 189 tons/yr
AG5	159 acres of agricultural land in row crop production	Implement conservation tillage (no till) with filter strips	TN= 734 lbs/yr TP= 393 lbs/yr TSS= 255 tons/yr
AG6	132 acres of agricultural land in row crop production at headwaters of Tributary G	Implement conservation tillage (no till) with filter strips	TN= 620 lbs/yr TP= 333 lbs/yr TSS= 217 tons/yr
AG7	88 acres of agricultural land in row crop production	Implement conservation tillage (no till) with filter strips	TN= 431 lbs/yr TP= 231 lbs/yr TSS= 152 tons/yr
Other Management Measure Sites			
B1	Approximately 4,500 linear feet of severe/accelerated bluff erosion along Lake Michigan on land owned by Milwaukee Co. Parks and We Energies	Develop a feasibility study to determine the need for and costs of stabilizing the eroded bluff using approaches similar to the bluff stabilization work that was completed at Bender Park	Pollutant reduction cannot be assessed via modeling



5.3 Watershed Impairment Reduction Targets

Establishing water quality “Impairment Reduction Targets” is important because these targets provide a means to measure how implementation of Management Measures at Critical Areas is expected to reduce watershed pollutants over time. Table 34 summarizes the basis for *known* pollution impairments and reduction targets. Reduction targets listed in Table 34 are based on documented information, modeling results, and/or water quality standards and criteria set by the Wisconsin DNR, USEPA (2000), and USGS (2006).

It is important to note that the assumption is made that percent decrease in sample concentration (mg/l) needed correlates to the percent reduction in annual load (lbs/yr or tons/yr) for phosphorus, nitrogen, and sediment reduction targets. In addition, Table 34 summarizing the load reduction of phosphorus, nitrogen, and total suspended solids (sediment) expected from addressing Critical Areas. *E. coli* is also included in Table 34 but pollutant reductions are not calculated because modeling is unable to predict *E. coli* removal efficiencies.

Watershed-Wide Reduction Targets for Phosphorus, Nitrogen,

Suspended Solids & E. coli
Watershed-wide phosphorus and sediment reduction targets could be attained by addressing Critical Areas alone (Table 34). It is estimated that by implementing Critical Area projects, 11,886 lbs/yr of phosphorus (74%) and 10,910 tons/yr (100%) of sediment could be removed. Nitrogen levels already meet standards without having to install any Critical Area projects. However, it is estimated that 26,227 lbs/yr nitrogen or 88% of the total nitrogen load could be removed each year by implementing all Critical Area projects. It is now known if target *E. coli* levels can be attained because models to do predict removal efficiency.

Table 34. Basis for *known* impairments, reduction targets, & impairment reduction for pollutants from Critical Areas.

Impairment: Cause of Impairment	Basis for Impairment	Reduction Target	Reduction from Critical Area	Target Attainable?
Watershed-Wide Reduction Targets				
Phosphorus	16,058 lb/yr of phosphorus loading based on STEPL/WinSLAMM models; 0.188 mg/l total phosphorus (weighted average) in water quality samples	>60.1% or 9,605 lbs/yr reduction in phosphorus loading to achieve 0.075 mg/l total phosphorus WDNR numeric criteria for streams in Wisconsin	899 lbs/yr or 5.6% reduction from critical detention basins 162 lbs/yr or 1.0% reduction from critical wetlands/swales 8,238 lbs/yr or 34.1% reduction from critical streams/ravines 165 tons/yr or 1% reduction from critical riparian areas 2,422 lbs/yr or 15.1% reduction from critical agricultural land Unknown pollutant removal from critical GI protection areas	
TOTAL			11,886 lbs/yr or 74% total phosphorus reduction from all Critical Areas	Yes
Nitrogen*	29,807 lb/yr of total nitrogen loading based on STEPL/WinSLAMM models; 0.445 mg/l nitrogen (weighted average) in water quality samples	0% or 0 lbs/yr reduction in nitrogen loading needed to achieve 1.798 mg/l total nitrogen WDNR numeric criteria for streams in Wisconsin	3,745 lbs/yr or 12.6% reduction from critical detention basins 404 lbs/yr or 1.4% reduction from critical wetlands/swales 16,474 lbs/yr or 55.3% reduction from critical streams/ravines 1,087 tons/yr or 3.6% reduction from critical riparian areas 4,517 lbs/yr or 15.2% reduction from critical agricultural land Unknown pollutant removal from critical GI protection areas	
TOTAL			26,227 lbs/yr or 88% total nitrogen reduction from all Critical Areas	Yes
Total suspended solids (sediment)	9,531 tons/yr of sediment loading based on STEPL/WinSLAMM models; 85.8 mg/l total suspended solids (weighted average) in water quality samples	>78% or 7,415 tons/yr reduction in sediment loading to achieve 19 mg/l total suspended solids based on USGS numeric criteria in Great Lakes Region	932.5 lbs/yr or 9.8% reduction from critical detention basins 86.5 lbs/yr or 0.9% reduction from critical wetlands/swales 8,238 lbs/yr or 86.4% reduction from critical streams/ravines 80.5 tons/yr or 0.8% reduction from critical riparian areas 1,573 lbs/yr or 16.5% reduction from critical agricultural land Unknown pollutant removal from critical GI protection areas	
TOTAL			10,910 tons/yr or 100% sediment reduction from all Critical Areas	Yes

Impairment: Cause of Impairment	Basis for Impairment	Reduction Target	Reduction from Critical Area	Target Attainable?
Bacteria (<i>E.coli</i>)	2,417 MPN/100ml <i>E.coli</i> (weighted average) in water quality samples	>90.3% or 2,182 MPN/100ml reduction in <i>E. coli</i> to achieve <235 MPN/100ml based on WDNR standard	Unknown reduction from critical detention basins	
			Unknown reduction from critical wetlands/swales	
			Unknown reduction from critical streams/ravines	
			Unknown reduction from critical riparian areas	
			Unknown reduction from critical agricultural land	
			Unknown pollutant removal from critical GI protection areas	
TOTAL			Unknown sediment reduction from all Critical Areas	Unknown

*Nitrogen levels in the watershed already meet WDNR numeric criteria without implementation of Critical Area projects



6.0 Management Measures Action Plan

Earlier sections of this plan summarized Wind Point watershed's characteristics and identified causes and sources of watershed impairment. This section includes an "Action Plan" developed to provide stakeholders with recommended "Management Measures" (Best Management Practices) to specifically address plan goals at general and site specific scales. The Action Plan is divided into two subsections:

- *Programmatic Measures:* general remedial, preventive, and policy watershed-wide Management Measures that can be applied across the watershed by various stakeholders.

- *Site Specific Measures:* actual locations where Management Measure projects can be implemented to improve surface and groundwater quality, green infrastructure, and flooding.

The recommended programmatic and site specific Management Measures provide a solid foundation for protecting and improving watershed conditions but should be updated as projects are completed or other opportunities arise. Key implementation stakeholders are encouraged to organize partnerships and develop various funding arrangements to help delegate and implement the recommended actions. The key stakeholders in the watershed are listed in Table 35.

Table 35. Key Wind Point watershed stakeholders/partners.

Key Watershed Stakeholder/Partner	Acronym/Abbreviation
Root-Pike Watershed Initiative Network	Root-Pike WIN
City of Racine	Racine
City of Racine Health Department	Racine Health Dept.
City of Oak Creek	Oak Creek
City of South Milwaukee	South Milwaukee
Village of Caledonia	Caledonia
Village of North Bay	North Bay
Village of Wind Point	Wind Point
United States Environmental Protection Agency (Region 5)	USEPA
Wisconsin Department of Natural Resources	WDNR
University of Wisconsin Extension	UWEX
Fund for Lake Michigan	FLM
SC Johnson & Son	SCJ
The Prairie School	Prairie School
Racine County Land Conservation Committee	LCC
Thompson & Associates	TA
Caledonia Conservancy	CC
Southeastern Wisconsin Regional Planning Commission	SEWRPC
We Energies	We
Racine County	Racine County
Milwaukee County	Milwaukee County
USDA Natural Resource Conservation Service	USDA
Developers	Developer
Farming Community	Farm

6.1 Programmatic Management Measures Action Plan

Numerous types of programmatic Management Measures are recommended to address watershed objectives for each plan goal. The following pages include recommended measures that are applicable throughout the watershed and information needed to facilitate implementation of specific actions. A brief summary of the general programmatic measure types is included below:

Policy: Local, state, and federal government can help prevent watershed impairments in various

ways through policy but specifically by adopting the Wind Point watershed plan, implementing green infrastructure policy, requiring conservation developments, protecting groundwater, reducing road salt usage, requiring natural detention basins, and allowing use of native vegetation/landscaping.

Non-Structural: This includes a broad group of practices that prevent impairment through maintenance and management of Management Measures or programs that are ongoing in nature and designed to control pollutants at their source. Such BMPs include agricultural programs available to farmers and street sweeping.

Structural: This includes a broad group of practices that prevent impairment via installation of in-the-ground measures. This plan focuses on implementation of naturalized stormwater measures/retrofits, permeable paving, vegetated filter strips/buffers, natural area restoration, wetland restoration, and use of rainwater harvesting devices.

Educational: Outreach is important to educate the public related to environmental impacts of daily activities and to build support for watershed planning and projects. Topics typically addressed include land management, pet waste management, good housekeeping, etc.

Local Watershed Resource Educational Material

- *"The Water's Edge – Helping fish and wildlife on your waterfront"*: Produced by WDNR & UWEX
- *"Shoreline Plants and Landscaping"*: Produced by WDNR & UWEX
- *"Managing the Water's Edge – Making Natural Connections"*: Produced by SWRPC
- *"Protecting Your Waterfront Investment"*: Produced by WDNR, UW Extension Center for Land Use Education, & UWEX
- *"Impervious Surfaces – How they Impact Fish, Wildlife, and Waterfront Property Values"*: Produced by WDNR, UW Extension Center for Land Use Education, & UWEX
- *"Managing Leaves and Yard Trimmings"*: Produced by WDNR, UWEX, and SWRPC
- *"Storm Sewers – The Rivers Beneath our Feet"*: Produced by WDNR & UWEX
- *"Rain Gardens – A how-to manual for homeowners"*: Produced by WDNR & UWEX

6.1.1 Policy Recommendations

Various recommendations are made throughout this report related to how local governments can improve the condition of Wind Point watershed through policy. Policy recommendations focus on improving watershed conditions by preserving green infrastructure, protecting groundwater, minimizing road salts, sustainable management of stormwater, and allowances for native landscaping. To be successful, the Wind Point Watershed-Based Plan would need to be adopted and local plans and ordinances would need to be updated with recommendations. The process of creating and implementing policy changes can be complex and time consuming. And, although there are numerous possible policy recommendations for the watershed, the following policy recommendations are considered the most important and highest priority for implementation.

Plan Adoption & Implementation Policy Recommendations

- Watershed Partners adopt the Wind Point Watershed-Based Plan and incorporate plan goals, objectives, and recommended actions into comprehensive plans and ordinances.

Green Infrastructure Network Policy Recommendations

- Each municipality consider incorporating the identified Green Infrastructure Network into comprehensive plans and development review maps.
- Utilize tools such as protection overlays, setbacks, open space zoning, conservation easements, conservation and/or low impact development, etc.

in municipal comprehensive plans and zoning ordinances to protect environmentally sensitive areas on identified Green Infrastructure Network parcels.

- Utilize tools such as Development Impact Fees, Stormwater Utility Taxes, Special Service Area (SSA) Taxes, etc. to help fund future management of green infrastructure components where new and redevelopment occurs.
- Encourage developers to protect sensitive natural areas, restore degraded natural areas and streams, then donate all natural areas and naturalized stormwater management systems to a public agency or conservation organization for long term management with dedicated funding such as Development Impact Fees, Stormwater Utility Taxes, Special Service Area (SSA) Taxes, etc. In general, it is not recommended that these features be turned over to HOA's to manage.
- Establish incentives for developers who propose sustainable or innovative approaches to preserving green infrastructure and using naturalized stormwater treatment trains.
- Consider limiting mitigation for wetlands lost to development to occur within the watershed.

Groundwater Policy Recommendations

- Encourage stormwater management practices that infiltrate water in any development or redevelopment.
- Limit impervious cover within new and redevelopments occurring within Subwatershed Management Units 2, 4, 6, 7, 12,

13, and 17 which are ranked as highly vulnerable to future impervious cover.

- Limit impervious cover and incorporate infiltration practices within new and redevelopments in areas having "High" to "Very High" groundwater recharge potential.

Road Salt Policy Recommendations

- Each municipality consider supplementing existing programs with deicing best management practices such as utilizing alternative deicing chemicals, anti-icing or pretreatment, controlling the amount and rate of spreading, controlling the timing of application, utilizing proper application equipment, and educating/training deicing employees.

Stormwater Management Facility Policy Recommendations

- Encourage new development and redevelopment to use stormwater management facilities that serve multiple functions including storage, water quality benefits, infiltration, and wildlife habitat.
- Consider reduced runoff volume from new and retrofitted detention basins.

Native Landscaping/Natural Area Restoration

- Allow native landscaping within local ordinances.
- Ensure local "weed control" ordinances do not discourage or prohibit native landscaping.
- Include requirements for short and long term management with performance standards for restored natural areas and stormwater features within new and redevelopment.

6.1.2 Dry & Wet Bottom Detention Basin Design/ Retrofits, Establishment, & Maintenance

Detention basins are best described as human made depressions for the temporary storage of stormwater runoff with controlled release following a rain event. There are 39 detention basins in Wind Point watershed and most are associated with residential and commercial development and do not necessarily benefit water quality and wildlife. Many existing wet bottom and dry bottom basins are planted with turf grass along the slopes and bottoms. These attributes do not promote good infiltration, water quality improvement, or wildlife habitat capabilities.

Studies conducted by several credible entities over the past two decades reveal the benefits of detention basins that serve multiple functions. According to USEPA, properly designed dry bottom infiltration basins can reduce total suspended solids (sediment) by 75%, total phosphorus by 65%, and total nitrogen by 60%. Wet bottom basins designed to have wetland characteristics can reduce total suspended solids (sediment) by 77.5%, total phosphorus by 44% and total nitrogen by 20%.

Detention Basin Recommendations

Future detention basin design within the watershed should consist of naturalized basins that serve multiple functions, including appropriate water storage, water quality improvement, natural aesthetics, and wildlife habitat. There are also a large number of opportunities to retrofit existing dry or wet bottom detention basins by incorporating minor engineering changes and naturalizing with native vegetation. Site specific retrofit opportunities are identified in the Site Specific Action Plan. Location, design, establishment, and long term maintenance recommendations for naturalized

detention basins are included below.

Detention Location Recommendations

- Naturalized detention basins should be restricted to natural depressions or drained hydric soil areas and adjacent to other existing green infrastructure where feasible in an attempt to aesthetically fit and blend into the landscape. Use of existing wetlands for detention should be evaluated on a case by case basis.
- Basins should not be constructed in any average to high quality ecological community.
- Outlets from detentions should not enter sensitive ecological areas.

Detention Design Recommendations

- One appropriately sized, large detention basin should be constructed across multiple development sites where feasible rather than constructing several smaller basins.
- Side slopes should be no steeper than 4H: 1V, planted to native prairie vegetation, and stabilized with erosion control blanket. Native oak trees (*Quercus sp.*) and other fire-tolerant species should be the only tree species planted on the side slopes for management purposes.
- Dry bottom basins should be planted to mesic, wet-mesic, or wet prairie.
- A minimum 5-foot wide shelf planted to native wet prairie and stabilized with erosion control blanket should be constructed above normal water level in wet and wetland bottom basins. This area should be designed to inundate after every 0.5 inch rain event or greater.
- A minimum 10-foot wide shelf planted with native emergent plugs should extend from normal water level to 2 feet below normal water level in wet and wetland bottom basins.
- Permanent pools in wet and wetland bottom basins should

be at least 4 feet deep.

- Irregular islands and peninsulas can be constructed in wet and wetland bottom basins to slow the movement of water through the basin to improve water quality. These features should be planted to native prairie.
- A 4-6 foot deep forebay can be constructed at the inlet(s) of wet and wetland bottom basins to capture sediment; a 4-6 foot deep micropool can also be constructed at the outlet to prevent clogging.

Short Term (3 Years) Native Vegetation Establishment Recommendations

Developers should generally be responsible for implementing short term management (three years) of detention basins and other natural areas to meet a set of performance standards. Measures needed include mowing during the first two growing seasons to reduce annual and biennial weeds. Spot herbiciding is required to eliminate problematic non-native/ invasive species. In addition, the inlet and outlet structures should be checked periodically for erosion and clogging. Table 36 includes a three year schedule appropriate to establish native plantings around naturalized detention basins.

Long Term (4 Years +) Native Vegetation Maintenance Recommendations

HOA's and businesses often lack the knowledge and funding to implement long term management resulting in the decline of these areas over time. Developers should be encouraged to donate naturalized detention basins and other natural areas to a local municipality or conservation organization for long term management who receive funding via a Special Service Area (SSA) tax or other means. Table 37 includes a cyclical long term schedule appropriate to maintain native vegetation around detention basins.

Figure 57. Naturalized dry bottom infiltration basin design.

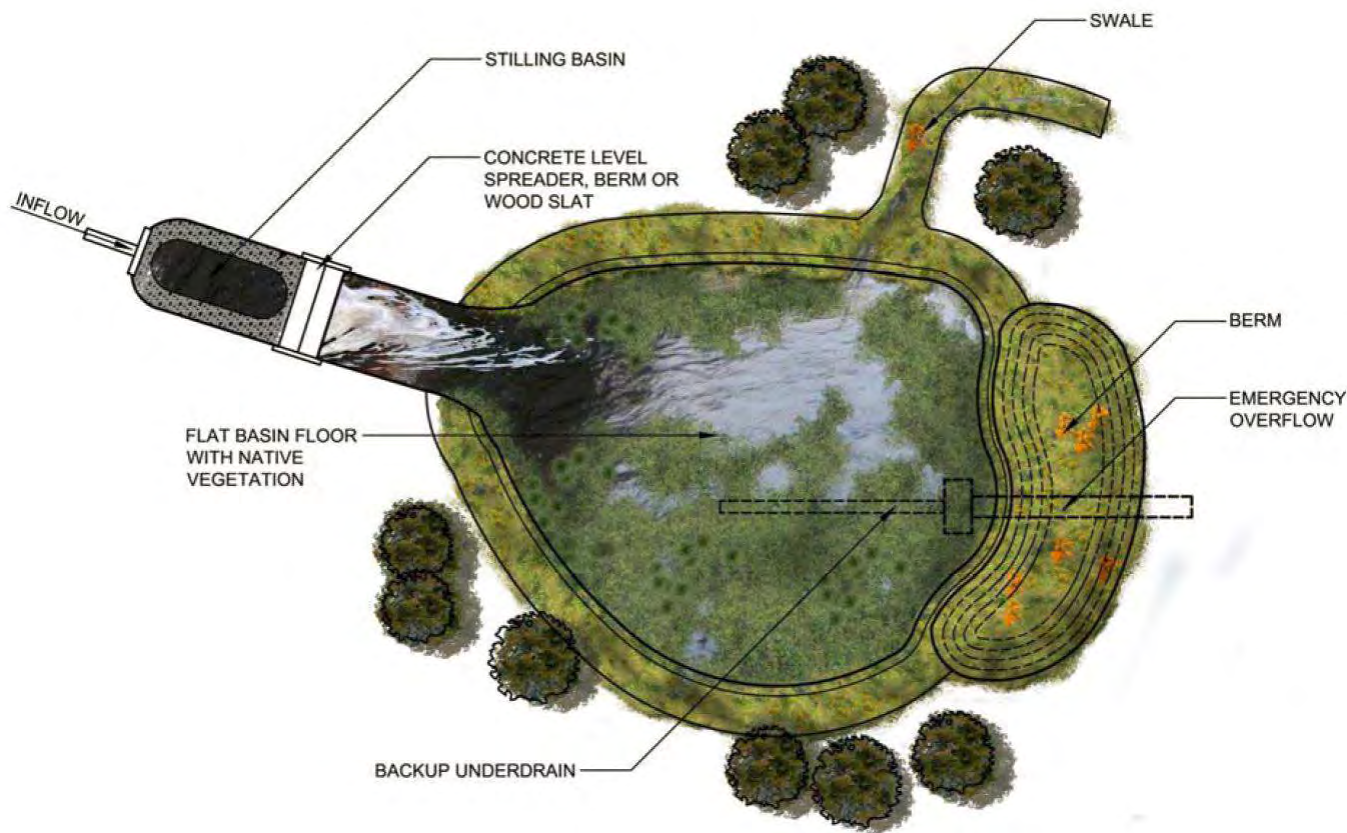


Figure 58. Naturalized wet bottom detention basin design.

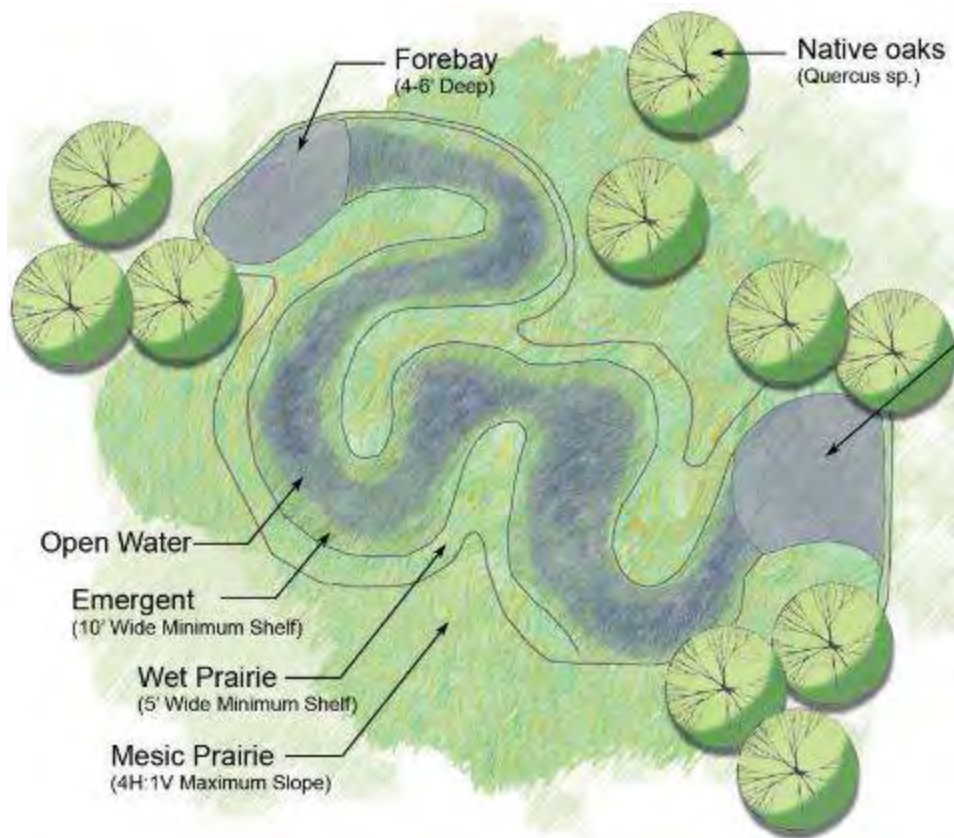


Table 36. Three-year vegetation establishment schedule for naturalized detention basins.

Year 1 Establishment Recommendations
Mow prairie areas to a height of 6-12 inches in May, July, and September.
Spot herbicide non-native/invasive species throughout site in late May and again in August/September. Target thistle, reed canary grass, common reed, purple loosestrife, and all emerging woody saplings.
Check for clogging and erosion control at inlet and outlet structures during every site visit.
Year 2 Establishment Recommendations
Mow prairie areas to a height of 12 inches in June and August.
Spot herbicide non-native/invasive species throughout site in May and again in August/September. Target thistle, reed canary grass, common reed, purple loosestrife, and all emerging woody saplings.
Plant additional emergent plugs if needed and reseed any failed areas in fall.
Check for clogging and erosion control at inlet and outlet structures during every site visit.
Year 3 Establishment Recommendations
Spot herbicide non-native/invasive species throughout site in May and again in August/September. Target thistle, reed canary grass, common reed, purple loosestrife, and all emerging woody saplings.
Check for clogging and erosion control at inlet and outlet structures during every site visit.

Table 37. Three year cyclical long term maintenance schedule for naturalized detention basins.

Year 1 of 3 Year Maintenance Cycle
Conduct controlled burn in early spring. Mow to height of 12 inches in November if burning is restricted.
Spot herbicide problematic non-native/invasive species throughout site in mid-August. Specifically target thistle, reed canary grass, common reed, and emerging woody saplings such as willow, cottonwood, buckthorn, and box elder.
Check for clogging and erosion control at inlet and outlet structures during every site visit.
Year 2 of 3 Year Maintenance Cycle
Spot herbicide problematic non-native/invasive species throughout site in August. Specifically target thistle, reed canary grass, common reed, and emerging woody saplings such as willow, cottonwood, buckthorn, and box elder.
Mow prairie areas to a height of 6-12 inches in November.
Check for clogging and erosion control at inlet and outlet structures during every site visit.
Year 3 of 3 Year Maintenance Cycle
Spot herbicide problematic non-native/invasive species in August. Specifically target thistle, reed canary grass, common reed, and emerging woody saplings. Cutting & herbiciding stumps of some woody saplings may also be needed.
Check for clogging and erosion control at inlet and outlet structures during every site visit.



Rain garden adjacent to single family home

6.1.3 Rain Gardens

Rain gardens have become a popular new way of creating a perennial garden that cleans and infiltrates stormwater runoff from rooftops and sump pump discharges. A rain garden is a small shallow depression that is typically planted with deep rooted native wetland vegetation. These small gardens can be installed in a variety of locations but work best when located in existing depressional areas or near gutters and sump pump outlets. Not only do rain gardens clean and infiltrate water, they also provide food and shelter for many birds, butterflies, and insects.

Rain Garden Recommendations Education programs in the watershed should focus on teaching residents and businesses the beneficial uses of rain gardens. Local governments in the watershed should also install demonstration rain gardens as a way for the general public to better understand their application. The Root-Pike Watershed Initiative Network website contains valuable information for anyone wanted to construct a rain garden. The website contains information related to calculating costs, finding professional landscapers, and recommends appropriate native plants and plant retailers. In addition, rain gardens can be

registered as part of Root-Pike WIN's Rain Garden Initiative - see rootpikewin.org/ for more information. A second valuable rain garden resource was produced by WDNR and UW-Extension entitled "*Rain Gardens- a how-to manual for homeowners*" (WDNR, 2003). This document provides details on how a homeowner can design and install a rain garden and can be found at clean-water.uwex.edu/pubs/rain_garden.

6.1.4 Vegetated Swales (Bioswales)

Vegetated swales, also known as bioswales, are designed to convey water and can be modified slightly

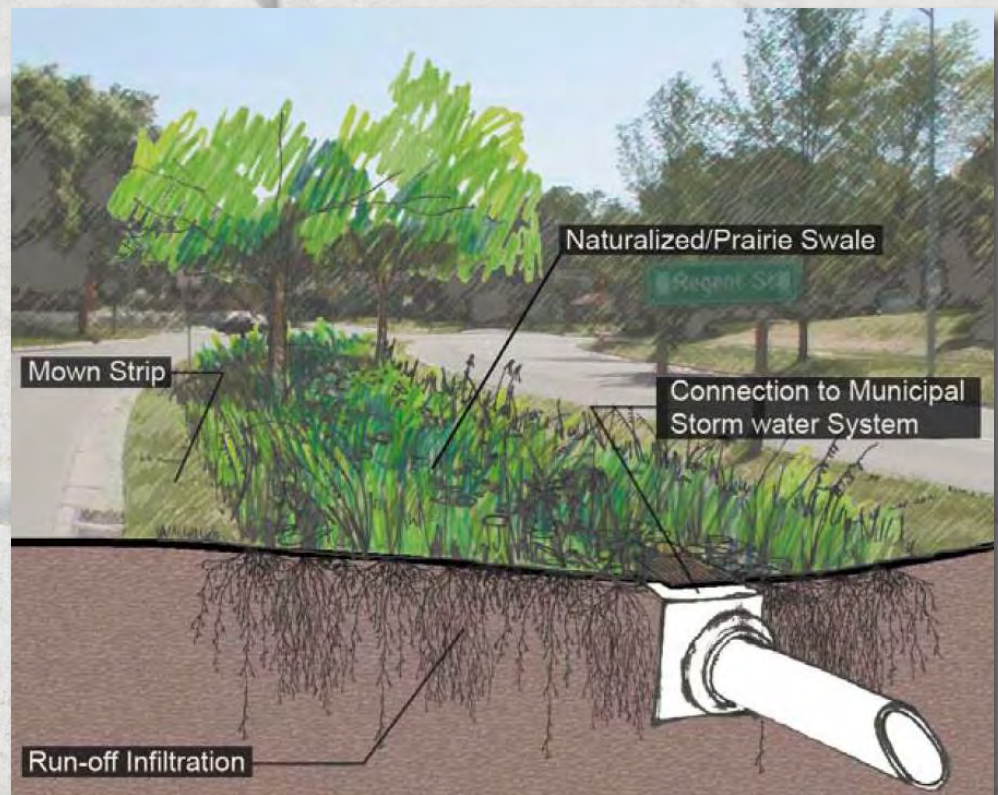
to capture and treat stormwater for the watershed. Vegetated swales are designed to remove suspended solids and other pollutants from stormwater running through the length of the swale. The type of vegetation can dramatically affect the functionality of the swale. Turf grass is not recommended because it removes less suspended solids than native plants. In addition, vegetated swales can add aesthetic features along a roadway or trail. They can be planted with wetland plants (preferably native) or a mixture of rocks and plant materials can be used to provide interest.

Swales can be designed as either wet or dry swales. Dry swales include an underdrain system that allows filtered water to move quickly through the stormwater treatment train. Wet swales retain water in small wetland like basins along the swale. Wet swales act as shallow, narrow wetland treatment systems and are often used in areas with poor soil infiltration or high water tables.

Water quality is improved by filtration through engineered soils in dry swales and through sediment accumulation and biological systems in wet swales. According to USEPA, vegetated swales reduce total suspended solids (sediment) by 65%, total phosphorus by 25%, and total nitrogen by 10%.

Vegetated Swale Recommendations

Vegetated swales should be used to replace pipes or curbs in new and redevelopment where feasible. Swales can easily be integrated into various urban fabrics with curb cuts for water to access them from roadways, or they can be added between existing lots or in the grassy parkways between roads and sidewalks. Typically swales are used in lower density settings where infiltration might be maximized. Dry swales should be used for smaller development areas with small drainages. Wet swales should be used



Above: Dry vegetated swale rendering. Overlay: One type of pervious pavement.

along larger roadways, small parking areas, and commercial developments.

6.1.5 Pervious Pavement & Porous Asphalt

Pervious pavement and porous asphalt are used in place of traditional impervious paving materials to decrease the total amount of runoff leaving a site by promoting infiltration of stormwater runoff into the ground. Other benefits include filtering of contaminants from runoff, reducing peak velocity and volume of runoff thereby alleviating flooding downstream, groundwater recharge, and less need for stormsewers.

Traditionally, the quantity and quality of water running off paved surfaces, together with buildings, are the primary reason for stormwater treatment. Pervious surfaces reduce runoff rates and volumes and can be used in almost every capacity in which traditional asphalt, concrete, or pavers are used. Pervious surfaces captures first flush rainfall

events and allows water to percolate into the ground. It also allows for stormwater to be treated through soil biology and chemistry as the water slowly infiltrates. Groundwater and aquifers are recharged and water that might otherwise go directly to stormsewers will slowly infiltrate, reducing flooding and peak flow rates entering streams. Studies documented by USEPA show that properly designed and maintained pervious surfaces can reduce total suspended solids (sediment) by as much as 90%, total phosphorus by 65%, and total nitrogen by up to 85%.

Pervious Pavement and Porous Asphalt Recommendations

Future development and redevelopment should consider the use of pervious pavement & porous asphalt. Certain policy requirements should also be considered for using these products in important groundwater recharge areas. Pervious surfaces can be used in a variety of settings including parking lots, parking aprons, private roads, fire lanes, residential driveways, sidewalks, and bike paths.

6.1.6 Riparian Buffers

Riparian buffers are defined as land adjoining any water body including ponds, lakes, streams, and wetlands. In 2010 the Southeastern Wisconsin Regional Planning Commission (SWRPC) produced a document entitled “Managing the Water’s Edge: Making Natural Connections” (SWRPC 2010). The research presented in this document was conducted to determine if an optimal riparian buffer design or width could be determined that effectively reduces pollutants, provides water quality protection, helps prevent channel erosion, provides adequate fish and wildlife habitat, enhances environmental corridors, augments baseflow, and moderates water temperature.

Interestingly, no consensus of optimal buffer width could be determined but what is apparent is that many riparian corridors no longer fulfill their potential due to encroachment by agricultural and urban development. SEWRP’s document summarizes how to maximize both water quality protection and conservation of aquatic and terrestrial wildlife populations using buffers as shown in Figures 59 and 60.

Riparian Buffer Recommendations
As described in SERWPC’s document, the use of “Environmental Corridors” or what is also known as green infrastructure to connect open space and other natural area features should be embraced and the minimum Goals

of 75 should be achieved where feasible whereby 75% minimum of the total stream length should be naturally vegetated to protect the functional integrity of the water resource and 75 foot wide minimum riparian buffers are recommended from the top edge of each stream bank that are naturally vegetated to protect water quality. SEWRPC also recommends that new development should incorporate water quality and wildlife enhancement or improvement objectives by creating green infrastructure and buffer linkages. This can be achieved by maintaining a minimum 150 foot protection area around isolated riparian features. This protection area consists of optimal core habitat that is protected with minimized edge effects (Figure 60).

Figure 59. Riparian function, pollutant removal, and wildlife benefits for various buffer widths (Source: SEWRPC 2010).

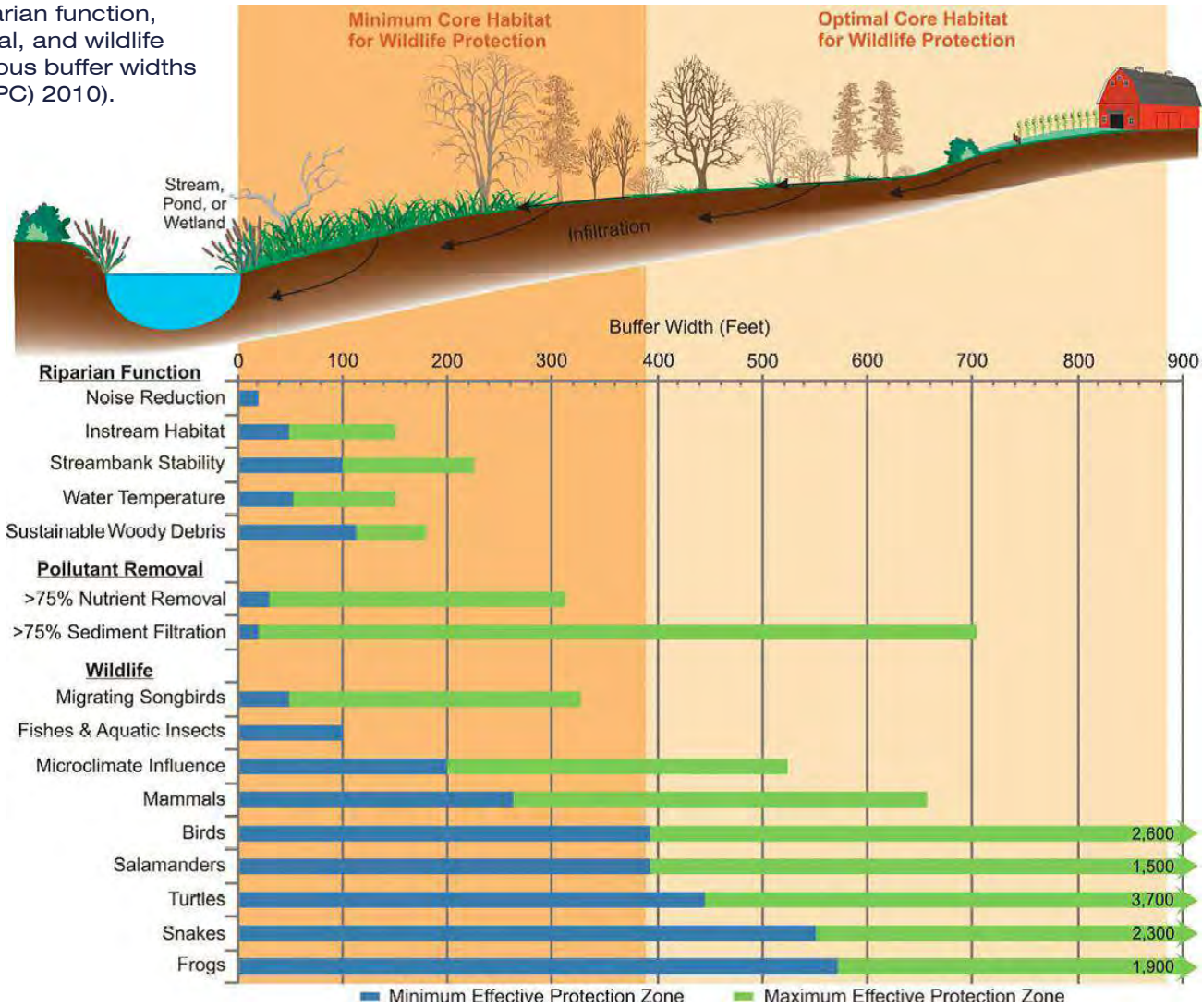
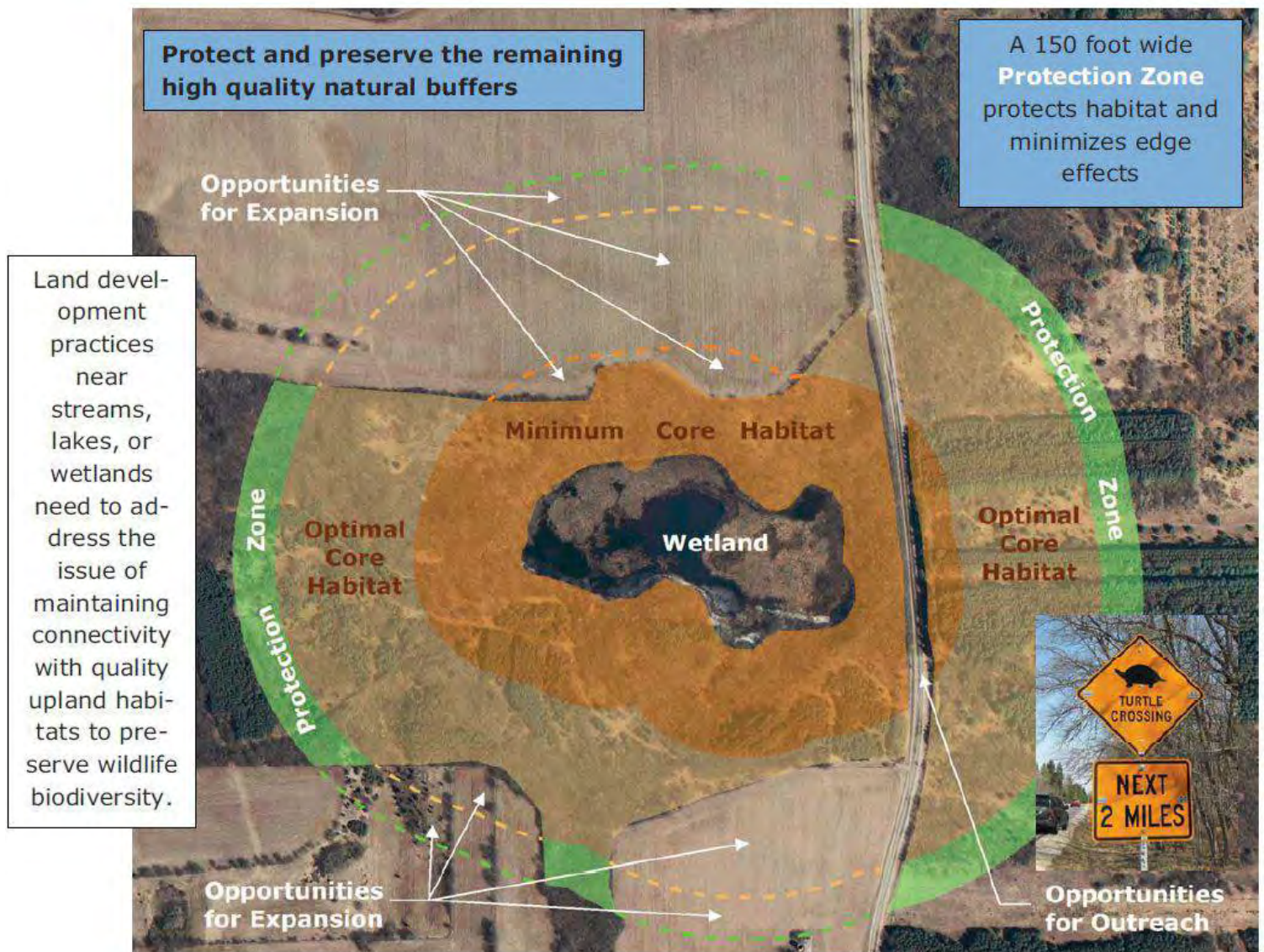


Figure 60. Riparian area core habitat and protection zones (Source SEWRPC 2010).



6.1.7 Natural Area Restoration & Native Landscaping

Natural area restoration and native landscaping are essentially one in the same but at different scales. Natural area restoration involves transforming a degraded natural area into one that exhibits better ecological health and is typically done on larger sites such as publically owned open space. Native landscaping is done at smaller scales around homes or businesses and is often formal in appearance. Both require the use of native plants to create environments that mimic historic landscapes of the Midwest

such as prairie, woodland, and wetland. Native plants are defined as indigenous, terrestrial or aquatic plant species that evolved naturally in an ecosystem. The use of native plants in natural areas or native landscaping is well documented. They adapt well to environmental conditions, reduce erosion, improve water quality, promote water infiltration, do not require fertilizer, provide wildlife food and habitat, and have minimal maintenance costs.

Natural Area Restoration/Native Landscaping Recommendations
Large residential lots with existing natural components and rough

areas within golf courses provide many of the best opportunities for natural area restoration and native landscaping at a larger scale. Homeowners interested in restoring natural areas or implementing native landscaping can find guidance through Root-Pike Watershed Initiative Network (WIN) or by contacting an Ecological Consulting company. Backyard habitats can be certified through the National Wildlife Federation's Certified Wildlife Habitat program.

Shoop Park Golf Course is the only golf course in the watershed and is situated along Lake Michigan in the

Village of Wind Point. The course could be improved ecologically and serve as more functional green infrastructure by implementing natural area restoration into existing designs. The Audubon Cooperative Sanctuary Program (ACSP) is an education and certification program that helps golf courses protect the environment by providing guidance for outreach and education, resource management, water quality and conservation, and wildlife habitat management. A golf course becomes certified under the program when implementing and documenting recommended environmental management practices. Annual program membership fees are \$200.

6.1.8 Wetland Restoration

Over 2,300 acres or 80% of the historic wetlands in Wind Point watershed have been lost to farming and other development practices since European settlement in the 1830s. Wetlands are one of the most important habitat types for harboring plant and animal diversity, as well as for protecting surface water quality, and reducing flooding. These potential benefits make wetland restoration highly beneficial and rewarding.

Approximately 267 acres of drained wetland was discovered in areas of the watershed where wetland restoration might be possible but many of these areas are located on land that is currently in agricultural production, golf course land, or land likely to be mined in the future. The wetland restoration process involves returning hydrology (water) and vegetation to soils that once supported wetlands. The USEPA estimates that wetland restoration projects can reduce suspended solids (sediment) by 77.5%, total phosphorus by 44%, and total nitrogen by 20%.

Wetland Restoration Recommendations
Municipalities should strongly consider requiring "Conservation



Clockwise from above: Native landscaping near residential home (source: Mike Halverson); Wetland restoration within Conservation Development; Dune restoration at North Beach Park.

Design" that incorporates wetland restoration on parcels slated for future development. Another potential option is to restore wetlands as part of a wetland mitigation bank where wetlands are restored on private or public land and become "fully certified." Then, developers are able to buy wetland mitigation credits from the wetland bank for wetland impacts occurring elsewhere in the watershed. It may also be possible for owners of wetland mitigation banks to sell "water quality trading credits" to wastewater treatment plants that produce phosphorus in effluent that exceeds state standards. The Site Specific Action Plan section of this report identified sites where wetland restoration might be feasible.

6.1.9 Dune Swales Restoration

The idea of restoring dune swales along Lake Michigan as a mitigation measure is a relatively new idea that was spearheaded by the City of Racine

Parks & Health Departments in 2004 between Kid's Cove Playground and North Beach Oasis. Dunes were strategically placed and planted adjacent in this area to address several issues impacting beach management practices and water quality. The result of the project is a dune system that utilizes vegetation as a means of controlling wind-blown sand, provides a natural landscape, deters roosting gulls, and aids in the infiltration of non-point source runoff from nearby impervious surfaces thereby preventing polluted stormwater from entering the near shore waters.

Dune Swale Restoration Recommendations

There are likely many opportunities for dune swale restoration along the coast of Lake Michigan within Wind Point Watershed. Local municipalities and other entities should use the example at North Beach and implement similar restorations as a way to enhance green infrastructure along the lake.





Top: Routine street sweeping is an effective Management Measure. Source: USGS.
Bottom: Stream restoration project example.



6.1.10 Street Sweeping

Street sweeping is often overlooked as a Management Measure option to reduce pollutant loading in watersheds. With approximately 1,400 acres of roads accounting for about 10% of the watershed, municipal street sweeping programs could significantly reduce non-point source pollutants from urban areas in Wind Point watershed. Street sweeping works because pollutants such as sediment, trash, road salt, oils, nutrients, and metals that would otherwise wash into stormsewers and streams following rain events are gathered and disposed of properly. The USEPA and Center for Watershed Protection (CWP) report similar pollutant removal efficiencies for street sweeping; weekly street sweeping can remove between 9% and 16% of sediment and between 3% and 6% of nitrogen and phosphorus. This is equivalent to removing about 200 tons/year sediment and 122 lbs/yr phosphorus and nitrogen from 1,400 acres of roads in the watershed.

Street Sweeping Recommendations

It is likely that several if not all of the municipalities in the watershed already implement street sweeping to some degree. The frequency of street sweeping is a matter of time and budget and should be determined by each municipality. Weekly street sweeping would provide the best results but bi-weekly sweeping is cited as being sufficient in most cases.

6.1.11 Stream, Ravine, & Riparian Area Restoration & Maintenance

The leading causes of degraded stream conditions in Wind Point watershed are channel modification and degraded riparian areas. Streambank erosion is generally problematic only where various streams become ravines along Lake Michigan. Stream surveys reveal that about 35% (34,950 linear feet) of stream length in the watershed is highly channelized. Another 31% (29,639 linear feet) is moderately channelized. 45% of riparian areas are in poor condition. Severe erosion is occurring along 7% (5,448 linear feet) of stream length within ravines. Pollutant modeling indicates that approximately 5,600 tons/yr of sediment or 59% of sediment loading comes from eroded streambanks and ravines within the watershed.

Stream and ravine restoration requires more data, more paperwork, and more negotiating than most other kinds of restoration projects. Permits are required for even the simplest component such as bank stabilization. After getting through regulatory hurdles, stream/ravine restoration is one of the best Management Measures that can be implemented to improve degraded stream and riparian area conditions. This work involves improvements to a stream channel using artificial pool-riffle complexes, streambank stabilization using a combination of bioengineering with native vegetation and hard armoring

with rock if needed, and adjacent riparian area improvements via removal of non-native vegetation and replacement with native species. These practices are typically done together as a way to improve water quality by reducing sediment transport, increasing oxygen, and improving habitat. The USEPA reports that as much as 90% of sediment, phosphorus, and nitrogen can be reduced following stream restoration. The downside to stream restoration is that it is technical and expensive. Stream restoration projects include detailed construction plans, often complicated permitting, and construction that must be done by a qualified contractor.

With so many individual landowners with parcels intersecting the tributary streams in the watershed, routine maintenance of stream systems is challenging. In many cases, landowners simply do not have the knowledge or are not physically capable of maintaining streams on their property. Stream maintenance includes an ongoing program to remove blockages caused by accumulated sediment, fallen trees, etc. and is a cost effective way to prevent flooding and streambank erosion.

Stream , Ravine, & Riparian Area Recommendations

There are many opportunities to implement stream, ravine, and riparian area restoration in the watershed. These opportunities are identified in the Site Specific Action Plan. As far as stream maintenance goes, agencies such as the

Wisconsin Department of Natural Resources (WDNR), University of Wisconsin-Extension, and Root-Pike Watershed Initiative Network (WIN) can help guide land management for riparian owners. In addition, the American Fisheries Society has created a short document called "Stream Obstruction Removal Guidelines" which is meant to clarify the appropriate ways to maintain obstructions in streams to preserve fish habitat.

6.1.12 Septic System Maintenance

The number of households and businesses on septic systems in Wind Point watershed is not well known. However, many older residential developments in rural areas are likely on septic. When septic systems are not maintained and fail they can contribute high levels of nutrients and bacteria to the surrounding environment. Literature sources from USEPA indicate a general septic system failure rate of between 2% and 5%.

Septic System Recommendations
Septic owners should become compliant with sewage treatment and disposal ordinances and have routine inspections and sampling completed at least every six months. The USEPA provides an excellent guide for septic system owners called "A Homeowner's Guide to Septic Systems (USEPA, 2005)." The guide explains how septic systems work, why and how they should be maintained, and what makes a system fail.

6.1.13 Agricultural Management Practices

Much of Wind Point watershed has been developed to residential, commercial, and industrial uses but 1,311 acres of agricultural land remain in 2012. This accounts for 11% of the watershed area. Pollutant loading estimates using USEPA's STEPL model point to agricultural land as a significant contributor of nutrients and sediment in runoff. In fact, agricultural areas are estimated to contribute about 11,197 lbs/yr (37.5%) of nitrogen, 2,689 lbs/yr (15.7%) of phosphorus, and 1,432.4 tons/yr (15%) sediment. Fortunately, there are numerous agricultural measures and funding sources that can be used by farmers to protect water quality. Many recommended programs are offered through the United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS). The following is a summary of USDA 2014 Farm Bill and Wisconsin NRCS agricultural programs that have environmental benefits: (www.usda.gov/wps/portal/usda/usdahome).

2014 Farm Bill Financial Assistance Programs

NRCS offers financial and technical assistance to help agricultural producers make and maintain conservation improvements on their land:

Environmental Quality Incentive Program (EQIP)

The NRCS's Environmental Quality Incentive Program (EQIP) is a voluntary conservation program that provides financial assistance to individuals/entities to address soil, water, air, plant, animal and other related natural resource concerns on their land. EQIP offers financial and technical help to assist participants to install or implement structural and management practices on eligible agricultural land.

Conservation Stewardship Program (CSP)

The Conservation Stewardship Program helps agricultural producers maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resources concerns. Participants earn CSP payments for conservation performance - the higher the performance, the higher the payment. The benefit is improved resource condition including soil quality, water quality and quantity air quality, and habitat quality. CSP provides two types of payments through five-year contracts: annual payments for installing new conservation activities and maintaining existing practices; and supplemental payments for adopting a resource-conserving crop rotation.

2014 Farm Bill Easement Programs

NRCS offers easement programs to eligible landowners to conserve working agricultural lands, wetlands, grasslands and forestlands:

Agricultural Conservation Easement Program (ACEP)

The Agricultural Conservation Easement Program (ACEP) provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits.

Agricultural Land Easements NRCS provides financial assistance to eligible partners for purchasing Agricultural Land Easements that protect the agricultural use and conservation values of eligible land. The program protects grazing uses and related conservation values by conserving grassland, including rangeland, pastureland and shrubland. Under the Agricultural Land component, NRCS may contribute up to 50 percent of the fair market value of the agricultural land easement. Where NRCS determines that grasslands of special environmental significance will be protected, NRCS may contribute up to 75 percent of the fair market value of the agricultural land easement.

Wetland Reserve Easements provide habitat for fish and wildlife, including threatened and endangered species, improve water quality by filtering sediments and chemicals, reduce flooding, recharge groundwater, protect biological diversity and provide opportunities for educational, scientific and limited recreational activities.

NRCS provides technical and financial assistance directly to private landowners and Indian tribes to restore, protect, and enhance wetlands through the purchase of a wetland reserve easement. Through the wetland reserve enrollment options, NRCS may enroll eligible land through:

- **Permanent Easements** – conservation easements in perpetuity. NRCS pays 100 percent of the easement value for the purchase of the easement. Additionally, NRCS pays between 75 to 100 percent of the restoration costs.
- **30-year Easements** – 30-year easements expire after 30 years. NRCS pays 50 to 75 percent of the easement value for the purchase of the easement. Additionally, NRCS pays between 50 to 75 percent of the restoration costs.
- **Term Easements** - easements that are for the maximum duration allowed under applicable State laws. NRCS pays 50 to 75 percent of the easement value for the purchase of the term easement. Additionally, NRCS pays between 50 to 75 percent of the restoration costs.

Healthy Forests Reserve Program (HFRP)

The Healthy Forests Reserve Program (HFRP) helps landowners restore, enhance and protect forestland resources on private lands through easements and financial assistance. Through HFRP, landowners promote the recovery of endangered or threatened

species, improve plant and animal biodiversity and enhance carbon sequestration.

HFRP provides landowners with 10-year restoration agreements and 30-year or permanent easements for specific conservation actions. For acreage owned by an Indian tribe, there is an additional enrollment option of a 30-year contract. Some landowners may avoid regulatory restrictions under the Endangered Species Act by restoring or improving habitat on their land for a specified period of time.

2014 Farm Bill Partnership Programs

NRCS works with partners to leverage additional conservation assistance for agricultural producers and landowners in priority conservation areas:

Regional Conservation Partnership Program (RCPP)

The Regional Conservation Partnership Program (RCPP) promotes coordination between NRCS and its partners to deliver conservation assistance to producers and landowners. NRCS provides assistance to producers through partnership agreements and through program contracts or easement agreements. RCPP encourages partners to join in efforts with producers to increase the restoration and sustainable use of soil, water, wildlife and related natural resources on regional or watershed scales.

Other 2014 Farm Bill Programs

Agricultural Conservation Experienced Services (ACES)

Through the Agriculture Conservation Experienced Services (ACES) Program, experienced workers, age 55 and over, help NRCS employees provide technical services in support of conservation. NRCS enters into agreements with nonprofit organizations that provide ACES workers on a part-time or full-

time basis. NRCS provides funds, office space, position descriptions, work assignments and oversight for the ACES positions, while the nonprofit organization handles advertising, recruiting, hiring and payroll for each position.

Conservation Innovation Grants (CIG)

Conservation Innovation Grants (CIG) are competitive grants that stimulate the development and adoption of innovative approaches and technologies for conservation on agricultural lands. CIG accelerates technology development and transfer, and the adoption of promising technologies and approaches to address some of the nation's most pressing natural resource concerns. NRCS identifies successful projects for potential integration of technologies and approaches into NRCS' toolkit of conservation practices.

Emergency Watershed Protection Program (EWP)

The purpose of the Emergency Watershed Protection Program (EWP) was established by Congress to respond to emergencies created by natural disasters. The EWP Program is designed to help people and conserve natural resources by relieving imminent hazards to life and property caused by floods, fires, drought, windstorms, and other natural occurrences.

Wisconsin NRCS Programs

Cooperative Conservation Partnership Initiative (CCPI)

The CCPI provides funding for eligible partner organizations through grant agreements focusing on the priorities of the Environmental Quality Incentives Program or the Wildlife Habitat Incentives Program.

Conservation Stewardship Program (CSP)

The CSP will help owners and operators of agricultural lands maintain conservation stewardship

and implement and maintain additional needed conservation practices. The conservation benefits gained will keep farms and ranches more sustainable and profitable and increase the benefits through improved natural resources.

Conservation Technical Assistance (CTA)

Through Conservation Technical Assistance, NRCS assists landowners and land users, communities, units of state and local government, Tribes, and other Federal agencies in planning and implementing conservation systems.

Conservation Reserve Program (CRP)

CRP can reduce erosion, increase wildlife habitat, improve water quality, and increase forestland. Landowners set aside cropland with annual rental payments based on amount bid. Tree planting, wildlife ponds, grass cover, and other environmental practices are eligible practices. Land is accepted into the program if bid qualifies. Continuous signup is open for buffers, waterways and environmental practices. Periodic signups are announced throughout the year for other practices. The contract period is 10 years, 15 years if planting hardwood trees. It is transferable with change in ownership and public access is not required.

Environmental Quality Incentives Program (EQIP)

EQIP provides technical and financial help to landowners for conservation practices that protect soil and water quality. Grassed waterways, stream fencing, critical area planting, terraces, manure management systems including storage structures and barnyard runoff protection, and many other conservation practices are eligible for EQIP. Projects are selected based on environmental value. Contracts run for 1-10 years and may be eligible for financial assistance, up to \$300,000 for the life of the Farm Bill. Public Access is not required.

Forestry Programs

Forestry programs provide cost-sharing for forestry practices with 10 or more acres. Practices eligible include tree planting, site preparation for natural regeneration, timber stand improvement, etc. Landowners must agree to maintain practices for the estimated life span. A management plan is required but public access is not required.

Grassland Reserve Program

The Grassland Reserve Program (GRP) is a voluntary program for landowners and operators to protect grazing uses and other related conservation values by restoring and conserving eligible grassland and certain other lands through rental contracts and easements. When properly managed, grasslands can result in cleaner, healthier streams, and reduced sediment loads in water bodies. These lands are vital for the production of livestock forage and provide forage and habitat for maintaining healthy wildlife populations. They also add to the beauty of the landscape, provide scenic vistas and open space, provide for recreational activities and protect the soil from water and wind erosion.

Grazing Lands Conservation Initiative

The Grazing Lands Conservation Initiative is intended to provide technical, educational and other help to conserve and improve privately owned grazing and pasture lands. Intended practices include prescribed grazing, animal trails and walkways, and fencing.

Great Lakes Restoration Initiative

To improve the health of the Great Lakes, NRCS is providing financial

and technical resources to 8 states to improve water quality in the region. Through this Initiative, NRCS focuses on helping farmers implement conservation practices that reduce erosion, improve water quality, and maintain agricultural productivity in selected watersheds.

Wetlands Reserve Program (WRP)

The WRP provides an opportunity to restore wetlands previously altered for agricultural use. Eligible land is land which has been owned for one year and can be restored to wetland conditions. Landowners may restore wetlands with permanent or 30-year easements or 10-year contracts. Permanent easements pay 100% of the agricultural value of the land and 100% cost-sharing; 30-year easements pay 75% of the agricultural value and 75% cost-sharing; 10-year contract pays 75% cost-share only.

Wildlife Habitat Incentive Program (WHIP)

WHIP can develop or improve wildlife habitat on privately owned land through installation of in-stream structures, restoring prairies and oak savannas, providing brush management and control of invasive species. Almost any type of land is eligible, including agricultural and non-agricultural lands. WHIP provides funding to assist with restoration costs and public access is not required.

Other Agricultural Recommendations

Subsurface (Tile) Drainage Best Management Practices

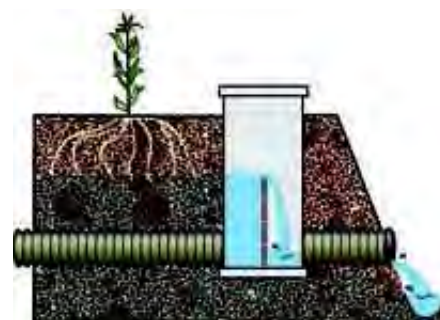
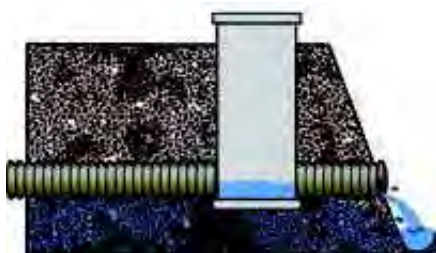
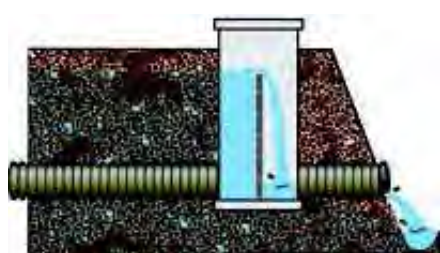
Subsurface drain tiles are a commonly used practice by farmers to help lower the water table of

poorly drained fields and/or wet areas within fields. Unfortunately, nitrogen and phosphorus often find their way into tiles through cracks and macropores in the soil. The tiles then carry these nutrients to local streams. Management of the water table through control structures at drain tile outlets is a promising approach to reduce the amount of nutrients that exit the tile lines (Figure 61). This is accomplished by adjusting the control structure so that the water table rises after harvest to limit drainage during the off-season. The water table can then be lowered a few weeks prior to planting in spring. The water table can also be raised in midsummer to store water for crops.

Waste (Manure) Management

Livestock production within the agricultural industry is a producer of waste materials that need management. These wastes include primarily manure from livestock. The NRCS has produced the "Agricultural Waste Management Field Handbook (AWMFH)" to provide specific guidance for planning, designing, and managing systems where agricultural wastes are involved. It can help assist agricultural producers in organizing a comprehensive plan that results in the integration of waste management into overall farm operations. Material in this handbook covers a wide range of activities from incorporating available manure nutrients into crop nutrient budgets to proper disposal of waste materials that do not lend themselves to resource recycling.

Figure 61. Use of tile control to raise water table after harvest (left), drawdown prior to seeding (middle), and raised again in midsummer (right) (Source: Purdue University)



6.1.14 Rainwater Harvesting & Re-use

Water harvesting and re-use via rain barrels and cisterns are important options to decrease the amount of stormwater runoff in a watershed. It is a simple, economical solution that can be done by any homeowner or business. On most homes and buildings, the water from roofs flows into downspouts and then onto streets, parking areas, or into stormsewers. Disconnecting the downspouts and using either rain barrels or cisterns for re-use later can reduce the flood levels in local streams.

Water re-use differs based on the type of storage and water treatment. A rain barrel is typically attached to a downspout and collects water for irrigation purposes. In many areas, residential irrigation can account for almost 50 percent of residential water consumption. Re-using water is a great way of minimizing water use and lowering water bills.

A cistern also stores water from rooftop runoff to be used later. However a cistern is often larger, sealed, and the water can be filtered for a wider variety of uses. With appropriate sanitation treatments, water from cisterns can even be reused for toilets, housecleaning, showers, hand washing, and dish washing. Cistern water, without any sanitation, can be used for lawn and garden watering, irrigation, car washing, and window cleaning.

The primary purpose of rain barrels and cisterns is water storage. Rain barrels typically store 55 gallons each. Cisterns can store greater amounts. Rain barrels and cisterns also reduce water demand in the summer months by reducing the potable water used for irrigation or other household uses.

Rainwater Harvesting & Reuse Recommendations

Education programs in the watershed should focus on teaching residents and businesses the beneficial uses of rain barrels



Rain barrel adjacent to residential home (source: Rainbarrelsource.com)

and cisterns. Local governments in the watershed should aim to install demonstration rain barrels as a way for the public to better engage in their use around residential homes. Local governments and

organizations such as Root-Pike Watershed Initiative Network (WIN) should begin to or continue sponsoring programs where residents and businesses can purchase rain barrels.

6.1.15 Conservation & Low Impact Development

The negative effects of “Traditional Development” are well documented. As additional residential and other development occurs within Wind Point watershed, it will be extremely important to consider development alternatives such as Conservation or Low Impact development. Caledonia, for example, is a proactive community in the watershed that has already introduced a Conservation Subdivision ordinance.

Conservation Development Design

Conservation Development design facilitates development density needs while preserving the most valuable natural features and ecological functions of a site. It does this by reducing lot size, especially lot width thereby reducing the amount of roads and infrastructure (Figures 62 & 63). The open space is typically preserved or restored natural areas that are integrated with newer natural Stormwater Treatment Train features and

recreational trails. The open space allows the residents to feel like they have larger lots because most of the lots adjoin the open space system.

Such flexibility is intended to retain or increase the development rights of the property owner and the number of occupancy units permitted by the underlying zoning designation, while encouraging environmentally responsible development. Conservation design is most appropriate in areas having natural and open space resources to be protected and preserved such as floodplains, groundwater recharge areas, wetlands, woodlands, streams, wildlife habitat, etc. It can also be used to preserve and integrate agricultural uses into the land pattern. The approach first takes into account the natural landscape and ecology of a development site rather than determining design features on the basis of pre-established density criteria. The general steps included below are generally followed when designing the layout of a development site:

Step 1: Identify all natural resources, conservation areas, open space areas, physical features, and scenic areas and preserve and protect these areas from any negative impacts generated as a result of the development.

Step 2: Locate building sites to take advantage of open space and scenic views by requiring smaller lot sizes or cluster housing as well as to protect the development rights of the property owner and the number of occupancy units permitted by the underlying zoning of the property.

Step 3: Design the transportation system to provide access to building sites and to allow movement throughout the site and onto adjoining lands; roads should not traverse sensitive natural areas.

Step 4: Prepare engineering plans which indicate how each building site can be served by essential public utilities

Figure 62. Stormwater Treatment Train within Conservation Development.



Figure 63. Traditional vs. Conservation Development Design (Elkhorn, WI)

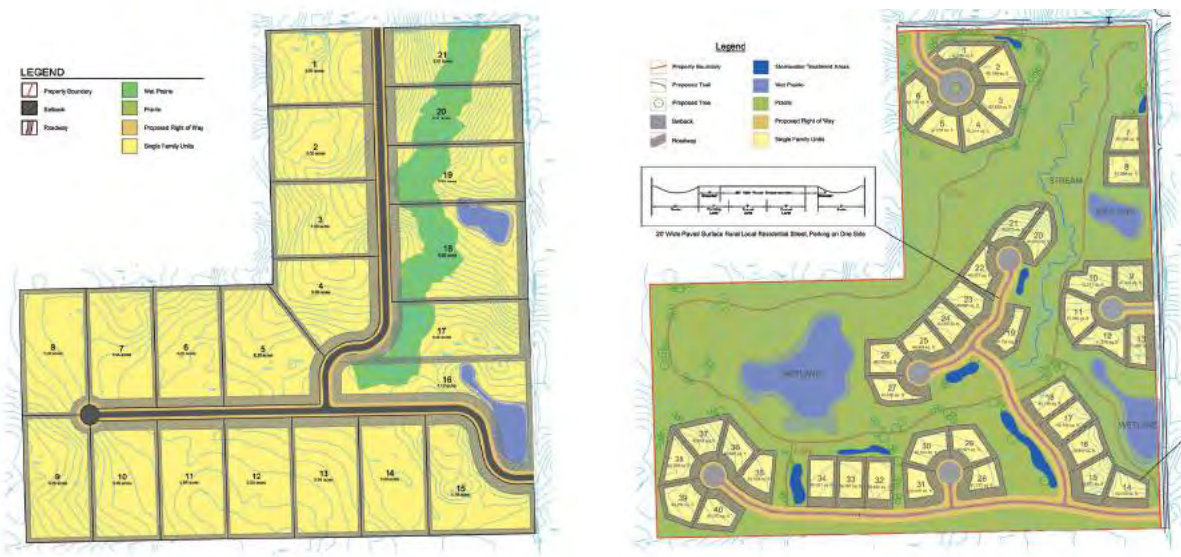


Figure 64. Conservation/Low Impact development design



Low Impact Development (LID)

Low impact development (LID) focuses on the hydrologic impact of development and tries to maintain pre-development hydrologic systems, treating water as close to the source as possible. LID principals can be incorporated into development or stormwater ordinances and used in new development or retrofitting existing developments. Green infrastructure systems are created to mimic natural processes that promote water infiltration, native plant evapotranspiration, and stormwater reuse.

Low impact development seeks to keep stormwater out of pipes and instead keep the entire infrastructure more natural and above ground. Solutions start at the lot scale such as rain gardens and overflows to swales adjacent to roads. Larger impervious areas, such as a commercial development may utilize constructed wetlands for stormwater storage while adding value to the area by enhancing aesthetics, site interest and the ecology. Milwaukee Metropolitan Sewerage District (MMSD) has been influential in determining pollutant reductions for various LID methodologies. The Noteworthy section below is a list of possible Management Measure practices, as described by MMSD in, "Evaluation of Stormwater Reduction Practices (MMSD, 2003)."

Figure 65. Greener Streetscape using LID practices. "Greening the Code" Washington County, OR



MMSD Recommended Management Measure Practices

Downspout Disconnection: Disconnection of roof downspouts from sewers or from direct runoff to other impervious land surfaces.

Rain Barrels: Collection of roof runoff in barrels, later used as irrigation.

Cisterns: Roof runoff collection systems that store water in a tank: water may be reused for toilet, laundry, and lawn watering purposes.

Rain Gardens: Small vegetated depressions used to capture water and promote infiltration and evapotranspiration.

Green Roofs: Soil and vegetation installed on top of a conventional flat or slightly sloped roof. A complete green roof system may include a watertight membrane, protective layer, insulation, irrigation system, drainage system, filter layer, soil, and plants.

Rooftop Storage: Temporary storage of rain on a flat roof and the gradual release of this volume using restricted roof drain inlets.

Green Parking Lots: Various measures used to reduce the impervious area of a parking lot and promote infiltration and/or evapotranspiration.

Stormwater Trees: Increasing tree canopies to provide stormwater interception and evapotranspiration.

Porous Pavement: The use of porous asphalt or concrete, modular block systems, grass pavers, or gravel pavers to allow stormwater infiltrate and not runoff.

Inlet Restrictors/Pavement storage: Grading and flow restrictors that allow the temporary storage of stormwater on streets and parking lots.

Bioretention: Landscaped depressions planted with grass, shrubs, and/or trees. Typically built with a sand/gravel underdrain, mulch, and soil amendments to maximize storage, infiltration and water cleansing.

Onsite Filtering Practices: Practices such as sand filters, bioretention cells, swales, and filter strips that use a filter media (sand, soil, gravel, peat, or compost) to reduce runoff and promote water cleansing.

Pocket Wetlands: Small constructed wetlands that can reduce peak flows and runoff volumes, and remove pollutants via settling and bio-uptake.

French Drains and Dry Wells: Gravel-filled trenches used to capture roof runoff and allow it to percolate into the soil.

Infiltration Sumps: Below ground, perforated, cylindrical, concrete structures used to collect stormwater and allow it to percolate into the soil.

Compost Amendments: Incorporating decomposed organic material into the soil to improve infiltration and vegetation performance.

Stormwater Policies: Land development and stormwater management criteria and requirements

Economics of Conservation Developments and Low Impact Development

Both conservation developments and low impact development (LID) are not only environmentally sound choices, but economical ones for both developers and municipalities. Conservation design can produce some of its biggest cost savings in infrastructure costs such as site preparation, stormwater management, site paving, and sidewalks (Conservation Research Institute, 2005). According to a study conducted by Applied Ecological Services, Inc., the average savings created by choosing conservation development over more traditional footprints is 24% (Table 38) (AES, 2007). Not only do lots in conservation developments typically cost less to install, but they also “carry a price premium ... and sell more quickly than lots in conventional subdivisions

(Mohamed, 2006).” Another study conducted in Concord, Massachusetts found that over an eight year period, a cluster development with protected open space had a 2.6% higher annual appreciation rate over “residential properties with significantly larger private yards, but without the associated open-space (Lacy, 1990).”

While low impact development covers a range of stormwater practices, it has some of the same cost benefits as conservation design. Typically LID practices “can cost less to install, have lower operations and maintenance costs, and provide more cost-effective stormwater management and water-quality services than conventional stormwater controls (ECONorthwest, 2007).” Similarly to conservation design, cost savings from utilizing LID practices can be found as a reduction in the amount

of drainage infrastructure and land disturbance required; additionally, property values can be increased by 12 - 16% (UNH Stormwater Center, 2011).

There is also evidence that combining both conservation and low impact development practices through holistic site design can create deeper cost savings for developers as well as increased ecosystem benefits – particularly by combining clustered site designing and naturalized stormwater management systems (Conservation Research Institute, 2005). Not only do conservation and low impact development practices provide a more economical possibility for developers and municipalities, but they can improve water quality, habitat, and property values in the watershed.

Table 38. Savings of Conservation Development over Traditional Subdivision Design for ten Midwestern conservation development projects.

Savings of Conservation Development over Traditional Subdivision Design (P=Project)

Positive numbers are savings of Conservation Development over Traditional.

Negative numbers are costs of Conservation Development over Traditional.

Project:	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Average
ITEM											
Grading	-\$214,740	\$257,832	\$1,813,726	\$2,215,025	\$1,856,206	\$1,862,988	\$796,705	\$291,957	\$302,497	\$2,852,312	51.00%
Roadway	\$84,702	\$18,754	-\$16,477	-\$130,230	\$1,464,599	\$1,187,386	\$205,168	\$9,231	-\$9,963	\$801,484	18.00%
Storm Sewer	\$181,611	\$31,220	\$6,648	\$89,676	\$974,689	\$547,184	\$210,289	\$65,501	\$110,021	\$678,302	40.00%
Sanitary Sewer	\$41,614	-\$4,365	\$0	-\$203,064	\$850,962	\$224,776	\$72,436	-\$15,502	\$5,960	\$423,458	6.00%
Water	\$44,483	-\$4,671	-\$63,680	-\$215,881	\$905,157	\$240,064	\$76,815	-\$16,257	\$5,973	\$451,084	5.00%
Ecological	-\$56,500	-\$74,857	-\$277,472	-\$400,321	-\$407,131	-\$625,084	-\$160,341	-\$93,954	-\$264,513	-\$380,992	-154.00%
Amenities	\$17,572	-\$16,202	-\$94,399	-\$226,216	\$552,667	\$221,666	\$7,825	-\$15,749	-\$39,274	\$266,982	6.00%
Contingencies	\$132,055	\$51,928	\$342,087	\$282,247	\$1,549,287	\$914,745	\$302,225	\$56,307	\$27,675	\$1,273,157	24.00%
Total Savings	\$660,277	\$259,639	\$1,710,433	\$1,411,235	\$7,746,436	\$4,573,725	\$1,511,124	\$281,534	\$138,377	\$6,365,787	
Total Percent Savings	19.00%	20.00%	33.00%	15.00%	43.00%	32.00%	25.00%	15.00%	4.00%	37.00%	24.30%*
Cost Savings Per Lot	\$8,725.00	\$6,978.00	\$147,012.00	\$29,012.00	\$7,904.00	\$20,077.00	\$7,346.00	\$4,078.00	\$4,959.00	\$67,676.00	\$30,376.70

* Total Savings Percentage is *not* the percentage savings of all individual Items added together, because dollar-values of Items are different.

Visit www.appliedeco.com for more detailed info.

6.1.16 Green Infrastructure Planning

A green infrastructure network provides communities with a tool to identify and prioritize land use or conservation opportunities and plan development that benefits both people and nature by providing a framework for future growth. It identifies areas not suitable for development, areas suitable for development but that should incorporate conservation or low impact design standards, and potential development areas that do not affect green infrastructure. Watershed stakeholders can use green infrastructure plans for trail routing, open space linkages, and natural area restoration decisions. Residents can use green infrastructure recommendations to reduce runoff from their properties and to see how their properties fit into the larger network. A Green Infrastructure Network for the watershed was developed in Section 3.11.

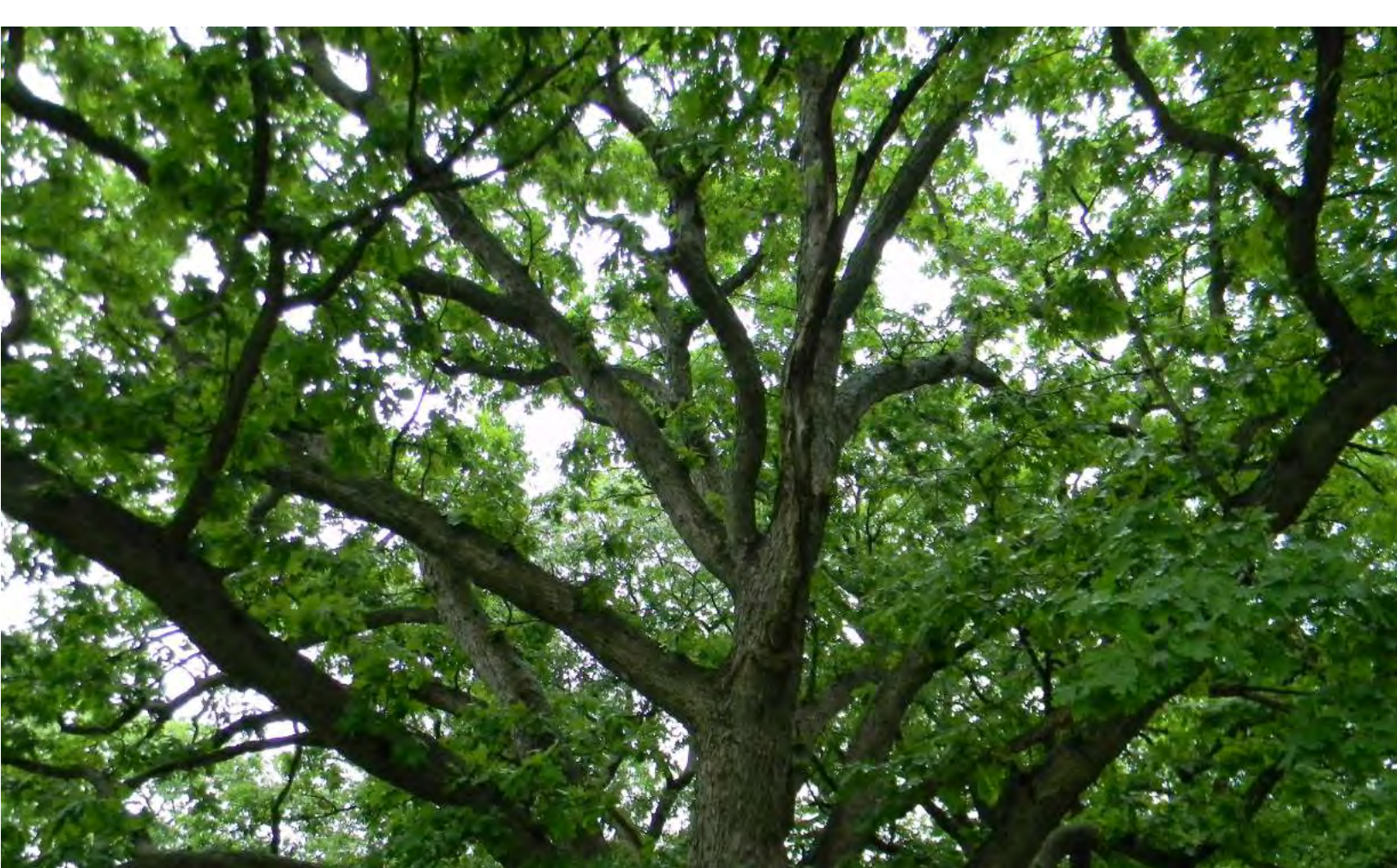
Green Infrastructure Network *implementation* has several actions:

- Protect specific unprotected green infrastructure parcels through acquisition, regulation, and/or incentives.
- Incorporate conservation or low impact design standards on green infrastructure parcels where development is planned.
- Limit future subdivision of green infrastructure parcels.
- Implement long term management of green infrastructure.

Green Infrastructure Recommendations

A Green Infrastructure Network can only be realized by coordinated planning efforts of local municipalities, park districts, developers, and private land owners. Stakeholders should follow the recommended process below to initiate and implement the Green Infrastructure Network for Wind Point watershed.

1. Include all green infrastructure parcels in updated community comprehensive plans and development review maps.
2. Create zoning overlay and update development ordinances to require conservation development/low impact design on all green infrastructure parcels.
3. Require Development Impact Fees and/or Special Service Area taxes for all new development to help fund future management of green infrastructure.
4. Identify important unprotected green infrastructure parcels not suited for development then protect and implement long term management.
5. Work with private land owners along stream/tributary corridors to manage their land for green infrastructure benefits.
6. Use the Green Infrastructure Network to identify new trails and trail connections.



6.1.17 Water Quality Trading & Adaptive Management

The following information is cited directly from a Wisconsin Department of Natural Resource's (WDNR) document entitled "A Water Quality Trading How To Manual" (WDNR 2013). Water Quality Trading (WQT or "trading") presents a way for municipal and industrial Wisconsin Pollutant Discharge Elimination System (WPDES) permit holders to demonstrate compliance with water quality-based effluent limitations (WQBELs). Generally, trading involves a point source facing relatively high pollutant reduction costs compensating another party to achieve less costly pollutant reduction with the same or greater water quality benefit. In other words, trading provides point sources with the flexibility to acquire pollutant reductions from other sources in the watershed to offset their point source load so that they will comply with their own permit requirements. Trading is not a mandatory program or regulatory requirement, but rather a market-based option that may enable some industrial and municipal facilities within Wind Point watershed to meet regulatory requirements more cost-effectively. Now that more restrictive water quality standards are effective in Wisconsin, such as those for phosphorus, trading may be economically preferable to other compliance options.

There are many benefits to trading:

1. Permit compliance through trading may be economically preferable to other compliance options.
2. New and expanding point source discharges can utilize trading to develop new economic opportunities in a region, while still meeting water quality goals.
3. Permittees, and the point and nonpoint sources that work cooperatively with them, can

demonstrate their commitment to the community and to the environment by working together to protect and restore local water resources.

Adaptive management is often confused with trading, as both options allow permittees to work with nonpoint or other point sources of phosphorus in a watershed to reduce the overall phosphorus load to a given waterbody. Adaptive management is solely focused on phosphorus compliance and improving water quality so that the applicable phosphorus criterion is met. Trading is not limited to phosphorus and may be used to meet limits for various compounds. Trading focuses on compliance with a discharge *limit* while adaptive management focuses on compliance with phosphorus *criteria*.

Water quality trading has seven components: pollutant, trading participants, pollution reduction credit, credit threshold, trade ratio, location, and timing (Figure 66). Each of these components must be adequately addressed in a trading strategy. The "pollutant" is simply the contaminant being traded. The "trading participants" are entities involved in the trade. "Credit" is the amount of a given pollutant that is available for trading. "Credit Threshold" is the amount of pollutant reduction that needs to be achieved before credits are generated. "Trade ratios" are put in place due to uncertainty margins. "Location" refers to the fact that the credit user and generator must discharge to the same waterbody. "Timing" is important because credits must be generated before they can be used to offsite the pollution.

Figure 66. Water quality trading components (source: WDNR).



6.1.18 Brownfield Redevelopment

Brownfields are parcels of land that once harbored industrial or commercial uses but have since been vacated. These sites often contain remnants of infrastructure and may have contaminated soils depending on what was located there previously and can be difficult to appropriately reuse. Nevertheless, the conversion of former brownfield sites into natural areas, parks, or open space can be a great way to reintroduce green spaces into highly urbanized areas.

The Lakefront Redevelopment Area is one such site in Wind Point watershed. The site is 250 acres of brownfield on the Lake Michigan shoreline within the City of Oak Creek. The City hired a consultant to engage citizens and stakeholders to help develop a vision for the site with the overall purpose to create an overall development framework for the site that provides public access to the lakefront. The results of the planning effort are included in a document entitled *Lakefront Redevelopment Action Plan* (City of Oak Creek 2011) that was adopted in February, 2012 (Figure 67). This plan follows in the footsteps of the 2009 effort by UW-Milwaukee that produced a document entitled *Lakeview Redevelopment Plan: City of Oak Creek, Wisconsin* (UW-Milwaukee 2009). Groups interested in brownfield redevelopment should follow a similar planning approach to that which was used for the Lakefront Redevelopment Area.

Funding for the redevelopment efforts should be leveraged through Tax Increment Financing (TIF) financing and brownfield and environmental remediation grants. Final redevelopment plans should also be refined through an intensive public planning workshop complemented by an in-depth market analysis. This will result in a final plan which has the support of the public and is rooted in economic realities.

Figure 67. Lakefront Redevelopment Plan (Source: Oak Creek 2011)



The Wisconsin Department of Natural Resources (WDNR) has a Remediation and Redevelopment program that oversees the investigation and cleanup of environmental contamination and the redevelopment of contaminated brownfields. This program provides a range of financial and liability tools available to assist local governments and other groups to clean up and redevelop brownfields in Wisconsin. In addition, The Brownfields Study Group was created in 1998 at the direction of the governor and State Legislature, to evaluate Wisconsin's current brownfields initiatives and recommend changes, as well as

propose additional incentives for the cleanup and reuse of brownfields. The Study Group continues to drive important brownfields policy changes in Wisconsin.

Grant monies from the state and federal government are often used in brownfield redevelopments, especially for projects with large amounts of brownfield and infill land. Available grants through the State of Wisconsin include those administered by the Department of Natural Resources and the Department of Commerce. Federal grants and loans from the US Environmental Protection Agency are available as well.

Additionally, the federal American Recovery and Reinvestment Act of 2009 designated spending in more than 130 different state and federal programs, with the majority of the funds flowing through existing programs. Nationwide funding has been approved for three federal environmental cleanup programs: \$600 million for Superfund sites; \$200 million for leaking underground storage tanks (LUSTS); and \$100 million for brownfields. The State of Wisconsin has received funding through this federal program to be used for LUSTS and brownfields.

6.2 Site Specific Management Measures Action Plan

Site Specific Management Measure (Best Management Practice [BMP]) recommendations made in this section of the report are backed by findings from the watershed field inventory, overall watershed resource inventory, and input from stakeholders. In general, the recommendations address sites where watershed problems and opportunities can best be addressed to achieve watershed goals and objectives. The Site Specific Management Measures Action Plan is organized by the jurisdiction in which recommendations are located making it easy for users to identify the location of project sites and corresponding project details. It is important to note that project implementation is voluntary and there is no penalty or reduction in future grant opportunities for not following recommendations. Site Specific Management Measures were identified within the following jurisdictional boundaries and are included in the Site Specific Action Plan:

- Caledonia
- North Bay
- Oak Creek
- Racine
- South Milwaukee
- Wind Point

Management Measure categories in

the Site Specific Action Plan include:

- Detention Basin Retrofits & Maintenance
- Wetland Restoration
- Streambank , Ravine, & Channel RestorationGreen Infrastructure Protection Areas
- Riparian Area Restoration & Maintenance
- Green Infrastructure Protection Areas
- Agricultural Management Practices
- Other Management Measures

Descriptions and location maps for each Management Measure category follow. Table 41 includes useful project details such as site ID#, Location, Units (size/length), Owner, Existing Condition, Management Measure Recommendation, Pollutant Load Reduction Efficiency, Priority, Responsible Entity, Sources of Technical Assistance, Cost Estimate, and Implementation Schedule.

Project importance, technical and financial needs, cost, feasibility, and ownership type were taken into consideration when prioritizing and scheduling Management Measures for implementation. High, Medium, or Low Priority was assigned to each recommendation. “Critical Areas” as discussed in Section 5.2 are all High Priority and highlighted in red on project category maps and the Action Plan table. For this watershed plan a “Critical Area” is best described as a location in

the watershed where existing or potential future causes and sources of an impairment or existing function are significantly worse than other areas of the watershed. Implementation schedule varies greatly with each project but is generally based on the short term (1-10 years) for High Priority/Critical Area projects and 10-20+ years for medium and low priority projects. Maintenance projects are ongoing

The Site Specific Management Measures Action Plan is designed to be used in one of two ways.

Method 1: The user should find the respective jurisdictional boundary (listed alphabetically in Table 41) then identify the Management Measure category of interest within that boundary. A Site ID# can be found in the first column under each recommendation that corresponds to the Site ID# on a map (Figures 68-74) associated with each category.

Method 2: The user should go to the page(s) summarizing the Management Measure category of interest then locate the corresponding map and Site ID# of the site specific recommendations for that category. Next, the user should go to Table 41 and locate the jurisdiction where the project is located, then go to the project category and Site ID# for details about the project.

Table 39. Percent pollutant removal efficiencies for various Management Measures.

Management Measures	TSS	TN	TP	Bacteria
Vegetated Filter Strips	73%	40%	45%	37%
Wet Pond/Detention	60%	35%	45%	70%
Wetland Detention	77.5%	20%	44%	78%
Dry Detention	57.5%	30%	26%	88%
Infiltration Basin	75%	60%	65%	90%
Streambank/Lake Shoreline Stabilization	90%	90%	90%	N/A
Weekly Street Sweeping	16%	6%	6%	N/A
Porous Pavement	90%	85%	65%	90%

Pollutant Load Reduction Estimates

Where applicable, pollutant load reductions and/or estimates for total suspended solids (TSS), nitrogen (TN), and phosphorus (TP) were evaluated for each recommended Management Measure based on efficiency calculations developed for the USEPA's Region 5 Model. This model uses "Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual" (MDEQ, 1999) to provide estimates of sediment and nutrient load reductions from the implementation of *agricultural* Measures. Estimate of sediment and nutrient load reduction from implementation of *urban* Measures is based on efficiency calculations used in the Region 5 model. Reduction estimates for bacteria such as *E. coli* are not included in these models.

Estimates of pollutant load reduction using the Region 5 Model are measured in weight/year (tons/yr for total suspended solids and lbs/yr for nitrogen and phosphorus). The model was generally used to calculate weight of pollutant reductions for all recommended High Priority-Critical Areas where calculation of such data is applicable. In summary, pollutant reductions were calculated for 8 detention basin retrofit projects, 8 wetland restoration projects, 4 streambank, ravine, & channel

restoration projects, 2 riparian area restoration projects, and 7 agricultural management projects. Spreadsheets used to determine pollutant load reductions can be found in Appendix E.

Estimated *percent* removal of total suspended solids, nitrogen, and phosphorus are included in the Action Plan table for most medium and low priority projects and those projects where calculation of pollutant weight reduction is beyond the scope of this project. The percent removal efficiencies for total suspended solids, nitrogen, and phosphorus were based on various Management Measures included in the Region 5 Model as shown in Table 39. Percent removal efficiencies for total bacteria such as *E. coli* were derived from the National Pollutant Removal Performance Database that was developed by the Center for Watershed Protection (CWP 2007).

Watershed-Wide Summary of Action Recommendations

All Site Specific Management Measures, Education Plan (Section 7.0), and Monitoring Plan (Section 9.1) recommendation information is condensed by Category in Table 40. This information provides a watershed-wide summary of the "Total Units" (size/length), "Total Cost," and "Total Estimate of Pollutant Load Reduction" if all the recommendations in the Site

Specific Management Measures Action Plan, Education Plan, and Monitoring Plan are implemented. Key points include:

- 3,238 acres of ecological restoration costing \$2,914,795.
- 117,016 linear feet of streambank/ravine restoration costing \$6,942,500.
- 118 acres and 86,758 linear feet maintenance costing \$150,100 per year.
- 10,910 tons/year of total suspended solids (TSS) would potentially be reduced each year exceeding 7,415 tons/yr Reduction Target identified in Section 5.0.
- 26,227 pounds/year of nitrogen (TN) would potentially be reduced each year.
- 11,886 pounds/year of phosphorus (TP) would potentially be reduced each year, exceeding the 9,605 pounds/year Reduction Target identified in Section 5.0.
- Education programs will cost \$67,750 over five years to implement (see Section 7.0).
- A water quality monitoring plan will cost at least \$160,000 to implement (see Section 9.0).

Table 40. Watershed-wide summary of Management Measures recommended for implementation.

Management Measure Category	Total Units (size/length)	Total Cost	Estimated Load Reduction		
			TSS (t/yr)	TN (lbs/yr)	TP (lbs/yr)
Detention Basin Retrofits & Maintenance*					
<i>Retrofits (prairie buffers, emergent plantings, etc.)</i>	114.5 acres	\$1,822,000	932.5	3,745	899
<i>Maintenance (burning, mowing, invasives, brushing, etc.)</i>	118 acres	\$54,100/yr	na	na	na
Wetland Restoration	445 acres	\$3,795,000	86.5	404	162
Streambank/Ravine & Channel Restoration*	16,758 lf	\$5,710,000	8,238	16,474	8,238
Riparian Buffer Restoration & Maintenance*					
<i>Riparian Areas</i>	86,758 lf	\$882,500	80.5	1,087	165
<i>Maintenance (burning, invasive control, brushing, etc.)</i>	86,758 lf	\$96,000/yr	na	na	na
Green Infrastructure Protection Areas**	1,403 acres	na	na	na	na
Agricultural Management Practices*					
<i>Conservation Tillage (no till) and Filter Strips Farming</i>	975 acres	na	1,573	4,517	2,422
Other Management Measures**					
<i>1 Dump Site Cleanup</i>	0.5 acres	\$183,000	na	na	na
<i>1 Bluff Erosion Feasibility Study</i>	4,500 lf	\$50,000	na	na	na
<i>5 Bioswale Projects</i>	9,000 lf	\$300,000	na	na	na
<i>1 Naturalized Detention Basin Construction</i>	0.5 acre	\$80,000	na	na	na
<i>Native Prairie Implementation at Shoop Park Golf Course</i>	30 acres	\$100,000	na	na	na
<i>5 Rain Garden Projects</i>	1 acre	\$51,000	na	na	na
<i>Short Native Prairie Implementation at Batten Airport</i>	150 acres	\$400,000	na	na	na
<i>1 Parking Lot Retrofit (Racine Municipal Parking Area)</i>	1 acres	\$200,000	na	na	na
Information/Education Plan	Entire Plan	\$60,750/5yr	na	na	na
Water Quality Monitoring Plan	Entire Plan	\$160,000	na	na	na
TOTALS	3,238 acres	\$2,914,795	10,910 tons/yr	26,227 lbs/yr	11,886 lbs/yr
	118 ac, 86,758 lf maintenance	\$150,100/yr			
	117,016 lf	\$6,942,500			
	Education	\$60,750/5yr			
	Monitoring	\$160,000			

* Pollutant load reduction calculated for applicable High Priority-Critical Area projects only.

** Pollutant load reductions were not or could not be calculated using STEPL/Win SLAMM or other modeling.

6.2.1 Detention Basin Retrofits & Maintenance Recommendations

Most detention basins within Wind Point watershed are designed primarily for stormwater storage and provide little in the way of water quality improvement, wildlife habitat, and green infrastructure connections. In the future it is recommended that new standards for detention basins be implemented in local and county development ordinances that reflect recommendations made in Section 6.1.2. Applied Ecological Services, Inc. (AES) conducted an inventory of 39 detention basins in fall of 2012. The results of the detention basin inventory are summarized in Section 3.14.2. Detailed field investigation datasheets and maps can be found in Appendix B.

The condition of detention basins in the watershed varies. Ten (10) dry bottom turf grass, 13 naturalized

wet or wetland bottom, and 16 wet or wetland bottom with turf slopes detention basins were inventoried. Of the 39 basins, 10 (26%) provide “Good” ecological and water quality benefits while 18 (46%) basins provide “Average” benefits. The remaining 11 (28%) basins provide “Poor” ecological and water quality benefits because most were designed to meet stormwater storage volume requirements only.

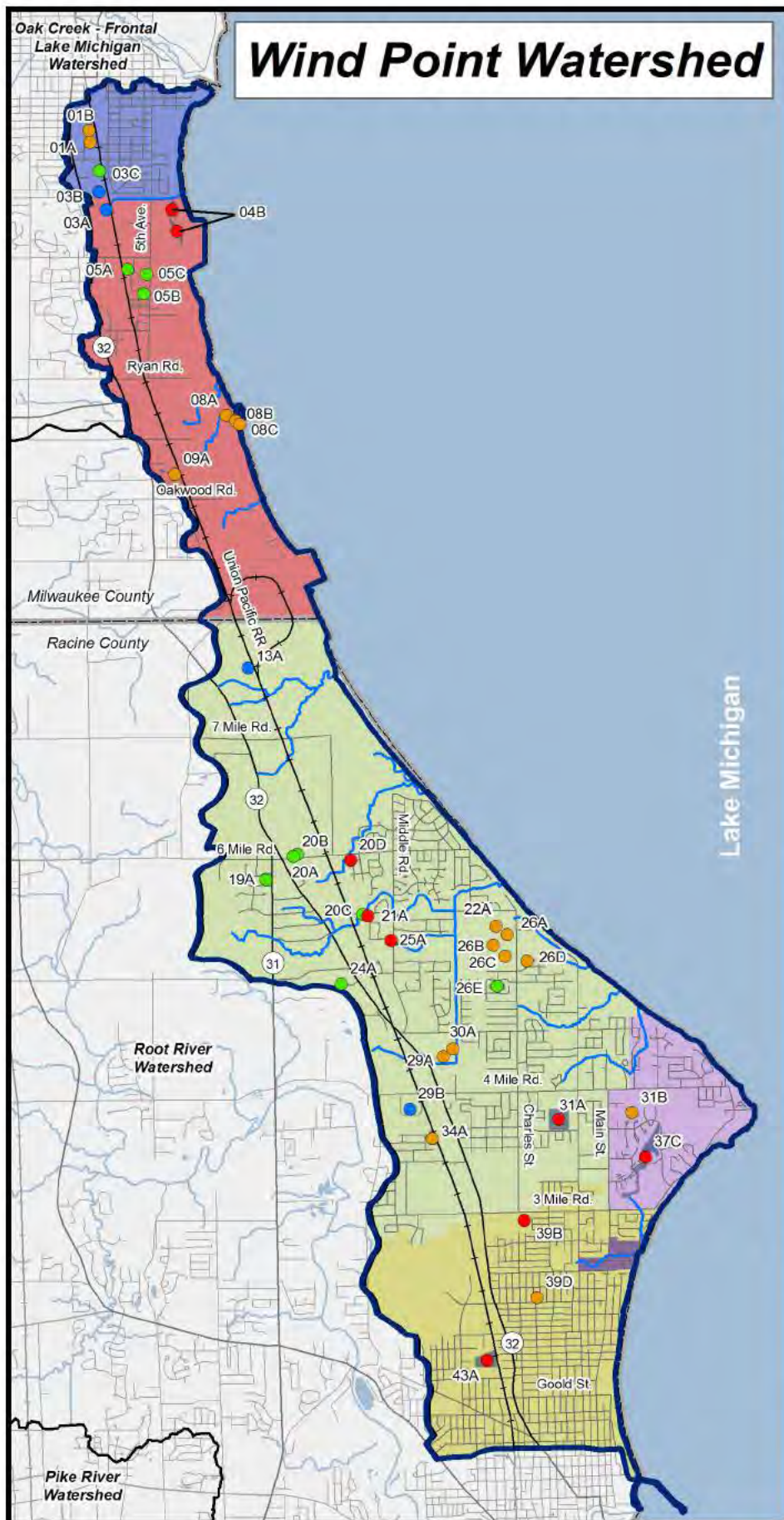
All recommended detention basin retrofits and/or maintenance recommendations are shown on Figure 68 by priority and Site ID# which correspond with the ID# used in the field investigation. General details about each recommendation can be found in the Action Plan Table (Table 41) within the appropriate jurisdictional boundary. All of the High priority recommendations are considered “Critical Areas.” Many of these are publicly owned basins and other private basins with significant problems or that present good

opportunities; funding and implementation are usually easier on public land or where major problems/opportunities exist. Low or Medium priority is generally assigned to smaller private basins and those with fewer problems or maintenance needs. In addition, there are several detention basins with no retrofit or maintenance recommendations. In some cases, basins are assigned higher priority based on location and/or ability to treat polluted stormwater runoff in a pollutant hotspot subwatershed management unit as determined via the water quality monitoring (see Section 4.0).

It is important to note that detention basin recommendations in Table 41 do not include highly detailed descriptions of proposed work and therefore cost estimates are general in nature and should not typically be used when bidding a project or pursuing a grant until a concept plan with more accurate costs is developed.



Critical Area (#31A) detention basin retrofit opportunity in Caledonia.



Wind Point Watershed



Legend

- County Boundary
- Wind Point Watershed Bndy
- Surrounding Watersheds
- Open Water
- Streams
- Highway
- Streets/Roads
- Railroad

Detention Basin Recommendation Priority

- High: Critical Area
- Medium
- Low
- No Recommendations

Municipality

- Caledonia
- North Bay
- Oak Creek
- Racine
- South Milwaukee
- Wind Point

DATA SOURCES
AES 2012 Detention Basin Inventory

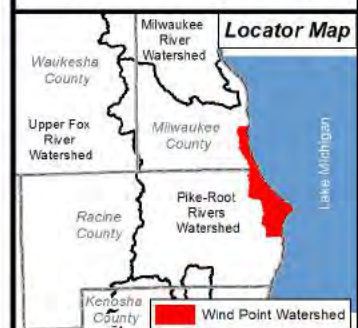
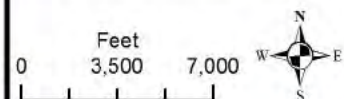


Fig. 68: Detention Basin Retrofit & Maintenance Recommendations

6.2.2 Wetland Restoration Recommendations

Wetland restoration is the process of bringing back historic wetlands in areas where they have been drained. This section does not include enhancement and maintenance for existing wetlands. Restoration can be important for mitigation purposes or done simply to benefit basic environmental functions that historic wetlands once served. Improvement in water quality is the greatest benefit provided by wetland restoration. Other benefits include reducing flood volumes/rates and improved habitat to increase plant and wildlife biodiversity. The wetland restoration process is generally the same for all sites. First a study must be completed to determine if restoration at the site is actually feasible. If it is, a design plan is developed, permits obtained, then the project is implemented by breaking existing drain tiles and/

or regrading soils to attain proper hydrology to support wetland vegetation. Planting with native wetland species is the next step followed by short and long term maintenance and monitoring to ensure establishment.

Wetland restoration sites were identified in Section 3.14.3 using a GIS exercise and specific criteria determined to be essential for restoration of a functional and beneficial wetland. The initial analysis resulted in 28 sites meeting these criteria. However, only 14 of these sites were determined to be “potentially feasible” and 11 are considered to have only “limited feasibility” based on careful review of each site using recent aerial photography, open space inventory results, existing land use, and field inspections where appropriate.

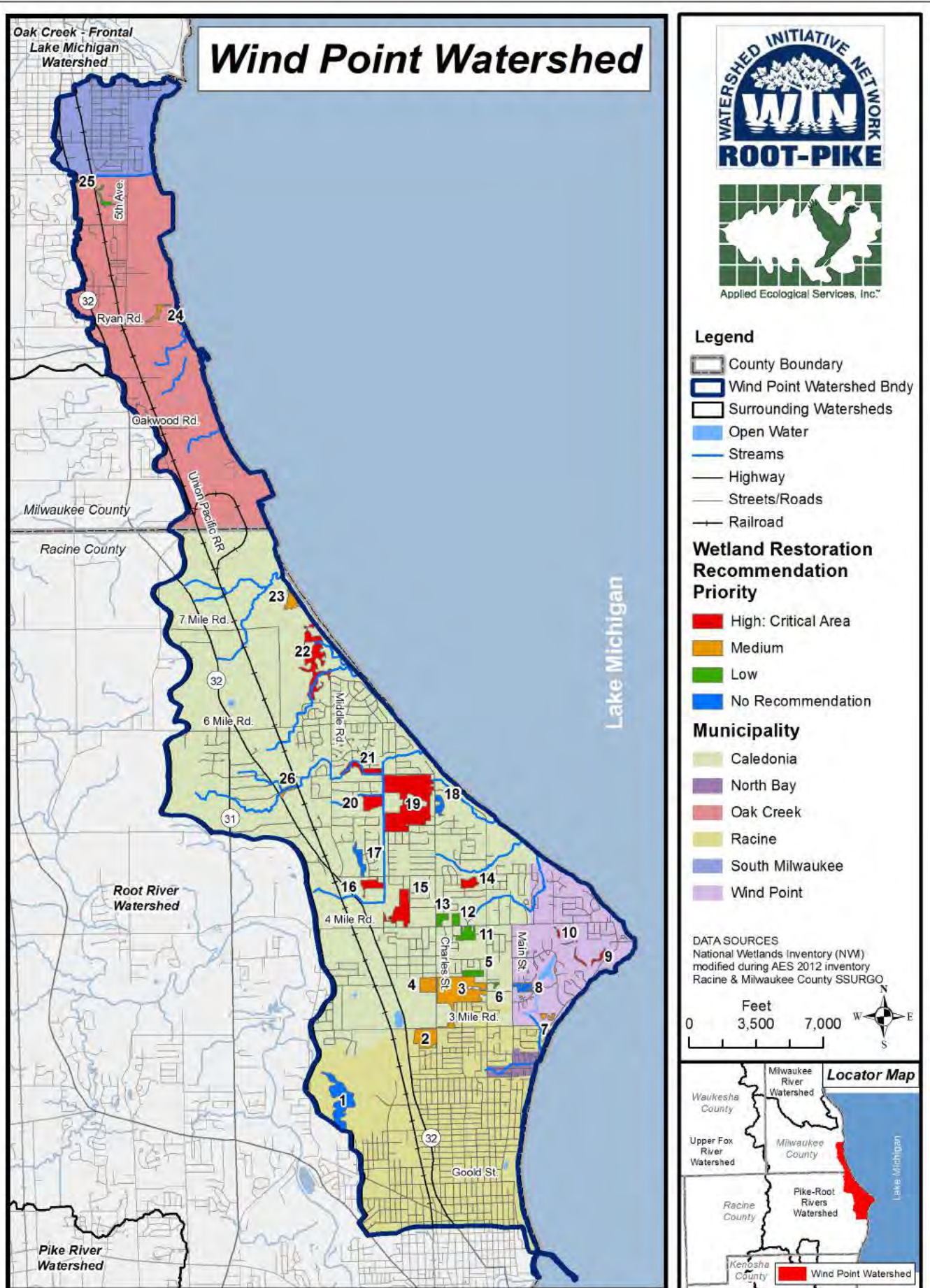
Figure 69 includes the location of all recommended wetland restoration sites by site priority and site ID#. The site ID#s match those used in

Section 3.14.3. Wetland restoration sites that were determined to have very limited feasibility are not included in the Action Plan. Details about each recommendation can be found in the Action Plan Table (Table 41) within the appropriate jurisdictional boundary.

In general, large sites on agricultural land, sites on public land, and sites within the identified Green Infrastructure Network are higher priority than smaller sites and those on private land. In many cases, potential wetland restoration sites are located on land that is currently farmed but slated for future development. In these cases it is recommended that future development include wetland restoration to the extent possible to act as both detention for the development and possibly as wetland mitigation. The potential 45+ acre wetland restoration site at Cliffside Park could be used as a wetland mitigation bank for wetland impacts in the watershed.



Potential wetland restoration site (#9) at Shoop Park Golf Course



6.2.3 Streambank, Ravine, and Channel Restoration Recommendations

Applied Ecological Services, Inc. (AES) completed a general inventory of 12 primary tributary streams, including ravines in fall of 2012. All streams and tributaries were assessed based on divisions into “Stream Reaches”. Twenty eight (28) stream reaches were assessed accounting for 96,911 linear feet or 18.4 linear miles. Detailed notes were recorded for each stream reach related to potential Management Measure recommendations such as improving streambank and channel conditions and maintaining these reaches long term. The results of the stream inventory are summarized in Section 3.14.1; detailed field investigation datasheets can be found in Appendix B.

The condition of tributaries in the watershed varies. According to the inventory, 34% of tributary

length is naturally meandering; approximately 31% is moderately channelized; 35% is highly channelized. Approximately 86% of the total tributary length exhibits no or low bank erosion while moderate erosion is occurring along 7% of streambanks. Highly eroded streambanks are all associated with ravine systems near Lake Michigan and accounting for 7% of the total stream length. Many of these eroded ravines are considered “Critical Areas” because they are actively contributing significant sediment loads to Lake Michigan as a result of headcutting.

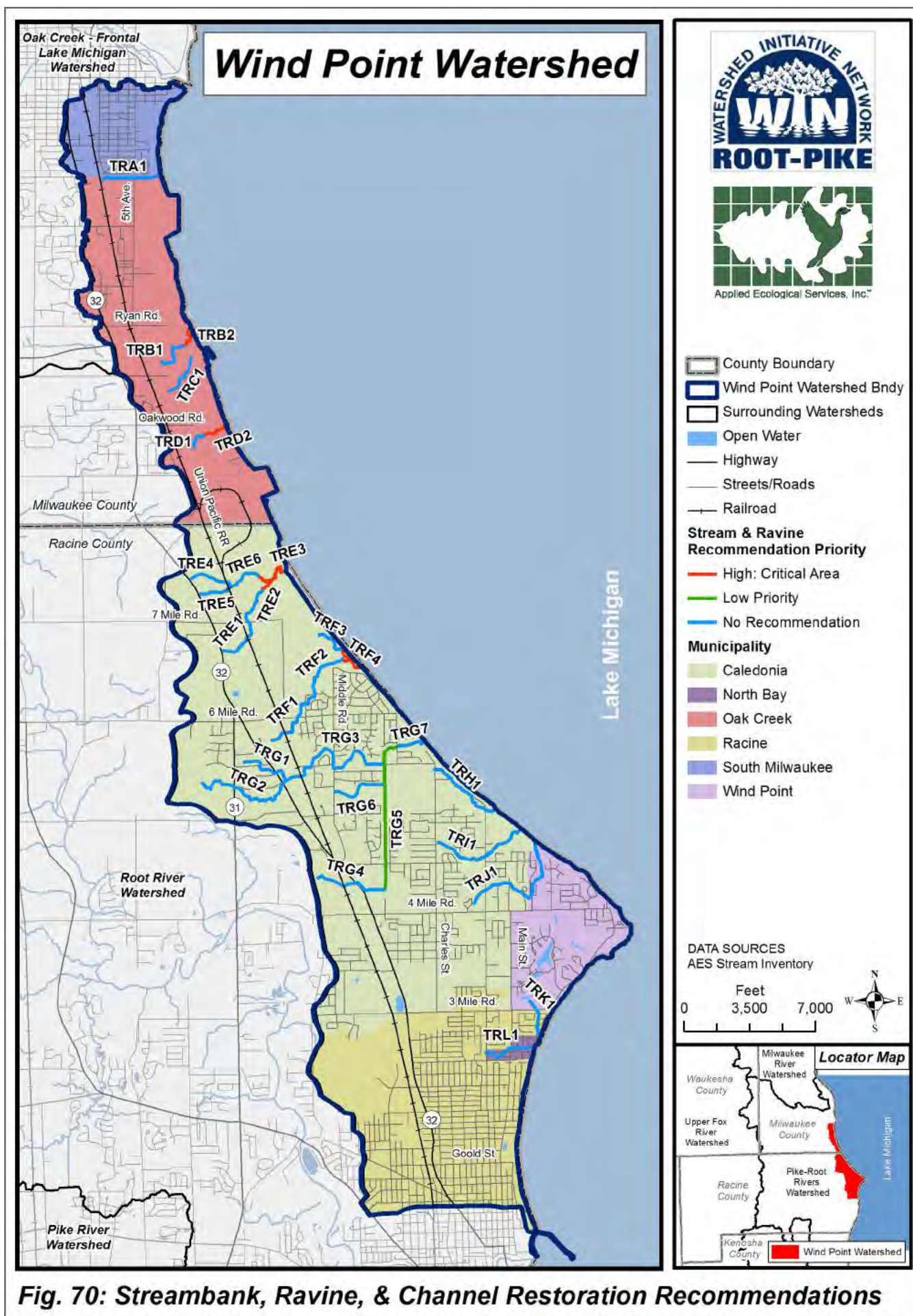
Most stream and ravine restoration projects include at least one of the following three water quality and habitat improvement components; 1) removal of existing invasive vegetation including trees and shrubs from the banks followed by; 2) stabilized banks using bioengineering, regrading of banks, installation of native vegetation, and hard armoring where necessary; and 3) restored riffles/grade controls

in the stream channel to simulate conditions found in naturally meandering streams and to prevent headcutting.

Figure 70 shows the location of all potential streambank/channel and ravine restoration projects by reach ID# and priority while Table 41 lists project details about each recommendation within the appropriate jurisdictional boundary. Potential streambank and channel restoration projects on public land and reaches exhibiting severe problems on private land are generally assigned as higher priority for implementation. Medium and Low priority was generally assigned to stream reaches exhibiting only minor problems. Recommendations are not made for stream reaches where restoration is not needed. It is also important to note that implementation costs listed in Table 41 are estimates only. Actual costs will need to be developed via a conceptual plan prior to applying for grants and installing the project.



Examples of AES streambank stabilization (left) and headcut stabilization (right).



6.2.4 Riparian Area Restoration & Maintenance Recommendations

Applied Ecological Services, Inc. (AES) completed a general inventory of the riparian areas along all 12 primary tributary reaches in fall of 2012. Riparian areas were assessed by noting the “Condition” as it relates to function and quality of ecological communities present. Field notes also included potential recommendations such as ecological restoration and maintenance. The results of the inventory are summarized in Section 3.14.1; detailed field investigation datasheets can be found in Appendix B.

According to AES’s inventory, approximately 22% of the riparian areas are in “Good” ecological

condition, 33% are in “Average” ecological condition, and 45% are in “Poor” condition. Riparian areas in poor condition are generally the result of past or present farming and development. Degradation comes in the form of invasive species, narrow buffers, and are comprised of turf grass within residential and commercial areas.

Riparian area restoration and/or maintenance projects generally focus on converting degraded ecological communities into higher quality communities that function to store and filter stormwater while also providing excellent wildlife habitat and green infrastructure corridors. The restoration process usually includes removal of invasive trees, shrubs, and herbaceous vegetation such as turf grass followed by planting with native vegetation. Short and

long term maintenance then follows and is critically important in the development process and to maintain restored conditions.

Figure 71 shows the location of all recommended riparian area restoration and maintenance projects by ID# and priority while Table 41 lists project details related to each recommendation within the appropriate jurisdictional boundary. Large scale projects located on public land are generally assigned as higher priority for implementation whereas smaller privately owned areas are Medium and Low priority. It should be noted that implementation costs listed in Table 41 are estimates only. Actual costs will need to be developed via a conceptual plan prior to applying for grants and installing the project.



Potential riparian area restoration site along Tributary G Reach 5

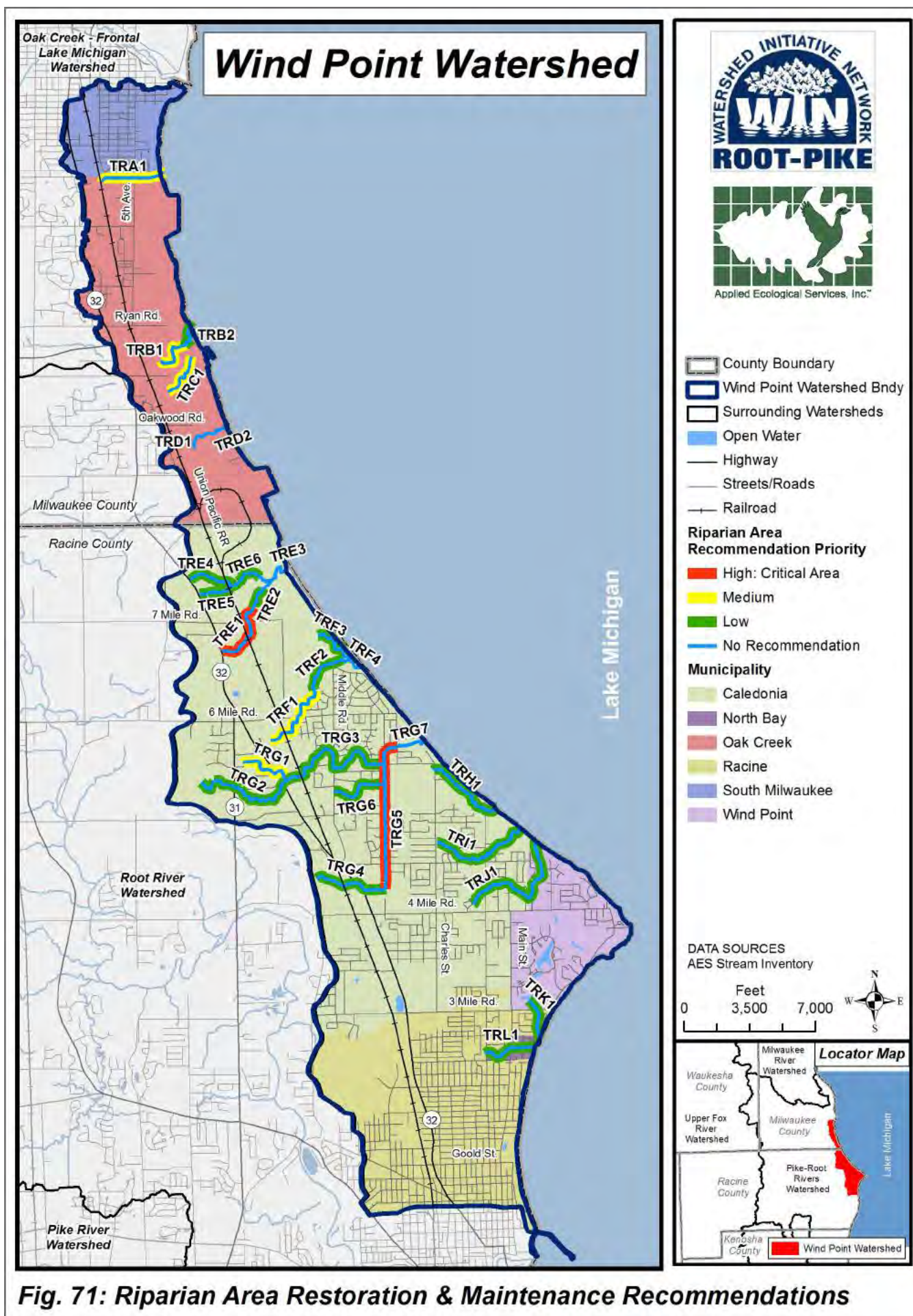


Fig. 71: Riparian Area Restoration & Maintenance Recommendations

6.2.5 Green Infrastructure Protection Area Recommendations

For this watershed plan, Green Infrastructure Protection Areas are best described as large, unprotected open parcels of land identified in Section 3.11 as part of the Wind Point green infrastructure network and that are currently undeveloped and where future development is planned. The significance is that these parcels are situated in environmentally sensitive or important green infrastructure areas where protecting and restoring or developing using “Conservation Design” or “Low Impact” design standards would best benefit watershed health. In total, 11 Green Infrastructure Protection Areas totaling 1,403 acres were identified.

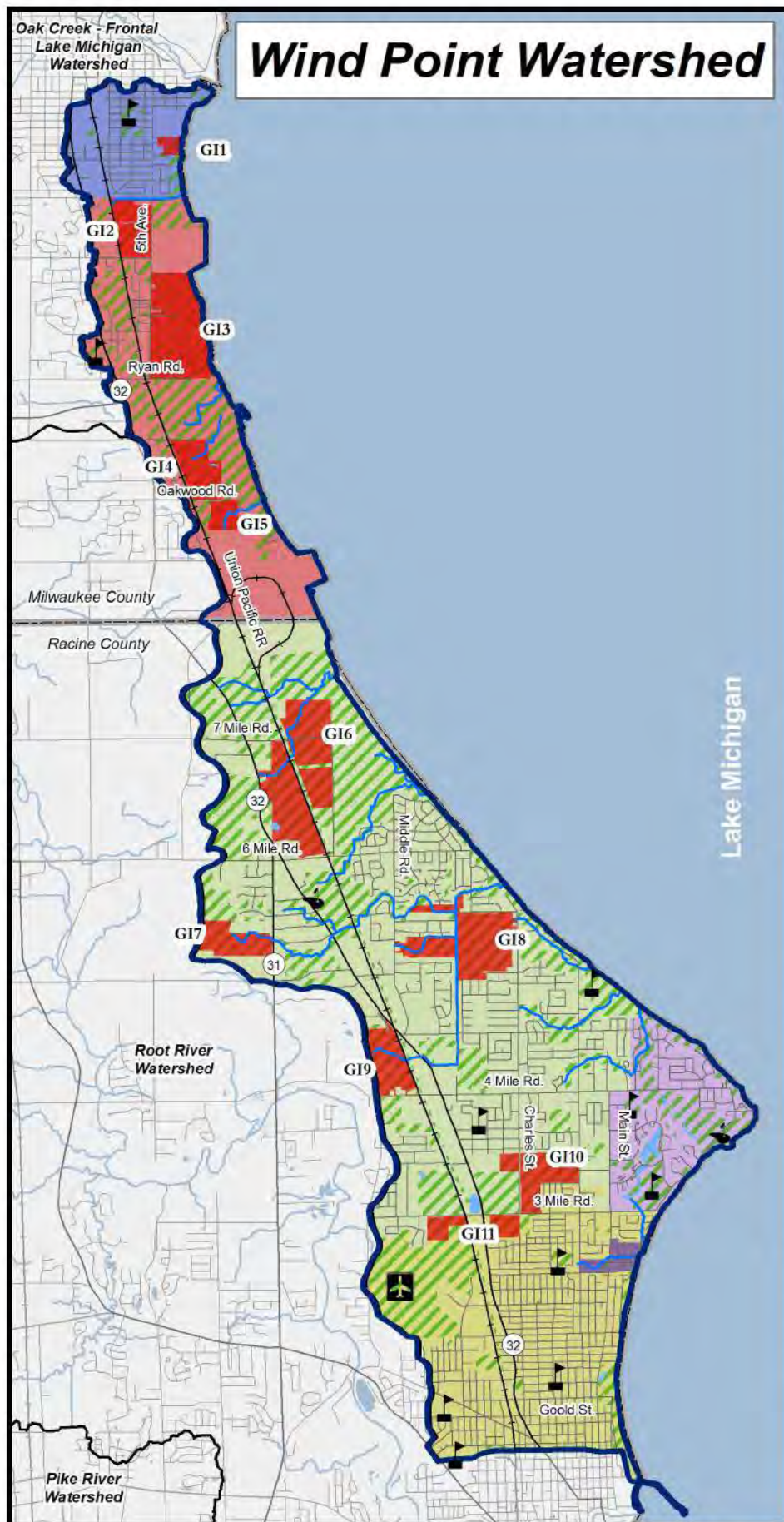
Most of the Green Infrastructure Protection Areas are situated along tributary corridors and currently consist primarily of agricultural or vacant land. One of the sites (GI1)

is a USEPA Superfund Site. Many of these areas also harbor SEWRPC Environmental Corridors or are located adjacent to existing parks such as Bender Park and Cliffside Park.

Figure 72 shows the location of all 11 Green Infrastructure Protection Areas by site ID# while Table 41 includes action recommendations for each. All 11 sites are considered High Priority-Critical Areas. Cost estimates and schedules for implementing recommendations for these areas is not included due to the difficulty in determining how or if each site will be protected or developed. In addition, pollutant reduction estimates cannot be determined for these areas.

Green Infrastructure Protection Areas GI4 (top right) adjacent to Bender Park & GI1 (below) USEPA Superfund Site





Legend

- County Boundary
- Wind Point Watershed Bndy
- Surrounding Watersheds
- Open Water
- Streams
- Highway
- Streets/Roads
- Railroad
- Green Infrastructure Network

Green Infrastructure Recommendation Priority

- High: Critical Area

Municipality

- Caledonia
- North Bay
- Oak Creek
- Racine
- South Milwaukee
- Wind Point

- School
- Golf Course
- Airport

DATA SOURCES

- MCAMLIS
- Racine County
- SEWRPC

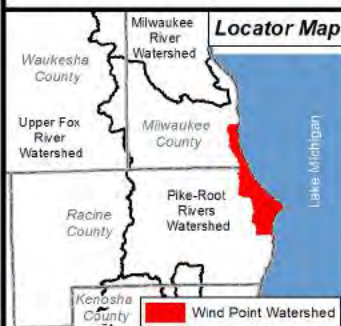
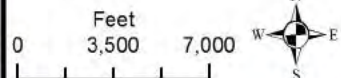


Fig. 72: Green Infrastructure Protection Area Recommendations

6.2.6 Agricultural Management Practice Recommendations

Row crop farming operations remain a significant land use in Wind Point watershed despite recent urban growth. By 2012, cropland accounted for approximately 1,111 acres or about 9% of the watershed. Most existing cropland is located in the central and western portions of the watershed. In addition, many agricultural areas are slated for future residential and commercial development.

Agricultural land can be a significant contributor of nutrients and sediment to local streams when practices such as filter strips, grass swales, and "Conservation Tillage" (no till) farming are not in place.

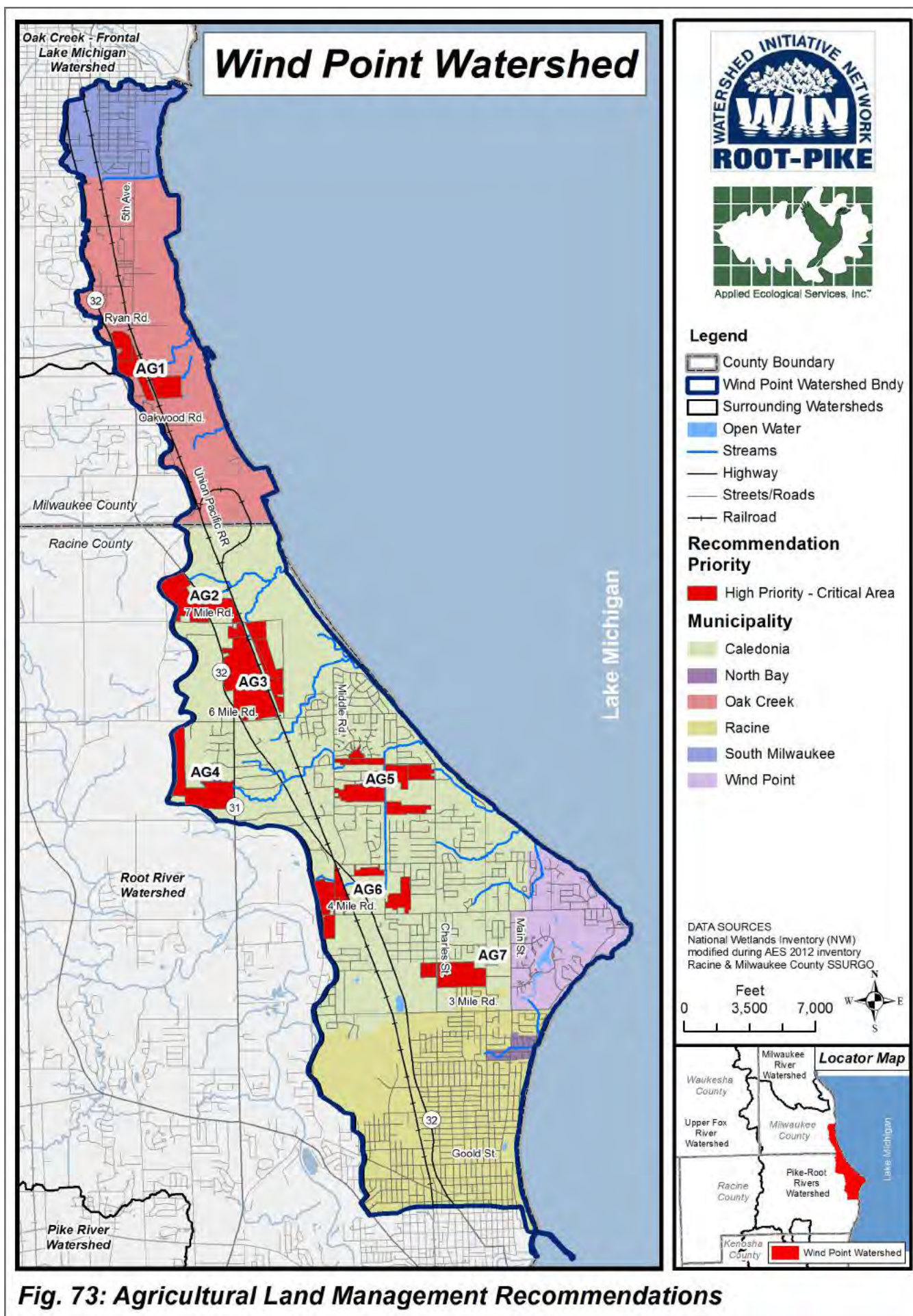
Observations made during Applied Ecological Service's, field inventory in fall 2012 indicate that some practices such as grassed swales are in place but that conservation tillage and filter strips are not common practices. Pollutant load modeling estimates show that agricultural land in Wind Point watershed contributes most to nitrogen pollution (32%; 9,603 lbs/yr) and third highest phosphorus loading (16%; 2,523 lbs/yr). Agricultural land also is the second highest contributor of sediment loading at 14.5% or 1,386 tons/yr. These pollutant load contributions are significant, and according to pollutant reduction modeling, the use of conservation tillage on select larger fields could potentially reduce phosphorus loading by 2,422 lbs/yr, nitrogen loading by 4,517 lbs/yr, and

sediment loading by 1,627 tons/yr.

Seven row crop agricultural areas totaling 975 acres were identified as High Priority-Critical Areas for potential nutrient and sediment reduction based on their size and/or location in the watershed. If agricultural management practices are used in these areas pollutant loading could be reduced. Practices recommended include conservation tillage and filter strips for row crop land. Figure 73 shows the location of all seven sites by ID# while Table 41 includes action recommendations for each. Note: cost estimates for implementing conservation tillage are not included because the costs are largely dependent on a farmer's available equipment and other factors.



Example of conservation tillage (no till) farming

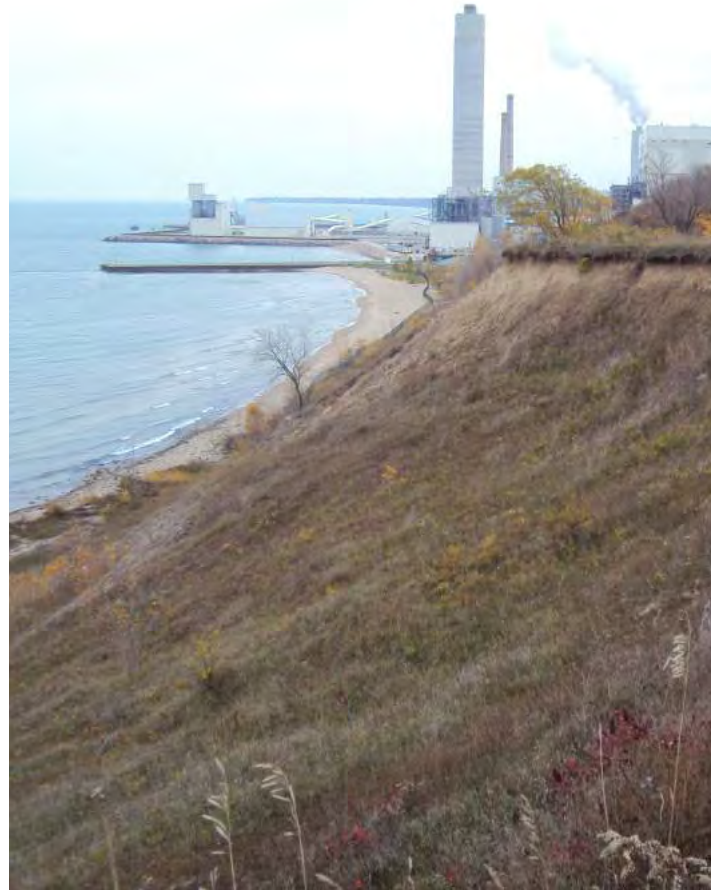


6.2.7 Other Management Measure Recommendations

While completing the inventory of Wind Point watershed, Applied Ecological Services, Inc. (AES) noted potential Management Measures that fit under miscellaneous other categories. Detailed field investigation datasheets for these projects can be found in Appendix B. Figure 74 shows the location of all “Other Management Measure” recommendations by ID# while Table 41 lists details about each recommendation within the appropriate jurisdictional boundary. Potential projects include:

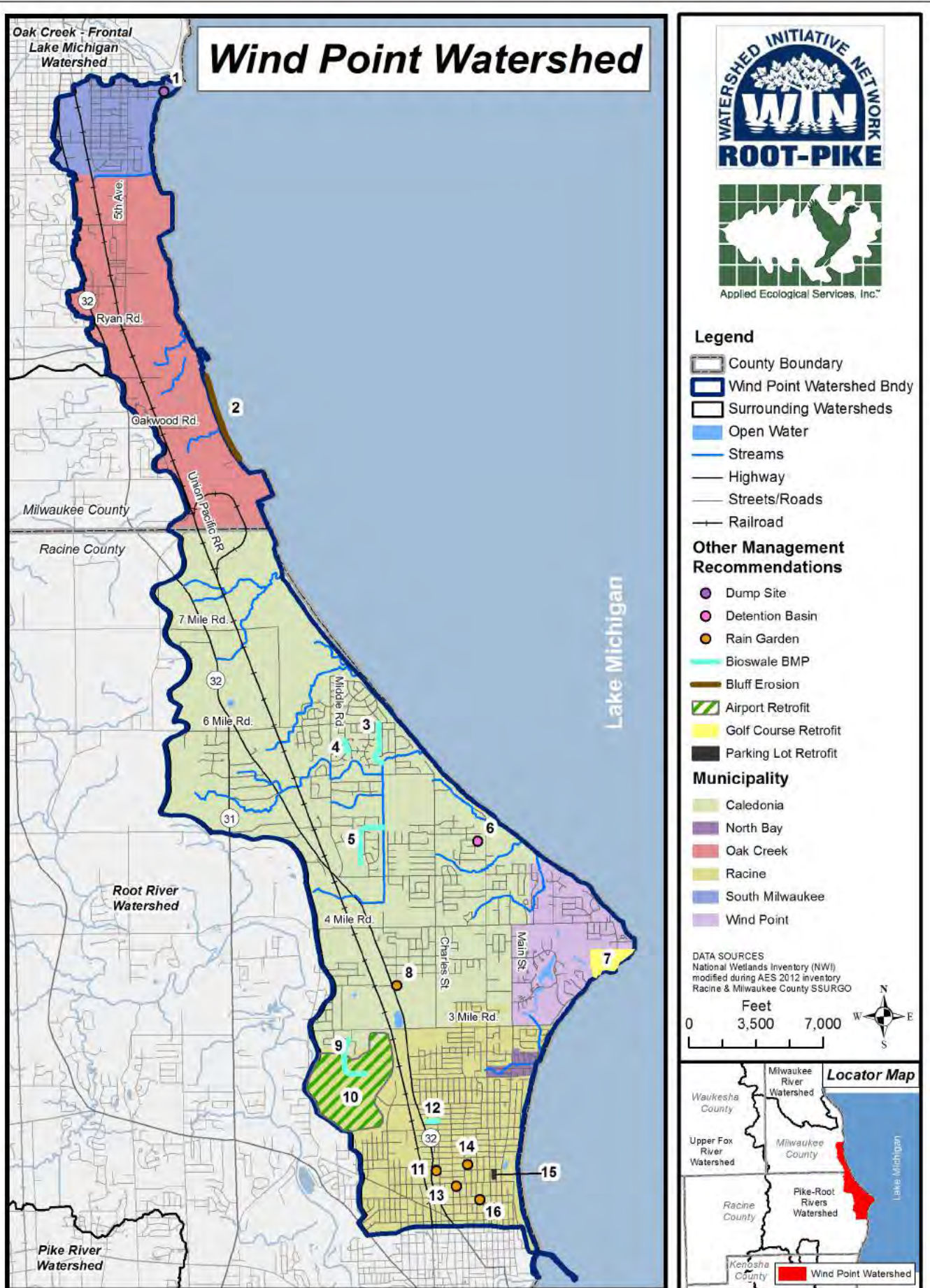
1. Dump site cleanup at corner of Lake Shore Dr. & Menomonee Ave.
2. Approximately 4,500 linear feet of severe bluff erosion along Lake Michigan from Fitzsimmons Rd. south the Elm Rd.
3. Bioswale BMP between 6 Mile Rd. and Tributary G.
4. Bioswale BMP at Crestview Park.
5. Bioswale BMP between 4 ½ Mile Rd. and Tributary G.
6. Detention basin need within Ravine Bay Estates Subdivision.
7. Naturalization of rough areas as Shoop Park Golf Course.
8. Rain garden opportunity at St. Rita School.
9. Bioswale BMP in Sundance Subdivision/Batten Airport.
10. Naturalization of turf grass areas at Batten Airport.
11. Rain garden opportunity at Douglas Park parking lot.
12. Bioswale BMP at Second Presbyterian Church.

13. Rain garden opportunity at Trinity Lutheran Church
14. Rain garden opportunity at Roosevelt Elementary School.
15. Park/stormwater retrofit at Racine Municipal Parking Area.
16. Rain garden opportunity at St. Johns Church.



Images: Bluff erosion (top left), rain garden opportunity at Trinity Lutheran Church (top right), parking lot retrofit Opportunity in Racine (bottom left), and rain garden opportunity at Roosevelt elementary school (bottom right).





6.2.8 Site Specific Management Measures Action Plan Table

Table 41. Site Specific Management Measures Action Plan.

CALEDONIA											
ID#	Location	Units (acres/ linear feet)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
DETENTION BASIN RETROFITS & MAINTENANCE (See Figure 68)											
Technical and Financial Assistance Needs: Technical assistance needed to implement detention basin retrofits is relatively low while financial assistance needs are moderate. Private landowners will require the greatest assistance.											
19A	Between Kingdom Ct. & Mary Drew Dr.	0.7 acres	Residential HOA (private)	Existing wet bottom detention basins with mown turf grass side slopes.	Design and implement project revegetate basin side slopes with native vegetation.	Wetland Det.: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Low	Residential HOA	Ecological Consultant/ Contractor	\$8,500 to design and install prairie vegetation; \$1,000/ year maintenance	10-20+ Years
20A, 20B	Prince of Peace Lutheran Church	0.1 acres	Church (private)	Two existing small depressional detention areas near access road to church. Both areas are dominated by invasive wetland vegetation.	Design and implement project to create aesthetically pleasing stormwater features by removing invasive species and replanting with native vegetation similar to a grain garden.	Wetland Det.: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Low	Prince of Peace Lutheran Church	Root-Pike WIN; Ecological Consultant	\$10,000 to design and plant as rain gardens; \$500/yr maintenance	1-10 Years
20C	N end of Nature Dr.	0.1 acres	Resident (private)	Existing small dry bottom detention basin with mown turf grass adjacent to Tributary G within residential area.	Design and implement project to revegetate basin with native vegetation to establish aesthetically pleasing rain garden feature that will improve water quality, wildlife habitat, and green infrastructure connection benefits.	Dry Detention: TSS = 77.5% TN = 20% TP = 44% Bacteria = 88%	Low	Resident	Root-Pike WIN	\$3,000 to design and plant as rain garden; \$100/yr maintenance	1-10 Years
20D	NW side of Baywood Estates Subdivision	0.7 acres	Residential HOA (private)	Existing wetland bottom detention basin servicing Baywood Estates Subdivision. Basin is dominated by invasive species and a 400 lf low flow concrete channel with turf grass slopes enters the basin from the south.	Design and implement project to alter low flow concrete channel and plant side slopes with native vegetation. Replant detention area with native wetland vegetation.	Wetland Det.: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	High: Critical Area	Caledonia; Developer; Residential HOA	Caledonia; Civil Engineer; Ecological Consultant/ Contractor	\$25,000 to design and install; \$1,000/yr maintenance	1-10 Years
21A	SW corner of Stephan Rd & Ambassador Ln.	0.4 acres	Residential HOA (private)	Existing dry bottom basin with mown turf grass servicing adjacent subdivision. Basin is located adjacent to Tributary G Reach 3.	Design and implement project to naturalize detention basin by replacing turf grass with native vegetation to improve water quality, wildlife habitat, and green infrastructure connection.	Dry Detention: TSS = 5 tons/yr TN = 52 lbs/yr TP = 6 lbs/yr Bacteria = 88%	High: Critical Area	Residential HOA	Caledonia; Civil Engineer; Ecological Consultant/ Contractor	\$20,000 to design and install native vegetation; \$1,500/yr maintenance	1-10 Years
24A	Candlelight Meadows Subdivision	0.7 acres	Residential HOA (private)	Existing dry bottom detention in form of mown turf grass swale along north side of development.	Design and implement project to convert dry bottom detention into bioswale planted with native vegetation.	Dry Detention: TSS = 77.5% TN = 20% TP = 44% Bacteria = 88%	Low	Residential HOA	Caledonia; Civil Engineer; Ecological Consultant/ Contractor	\$12,000 to design and install native vegetation; \$1,000/yr maintenance	10-20+ Years
25A	SW corner of Heartland Ln. & Middle Road	0.4 acres	Residential HOA (private)	Existing dry bottom basin with mown turf grass servicing adjacent subdivision. Basin is located at headwaters of Tributary G Reach 6.	Design and implement project to naturalize detention basin by replacing turf grass with native vegetation to improve water quality, wildlife habitat, and green infrastructure connection.	Dry Detention: TSS = 5 tons/yr TN = 52 lbs/yr TP = 6 lbs/yr Bacteria = 88%	High: Critical Area	Residential HOA	Caledonia; Civil Engineer; Ecological Consultant/ Contractor	\$20,000 to design and install native vegetation; \$1,500/yr maintenance	1-10 Years
22A, 26A, 26B, 26C	Audubon Arboretum Subdivision	3.5 acres	Caledonia; Developer (private)	Four existing naturalized wet bottom detention basins in uncompleted Audubon Arboretum conservation development.	Spot seed and plant with additional native vegetation and maintain to preserve quality.	Wetland Det.: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Medium	Caledonia; Developer; HOA long term	Ecological Consultant/ Contractor	\$20,000 to remediate; \$4,000/yr maintenance	When development resumes

ID#	Location	Units (acres/ linear feet)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
26D	NE of Five Mile Rd. & Charles St.	2.3 acres	Residential HOA (private)	Existing wet bottom detention basin with mown turf grass slopes surrounded by residential development. Landowners have installed multiple shoreline features.	Work with landowners to develop a consistent buffer of native plants around pond to enhance water quality and wildlife benefits.	Wetland Det.: TSS = 60% TN = 35% TP = 45% Bacteria = 70%	Low	Residential HOA	Root-Pike WIN; Ecological Consultant/ Contractor	\$40,000 to design and install native vegetation; \$3,000/yr maintenance	10-20+ Years
26E	Between Shore Dr. & Newberry Ln.	4.2 acres	Residential HOA (private)	Existing wet bottom detention basin with mown turf grass slopes surrounded by residential development. Landowners have installed multiple shoreline features.	Work with landowners to develop a consistent buffer of native plants around pond to enhance water quality and wildlife benefits.	Wetland Det.: TSS = 60% TN = 35% TP = 45% Bacteria = 70%	Low	Residential HOA	Root-Pike WIN; Ecological Consultant/ Contractor	\$70,000 to design and install native vegetation; \$4,000/yr maintenance	10-20+ Years
29A, 30A	Parkview Senior Living	0.8 acres	Association (private)	Two existing naturalized wet bottom detention basins in average ecological condition but with many invasive species along shoreline and buffer.	Implement annual management program to control invasive species.	Wetland Det.: TSS = 60% TN = 35% TP = 45% Bacteria = 70%	Medium	Association	Ecological Contractor	\$2,000/yr maintenance	Ongoing
31A	N side of Johnson Ave.	18 acres	Caledonia (public)	Large dry bottom regional detention basin servicing surrounding development. Basin consists of low flow concrete channels and mown turf grass. Basin is also located at headwaters of Tributary J.	Design, permit, and install project to retrofit exiting detention basin by altering low flow channels and creating wetland and prairie storage areas that would provide water quality benefits, wildlife habitat and, green infrastructure.	Wetland Det: TSS=67 tons/yr TN=474 lbs/yr TP=107 lbs/yr Bacteria=78%	High: Critical Area	Caledonia	Caledonia; Civil Engineer; Ecological Consultant/ Contractor	\$450,000 to design, permit, and install; \$6,000/yr maintenance	1-10 Years
34A	NW corner of Pilgrim Dr. & Stonebridge Dr.	3.7 acres	Residential HOA (private)	Existing dry bottom detention basin servicing adjacent subdivision. Basin consists mostly of mown turf grass and also abuts the Union Pacific RR.	Design and implement project to retrofit basin by removing turf grass and installing native vegetation to improve water quality, wildlife, and green infrastructure benefits while reducing long term maintenance costs.	Dry Detention: TSS = 77.5% TN = 20% TP = 44% Bacteria = 88%	Medium	Residential HOA	Ecological Consultant/ Contractor	\$45,000 to design and install native vegetation; \$3,000/yr maintenance	10-20+ Years
WETLAND RESTORATION (See Figure 69)											
Technical and Financial Assistance Needs: Wetland restoration projects are typically complex and require high technical and financial assistance needs to protect land, design, construct, monitor, and maintain the restoration.											
3, 4	Charles St. and 3 Mile Rd.	90 acres	Vulcan Materials Company (private)	90 acres of drained wetland located within two parcels owned by Vulcan Materials Company. Land is slated for future residential development	Incorporate up to 50% of the site as wetland restoration into future development plans and use restored wetland areas as wetland detention and mitigation.	Wetland: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Medium	Future Developer; Caledonia	WDNR; NRCS; Engineer; Ecological Consultant	\$675,000 to design/ permit/install/ maintain wetland mitigation bank	When planning for development occurs
5	W of Erie St.	8 acres	Resident (private)	8 acres of drained wetland behind residence.	Resident could restore 8 acres of wetland as personal wildlife sanctuary by restoring hydrology and planting native wetland vegetation.	Wetland: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Low	Resident	Root-Pike WIN; Ecological Consultant	\$60,000 to design, permit, and install wetland	10-20+ Years
6	W side of Ruby Ave.	2 acres	Owner (private)	2 acres of drained wetland on private vacant land that is slated for future residential development.	Land could be purchased by Caledonia or other entity and restored to wetland for stormwater storage purposes.	Wetland: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Low	Owner; Caledonia	Civil Engineer; Ecological Consultant	\$40,000 to design, permit and install wetland	10-20+ Years
7	Ag field S of Prairie School	4 acres	Owner (private)	4 acres of drained wetland on existing agricultural field. Land is likely to be developed in future.	Incorporate wetland restoration into future development plans by using areas as wetland detention basis.	Wetland: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Medium	Future Developer; Caledonia	WDNR; NRCS; Engineer; Ecological Consultant	\$80,000 to design/ permit/install/ maintain wetland detentions	When planning for development occurs

ID#	Location	Units (acres/ linear feet)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
11	W of Royal Park Rd. & S of Four Mile Rd.	14 acres	Residence (private)	14 acres of drained wetlands on private residential property and abutting a large regional detention area to south. Area is headwaters of Tributary J.	Investigate homeowner(s) openness to restoring wetlands in their back yards.	Wetland Restore: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Low	Private Residence	Root-Pike WIN	\$70,000 to install and maintain wetland	10-20+ Years
12 & 13	NE of 4 Mile Rd. & Charles Rd.	12.5 acres	Agricultural Land Owner (private)	12.5 acres of drained wetlands on private agricultural land near headwaters of Tributary J. Areas are also slated for future residential development.	Investigate future developer's openness to restoring wetlands as a green infrastructure feature of the development.	Wetland Restore: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Low	Future Developer; Caledonia	Root-Pike WIN	\$50,000 to install and maintain wetland	As new development is planned
14	Between Erie St. & Whirlaway Ln.	9 acres	Agricultural Land Owner (private)	9 acres of drained wetlands along the south side of Tributary I on private agricultural land that is slated for future residential development.	Incorporate wetland restoration in future conservation or low impact residential development plans by using most feasible areas as wetland detention and/or mitigation.	Wetland Restore: TSS=2.5 tons/yr TN=24 lbs/yr TP=7 lbs/yr Bacteria=78%	High: Critical Area	Future Developer; Caledonia	Caledonia; Engineer; Ecological Consultant	\$150,000 to design/ permit/install/ maintain wetland	As new development is planned
15	NE of 4 Mile Rd. & Chester Ln.	30 acres	Agricultural Land Owner (private)	30 acres of drained wetlands adjacent to Crawford Park on private agricultural land that is slated for future residential development.	Incorporate wetland restoration in future conservation or low impact residential development plans by using most feasible areas as wetland detention and/or mitigation.	Wetland Restore: TSS=8 tons/yr TN=49 lbs/yr TP=15 lbs/yr Bacteria=78%	High: Critical Area	Future Developer; Caledonia	Caledonia; Engineer; Ecological Consultant	\$225,000 to design/ permit/install/ maintain wetland	As new development is planned
16	SD corner of 4 ½ Mile Rd. & Route 32	12 acres	Agricultural Land Owner (private)	12 acres of drained wetlands on 20+ acre agricultural parcel that is adjacent to Tributary G. Parcel is slated for future residential development.	Incorporate wetland restoration in future conservation or low impact residential development plans by using most feasible areas as wetland detention and/or mitigation.	Wetland Restore: TSS=4 tons/yr TN=27 lbs/yr TP=8 lbs/yr Bacteria=78%	High: Critical Area	Future Developer; Caledonia	Caledonia; Engineer; Ecological Consultant	\$150,000 to design/ permit/install/ maintain wetland	As new development is planned
19	SW corner of 5 ½ Mile Rd. & Charles St.	130 acres	Ag and natural land W of Audubon Arboretum	Primary agricultural land along Tributary G and abutting uncompleted Audubon Arboretum residential subdivision. Land is slated for future residential development.	Incorporate wetland restoration along Tributary G into future conservation development plans where feasible. Restored wetlands can be used as detention and/or wetland mitigation.	Wetland Restore: TSS=25 tons/yr TN=24 lbs/yr TP=37 lbs/yr Bacteria=78%	High: Critical Area	Future/ Existing Developer; Caledonia	Caledonia; Engineer; Ecological Consultant	\$600,000 to design/ permit/install/ maintain wetland	As new development is planned or resumes
20	Between Catherine Dr. & Rebecca Rd.	16.5 acres	Agricultural Land Owner (private)	Primary agricultural land along Tributary G on east end of parcel. Land is slated for future residential development. Area is also adjacent to SEWRPC Environmental Corridor.	Incorporate wetland restoration along Tributary G into future conservation development plans where feasible. Restored wetlands can be used as detention and/or wetland mitigation.	Wetland Restore: TSS=10 tons/yr TN=64 lbs/yr TP=24 lbs/yr Bacteria=78%	High: Critical Area	Future Developer; Caledonia	Caledonia; Engineer; Ecological Consultant	\$240,000 to design/ permit/install/ maintain wetland	As new development is planned
21	N of 5 ½ Mile Rd. along Tributary G Reach 3	15 acres	Agricultural Land Owner (private)	16.5 acres of drained wetlands along Tributary G Reach 3. Land is currently agricultural and slated for future residential development. Area is also adjacent to SEWRPC Environmental Corridor.	Incorporate wetland restoration in future conservation or low impact residential development plans by using drained wetlands along Tributary G as wetland/ floodplain detention and/or mitigation.	Wetland Restore: TSS=7 tons/yr TN=43 lbs/yr TP=13 lbs/yr Bacteria=78%	High: Critical Area	Future Developer; Caledonia	Caledonia; Engineer; Ecological Consultant	\$225,000 to design/ permit/install/ maintain wetland	As new development is planned
22	Cliffside Park	46.5 acres	Racine County (public)	46.5 acres of drained wetland within Cliffside Park abutting Tributary F. The majority of the existing vegetation here is comprised of old field species.	Investigate possibility to restore hydrology and native vegetation as part of a potential wetland mitigation bank.	Wetland Restore: TSS=3 tons/yr TN=10 lbs/yr TP=7 lbs/yr Bacteria=78%	High: Critical Area	Racine County	WDNR; Hydrologist; Ecological Consultant	\$460,000 to design/ permit/install/ maintain wetland mitigation bank	1-10 Years
26	Between Douglas Ave. & Union Pacific RR	5 acres	Agricultural Land Owner (private)	5 acres of drained wetlands along Tributary G on agricultural land. Land is slated for future residential development.	Incorporate wetland restoration in future development plans by using drained wetlands along Tributary G as wetland/ floodplain detention.	Wetland Restore: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Medium	Future Developer; Caledonia	Caledonia; Engineer; Ecological Consultant	\$40,000 to design/ permit/install/ maintain wetland	As new development is planned

ID#	Location	Units (acres/ linear feet)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
STREAMBANK, RAVINE, & CHANNEL RESTORATION (See Figure 70)											
Technical and Financial Assistance Needs: Stream restorations are complex and require high technical and financial assistance needs to protect land, design, construct, monitor, and maintain the restoration. The project becomes more complex in areas that flow through several governing bodies or multiple private residences. Technical and financial assistance associated with stream maintenance is generally low for minor tasks such as removing debris.											
TRE 3: Tributary E Reach 2	We Energies property (Rifle Range Ravine)	3,201 linear feet	We Energies (private)	3,201 lf of tributary/ravine (to Lake Michigan) on land owned by We Energies (Rifle Range Ravine). A headcut is located at upper portions of reach followed by a deeply incised ravine exhibiting severely eroded slopes.	Design, permit, and implement project to stabilize headcut and highly eroded ravine slopes using a combination of bioengineering and hard armoring approaches. Grade controls will also be needed within the channel to control flow velocities.	Stabilize Banks: TSS=5,510 t/yr TN=11,019 lbs/yr TP =5,510 lbs/yr Bacteria = n/a	High: Critical Area	We Energies	WDNR; Hydrologist; Ecological Consultant; Contractor	\$3,000,000 to design, permit, and implement stabilization measures	1-10 Years Design; 10+ Years Build
TRF 4: Tributary F Reach 4	Cliffside Park (Cliffside Park Ravine)	2,450 linear feet	Racine County (public)	2,450 lf of tributary/ravine (to Lake Michigan) on land owned by Racine County (Cliffside Park Ravine). Two headcuts are located at upper portions of reach where it meets Reaches 2 & 3. This is followed by a moderately incised ravine exhibiting highly eroded slopes.	Design, permit, and implement project to stabilize headcuts and highly eroded ravine slopes using a combination of bioengineering and hard armoring approaches. Grade controls will also be needed within the channel to control flow velocities.	Stabilize Banks: TSS=906 t/yr TN=1,812 lbs/yr TP =906 lbs/yr Bacteria = n/a	High: Critical Area	Racine County	WDNR; Hydrologist; Ecological Consultant; Contractor	\$1,200,000 to design, permit, and implement stabilization measures	1-10 Years Design' 10+ Years Build
TRG 5: Tributary G Reach 5	Crawford Park to Novak Rd.	8,073 linear feet	Caledonia (public)	8,073 lf of tributary between Crawford Park and Novak Rd. within a human created drainage ditch with concrete low flow channel.	Design and implement project to disable low flow channel in up to 20 locations to install artificial riffles. This could be completed in conjunction with riparian area restoration.	n/a	Low	Caledonia	Stormwater Engineer	\$60,000 to install up to 20 artificial riffles	In conjunction with riparian area restoration
RIPARIAN AREA RESTORATION & MAINTENANCE (See Figure 71)											
Technical and Financial Assistance Needs: Technical assistance needed to implement riparian area & lake buffer restoration and maintenance is moderate at first because an environmental consultant is usually hired to complete a plan and implement the work. However, costs can be greatly reduced over time if municipal or park district staff complete some restoration and most of the long term maintenance in house. Private landowners will need the greatest assistance.											
TRE 1: Tributary E Reach 1	Route 32 to N of 7 Mile Rd.	3,781 linear feet	Mostly private agricultural land	3,468 lf of tributary with a narrow degraded riparian buffer of invasive shrubs and trees in most agricultural areas.	Achieve SEWRPC recommended Goals of 75 whereby 75% minimum of the total stream length should be naturally vegetated and 75 foot wide minimum riparian buffer established.	Filter Strip: TSS =5.5 tons/yr TN = 103 lbs/yr TP = 11 lbs/yr Bacteria = 37%	High: Critical Area	Private Owners	USDA-NRCS	\$55,000 to restore riparian buffer; \$5,000/yr maintenance	1-10 Years
TRE 4/5: Tributary E Reaches 4 & 5	Route 32 to Union Pacific RR	4,409 linear feet	We Energies (private)	4,409 lf at headwaters of Tributary E on property owned by We Energies. Buffer area consists primary of old field vegetation.	Achieve SEWRPC recommended Goals of 75 whereby 75% minimum of the total stream length should be naturally vegetated and 75 foot wide minimum riparian buffer established.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Low	We Energies	Ecological Consultant/ Contractor	\$37,500 to restore riparian buffer; \$5,000/yr maintenance	10-20+ Years
TRE 2/6: Tributary E Reaches 2 & 6	We Energies property	3,158 linear feet	We Energies (private)	3,158 linear feet of riparian area that is generally in good condition but with invasive woody species present.	Enhance riparian buffer by selectively removing invasive woody species.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Low	We Energies	Ecological Consultant/ Contractor	\$45,000 to enhance riparian buffer; \$5,000/yr maintenance	10-20+ Years
TRF 1: Tributary F Reach 1	W of Union Pacific RR to Cliffside Park	4,390 linear feet	Private Ag & Residential Properties	4,390 lf of tributary beginning primarily in agricultural fields then flowing through a residential subdivision through a concrete channel prior to entering Cliffside Park. The riparian buffer is narrow in the ag areas and is mown turf grass in the residential area.	Design and implement project to enhance riparian areas with native prairie vegetation where feasible. Project would create a wildlife corridor and have water quality benefits.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Medium	Private Owners	Root-Pike WIN; Stormwater Engineer; Ecological Consultant	\$40,000 to enhance riparian buffer; \$5,000/yr maintenance	10-20+ Years
TRF 2/3: Tributary F Reaches 2 & 3	Cliffside Park	4,790 linear feet	Racine County	4,790 lf of tributary with average quality riparian buffer but with presence of many invasive woody species.	Enhance riparian buffers by selectively removing invasive woody species.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Low	Racine County	Ecological Consultant/ Contractor	\$66,000 to enhance riparian buffer; \$6,000/yr maintenance	10-20+ Years

ID#	Location	Units (acres/ linear feet)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
TRG 1: Tributary G Reach 1	Between Route 31 & Route 32	3,197 linear feet	Private Residential Properties	3,197 lf of tributary flowing through a channelized swale in residential subdivision. Swale side slopes are primarily mown turf grass.	Design and implement project to enhance riparian areas and swale bottom with native prairie & wetland vegetation where feasible to create wildlife corridor and provide water quality benefits.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Medium	Private Owners	Root-Pike WIN; Stormwater Engineer; Ecological Consultant	\$35,000 to enhance riparian buffer; \$4,000/yr maintenance	10-20+ Years
TRG 2: Tributary G Reach 2	Headwaters to Union Pacific RR	7,231 linear feet	Multiple Private Properties	7,231 lf of tributary spanning many private properties between the headwaters west of Route 31 and Union Pacific RR. Much of the riparian area is at least moderate quality but with many invasive woody species.	Enhance select riparian buffer areas by selectively removing invasive woody species.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Low	Private Owners	Root-Pike WIN; Ecological Consultant/ Contractor	\$40,000 to enhance riparian buffer; \$5,000/yr maintenance	10-20+ Years
TRG 3: Tributary G Reach 3	Union Pacific RR to 5 ½ Mile Rd.	7,108 linear feet	Multiple Private Properties	7,108 lf of tributary located across multiple private properties from Union Pacific RR to 5 ½ Mile Rd. Most of reach has a natural but low quality riparian buffer dominated by invasive woody species.	Enhance select riparian buffer areas by selectively removing invasive woody species and extending buffer width where feasible in agricultural areas.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Low	Private Owners	Root-Pike WIN; Ecological Consultant/ Contractor	\$60,000 to enhance riparian buffer; \$6,000/yr maintenance	10-20+ Years
TRG 4: Tributary G Reach 4	Holy Cross Cemetery to Crawford Park	4,056 linear feet	Multiple Urban Private Properties	4,056 lf of tributary that is channelized through multiple urban areas. Riparian condition varies but is mown turf grass in many areas.	Achieve SEWRPC recommended Goals of 75 whereby 75% minimum of the total stream length should be naturally vegetated and 75 foot wide minimum riparian buffer established.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Low	Private Owners	Root-Pike WIN; Ecological Consultant/ Contractor	\$70,000 to enhance riparian buffer; \$7,000/yr maintenance	10-20+ Years
TRG 5: Tributary G Reach 5	Crawford Park to Novak Rd.	8,073 linear feet	Caledonia (public)	8,073 lf of tributary between Crawford Park and Novak Rd. within a human created drainage ditch with concrete low flow channel. Side slopes are mown turf grass.	Design and implement project to restore native prairie and wetland vegetation along buffer areas to create green infrastructure connection benefits. A bike or walking trail could also be constructed.	Filter Strip: TSS =75 tons/yr TN = 984 lbs/yr TP = 154 lbs/yr Bacteria = 37%	High: Critical Area	Caledonia	Stormwater Engineer; Ecological Consultant	\$100,000 to enhance riparian buffer; \$10,000 /yr maintenance	1-10 Years
TRG 6: Tributary G Reach 6	Middle Rd. to TRG5	3,198 linear feet	Private Agricultural Property	3,198 lf of tributary that is moderately channelized along north side of agricultural field. Riparian buffer is mostly a narrow bank of second growth invasive woody species.	Increase riparian buffer width to at least 75 feet along south side of tributary within agricultural field.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Low	Private Owner	USDA-NRCS	\$10,000 to restore riparian buffer; \$1,000/yr maintenance	10-20+ Years
TRH 1: Tributary H Reach 1	Charles St. to Lake Michigan	4,501 linear feet	Primarily Private Residential Properties	4,501 lf of tributary that is in average ecological condition with intact floodplain dominated by second growth woody species. Some invasive species such as buckthorn and honeysuckle are found in the riparian area.	Enhance select riparian buffer areas by selectively removing invasive woody species.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Low	Private Owners	Root-Pike WIN; Ecological Consultant/ Contractor	\$40,000 to enhance riparian buffer; \$5,000/yr maintenance	10-20+ Years
TRI 1: Tributary I Reach 1	Charles St. to Lake Michigan	5,880 linear feet	Primarily Private Residential Properties	5,880 lf of tributary that is in good ecological condition with intact floodplain dominated by older second growth woody species. Some invasive species such as buckthorn and honeysuckle are found in the riparian area.	Enhance select riparian buffer areas by selectively removing invasive woody species.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Low	Private Owners	Root-Pike WIN; Ecological Consultant/ Contractor	\$54,000 to enhance riparian buffer; \$6,000/yr maintenance	10-20+ Years
TRI J: Tributary J Reach 1	West of Erie St. to Lake Michigan	7,468 linear feet (3,700 in Caled.)	Primarily Private Residential Properties	3,700 lf of upstream portion of tributary that is in good ecological condition with intact floodplain dominated by older second growth woody species. Some invasive species such as buckthorn and honeysuckle are found in the riparian area.	Enhance select riparian buffer areas by selectively removing invasive woody species.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Low	Private Owners	Root-Pike WIN; Ecological Consultant/ Contractor	\$34,000 to enhance riparian buffer; \$4,000/yr maintenance	10-20+ Years
GREEN INFRASTRUCTURE PROTECTION AREAS (See Figure 72)											
Technical and Financial Assistance Needs: Technical and financial assistance needed to protect open space or implement conservation/low impact development is high because of land, design/permitting, and construction costs.											
GI6	Generally between 6 Mile and 7 Mile Rd.	334 acres	Private agricultural and vacant land	334 acres on private agricultural and vacant parcels along Tributary E Reach 1 and Cliffside Park to the southeast. Parcels are slated for residential and also contain SEWRPC Environmental Corridors.	Incorporate Conservation or Low Impact design standards into future development plans.	Pollutant reduction cannot be assessed via modeling	High: Critical Area	Future Developer; Caledonia	WDNR; USACE; NRCS/ SWCD; Eco. Consultant	Cost for implementing a Conservation or Low Impact Development cannot be determined	As new development occurs

ID#	Location	Units (acres/ linear feet)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
GI7	NW of 5 Mile Rd. and Rt. 31	85 acres	Private agricultural land and woodland	85 acres on private agricultural land and woodland at headwaters of Tributary G Reach 2. SEWRPC Environmental Corridors are also included on these parcels. Parcels are slated for future residential development.	Incorporate Conservation or Low Impact design standards into future development plans.	Pollutant reduction cannot be assessed via modeling	High: Critical Area	Future Developer; Caledonia	WDNR; USACE; NRCS/ SWCD; Eco. Consultant	Cost for implementing a Conservation or Low Impact Development cannot be determined	As new development occurs
GI8	Generally between 5 ½ and 5 Mile Rd.	228 acres	Primary private agricultural	228 acres of land on parcels that are primarily agricultural and slated for future residential development along Tributary G Reaches 5 & 6. The unfinished “Arboretum” subdivision and SEWRPC Environmental Corridors are also located within this area.	Incorporate Conservation or Low Impact design standards into future development plans.	Pollutant reduction cannot be assessed via modeling	High: Critical Area	Future Developer; Caledonia	WDNR; USACE; NRCS/ SWCD; Eco. Consultant	Cost for implementing a Conservation or Low Impact Development cannot be determined	As new development occurs
GI9	N of 4 Mile Rd.	96 acres	Primary private agricultural	96 acres of land on parcels that are primarily agricultural and slated for future residential development and cemetery expansion at headwaters of Tributary G Reach 4.	Incorporate Conservation or Low Impact design standards into future residential development plans and incorporate stormwater best management practices into cemetery expansion where feasible.	Pollutant reduction cannot be assessed via modeling	High: Critical Area	Future Developer; Caledonia	WDNR; USACE; NRCS/ SWCD; Eco. Consultant	Cost for implementing a Conservation or Low Impact Development & other stormwater BMPs cannot be determined	As new development occurs
GI10	NE or Charles St. & 3 Mile Rd.	115 acres	Vulcan (private)	115 acres of land owned by Vulcan that is mostly agricultural and slated for future residential development.	Incorporate Conservation or Low Impact design standards into future residential development plans.	Pollutant reduction cannot be assessed via modeling	High: Critical Area	Future Developer; Caledonia	WDNR; USACE; NRCS/ SWCD; Eco. Consultant	Cost for implementing a Conservation or Low Impact Development cannot be determined	As new development occurs
AGRICULTURAL MANAGEMENT PRACTICES (See Figure 73)											
Technical and Financial Assistance Needs: Technical and financial assistance needed to implement farm management practices is relatively low because of programs offered by agencies such as USDA/NRCS.											
AG2	E & W of Route 32 & N or 7 Mile Rd.	115 acres	Private agricultural land	115 acres of agricultural land in row crop production at headwaters of Tributary E.	Enroll in NRCS/SWCD programs and implement conservation tillage (no till) with filter strips.	No Till w/Filters: TN= 548 lbs/yr TP= 294 lbs/yr TSS=192 tons/yr	High: Critical Area	Existing Farmers/ Land Owners	NRCS/SWCD	The cost for implementing conservation tillage depends on available equipment and crop type	Annually
AG3	Along Union Pacific RR between 7 Mile & 6 Mile Rds.	259 acres	Private agricultural land	259 acres of agricultural land in row crop production.	Enroll in NRCS/SWCD programs and implement conservation tillage (no till) with filter strips.	No Till w/Filters: TN= 1138 lbs/yr TP= 610 lbs/yr TSS=391 tons/yr	High: Critical Area	Existing Farmers/ Land Owners	NRCS/SWCD	The cost for implementing conservation tillage depends on available equipment and crop type	Annually
AG4	W of Route 31 & S of 6 Mile Rd.	113 acres	Private agricultural land	113 acres of agricultural land in row crop production at headwaters of Tributary G.	Enroll in NRCS/SWCD programs and implement conservation tillage (no till) with filter strips.	No Till w/Filters: TN= 539 lbs/yr TP= 289 lbs/yr TSS=189 tons/yr	High: Critical Area	Existing Farmers/ Land Owners	NRCS/SWCD	The cost for implementing conservation tillage depends on available equipment and crop type	Annually
AG5	E of Middle Rd. & S of 6 Mile Rd.	159 acres	Private agricultural land	159 acres of agricultural land in row crop production.	Enroll in NRCS/SWCD programs and implement conservation tillage (no till) with filter strips.	No Till w/Filters: TN= 734 lbs/yr TP= 393 lbs/yr TSS=255 tons/yr	High: Critical Area	Existing Farmers/ Land Owners	NRCS/SWCD	The cost for implementing conservation tillage depends on available equipment and crop type	Annually
AG6	E & W of Route 32 & along 4 Mile Rd.	132 acres	Private agricultural land	132 acres of agricultural land in row crop production at headwaters of Tributary G.	Enroll in NRCS/SWCD programs and implement conservation tillage (no till) with filter strips.	No Till w/Filters: TN= 620 lbs/yr TP= 333 lbs/yr TSS=217 tons/yr	High: Critical Area	Existing Farmers/ Land Owners	NRCS/SWCD	The cost for implementing conservation tillage depends on available equipment and crop type	Annually
AG7	Along Charles St. & N of 3 Mile Rd.	88 acres	Private agricultural land	88 acres of agricultural land in row crop production.	Enroll in NRCS/SWCD programs and implement conservation tillage (no till) with filter strips.	No Till w/Filters: TN= 431 lbs/yr TP= 231 lbs/yr TSS=152 tons/yr	High: Critical Area	Existing Farmers/ Land Owners	NRCS/SWCD	The cost for implementing conservation tillage depends on available equipment and crop type	Annually

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OTHER MANAGEMENT MEASURES (See Figure 74)											
Technical and Financial Assistance Needs: Technical and financial assistance needed to implement these projects varies depending on complexity.											
3	Between 6 Mile Rd. & Trib G	2,000 lf	Caledonia (Pubic)	Existing concrete bottom channel flowing south between 6 Mile Rd. and Tributary G. Channel is located within residential subdivision.	Design and implement project to remove concrete channel and create bioswale dominated by native vegetation to improve water quality, wildlife habitat, and green infrastructure.	Filter Strip: TN= 40% TP= 45% TSS= 73%	Low	Caledonia	Engineer & Ecological Consultants	\$100,000 to design and install bioswale	10-20+ Years
4	Crestview Park on Crestview Park Dr.	1,000 lf	Caledonia (Public)	Series of existing turf grass swales within Crestview Park.	Design and implement project to retrofit existing turf grass swales with native vegetation to create bioswales.	Filter Strip: TN= 40% TP= 45% TSS= 73%	Low	Caledonia	Ecological Consultants	\$25,000 to design and install bioswale	10-20+ Years
5	Between 4 ½ Mile Rd. and Trib G	3,000 lf	Caledonia (Public)	Existing turf grass swale between 4 ½ Mile Rd. and Tributary G that flows between residential areas.	Design and implement project to retrofit existing turf grass swale with native vegetation to create bioswale.	Filter Strip: TN= 40% TP= 45% TSS= 73%	Low	Caledonia	Engineer & Ecological Consultants	\$60,000 to design and install bioswale	10-20+ Years
6	Ravine Bay Estates Subdivision	0.5 acre	Subdivision (Private)	Residential subdivision under construction that does not appear to have any stormwater detention. Subdivision stormsewers appear to outlet into small intermittent tributary that eventually flows to Tributary I. The intermittent tributary is currently stable with minimal erosion.	Consider designing and implementing a naturalized detention basin in open lot at corner of Horner Dr. & Marwood Dr. with strict stormwater release rates to project the condition of the small intermittent tributary.	Wetland Det: TSS=77.5% TN= 20% TP= 40% Bacteria=78%	Medium	Developer/ Caledonia	Engineer & Ecological Consultants	\$80,000 to design and construct detention basin	Before Residential Development is Complete
8	St. Rita School	1/8 acre	St. Rita School (Private)	Depressional area in front of school with several stormwater downspouts draining to it.	Design and construct demonstration rain garden.	Wetland Det: TSS=77.5% TN= 20% TP= 40% Bacteria=78%	Low	St. Rita School	Root-Pike WIN	\$10,000 to design and install rain garden	10-20+ Years

NORTH BAY											
ID#	Location	Units (acres/ linear feet)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
RIPARIAN AREA RESTORATION & MAINTENANCE (See Figure 71)											
Technical and Financial Assistance Needs: Technical assistance needed to implement riparian area & lake buffer restoration and maintenance is moderate at first because an environmental consultant is usually hired to complete a plan and implement the work. However, costs can be greatly reduced over time if municipal or park district staff complete some restoration and most of the long term maintenance in house. Private landowners will need the greatest assistance.											
TRI L: Tributary L Reach 1	Erie St. to Lake Michigan	3,141 linear feet	Private Residential Properties	3,141 lf of tributary in close proximity to residential lots. The channel is relatively stable but the riparian area is narrow and generally not in good ecological condition as private residents have elected to install different buffer treatments.	Enhance select riparian buffer areas by engaging residents in an educational forum where they learn to enhance buffer areas using ecologically sound approaches. Residents implement buffer enhancements following education.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Low	Private Owners	Root-Pike WIN; Ecological Consultant	\$15,000 to restore riparian buffer; \$3,000/yr maintenance	10-20+ Years

OAK CREEK											
ID#	Location	Units (acres/linear feet)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
DETENTION BASIN RETROFITS & MAINTENANCE (See Figure 68)											
Technical and Financial Assistance Needs: Technical assistance needed to implement detention basin retrofits is relatively low while financial assistance needs are moderate. Private landowners will need the greatest assistance.											
4B	N end of MMSD South Shore WWTP	35 acres	MMSD (private)	Series of existing linear dry bottom detention features with mown turf grass slopes and concrete channels on MMSD South Shore WWTP property.	Design and implement project to retrofit existing detention features to create linear bioinfiltration swales planted with native vegetation. Project would enhance and expand on existing green infrastructure along Lake Michigan.	Infiltration Basin: TSS=23 tons/yr TN=336 lbs/yr TP=42 lbs/yr Bacteria=78%	High: Critical Area	MMSD	Civil Engineer & Ecological Consultant/ Contractor	\$250,000 to design and install bioinfiltration features; \$5,000/year maintenance	1-10 Years
5A, 5B, 5C	Residential subdivision along 6th Street	2.3 acres	Residential HOA (private)	Three existing wet bottom detention basins with mown turf grass side slopes. Basin A in not yet complete. Scattered invasive willow is also present.	Design and implement project to retrofit existing detention basins by installing native vegetation along side slopes and emergent zones; control invasive willow.	Wetland Det.: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Low	Residential HOA	Ecological Consultant/ Contractor	\$37,000 to design and install native vegetation; \$2,000/year maintenance	10-20+ Years
8A, 8B, 8C	Bender Park	2.7 acres	Milwaukee County Parks (Public)	Three existing naturalized wetland bottom detention basins along restored bluff area in Bender Park. All are in good ecological condition.	Continue of begin to implement management program to maintain current condition.	Wetland Det.: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Medium	Milwaukee County Parks	None needed	\$2,000/yr maintenance	Ongoing
9A	NE corner of The Bluffs Subdivision	0.6 acres	Residential HOA (Private)	Existing wet bottom detention basin dominated by cattail along the edge and with mown turf grass side slopes adjacent to Union Pacific RR. Surrounding development is currently under construction.	Design and implement project to retrofit existing basin by installing native vegetation along side slopes to improve water quality, wildlife habitat, and green infrastructure connection benefits.	Wet Pond Det.: TSS = 60% TN = 35% TP = 45% Bacteria = 70%	Medium	Developer & Residential HOA	City of Oak Creek	\$8,000 to design and install native vegetation; \$1,000/year maintenance	Prior to developer completing subdivision
WETLAND RESTORATION (See Figure 69)											
Technical and Financial Assistance Needs: Wetland restoration projects are typically complex and require high technical and financial assistance needs to protect land, design, construct, monitor, and maintain the restoration.											
23	We Energies Property	9 acres	We Energies (private)	9 acres of drained hydric soils on south side of We Energies plant along the Lake Michigan coast/bluff. Area is partially developed.	Investigate potential for wetland restoration area that could be used to mitigate for future wetland impacts by We Energies.	Wetland Restore: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Medium	We Energies	Ecological Consultant	\$135,000 to design/ permit/install/ maintain wetland mitigation	As needed by We Energies
24	N of Ryan Rd.	5 acres	DuPont (private)	5 acres of wetland that has been altered via installation of a drainage channel.	Restore wetland as part of future redevelopment plan for the site.	Wetland Restore: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Medium	Future Developer; Oak Creek	Landscape Architect	\$40,000 to design & install wetland	When redevelopment occurs
25	Between 5th Ave. & Union Pacific RR	5 acres	Industrial Site Owner (private)	5 acres of drained hydric soils adjacent to existing wetland complex. Area is slated for future mixed use development.	Restore wetlands as part of future development.	Wetland Restore: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Low	Future Developer; Oak Creek	Engineer; Ecological Consultant	\$40,000 to design & install wetland	When redevelopment occurs

ID#	Location	Units (acres/ linear feet)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
STREAMBANK, RAVINE, & CHANNEL RESTORATION (See Figure 70)											
Technical and Financial Assistance Needs: Stream restorations are complex and require high technical and financial assistance needs to protect land, design, construct, monitor, and maintain the restoration. The project becomes more complex in areas that flow through several governing bodies or multiple private residences. Technical and financial assistance associated with stream maintenance is generally low for minor tasks such as removing debris.											
TRB 2: Tributary B Reach 2	Bender Park	1,497 linear feet	Milwaukee County Parks (public)	1,497 lf of tributary (to Lake Michigan) within Bender Park that is naturally meandering but with moderately to highly eroded streambanks resulting from a headcut. Reach is bordered immediately by young mesic woodland.	Design, permit, and implement project to stabilize headcut and selectively stabilize highly eroded areas using bioengineering techniques. In addition, install up to five artificial riffles/grade controls within the stream channel.	Stabilize Banks: TSS = 69 tons/yr TN = 137 lbs/yr TP = 69 lbs/yr Bacteria = n/a	High: Critical Area	Milwaukee County Parks	WDNR; Hydrologist; Ecological Consultant; Contractor	\$250,000 to design, permit, and implement stabilization measures	1-10 Years Design; 10+ Years Build
TRD 2: Tributary D Reach 2	N side of We Energies property	1,537 linear feet	We Energies (private)	1,537 lf of tributary (to Lake Michigan) on land owned by We Energies. Upper portion of reach is naturally meandering but exhibits highly eroded streambanks. About 500 lf along the downstream portion of the reach is a deep ravine with severe erosion prior to joining Lake Michigan.	Design, permit, and implement project to stabilize highly eroded stream and ravine slopes using a combination of bioengineering and hard armoring approaches. Grade controls will also be needed within the channel to control flow velocities.	Stabilize Banks: TSS=1,753 t/yr TN =3,506 lbs/yr TP =1,753 lbs/yr Bacteria = n/a	High: Critical Area	We Energies	WDNR; Hydrologist; Ecological Consultant; Contractor	\$1,200,000 to design, permit, and implement stabilization measures	1-10 Years Design; 10+ Years Build
RIPARIAN AREA RESTORATION & MAINTENANCE (See Figure 71)											
Technical and Financial Assistance Needs: Technical assistance needed to implement riparian area & lake buffer restoration and maintenance is moderate at first because an environmental consultant is usually hired to complete a plan and implement the work. However, costs can be greatly reduced over time if municipal or park district staff complete some restoration and most of the long term maintenance in house. Private landowners will need the greatest assistance.											
TRA 1: Tributary A Reach 1	Union Pacific RR to Lake Michigan	3,468 linear feet	Private residential lots & MMSD	3,468 lf of tributary reach with a degraded riparian buffer dominated by invasive mown turf grass and invasive shrubs and trees.	Achieve SEWRPC recommended Goals of 75 whereby 75% minimum of the total stream length should be naturally vegetated and 75 foot wide minimum riparian buffer established.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Medium	Private Owners	Ecological Consultant/ Contractor	\$45,000 to restore riparian buffer; \$5,000/yr maintenance	10-20+ Years
TRB 1: Tributary B Reach 1	Bender Park	2,291 linear feet	Milwaukee County Parks (public)	2,291 lf of tributary within Bender Park with riparian area dominated by invasive shrubs, trees, and other herbaceous species.	Remove invasive shrubs and trees and spot herbicide problematic herbaceous species within a minimum 75 foot buffer on each side of tributary.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Medium	Milwaukee County Parks	none	\$42,000 to enhance buffer; \$5,000/yr maintenance	10-20+ Years
TRB 2: Tributary B Reach 2	Bender Park	1,497 linear feet	Milwaukee County Parks (public)	1,497 lf of tributary within Bender Park with good quality mesic woodland buffer but with overabundant sugar maple that is shading the herbaceous layer.	Selectively remove young maple trees and other invasive species in the immediate riparian corridor and supplement herbaceous layer with native species to help stabilize stream bank and floodplain soils.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Low	Milwaukee County Parks	none	\$20,000 to enhance buffer; \$3,000/yr maintenance	10-20+ Years
TRC 1: Tributary C Reach 1	Bender Park	2,693 linear feet	Milwaukee County Parks (public)	2,693 lf of tributary within Bender Park with riparian area consisting of many second growth invasive woody species and degraded sedge meadow.	Enhance riparian area by selectively removing invasive woody species and interseeding existing sedge meadow to enhance diversity.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Medium	Milwaukee County Parks	none	\$40,000 to enhance buffer; \$5,000/yr maintenance	10-20+ Years
GREEN INFRASTRUCTURE PROTECTION AREAS (See Figure 72)											
Technical and Financial Assistance Needs: Technical and financial assistance needed to protect open space or implement conservation/low impact development is high because of land, design/permitting, and construction costs.											
GI2	NW corner of Puetz Rd. & 5th Ave.	90 acres	Private land	90 acres on private parcels along headwaters of Tributary A and also including SEWRPC Environmental Corridors. Parcels are slated to become residential development in the future.	Incorporate Conservation or Low Impact design standards into future development plans.	Pollutant reduction cannot be assessed via modeling	High: Critical Area	Future Developer; Oak Creek	WDNR; USACE; SEWRPC NRCS/ SWCD; Eco. Consultant	Cost for implementing a Conservation or Low Impact Development cannot be determined	As new development occurs
GI3	N of Ryan Road	250 acres	Mostly private vacant land	250 acres of mostly vacant brownfields know as the Lakefront Redevelopment Area. In 2011 the City of Oak Creek produced and adopted a redevelopment plan for the site that includes redevelopment incorporating green infrastructure.	Implement development concepts outlined in the City Redevelopment Plan and stabilize shoreline to prevent bluff erosion.	Pollutant reduction cannot be assessed via modeling	High: Critical Area	Future Developers; Oak Creek	UW-Milwaukee; WDNR; USACE; SEWRPC NRCS/ SWCD	Cost for implementing proposed designs cannot be determined	As new development occurs

ID#	Location	Units (acres/ linear feet)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
GI4	Between Fitzsimmons & Oakwood Rd.	95 acres	Private agricultural & vacant land	95 acres of private agricultural and vacant land adjacent to Bender Park and slated for future residential development.	Milwaukee County Department of Parks consider purchasing and restoring parcels to increase open space/green infrastructure adjacent to Bender Park.	Pollutant reduction cannot be assessed via modeling	High: Critical Area	Milwaukee County Parks	n/a	Cost cannot be determined	As parcels become available for purchase
GI5	S of Oakwood Rd.	36 acres	We Energies Property	36 acres of land currently owned by We Energies but slated for future residential/ mixed use development. Parcels also include SEWRPC Environmental Corridors.	Incorporate Conservation or Low Impact design standards into future development plans.	Pollutant reduction cannot be assessed via modeling	High: Critical Area	Future Developer; Oak Creek; We Energies	WDNR; USACE; SEWRPC NRCS/ SWCD; Eco. Consultant	Cost for implementing a Conservation or Low Impact Development cannot be determined	As new development occurs
AGRICULTURAL MANAGEMENT PRACTICES (See Figure 73)											
Technical and Financial Assistance Needs: Technical and financial assistance needed to implement farm management practices is relatively low because of programs offered by agencies such as USDA/NRCS.											
AG1	E & W of Union Pacific RR & between Ryan & Oakwood Rds.	109 acres	Private agricultural land	109 acres of agricultural land in row crop production.	Enroll in NRCS/SWCD programs and implement conservation tillage (no till) with filter strips.	No Till w/Filters: TN= 507 lbs/yr TP= 272 lbs/yr TSS=177 tons/yr	High: Critical Area	Existing Farmer/Land Owner	NRCS/SWCD	The cost for implementing conservation tillage depends on available equipment and crop type	Annually
OTHER MANAGEMENT MEASURES (See Figure 74)											
Technical and Financial Assistance Needs: Technical and financial assistance needed to implement these projects varies depending on complexity.											
2	Lake Michigan Bluff from Fitzsimmons Rd. S to Elm Rd.	4,500 lf	Milwaukee Co. Parks & We Energies	Approximately 4,500 linear feet of severe/ accelerated bluff erosion along Lake Michigan on land owned by Milwaukee Co. Parks and We Energies.	Develop a feasibility study to determine the need for and costs of stabilizing the eroded bluff using approaches similar to the bluff stabilization work that was completed at Bender Park.	n/a	High: Critical Area	Milwaukee Co. Parks & We Energies	Structural Engineer, Planning & Ecologist firms	\$50,000 to conduct feasibility study; cost to construct cannot be determined until plans are complete	1-10 Years Design; 10+ Years Build if determined necessary

RACINE

ID#	Location	Units (acres/ linear feet)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
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DETENTION BASIN RETROFITS & MAINTENANCE (See Figure 68)

Technical and Financial Assistance Needs: Technical assistance needed to implement detention basin retrofits is relatively low while financial assistance needs are moderate. Private landowners will need the greatest assistance.

39B	Vidian Chelsak Park	3 acres	Racine (public)	Existing dry bottom detention basin within Vidian Chelsak Park along the south side of 3 Mile Rd. Vegetation in the basin consists of mown turf grass.	Design and implement project to replace turf grass and revegetate with native vegetation to improve water quality, wildlife, and green infrastructure benefits while reducing long term maintenance costs. Project would also be good demonstration for public.	Dry Detention: TSS = 22 tons/yr TN = 148 lbs/yr TP = 32 lbs/yr Bacteria = 88%	High: Critical Area	Racine	Root-Pike WIN; Civil Engineer; Ecological Consultant/ Contractor	\$40,000 to design and install prairie vegetation; \$2,000/ year maintenance	1-10 Years
39D	Matson Park Detention	0.9 acres	Racine (public)	Existing dry bottom detention basin within Matson Park consisting of mown turf grass.	Design and implement project to naturalize basin with native vegetation as a demonstration project for the public to see the benefits of improved water quality, wildlife habitat, and green infrastructure.	Dry Detention: TSS = 77.5% TN = 20% TP = 44% Bacteria = 88%	Medium	Racine	Root-Pike WIN; Civil Engineer; Ecological Consultant/ Contractor	\$15,000 to design and install prairie vegetation; \$1,000/yr maintenance	10-20+ Years
43A	Between William St. & Layard Ave.	13.3 acres	Racine (private)	Existing regional storage area that has been naturalized in part with native prairie and wetland vegetation. Several invasive species are common on the site.	Implement a monitoring and management program to keep invasive species under control and to ensure the storage area performs as designed.	Wetland Det: TSS=280 tons/yr TN=1,800 lbs/yr TP=456 lbs/yr Bacteria=78%	High: Critical Area	Caledonia	Caledonia; Civil Engineer; Ecological Consultant/ Contractor	\$450,000 to design, permit, and install; \$6,000/yr maintenance	1-10 Years

WETLAND RESTORATION (See Figure 69)

Technical and Financial Assistance Needs: Wetland restoration projects are typically complex and require high technical and financial assistance needs to protect land, design, construct, monitor, and maintain the restoration.

2	SE corner of Route 32 and 3 Mile Rd.	25 acres	Vulcan Materials Company (private)	25 acres of drained wetland located within parcel owned by Vulcan Materials Company. Land is slated for future residential development.	Incorporate up to 50% of the site as wetland restoration into future development plans and use restored wetland areas as wetland detention and mitigation.	Wetland: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Medium	Future Developer; Caledonia	WDNR; NRCS; Engineer; Ecological Consultant	\$375,000 to design/ permit/install/ maintain wetland mitigation bank	When planning for development occurs
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RIPARIAN AREA RESTORATION & MAINTENANCE (See Figure 71)

Technical and Financial Assistance Needs: Technical assistance needed to implement riparian area & lake buffer restoration and maintenance is moderate at first because an environmental consultant is usually hired to complete a plan and implement the work. However, costs can be greatly reduced over time if municipal or park district staff complete some restoration and most of the long term maintenance in house. Private landowners will need the greatest assistance.

TRI K: Tributary K Reach 1	North of 3 Mile Rd. to Lake Michigan	2,428 linear feet mostly in Racine	Primarily Private Residential Properties	2,428 lf of tributary, most of which is located in close proximity to residential lots. The channel is relatively stable but the riparian area is narrow and generally not in good ecological condition as private residents have elected to install different buffer treatments.	Enhance select riparian buffer areas by engaging residents in an educational forum where they learn to enhance buffer areas using ecologically sound approaches.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Low	Private Owners	Root-Pike WIN; Racine	n/a	10-20+ Years
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GREEN INFRASTRUCTURE PROTECTION AREAS (See Figure 72)

Technical and Financial Assistance Needs: Technical and financial assistance needed to protect open space or implement conservation/low impact development is high because of land, design/permitting, and construction costs.

GI11	S of 3 Mile Rd.	56 acres	Vulcan (private)	56 acres of land owned by Vulcan that is mostly vacant and slated for future residential development.	Incorporate Conservation or Low Impact design standards into future residential development plans.	Pollutant reduction cannot be assessed via modeling	High: Critical Area	Future Developer; Racine	WDNR; USACE; NRCS/ SWCD; Eco. Consultant	Cost for implementing a Conservation or Low Impact Development cannot be determined	As new development occurs
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ID#	Location	Units (acres/ linear feet)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
OTHER MANAGEMENT MEASURES (See Figure 74)											
Technical and Financial Assistance Needs: Technical and financial assistance needed to implement these projects varies depending on complexity.											
9	W of Wyoming Way Rd. (Sundance Sub.) & N side of Batten Airport	2,000 lf	Sundance Sub. & Batten Airport (Private)	Existing concrete bottom swale beginning in Sundance Sub. & flowing south then east through the northern portion of Batten Airport.	Design and implement project to remove concrete channel and create bioswale dominated by native vegetation to improve water quality, wildlife habitat, and green infrastructure.	Filter Strip: TN= 40% TP= 45% TSS= 73%	Low	Sundance Sub. & Batten Airport	Engineering & Ecological Consultants	\$100,000 to create bioswale	10-20 + Years
10	Batten Airport	300 acres	Batten Airport (Private)	Existing mowed turf grass areas surrounding all runways.	Investigate possibility to naturalize about 150 acres of turf at airport with short grass native prairie vegetation.	Filter Strip: TN= 40% TP= 45% TSS= 73%	Low	Batten Airport	Ecological Consultant	\$400,000 to install 150 acres of native vegetation	10-20 + Years
11	Douglas Park/Cesar Chavez Center	1/8 acre	Racine (Public)	Parking lot at Douglas Park draining to manholes; adjacent unused mowed turf grass area.	Design and implement project to create curb cuts and drain stormwater runoff from parking lot to constructed rain gardens.	Wetland Det: TSS=77.5% TN= 20% TP= 40% Bacteria=78%	Low	Racine	Engineering & Ecological Consultants	\$15,000 to design and construct rain garden	10-20 + Years
12	Second Presbyterian Church	1/8 acre	Second Presbyterian Church (Private)	Parking lot at church drains stormwater NE to turf grass area.	Design and implement project to create bioswale at NE corner of parking lot.	Filter Strip: TN= 40% TP= 45% TSS= 73%	Low	Second Presbyterian Church	Ecological Consultant	\$15,000 to design and install bioswale	10-20 + Years
13	Trinity Lutheran Church	1/16 acre	Trinity Lutheran Church (Private)	Small depressional area near secondary entry to church taking on stomwater from small pipe.	Design and implement project to create rain garden in small depressional area.	Wetland Det: TSS=77.5% TN= 20% TP= 40% Bacteria=78%	Low	Trinity Lutheran Church	Ecological Consultant	\$6,000 to design and construct rain garden	10-20 + Years
14	Roosevelt Elementary School	1/16 acre	Roosevelt Elementary School (Private)	Several stormwater downspouts into linear turf grass area on east side of school/along Superior St.	Design and implement project to create rain gardens along turn area. This would also be a good demonstration project for the school.	Wetland Det: TSS=77.5% TN= 20% TP= 40% Bacteria=78%	Low	Roosevelt Elementary School	Root-Pike WIN	\$10,000 to design and construct rain garden	10-20 + Years
15	Racine Municipal Parking Area on Wisconsin St.	1.0 acres	Racine (Public)	Older municipal parking area on west side of Wisconsin St.	Consider designing and implementing community park that incorporates stormwater BMPs such as rain gardens, bioswales, etc.	Wetland Det: TSS=77.5% TN= 20% TP= 40% Bacteria=78%	Medium	Racine	Planner, Engineer, Ecologist Firms	\$200,000 to design and construct project	10-20 + Years
16	St. Johns Church	1/16 acre	St. Johns Church (Private)	Linear turf grass area along south side of church/English St. with several stormwater downspouts draining to it.	Design and implement project to create rain garden in turf area.	Wetland Det: TSS=77.5% TN= 20% TP= 40% Bacteria=78%	Low	St. Johns Church	Ecological Consultan	\$10,000 to design and construct rain garden	10-20 + Years

SOUTH MILWAUKEE

ID#	Location	Units (acres/ linear feet)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
DETENTION BASIN RETROFITS & MAINTENANCE (See Figure 68)											
Technical and Financial Assistance Needs: Technical assistance needed to implement detention basin retrofits is relatively low while financial assistance needs are moderate. Private landowners will need the greatest assistance.											
1A	N end of 11th Ave.	0.36 acres	Business Park (private)	Existing wet bottom detention basins with mown turf grass side slopes within business park along 11th Ave. Basin edges are overgrown in areas with invasive willow.	Design and implement project to remove turf grass from side slopes and revegetate with native vegetation then maintain indefinitely. Also remove invasive willow. Project would expand on green infrastructure located to north.	Wetland Det.: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Medium	Business Association	Ecological Consultant/ Contractor	\$12,000 to design and install prairie vegetation; \$1,000/year maintenance	10-20+ Years
1B	Behind Grant Park Plaza	0.50 acres	Business Park (private)	Existing naturalized wetland bottom detention basin servicing adjacent business park. Much of the prairie buffer planting has failed and there is a severely eroded swale near the inlet.	Design and implement project to replant prairie buffer and fixe eroded swale near inlet. Project would expand and enhance on surrounding green infrastructure.	Wetland Det.: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Medium	Business Association	Ecological Consultant/ Contractor	\$12,000 to replant prairie vegetation and stabilize eroded swale; \$1,000/year maintenance	1-10 Years
3C	Behind Franciscan Villa	0.53 acres	Common Living (private)	Existing wetland bottom detention basin with mown turf grass side slopes along the Union Pacific Railroad.	Design and implement project to remove turf grass from side slopes and revegetate with native vegetation then maintain indefinitely. Project would expand on green infrastructure along RR.	Wetland Det.: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Low	Association	Ecological Consultant/ Contractor	\$14,500 to design and install prairie vegetation; \$1,500/year maintenance	10-20+ Years
GREEN INFRASTRUCTURE PROTECTION AREAS (See Figure 72)											
Technical and Financial Assistance Needs: Technical and financial assistance needed to protect open space or implement conservation/low impact development is high because of land, design/permitting, and construction costs.											
GI1	NE corner of Marina Rd. and 5th Avenue	18 acres	South Milwaukee/ USEP	18 acres on public land that is currently a USEPA Superfund Site along the Lake Michigan coast. This parcel is slated for future residential development.	Incorporate Conservation Design or Low Impact design standards into future development plans to preserve green infrastructure benefits along Lake Michigan.	Pollutant reduction cannot be assessed via modeling	High: Critical Area	Future Developer; South Milwaukee	WDNR; USACE; NRCS/ SWCD; Eco. Consultant	Cost for implementing a Conservation or Low Impact Development cannot be determined	As new development occurs
OTHER MANAGEMENT MEASURES (See Figure 74)											
Technical and Financial Assistance Needs: Technical and financial assistance needed to implement these projects varies depending on complexity.											
1	Lake Shore Dr. & Menomonee Ave.	0.5	South Milwaukee (Pubic)	Existing dump site on side of cliff along Lake Michigan.	Clean up dumped debris and install educational signage.	n/a	Medium	South Milwaukee	Root-Pike WIN	\$5,000 to clean up and install signage	Annually

WIND POINT

ID#	Location	Units (acres/ linear feet)	Owner (public or private)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency	Priority	Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
DETENTION BASIN RETROFITS & MAINTENANCE (See Figure 68)											
Technical and Financial Assistance Needs: Technical assistance needed to implement detention basin retrofits is relatively low while financial assistance needs are moderate. Private landowners will need the greatest assistance.											
31B	S side of Wind Point School	3 acres	Wind Point School (public)	Existing shallow wetland bottom detention bottom servicing school grounds. Slopes adjacent to basin are mown turf grass. Existing basin is comprised almost entirely of invasive species.	Design and implement project to retrofit existing detention area with native vegetation. Project would be excellent demonstration project for school and surrounding community.	Wetland Det.: TSS = 77.5% TN = 20% TP = 44% Bacteria = 78%	Medium	Wind Point School	Root-Pike WIN; Ecological Consultant/ Contractor	\$30,000 to design and install prairie vegetation; \$2,000/ year maintenance	10-20+ Years
37C	Adjacent to Prairie School	20.2 acres	Prairie School & adjacent landowners	Large excavated pond used as detention for Prairie School and other surrounding development. Pond buffer is prairie north of Prairie School and generally weedy old field vegetation in other areas. Some moderate erosion is occurring around portions of the shoreline.	Design and implement project to alter outlet structure and concrete channel and naturalize entire pond shoreline and emergent zone to create wetland detention for water quality, wildlife, and green infrastructure benefits.	Wetland Det: TSS=55 tons/yr TN=328 lbs/yr TP=87 lbs/yr Bacteria=78%	High: Critical Area	Prairie School (lead); and other adjacent landowners	Root-Pike WIN; Ecological Consultant/ Contractor	\$230,000 to design and install prairie and wetland vegetation; \$5,000/yr maintenance	Phased over 1-10 Years
WETLAND RESTORATION (See Figure 69)											
Technical and Financial Assistance Needs: Wetland restoration projects are typically complex and require high technical and financial assistance needs to protect land, design, construct, monitor, and maintain the restoration.											
9	Shoop Park Golf Course W of Lighthouse Dr.	3 acres	Golf Course (private)	3 acre turf grass swale in Shoop Park Golf Course that drains adjacent course areas and residential area no north south to wetland swale complex that flows east to Lake Michigan.	Restore wetland swale within golf course. A restored wetland would help filter pollutants, provide wildlife habitat, green infrastructure, and be a good demonstration project for the public to see.	Wetland Restore: TSS=7 tons/yr TN=36 lbs/yr TP=12 lbs/yr Bacteria=78%	High: Critical Area	Golf Course	Wind Point; Course Superintendent; Ecological Consultant	\$40,000 to design/ permit/install/ maintain wetland	1-10 Years
10	Johnson Foundation at Wingspread	7 acres	Johnson Foundation (private)	Approximately 7 acres of shallow ponds created via earthen dams along a historic wetland swale on land owned by the Johnson Foundation.	Remove earthen dams and restore wetland hydrology and native wetland plants to benefit water quality, wildlife habitat, and other green infrastructure benefits.	Wetland Restore: TSS=20 tons/yr TN=127 lbs/yr TP=39 lbs/yr Bacteria = 78%	High: Critical Area	Johnson Foundation	WDNR; Ecological Consultant	\$175,000 to design/ permit/install/ maintain wetland	1-10 Years
RIPARIAN AREA RESTORATION & MAINTENANCE (See Figure 71)											
Technical and Financial Assistance Needs: Technical assistance needed to implement riparian area & lake buffer restoration and maintenance is moderate at first because an environmental consultant is usually hired to complete a plan and implement the work. However, costs can be greatly reduced over time if municipal or park district staff complete some restoration and most of the long term maintenance in house. Private landowners will need the greatest assistance.											
TRI J: Tributary J Reach 1	West of Erie St. to Lake Michigan	7,468 linear feet (3,700 in Wind Point)	Primarily Private Residential Properties	3,700 lf of downstream portion of tributary that is in good ecological condition with intact floodplain dominated by older second growth woody species. Some invasive species such as buckthorn and honeysuckle are found in the riparian area.	Enhance select riparian buffer areas by selectively removing invasive woody species.	Filter Strip: TN = 40% TP = 45% TSS = 73% Bacteria = 37%	Low	Private Owners	Root-Pike WIN; Ecological Consultant/ Contractor	\$34,000 to enhance riparian buffer; \$4,000/yr maintenance	10-20+ Years
OTHER MANAGEMENT MEASURES (See Figure 74)											
Technical and Financial Assistance Needs: Technical and financial assistance needed to implement these projects varies depending on complexity.											
7	Shoop Park Golf Course	60 acres	Shoop Park Golf Course (Pubic)	Golf course with rough areas consisting of mowed turf grass.	Retrofit rough areas of golf course by removing turf grass and replacing with native vegetation.	Filter Strip: TN= 40% TP= 45% TSS= 73%	Low	Golf Course/ Wind Point	Ecological and Golf Course Design Consultants	\$100,000 to install approximately 30 acres of prairie vegetation	10-20 + Years



7.0 Information & Education Plan

This Information & Education Plan (I&E Plan) recommends campaigns that are designed to enhance understanding of the issues, problems, and opportunities within Wind Point watershed. The intention is to promote general acceptance and stakeholder participation in selecting, designing, and implementing recommended Management Measures to improve watershed conditions. The first step in understanding the issues, problems, and opportunities within Wind Point watershed is to gain a better perspective of how the watershed evolved over time into what exists today.

The composition of the soil in Wind Point watershed is a remnant of the ancient ice movement. Above the bedrock lies a layer of deposits left behind from the glaciers, consisting of clay, silt, sand, and limestone cobble. A somewhat tundra-like environment covered by spruce forest was the first ecological

community to colonize after the glaciers retreated. As temperatures continued to rise, cool moist deciduous forests dominated by maple, basswood, and beech trees developed along Lake Michigan coastal areas and oak-hickory forests, oak savannas, marshes, and prairies developed more inland. Black ash, relict cedar, and tamarack swamps were also part of the landscape.

Ecological conditions changed drastically following European settlement that began in the 1830s as the timber industry, farming, and brickyards took hold. Significant portions of forested communities and nearly all wetland areas were cleared of trees, drained via tile systems, and farmed. By the early 1900s, farming became the primary land use. Conversion from farmland to primarily residential and commercial uses followed and continues to this day. Wind Point watershed is presently dominated by residential areas, vacant land,

transportation (roads, etc), cropland and mixture of commercial/ industrial centers.

The watershed has experienced rapid development in the past 30 years because of the close proximity to Milwaukee and Chicago, affordable land costs and existing transportation infrastructure. During the current economic recession beginning in 2008, the housing boom has slowed and the ecological impacts of development can be evaluated within the watershed context.

The watershed planning process is a collaborative effort involving voluntary stakeholders with the primary scope to restore impaired waters and protect unimpaired waters by developing an ecologically-based management plan for Wind Point watershed that focuses on improving water quality by protecting green infrastructure, creating protection policies, implementing ecological restoration, and educating the public. Another important outcome is to improve the quality of life for people in the watershed for current and future generations.

Many of the stakeholders in Wind Point watershed have been active in the creation and leadership of the Root-Pike Watershed Initiative Network (Root-Pike WIN). The key stakeholders include the City of Racine, City of Oak Creek, City of South Milwaukee, Village of Caledonia, Village of Wind Point and the WDNR. The Root-Pike WIN is actively engaging the public in watershed activities such as: educational seminars, research grants, paddling outings, rain garden demonstration areas and plants, beach clean-up days and extensive public education programs and a media campaign. The watershed planning process for Wind Point watershed began in 2013 with educational sessions. The watershed planning process has allowed watershed partnerships to form that will help with implementing the watershed

plan and initiating projects. It should be noted that the Root-Pike WIN will be combining information and education programs that will work in conjunction and support other watersheds plans in their region, as appropriate.

Recommended Information & Education Campaigns

A successful I&E Plan first raises awareness among stakeholders of watershed issues, problems, and opportunities. The second step is to provide stakeholders with information on alternatives to implement to address the issues, problems, and opportunities. This I&E Plan includes the following components as referenced in USEPA's "*Handbook for Developing Watershed Plans to Restore and Protect Our Waters*" (USEPA 2008):

- Define I&E goals and objectives.
- Identify and analyze the target audiences.
- Create the messages for each audience.
- Package the message to various audiences.
- Distribute the message.
- Evaluate the I&E program.

Goals and Objectives

Development of an effective I&E Plan begins by defining I&E goals and objectives. Goals were established for the Wind Point watershed to address the issues and opportunities raised during the issue identification survey, watershed summit visioning, public meeting questions and "Places of the Heart" exercises. The list was refined during the planning process. Objectives assigned to each goal are intended to be measurable where appropriate so that future progress can be assessed. The following goals refer to communications goals and objectives.

Goal 2: Implement watershed educational, stewardship, and recreational opportunities.



Example of watershed signage. Source: www.gptx.org

Objectives:

1. Create Wind Point Watershed Education & Public Outreach Committee to engage County, City and Village boards, schools, and foster partnerships
2. Educate the public about invasive species, native plants, balanced ecosystems, restoration, pollutants and their relation to the health of Wind Point watershed. Encourage public involvement and inform the public of their role in the stewardship of Wind Point watershed.
3. Provide watershed stakeholders with an education plan that promotes the knowledge, skills, and motivation needed to take action on implementing the watershed plan.
4. Inform the public and public officials on the benefits of sustainable development practices and support changes to ordinance language that promotes sustainable development.
5. Develop recommendations for adoption of conservation and/ or low density design standards for all new development or redevelopment.
6. Create targeted educational information for land owners in the watershed.
7. Install environmental interpretation signage at access points throughout public open space.
8. Develop recommendations for education and alternatives for fertilizer and pesticide use.
9. Develop recommendations for

- education and alternatives to road & other pavement salt use.
10. Increase water and land based recreational opportunities in Wind Point watershed
 11. Identify and protect open space that provides important green infrastructure preserves, corridor connections and provide appropriate recreational opportunities.
 12. Identify and protect historic park buildings.
 13. Increase environmental and recreational stewardship with volunteers and docents.
 14. Increase recreational safety on trails through increased civil use and patrols.
 15. Create environmental interpretive signage on trails explaining history, function and rules.

Goal 4: Increase communication and coordination among stakeholders.

Objectives:

1. Encourage governing bodies to adopt the Wind Point Watershed-Based Plan.
2. Encourage amendments of municipal comprehensive plans, codes and ordinances to include watershed plan goals and objectives.

3. Encourage and support business and agricultural communities and other stakeholder efforts to implement recommended actions within the watershed plan.

Target Audiences

The recommended target audience for each education campaign is selected based on the ability to attain objectives. The target audience is a group of people with a common denominator who are intended to be reached by a particular message. The target audience of the watershed includes people of all demographics, locations, occupations, and watershed roles. There can be multiple target audiences depending on which topic is being presented. The overall umbrella target audiences selected to meet watershed goals and objectives include landowners, homeowners, general public, local government, elected officials, homeowner and business associations, and schools.

Public Input

Creating and distributing a message for each audience is done via campaigns that address education goal objectives. The I&E Plan objectives for the Wind

Point watershed were determined through stakeholder meetings and an online survey (survey results are summarized in this chapter). An I&E Plan matrix (Table 47) was developed as a tool to help implement the I&E Plan. Not only does the matrix include recommended education campaigns, it also includes columns for 1) "Target Audience", 2) "Package" (vehicle) for delivery of the message, 3) "Schedule", 4) "Lead & Supporting Organizations", 5) "Outcomes/ Behavior Change", and 6) "Estimated Cost".

Evaluation

The I&E Plan should be evaluated regularly to provide feedback regarding the effectiveness of the outreach campaigns. Evaluation conducted early on in the effort will help determine campaigns that are successful and those that are not. Based on the evaluation, information, money, and time can be saved by focusing on the campaigns that work. Those that do not work should be ended and/or refined. Section 9.0 of this plan contains a "Report Card" with milestones related to watershed education that can be used to evaluate I&E Plan implementation efforts.

*Students measure a fallen tree in Tabor Woods as part of the Caledonia Conservancy's School to Nature program.
Source: Sandy DeWalt*



Existing Education Campaigns

Root-Pike Watershed Initiative Network

- Rain Garden Demonstration Projects.
- Funding of Environmental Education Projects through the Watershed-based Grant Program.
- Education of municipal stormwater engineers and public works managers who are members of the Southeast Wisconsin Clean Water Network, which is comprised of 17 cities, villages and towns and the University of Wisconsin-Parkside.

Root-Pike WIN and Sweet Water (Southeastern Wisconsin Watersheds Trust)

- *Respect Our Waters: Greener Yards, Cleaner Waters* homeowner workshops and e-newsletters.
- *Respect Our Waters* media and community outreach campaign, funded by Wisconsin Department of Natural Resources and over 30 municipalities and UW-Parkside.

River Bend Nature Center

- We All Take Environmental Responsibility (WATER) education program targeted to 4th and 7th grade students in Racine Unified School District.
- Nature camps and classes for youth and adults.

Caledonia Conservancy

- School to Nature Program for elementary and middle school students in Racine County.

The Prairie School

- Third grade water quality monitoring unit.

Great Lakes Community Conservation Corps

- Train-the-Trainer Water Quality Monitoring Initiative: Great Lakes CCC staff trained to train 150 AmeriCorps members (5 cohorts of 30 individuals) who will adopt and conduct weekly water quality sampling at accessible, informal beach areas near the Siena Retreat Center to monitor water quality for the health and safety of recreational users. Training provided by Racine Health Department staff and Wisconsin DNR staff.

City of Racine, City of Oak Creek, Village of Caledonia, Milwaukee Community Service Corps, Sierra Club-Gateway Chapter

- Rain barrel programs.

Milwaukee Metropolitan Sewerage District

- Rain barrel program
- Rain garden plants program (50% discount compared to retail prices. Each order receives 1 FREE 5-lb bag of Milorganite and 1 coupon for \$5.00 off an MMSD rain barrel)

Alliance for the Great Lakes

- *Great Lakes in My World* K-8 curriculum
- *Great Lakes in My World* 9-12 curriculum
- Adopt-a-Beach program

**Wind Point Watershed
Environmental Issues
Identification Survey**

What the Public Told Us

About the Watershed's Problems
and Potential

Background

Root-Pike WIN initiated a watershed restoration planning effort in Wind Point Watershed in 2013. The project area comprises the Village of Wind Point and North Bay in Racine County, portions of South Milwaukee and Oak Creek in Milwaukee County and the City of Racine and Village of Caledonia in Racine County.

Issue Identification Survey

Root Pike WIN asked UW-Extension's local natural resources educator, Andy Yench, to develop a web based questionnaire to help inform Phases II planning. Yench, with assistance from the evaluation unit located in UW-Extension's Environmental Resources Center, developed a web based survey consisting of 18 questions designed to reveal what people already knew about the current ecological and outdoor recreational conditions in the project area, what actions they felt should be included in the future watershed plan, the media outlets they prefer for news, and a few insights into their age, education and connection to the watershed. The survey was made available on October 22 and closed on November 29, 2013.

How Did People Find Out About the Survey?

Survey invitations were distributed widely by Root-Pike WIN in an attempt to reach a broad cross section of people who either live, work, or visit the watershed. Several methods were used. An invitation was distributed utilizing Root-Pike WIN's Constant Contact email marketing account and mailing lists. A press release was featured in the Racine Journal Times and Root Pike WIN asked municipalities in the project area to post links to the survey on their websites and announce it in their newsletters.

Personal email invitations were also sent to municipal heads of government and people who had previously volunteered for the Phase I advisory group meetings.

Demographics

One hundred and sixty (160) individuals opened the survey link, but not all of them answered every question. For this reason, the number of people who responded to a particular question, or to a particular answer within a question, is sometimes included in this report.

Age & Gender

One hundred and one (101) people provided their age which averaged 56 years old. The youngest person to take the survey was 21 and the oldest was 87. The median age was 58 and 54 was the age cited most frequently. One hundred and thirty five (135) people reported their gender. Slightly more men than women took the survey: 53% male, 47% female.

Residence

The majority of respondents, 86%, live in a single family home. Seven percent (7%) live in a condominium and the remaining 6% were split evenly between two family homes and apartments.

Occupation

Twenty one percent (21%) of the 136 respondents who provided information about occupation said they were retired. The remainder reported being employed in a variety of mostly professional fields, the largest of which was education related. Under the category of "other", the most common occupation provided was environmental or engineering related work.

Formal Education

One hundred and thirty four (134) people provided information about their level of formal education. The large majority, 78%, had obtained a bachelor's degree or higher. Nineteen percent (19%) had attended some college, and the remaining 4% had gone as far

as earning a high school diploma. Less than 30% of the population in Wisconsin has obtained a Bachelor's degree, so these results tell us this survey reached a remarkably well schooled subset of people who live, work, and play in the project area.

Attendance at Phase I Meetings

Twenty four percent (24%) of 136 respondents indicated they had attended at least one of the Phase I Wind Point Watershed Planning Meetings. Fifty three percent (53%) of 135 respondents answered yes to the question, "Have you attended any conferences, workshops, or classes, about lakes, rivers or streams in the last two years?"

Favorite Media - Print, TV, Radio, and Web

The most familiar and popular newspaper among respondents is the Racine Journal Times (82 readers out of 130 responses), followed by the Milwaukee Journal Sentinel (58 readers out of 118 responses). The most popular TV news channel was WTMJ (23%), followed by WISN (17%), WITI (13%), Other (11%), and WDJT (8%). Nearly 30% reported they don't regularly watch local TV news. Fox Cable News and local PBS were the most cited "Other" TV news providers. Just over 80% of 133 respondents said they regularly listen to the radio. The most identified radio station by a considerable margin was UW-Milwaukee's public radio station WUWM (89.7). Several other public radio outlets followed including WHAD (90.7), WYMS (88.9), and WGTD (91.1). WTMJ (AM 620) was the most commonly cited commercial radio station. The large majority of respondents answered "Yes" when asked, "Do you regularly use the internet as a source of news?" They went on to list a mix of internet news sites, almost all of which provide mostly national and international news. The most commonly listed local internet news site was that of the Milwaukee Journal Sentinel, <http://www.jsonline.com/>.

Connection to the Watershed
Sixty five percent (65%) said they live in the watershed and 47% said they work there. Twenty two percent (22%) visit people who live in the watershed and 9% reported using it for outdoor recreation, ongoing work related activities, or lived or worked there in the past.

Knowledge about Wind Point Watershed's Environmental Conditions
When asked to rate their level of knowledge about environmental

condition within the watershed, 31% of 150 respondents said they had "High" or "Very High" knowledge. An additional 31% said their knowledge was "Neither High or Low", and the remaining 38% rated their knowledge as either "Low" or "Very Low."

When it came to reporting on the ways they used the watershed in the last 12 months, two activities, Scenic Viewing and Walking/ Hiking, rated the highest (Table 42), followed by Wildlife Viewing, Bicycle Riding and Picnicking. The

outdoor activity with the lowest reported participation in the last 12 months was Hunting. Ten people provide additional activities they do in the watershed: Running was mentioned three times; followed by Gardening (twice); and then one mention each for Bat Monitoring, Surfing, School to Nature Program, Beach Combing, and Winter activities (skiing, snow shoeing and ice fishing all mentioned by the same individual who appears to love cold weather.).

Table 42. How survey respondents reported using the watershed in the past 12 months.

Activity	Not at all	Once	A Few Times	Many Times	Total Responses
Swimming	76	8	32	11	127
Fishing	89	7	18	9	123
Picnicking	56	16	38	11	121
Motorized boating	99	5	9	7	120
Non-motorized boating: canoe, kayak, sail, row	79	12	20	12	123
Bicycle riding	50	6	36	35	127
Golfing	87	3	23	11	124
Hunting	117	0	1	1	119
Wildlife viewing including bird watching	34	9	30	59	132
Scenic viewing	12	1	38	84	135
Walking or hiking	13	1	43	79	136
Others done regularly, please list	30	0	1	9	40

Problems in the Watershed

The survey asked people to rate a variety of possible threats to the streams, wetlands and Lake Michigan in the Watershed (Table 43). When the responses for both “Moderate Problem” and “Severe Problem” were combined, five issues of concern stood out: Invasive Species; Road Salt on Streets; Runoff from Roads, Parking Lots and Buildings; Fertilizer Washing off Lawns; and

Loss of Wildlife Habitat. The lowest rated problem was Flooding; followed by Pet Waste; Pollution from Sewage Treatment Plants; Runoff from New Building Construction; and Pollution from Industry. Several other issues were cited including: Algae (three citations); Shoreline Trash (three citations); Cliff Erosion; Existing Development Policy; and Nuisance Seagulls/Wildlife.

This question included a “Don’t Know” response to identify possible watershed problems that people might be confused about. Flooding was selected the most (25 respondents); followed by Pollution from Sewerage Treatment Plants (23); Eroding and Crumbling Stream Banks (22); Runoff from New Building Construction Sites (19); and Pollution from Industry (18).

Table 43. Possible watershed problems.

Problem	Not a Problem	Slight Problem	Moderate Problem	Severe Problem	Don't Know	Total Responses
Fertilizer washing off lawns	6	15	48	55	10	134
Pet waste	11	40	58	12	14	135
Loss of wildlife habitat	9	16	41	59	11	136
Flooding	19	37	43	11	25	135
Runoff from farmland	12	24	45	36	16	133
Runoff from new building construction sites	13	29	49	26	19	136
Runoff from roads, parking lots, buildings and homes	3	15	44	60	15	137
Pollution from industry	17	24	46	32	18	137
Pollution from sewage treatment plants	20	26	29	36	23	134
Eroding and crumbling stream banks	4	21	45	42	22	134
Road salt spread on streets to reduce ice	3	18	48	56	10	135
Invasive plants and animals	2	14	48	60	12	136
Other issues, please list	13	0	2	9	16	40

Projects to Improve the Watershed

Survey takers were asked how they felt about including a variety of recommendations in the watershed restoration plan (Table 44). After the responses for “Agree” and “Strongly Agree” were combined, the five highest rated actions were Remove Invasive Species, Clean up Trash, Protect Natural Areas, Expand Bicycle and Recreational Trails, and Restore wetlands. Only two recommendations received less than 50% support: Provide More Dog Parks, and Remove Downed Trees and

Other Natural Debris from Creeks and Streams. When asked if there were any particular improvement projects they would like to see happen within their lifetime in the watershed, nearly half the survey takers said yes and briefly described an action (Table 45). Although some of the suggestions refer to projects outside the project area they are included in the results because they have the potential to impact Lake Michigan which is connected to the Wind Point Watershed.

Table 44. Support for projects to improve watershed.

Projects/Plan Recommendations	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
Restore wetlands	0	6	16	47	64
Help interested homeowners build rain gardens & rain barrels	1	6	19	55	52
Remove invasive plants from natural areas	0	1	8	59	66
Protect natural areas from development	1	4	14	53	60
Expand bicycle, walking and other recreational trails	4	3	14	48	64
Clean up trash	0	1	11	50	71
Provide more dog parks	9	18	59	28	18
Make Lake Michigan more accessible	4	10	39	36	44
Remove downed trees and other natural debris from creeks and streams.	8	19	43	38	25
Improve existing stormwater detention ponds	0	6	33	49	46
Stabilize eroding streambanks	0	5	19	65	43
Reduce runoff from farms	1	3	28	53	49

Table 45. Project ideas.

Activity
Walking path along Lake Michigan on the east side of Shoop golf course.
Fix the concrete/cement fishing piers / docks along Lake Michigan.
Improve lakeshore at Shoop Park.
Provide more family friendly accessible trails in safe areas.
Use wildflowers in the rough areas of the golf course and where the local governments now mow and fertilize.
Keep trash out of the streams and roadways.
Improve/increase stormwater retention BEFORE it reaches the ravines.
Repair Lake Michigan coastline, buffer coast.
Purchase private land adjacent to Bender Park (SW corner) and make into parkland.
Clean up trash.
Increase public spaces, habitat corridors and pedestrian/bike paths up and down the lakeshore.
Shoreland landscaping in the yards along Lake Michigan yards instead of yard grass.
Make the shoreline become trash free!
Improve existing stormwater detention ponds.
Cap brownfields.
Expand bicycle & walking trails.
Improved beach management at Wind Point and Shoop beaches.
Pass ordinances that require conservation development on green infrastructure parcels with SSA funding
Reduce storm/sanitary sewer overflow contamination.
Investigate the aftereffects of wastefill that fell into lake from coal plant.
Wild areas restored.
More bike paths.
Provide safer connections to Oak Leaf Bike Trail on County Line Road.
Eradication of zebra mussels and cladophora from Lake Michigan, and protect lake from Asian carp.
Eliminate the terrible smell that occurs occasionally in the summer in Shoop golf course area.
Reinforce potential areas of erosion.
Maintain quality of shoreline if possible.
Stabilize the bluffs north of Bender Park and add habitat where bluff meets water's edge.
Lake Michigan ravine stabilization throughout the watershed
More clean shoreline activity.
Woodland restoration or at least dense landscape reforestation.
Maintain existing wild areas.
Public access to previously closed areas that have been rehabilitated (abatement of brown fields).
Decrease the amount of lawn, increase vegetated buffers around ditches and swales, decrease fertilizer use.
Clean-up trash in the river and along its banks.
Improve the drainage basin on The Johnson Foundation Lands
Erosion control on Lake Michigan bluffs.

Dredge the mill pond in Grant Park.
Connect lakefront properties with multi use paths where possible.
Create safe bike paths around lighthouse drive in Racine between 3 & 4 mile roads.
Expand walking paths.
Clean water naturally (retention pond/wetland) before it enters the Lake.
Stop Waukesha from using Lake Michigan water and dumping sewer water into the Root River.
Rain garden incorporation by cities in the watershed to decrease stormwater runoff.
Provide more public access.
The valley trail creek should have larger culverts. The current pipes are too small.
Cement piers near Shoop park need urgent repair.
Clean, prune and restore lake area behind Shoop that leads to what used to be a nice area.
Stop major erosion on Lake Michigan Shore Line in Bender Park
Help the public achieve a higher degree of understanding about importance of runoff quality.
Preserve natural areas.
Use less road salt on side streets.
Educate public about value of wetlands.
Bike lane continued along 4 Mile Road and Light House Drive and 3 Mile Road.
Preservation of Bender Park Native American path and history.
More stormwater runoff collection areas.
Meet goals of this initiative.

The last question inquired what, if any, final information people wanted to provide regarding topics mentioned earlier in the survey. Comments are in the Table 46 below.

The survey results were made available at the January 2014 Phase II Wind Point watershed planning meeting. A follow-up survey five years after the Plan's completion will measure if people are more aware

and knowledgeable about water quality and stormwater pollution and the extent they have adopted new "green" practices as a result of the information and education outreach efforts.

Table 46. Additional information regarding topics in survey.

Activity
I would like to see neighbor to neighbor communication - phone calls from neighbors to neighbors, stopping while walking and talking about the Wind Point watershed - engaging others through face to face or voice to voice interaction. Stopping a car, getting out and saying hello when driving past. Many people are not able to come to meetings but have so much knowledge, experience, and abilities that they could share in their own way if they were only asked.
I'm so happy that attention will be given to this topic. We spend 6 months in N WI and are very involved in the waterfront association and volunteer on our lakes monitoring for invasive species.
Educate people to pick-up trash and not throw trash on to streets and yards and allow it to enter our water ways.
I visit the Wind Point area very often to visit my family at our original homestead in Caledonia. I now live on a lake in Kenosha County and was, until very recently, a board member of our lake Management District. Much of this topic is of interest to me. I would like to regularly be informed of these issues in the Wind Point Watershed.
I have a rain garden with plants provided by you and it is doing very well.
I think the people along the shoreline do not realize what they have in their backyard. People take the Lake for Granted. People who own or live on the Lake Michigan shoreline should be held accountable for the things that wash up in the beaches of their property including the folks at the lighthouse.
It seems many times the local paper posts about meetings after they have happened or with very short notice, too short for someone who works and is busy to fit it into their schedule.
I would be interested in attending local watershed seminars.
I think you need to be careful about drawing too many conclusions from some of the questions as I believe many have nuanced answers to some of these issues.
I think most people are now aware of the importance of preventing rainwater runoff and would be willing to use rain barrels and plant rain gardens if they didn't have to do all of the work and maintenance by themselves. The initiative could start/back some start-up businesses that specialize in these two areas; that every homeowner and business could go to for any amount of help, from do-it-yourself projects to 100% of the work and maintenance.
I think there should be more signage educating people about the watershed they live in. On that sign, it would be great if the subwatersheds were marked so that people could get to know their local water body.
Open up the old Hunt's Landfill ponds for fishing.
Lake Michigan lower levels is an important and relevant consideration here.
Once it's built upon it's lost. Farming needs better soil and nutrient management assistance and preservation funding.

Table 47. Information and Education Plan Matrix.

Education Action of Campaign	Target Audience	Communications Vehicles	Schedule	Lead (Supporting) Organizations	Outcomes, Behavior Change	Estimated Cost
Educate elected officials about the completed plan and 1) Encourage them to adopt the Wind Point watershed-Based Plan. 2) Encourage amendments of municipal comprehensive plans, codes and ordinances to include watershed plan goals and objectives.	Elected Officials in the County of Milwaukee, County of Racine, City of Racine, City of Oak Creek, City of South Milwaukee, Villages of Caledonia and Wind Point and residents of the communities	Meetings with heads of government (mayor, chairperson, president, and county administrators), special mailing, and presentations to elected officials. Tour of watershed. Presentations on model ordinances, codes, stormwater management plans, and stormwater best management practices. Include elected officials in BMP presentations (porous pavement, green roofs, bioswale/rain garden streets, etc.) and field trips of SE WI Clean Water Network Conference or workshop on topic of “Planning for Watershed Sensitive Development” (street design, conservation design for new subdivisions & business development, etc.)	Immediately following completion of plan Quarterly meetings of SE WI clean Water Network (March, June September, December) Conference or workshop in 2015, 2017	Root-Pike Watershed Initiative Network, UW-Extension, WDNR	Within two years each municipality and county board of elected officials adopts the Plan.	\$12,000.00 (240 hours)
Educate farmland owners and renters about the plan and recommended actions, particularly the Critical and Priority areas. Encourage and support farmland owners and renters to implement recommended actions within the watershed plan.	Owners and renters of farmland identified for Critical and Priority projects in the plan.	Meetings of farmland owners and renters (available funding for projects, purchase of development rights, buffers and their impact on water quality, role of wetlands). Tour of completed projects.	Immediately following completion of plan	Milwaukee and Racine County Conservationists; USDA, land trusts, NRCS	See private landowners below	See private landowners below

Education Action of Campaign	Target Audience	Communications Vehicles	Schedule	Lead (Supporting) Organizations	Outcomes, Behavior Change	Estimated Cost
Educate private landowners about the watershed plan and the Critical and Priority areas identified for restoration, and inform them that these areas were selected, how these areas can be restored, on technical assistance and funding available.	Owners of land identified for Critical and Priority projects	Meetings, field trips, special mailings, hard copy and email newsletter targeted to the landowners including farmland owners.	Immediately following completion of plan	UW-Extension, SEWRPC, WDNR, USDA, County Conservationists	Root-Pike WIN will hold 20 meetings over five years (four per year) and will consult with landowners to help them find private landowners will initiate a restoration or easement project during the first five years following adoption of the plan.	\$18,000.00 (360 hours)
Inform the general public, that a Watershed-Based Plan has been developed for the Wind Point watershed to gain interest in implementing recommended actions.	General Public	Use Root-Pike WIN's website, <i>Respect Our Waters: Greener Yards, Cleaner Waters</i> e-newsletter and workshops, WIN's Facebook page, and Respect Our Waters media and community outreach campaign, news releases and media interviews to inform the public about the plan, how they can obtain the plan and actions they can take to implement projects.	Immediately following plan completion	Municipalities, UW-Extension, WDNR	The majority of the public in the watershed have good knowledge of the watershed conditions and who to contact to get involved and implement projects. The public also begins to alter every day activities leading to watershed improvement.	No additional cost using existing resources & programs
Fund restoration projects in the Wind Point watershed	Municipalities, schools	Root-Pike WIN's Resource Group gives projects in Critical and Priority areas priority for funding consideration in WIN's Watershed-based Grants program.	Starting in 2015-2016 funding cycle	Root-Pike WIN Board of Directors, Staff and Resource Group	The majority of Root-Pike WIN's grant funding is awarded to restoration projects identified in the completed watershed plans of the Pike River, Root River and Wind Point watersheds.	No additional cost using existing resources & programs
Educate homeowners on actions they can take in their yards to reduce polluted stormwater runoff	Homeowners	Offer workshops to homeowners to educate them on actions they can take in their yards to reduce polluted stormwater runoff: diverting rainwater and snow-ice melt to vegetated areas, rain gardens, use of rain barrels, benefits of removing non-native species and replacing with native vegetation, reducing turf grass and use of fertilizers and pesticides, planting trees, picking up pet waste.	4-6 workshops in Spring and Summer, <i>Respect Our Waters: Greener Yards, Cleaner Waters</i> workshops E-newsletter, <i>Respect Our Waters: Greener Yards, Cleaner Waters</i> , monthly February thru October each year	Municipalities; UW-Extension, consultants, Root-Pike Watershed Initiative Network and Southeastern Wisconsin Watersheds Trust	Over 300 people will attend a workshop over five years and over 3,000 people will receive the <i>Respect Our Waters: Greener Yards, Cleaner Waters</i> newsletters. The homeowners become more aware of the problem of stormwater runoff and how they contribute to it, and actions they can take in their yards to reduce their impact.	No additional cost using existing resources & programs

Education Action of Campaign	Target Audience	Communications Vehicles	Schedule	Lead (Supporting) Organizations	Outcomes, Behavior Change	Estimated Cost
Educate private land owners in the Wind Point watershed how to properly manage land to benefit green infrastructure.	Private land owners in non-critical and Critical and Priority areas of the Wind Point watershed	Conduct workshops for landowners that explains the green infrastructure plan and recommends bioengineering options, funding sources, and qualified contractors for projects. Provide homeowner and business associations with the knowledge needed to maintain naturalized detention basins.	Annual land restoration conference or seminar	Consultants, municipalities, WDNR, SEWRPC, UW-Extension, USDA, County Conservationists	Private landowners in the Wind Point watershed recognize the benefits of best management practices as part of green infrastructure. Members of homeowners associations will recognize the benefits of vegetating a detention basin and the steps needed to carry it out.	No cost if we get sponsors
Educate professional landscapers about green practices in landscaping	Professional Landscapers	Hold a workshop featuring experts in native plant landscaping and best management practices, such as bioswales and rain gardens.	Offer every 2-3 years	UW-Extension, WDNR	Professional landscapers will report that they are building more BMPs for their clients	Registration fees pay for costs of workshop.
Provide schools with information about the Wind Point watershed as a means to support outdoor curriculum within the watershed's green infrastructure.	Teachers/ Students (4th and 7th grades, college level)	Continue supporting and expanding reach of water education programs through Root-Pike WIN's Watershed-based Grant Program and the Respect Our Waters campaign to help integrate basic watershed planning and education into existing elementary, middle, and high school science curriculum. Continue to offer free presentations to teachers and student groups. Provide schools with copies of the Wind Point watershed plan Executive Summary to educate students about the role of watershed planning, importance of green infrastructure and actions they can take at home to improve overall watershed conditions.	Annual program	Racine Unified School District, Kenosha Unified School District, private schools, River Bend Nature Center, Alliance for the Great Lakes	4th and 7th grade students in the Racine Unified School District portion of the Wind Point watershed will understand the environment in which they live and realize the importance of maintaining a healthy place for people and nature to live in harmony and understand actions they and their family members can take to protect water quality. What is learned will be passed on to parents and future generations.	\$3,000 for 4,000 copies of Executive Summary
Offer (and participate in) volunteer activities related to stewardship activities in the watershed to the general public.	General Public	Offer "Volunteer Days" for people to remove invasive species from natural areas, survey wildlife, or clean up litter from beaches.	One program annually	Municipalities, Alliance for the Great Lakes, Weed Out! Racine	By interacting with the natural areas within the watershed, people develop an invested interest in watershed protection.	\$650.00 per event for staff and refreshments
Show public officials examples of best management practices installed in the watershed and Southeast Wisconsin.	Elected Officials; Stormwater Engineers, Public Works Directors	Continue to feature stormwater best management practices at meetings of the SE WI Clean Water Network, such as green roof, permeable pavement, street bioswales and rain gardens, parking lot rain gardens and other BMPs.	Immediately following plan completion & when projects are implemented	Southeast Wisconsin Clean Water Network, UW-Extension, WDNR, Root-Pike WIN	In five years, 6 of the municipalities in the watershed will install new BMPs.	No additional cost using existing resources & programs

Education Action of Campaign	Target Audience	Communications Vehicles	Schedule	Lead (Supporting) Organizations	Outcomes, Behavior Change	Estimated Cost
Install Wind Point "Watershed Boundary" signs along major roads in the watershed.	General Public	Design and install signs at key points along major roads in the watershed that inform drivers and passengers that they are "Entering Wind Point watershed"	Following plan completion	Municipalities, counties and state, Root-Pike WIN	Thousands of drivers see Wind Point watershed signage when entering the watershed. This sparks interest to search municipal and park district websites where they will find links to Root-Pike WIN's Wind Point watershed home page.	\$6,500 for consultation, design and installation of five signs
Maintain the existing Wind Point watershed web page on Root-Pike WIN's website and update with new information.	All Stakeholders	Post the Plan and its executive summary, announce restoration projects, grant funding opportunities, beach clean-up events, volunteer opportunities for invasive plant removal, meetings of groups engaged in restoration and stewardship, municipal tree, shrub and seed sales, Wild Ones plant sale, annual Plan update and other issues and opportunities.	Ongoing	Root-Pike WIN	The number of unique visits to the Wind Point watershed page will increase each year over five years.	\$15,000 over five years
Measurement of Outcomes	Random Sample	A Household Survey was carried out in 2010 to gather information on peoples' knowledge of the Root-Pike watershed, water quality, yard care impacts and more. These results can influence outreach, education, and technical assistance efforts provided by local water quality partners by clarifying assumptions about "target audiences" within the Root-Pike watershed. Consistent with other studies, respondents to this survey connected most directly with the aesthetic aspects of water, and most value the importance of clean water for their communities. Trash and debris were considered one of the most severe water quality problems in the area. There was low awareness of most pollutants of concern to resource managers. A full report of the survey can be found at: http://www.rootpikewin.org/images/stories/stormwater/SummaryReport.pdf	Every 5 years	Root-Pike WIN	A follow-up survey in 2015 will measure if people are more aware and knowledgeable about water quality and stormwater pollution and the extent they have adopted new "green" practices as a result of the information and education outreach efforts.	\$4,000 to cover cost of printing, postage, mail handling.

Education Action of Campaign	Target Audience	Communications Vehicles	Schedule	Lead (Supporting) Organizations	Outcomes, Behavior Change	Estimated Cost
Measurement of Outcomes: Wind Point watershed-specific	Random Sample within watershed	An anonymous online survey was carried out in 2013 to gather information on peoples' knowledge of the Wind Point watershed. The survey was designed to reveal what people already knew about the current ecological and outdoor recreational conditions in the watershed, what actions they felt should be included in the future watershed plan, the media outlets they prefer for news, and a few insights into their age, education and connection to the watershed. The survey was made available on 10/22/2013 and closed on 11/29/2013. These results can influence outreach, education, and technical assistance efforts provided by local water quality partners by clarifying assumptions about "target audiences" within the Root-Pike watershed. Survey results are found at http://www.rootpikewin.org/images/WindPoint/windpointpublicinputsurvey_rpt.pdf	Five years after plan completion	Root-Pike WIN, UW-Extension, Environmental Resources Center	A follow-up survey in will measure if people are more aware and knowledgeable about water quality and stormwater pollution and the extent they have adopted new "green" practices as a result of the information and education outreach efforts.	\$1,500
Evaluation of Programs	Participants	Root-Pike WIN asks attendees of its <i>Respect Our Waters: Greener Yards, Cleaner Waters</i> workshops to complete an evaluation of the workshop presentation and contents and uses the results to improve the program. Root-Pike WIN provides an Information and Education program for the Southeast Wisconsin Clean Water Network of municipalities under a renewable two-year contract. The I&E program is a requirement of their WIDNR-issued stormwater permit. Every two years the municipal representatives are asked to complete an evaluation survey of Root-Pike WIN's performance. Recommend that attendees of the proposed conference be asked to evaluate the workshops and overall conference.	Ongoing	Root-Pike WIN	Programs are improved; attract more participants resulting in improved water quality.	No additional cost using existing resources & programs



8.0 Plan Implementation

8.1 Plan Implementation Roles and Coordination/ Responsibilities

Identification of responsible entities for implementation of Management Measure recommendations was first mentioned in the Action Plan section of this report. These entities are key stakeholders that will be responsible in some way for sharing the responsibility required to implement the Watershed-Based Plan. However, no single stakeholder has the financial or technical resources to implement the plan alone. Rather, it will require working together and using the strengths of individual stakeholders to successfully implement this plan. Key stakeholders are listed in Table 43.

There are several important first steps that stakeholders/partners will

need to accomplish prior to plan implementation.

1. Watershed stakeholders/partners are encouraged to adopt and/or support (via a resolution) the Wind Point Watershed-Based Plan.
2. The stakeholders/partners will need to recruit “champions” within each municipality and other stakeholder groups to form a Watershed Implementation Committee that actively implements the Watershed-Based Plan and conducts progress evaluations.
3. The watershed partners may also need to fund a Watershed Implementation Coordinator such as Root-Pike WIN to follow through on plan implementation.

Table 48. Wind Point watershed stakeholders/partners.

Key Watershed Stakeholder/Partner	Acronym/Abbreviation
Root-Pike Watershed Initiative Network	Root-Pike WIN
City of Racine	Racine
City of Racine Health Department	Racine Health Dept.
City of Oak Creek	Oak Creek
City of South Milwaukee	South Milwaukee
Village of Caledonia	Caledonia
Village of North Bay	North Bay
Village of Wind Point	Wind Point
United States Environmental Protection Agency (Region 5)	USEPA
Wisconsin Department of Natural Resources	WDNR
University of Wisconsin Extension	UWEX
Fund for Lake Michigan	FLM
SC Johnson & Son	SCJ
The Prairie School	Prairie School
Racine County Land Conservation Committee	LCC
Thompson & Associates	TA
Caledonia Conservancy	CC
Southeastern Wisconsin Regional Planning Commission	SEWRPC
We Energies	We
Racine County	Racine County
Milwaukee County	Milwaukee County
USDA Natural Resource Conservation Service	USDA
Developers	Developer
Farming Community	Farm

8.2 Implementation Schedule

The Watershed Implementation Committee should try to meet at least quarterly each year to guide the implementation of the Wind Point Watershed-Based Plan. The development of an implementation schedule is important in the watershed planning process because it provides a timeline for when each recommended Management Measure should be implemented in relation to others. High Priority Critical Area projects, for example, are generally scheduled for implementation in the

short term. A schedule also helps organize project implementation evenly over a given time period, allowing reasonable time availability for developing funding sources and opportunities.

For this plan, each “Site Specific Management Measure” recommendation located in the Management Measures Action Plan (see Section 6.0) contains a column with a recommended “Implementation Schedule” based on the short term (1-10 years) for most High Priority Critical Areas and 10-20+ years for most medium and low priority

project recommendations. Other recommendations such as maintenance activities have ongoing or as needed schedules. Some projects that are high priority could be recommended for long term implementation based on selected practices, available funds, technical assistance needs, and time frame. In addition, the “Information & Education” plan (see Section 7.0) is designed to be ongoing beginning in 2015. Finally, the “Monitoring Plan” is designed to be conducted and evaluated every five years to determine if progress is being made toward achieving plan goals and objectives.

8.3 Funding Sources

Opportunities to secure funds for watershed improvement projects are widespread due to the variety and diversity of Management Measure recommendations found in the Action Plan. Public and private organizations that administer various conservation and environmental programs are often eager to form partnerships and leverage funds for land preservation, restoration, and environmental education. In this way, funds invested by partners in Wind Point watershed can be doubled or tripled, although actual dollar amounts are difficult to measure. A list of potential funding programs and opportunities is included in Appendix F. The list was developed by Applied Ecological Services, Inc. (AES) through involvement in other watershed and ecological studies.

Funds generally fall into two relatively distinct categories. The first includes existing grant programs, funded by a public agency or by other sources. These funds are granted following an application process. The EPA Nonpoint Source Management Program (Section 319 Grants) is an example: an applicant will submit a grant application to the program, and, if the proposed project meets the required criteria and if the funds appropriated have not been exhausted, a grant may be awarded.

The second category, one that can provide greater leverage, might be called “money to be found.” The key to this money is to recognize that any given project may have multiple benefits. It is important to note and explore all of the potential project benefits from the perspective of potential partners and to then engage those partners. Partners may wish to become involved because they believe the project will achieve their objectives, even if they

have little interest in the specific objectives of the Watershed-Based Plan.

It is not uncommon for an exciting and innovative project to attract funds that can be allocated at the discretion of project partners. When representatives of interested organizations gather to talk about a proposed project, they are often willing to commit discretionary funds simply because the proposed project is attractive, is a priority, is a networking opportunity, or will help the agency achieve its mission. In this way, a new partnership is assembled.

Leveraging and Partnerships

It is critically important to recognize that no one program has been identified that will simply match the overall investment of the Wind Point watershed partners in implementing the Watershed-Based Plan. Rather, partnerships are most likely to be developed in the context of individual and specific land preservation, restoration, or education projects that are recommended in the Plan. Partners attracted to one acquisition may not have an interest in another located elsewhere for jurisdictional, programmatic, or fiscal reasons.

Almost any land or water quality improvement project ultimately requires the support of those who live nearby if it is to be successful over the long term. Local neighborhood associations, homeowner associations, and similar groups interested in protecting water resources, open space, preventing development, or protecting wildlife habitat and scenic vistas, make the best partners for specific projects. Those organizations ought to be contacted in the context of specific individual projects.

It is equally important to note that the development of partnerships that will leverage funding or

goodwill can be, and typically is, a time-consuming process. In many cases, it takes more time and effort to develop partnerships that will leverage support for a project than it does to negotiate with the landowners for use or acquisition of the property. Each protection or restoration project will be different; each will raise different ecological, political and financial issues, and each will in all likelihood attract different partners. It is also likely that the process will not be fully replicable. That is, each jurisdiction or partner will have a different process and different requirements.

In short, a key task in leveraging additional funds is to assign responsibility to specific staff or for developing relationships with individual agencies and organizations, recognizing that the funding opportunities might not be readily apparent. With some exceptions, it will not be adequate simply to write a proposal or submit an application; more often, funding will follow a concerted effort to seek out and engage specific partners for specific projects, fitting those projects to the interests of the agencies and organizations. Successful partnerships are almost always the result of one or two enthusiastic individuals or “champions” who believe that engagement in this process is in the interests of their agency. There is an old adage in private fundraising: people give to other people, not to causes. The same thing is true with partnerships using public funds.

Partnerships are also possible, and probably necessary, that will leverage assets other than money. By entering into partnerships with some agencies, organizations, or even neighborhood groups, a stakeholder will leverage valuable goodwill, and relationships that have the potential to lead to funds and other support, including political support, from secondary sources.



9.0 Measuring Plan Progress & Success

It is essential to have a monitoring plan and evaluation component as part of any watershed plan to evaluate plan implementation progress and success over time. This watershed plan includes two monitoring/evaluation components:

1. The “**Water Quality Monitoring Plan**” includes methods and locations where monitoring should occur and a set of criteria (indicators & targets) used to determine whether

impairment reduction targets and other watershed improvement objectives are being achieved over time.

2. “**Report Cards**” for each plan goal were developed that include interim, measurable milestones linked to evaluation criteria that can be evaluated by the planning committee over time.

9.1 Water Quality Monitoring Plan & Evaluation Criteria

Background Information

This subsection provides a monitoring plan that can be implemented to measure changes in watershed impairments related primarily to water quality. Water quality monitoring is performed by first collecting physical, chemical, biological, and/or social indicator data. This data is then compared to criteria (indicators & targets) related to established water quality objectives.

Water quality in the Wind Point watershed is currently monitored at six locations by volunteers with the WDNR Citizens Monitoring programs and The Prairie School, four of which correspond to sites previously monitored by the Racine Health Department (RHD) as part of the watershed restoration plan development. A summary of water quality data, collected in recent years, can be found in Section 4.0. Although they may meet the statutory criteria, tributaries within Wind Point watershed are not included among WDNR's Draft 2012 303(d) list due to ephemeral stream conditions and limited accessibility. As they have no official designation, all sites are assumed supportive of fish and aquatic life.

The water quality monitoring plan is designed to: 1) capture snapshots of water quality within Wind Point watershed through time; 2) assess changes in water quality following implementation of Management Measures, and 3) assess the public's social behavior related to water quality issues. It is crucial that representative water quality samples be carefully collected using method appropriate handling procedures. Unrepresentative samples or samples contaminated during collection or handling are often useless. It is also critically important that all future monitoring be completed using WDNR or other approved protocols and methods, as the EPA requires the WDNR to submit a Quality Assurance Project Plan (QAPP) for all programs and projects receiving EPA funds. Additional guidance on QAPP requirements can be found in EPA's publication entitled *EPA Requirements for Quality Assurance Project Plans* (USEPA, March 2001).

Physical, chemical, and biological water quality indicators in streams are typically measured during base flow and after significant (≥ 1.5 inches) storm events. Chemical parameters typically include nutrients (nitrogen and phosphorous) and total suspended solids. All samples should be analyzed by certified labs to

ensure accurate results. Physical parameters, such as temperature, dissolved oxygen, pH, and water clarity (turbidity) should be collected in the field using properly maintained and calibrated field equipment. It is also important to obtain stream discharge calculations as a determination of potential pollutant loading. These calculations are easily obtained by measuring the stream width, average depth, and flow rate at the monitoring location. Biological (fish and macroinvertebrate) and habitat assessments may also be performed, site assessment criteria dependent.

Once implemented, monitoring related to individual Management Measures should ideally take place. Management Measure sampling locations should include points of water ingress and egress, e.g. the inflow and outflow appoints on a retrofitted detention basin. To achieve the best results with respect to performance, Management Measure monitoring should occur during or shortly after large rain events (≥ 1.5 inches). Biological and/or habitat assessments should also be included on any habitat improvement project, such as a stream restoration. Because funding for post implementation monitoring is typically limited, money should be built into the initial Management Measures project budget.

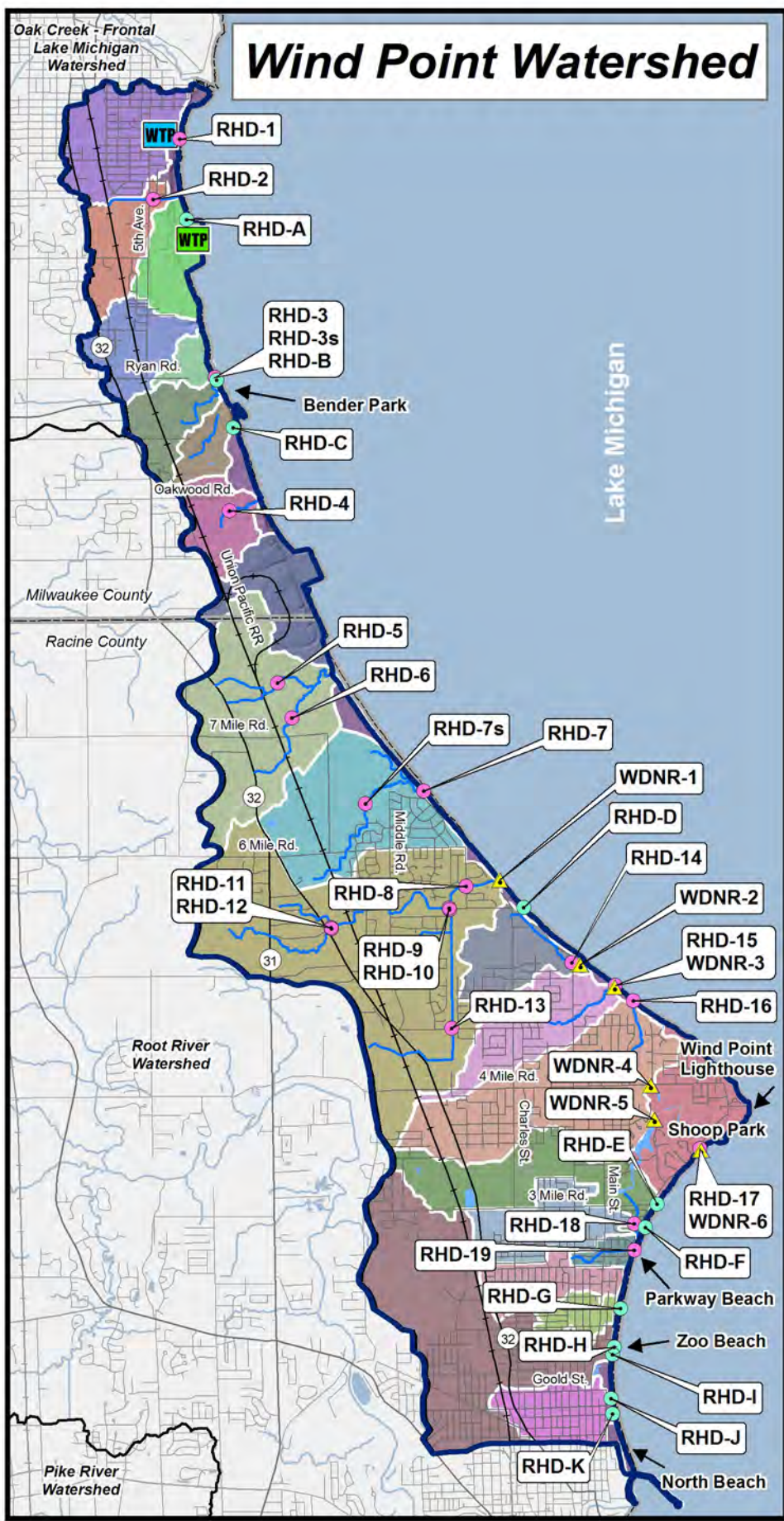
Future Water Quality Monitoring Plan Implementation (sampling locations & frequency)

Procedures by which physical, chemical, and biological monitoring data should be collected in the watershed, existing and recommended monitoring locations, monitoring

entity, and monitoring frequency are outlined in Table 49 and Figure 75. Note: Monitoring locations related to individual Management Measures are not described and will be developed as these restoration activities are implemented.

Table 49. Recommended future water quality monitoring locations.

Recommended or Existing Monitoring Entity	Sampling Location (See Figure 75)	Sampling Frequency	Parameters Tested
Racine Health Department	19 Tributary Sites & 11 Outfalls (See Figure 75)	Weekly for one year	Physical, Chemical, Microbial (<i>E. coli</i>)
Racine Health Department	11 Tributary Sites (See Figure 75)	Spring and Fall for one year	Biological (macroinvertebrates)
RHD, Prairie School, WDNR Citizens Monitoring	19 Tributary Sites & 4 Outfalls near Beaches (See Figure 75)	Monthly	Physical, Chemical, Microbial (<i>E. coli</i>)
Local Health Departments	Informal Beaches and Bender Park Beach	Seasonal (May-Sept)	Physical, Chemical, Microbial (<i>E. coli</i>)



Wind Point Watershed



Legend

- County Boundary
- Wind Point Watershed Bndy
- Surrounding Watersheds
- Open Water
- Streams
- Highway
- Streets/Roads
- Railroad
- Subwatershed Management Units

Water Quality Testing Sites

- WDNR
- RHD Outfalls
- RHD Tributaries

Wastewater Treatment Plants

- WTP South Milwaukee WTP
- WTP South Shore WTP

DATA SOURCES
WI Dept Natural Resources
Racine Health Dept

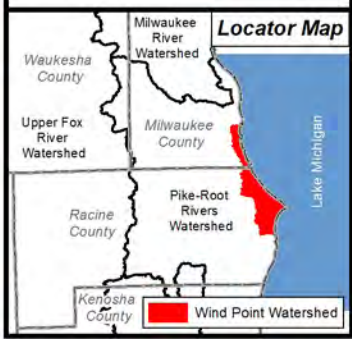
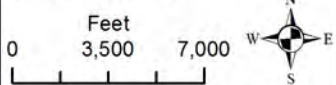


Fig. 75: Water Quality Monitoring Locations

In addition to continuing to participate in the WDNR's existing physical, chemical, and biological volunteer monitoring programs, monitoring of streams, stormwater outfalls, and coastal areas are recommended (Table 49 and Figure 75).

City of Racine Health Department (RHD)

The first recommendation is to reinstate the physical and chemical weekly assessments conducted by the Racine Health Department (RHD) for a period of one year. The initial one-year study, completed in 2013, included 19 permanent tributary sites and 11 stormwater outfall sites within Wind Point watershed. Since the initial assessments occurred in a relatively dry year, an additional year of monitoring at each tributary and outfall site is recommended in order to establish a more representative baseline of water quality and comprehensive understanding of inputs to Lake Michigan. For example, dry weather prevented regular sampling at tributary sites RHD-3 and RHD-19. Furthermore, low water levels were observed at other sites, including RHD-2, RHD-4, and RHD-18. An extension of the sampling program will provide not only more representative water quality data, but a better understanding of seasonal stream conditions. All tributary samples should be tested for the following parameters: air temperature, water temperature, dissolved oxygen, pH, conductivity, turbidity, *E. coli*, nutrients (phosphorus and nitrogen, bimonthly), chloride, and total suspended solids (once monthly).

Stormwater outfalls should be collected weekly, concurrent with sampling of surface water (tributary) sites. This will allow collection of samples at sites with low or no flow during the initial sampling period, including RHD-B and RHD-C. Additionally, sites RHD-E, RHD-F, and RHD-H through RHD-K should be monitored seasonally (May – September) with consideration to the collection of regulatory beach water samples

to determine if a correlation exists between stormwater outfall discharge and water quality at Lake Michigan beaches; these outfalls are at or near established or informal beaches within Wind Point watershed. At a minimum, stormwater outfall samples should be assessed for water temperature, *E. coli*, pH, conductivity, turbidity, chlorine, and detergents. Furthermore, outfall RHD-I demonstrated a significant positive correlation between *E. coli* and detergent concentration during the initial study period. This may indicate sanitary sewage infiltration, and additional testing for the presence of *Bacteroides*, a human specific marker, may indicate an illicit discharge to the storm sewer system. Annual costs for weekly chemical and physical parameter assessments at the 19 tributary and 11 stormwater outfall sites, including monthly assessment of total suspended solids, and bimonthly analysis of phosphorus and nitrogen, would amount to approximately \$100,000.

Existing biotic indexing data was collected on tributaries within Wind Point watershed by the Racine Health Department during the 2013 monitoring program. A Family Biotic Indexing (FBI) score was calculated at 11 tributary sites based on accessibility and flow conditions in fall 2013. Scores calculated during the initial assessment ranged from 7.5 to 8.0, corresponding to very poor water quality and likely severe organic pollution. Due to these scores and the limited number of sites, it is recommended that an FBI score be calculated at all available sites during the spring at a minimum, concurrent with the additional year of water quality monitoring. If funding allows, fall biotic indexing would increase the reliability of data collected.

The Prairie School and WDNR Citizens Monitoring

The second recommendation is to develop a joint monthly monitoring program between the RHD, The Prairie School, and WDNR

Citizens Monitoring Programs (to extend beyond the 1-year period in Recommendation #1 above). A continuation of monthly monitoring efforts by volunteers with the WDNR Citizens Monitoring program and The Prairie School is recommended at a minimum of four tributary sites. This volunteer monitoring has been conducted at or near sites selected by the RHD during the one-year monitoring project, and include tributaries monitored at RHD-8, RHD-14, RHD-15, and RHD-17.

In addition to the continuation of WDNR Citizens Monitoring, it is recommended that the remaining sites among the 19 permanent tributary sampling sites, as well as the six stormwater outfalls in proximity to beaches (RHD-E, RHD-F, and RHD-H through RHD-K), be monitored on a monthly basis. All samples collected should be assessed for similar physical and chemical parameters as those for Recommendation #1. The data collected as a function of these three recommendations will provide a snapshot of the inputs from each tributary and stormwater outfall within Wind Point watershed to Lake Michigan. Monitoring these variables at these key locations will yield data over time that will indicate if pollutants in the watershed are being reduced to target levels, staying the same, or increasing. The resulting data will help to locate pollutant sources. Annual costs for monthly water quality monitoring would be approximately \$60,000.

Local Health Departments

Sandy coastal areas on the shores of the Great Lakes are frequently utilized by the public for recreational swimming. However, they are not designated as public bathing beaches by the WI DNR, and as such are not monitored. In the Wind Point watershed, these informal beaches include the following areas: South of the South Milwaukee Wastewater Treatment Facility (south of RHD-1), North of the MMSD South Shore Reclamation Facility (east of RHD-A), the northern end of Bender

Park (north of RHD-3), the base of the bluffs on the eastern end of Cliffside Park (at the discharge point of RHD-7), north of the Siena Center (RHD-14 to RHD-15), and the former Michigan Boulevard Beach (north of RHD-H). Future monitoring of informal beaches should be a joint effort carried out by the respective local health departments (but could be supported by the RHD and/or volunteer groups). If volunteers are employed, they will be trained by RHD staff in correct sampling methods and on-site data collection, including air and water temperature, beach conditions, and wildlife presence. Following sample collection, laboratory analysis for chemical parameters, including *E. coli*, conductivity, and turbidity should be conducted by a certified laboratory or according to acceptable practices established for volunteers (e.g. WDNR WAV, Alliance for the Great Lakes Adopt-A-Beach, or others). Samples from informal beaches should be collected once weekly, if funding is available, or at minimum once monthly.

In addition to sampling the northern end of Bender Park, sampling should be expanded at Bender Park Beach, currently monitored twice-weekly during the summer beach season. Exceedances of regulatory advisory or closure thresholds have been observed at this location in more than 25% of samples for a single beach season (2005 and 2012), or more than 15% of samples across multiple beach seasons (three consecutive years, between 2003-2007 and 2010-2014). Additional sampling is also recommended at Shoop Park Beach, if it remains designated as a public bathing beach, where exceedances of the advisory or closure threshold occurred in more than 25% of samples in 2012, and in more than 15% of samples from 2010-2013. It is recommended that the additional samples be collected following significant rain events (≥ 1.5 inches) in order to determine sources of pollutant loading.

In summary, continued physical, chemical, and biological monitoring of Wind Point watershed over the next 25 plus years is paramount to the success of the plan. Only through continued monitoring and assessment will the effectiveness of restoration initiatives in improving watershed health be ascertained.

Recommended Methods

Physical and chemical monitoring of water can be time consuming and expensive depending on the complexity of the sampling program. Usually the budget and/or personnel available for monitoring limit the amount of data that can be collected. Therefore, the monitoring program should be developed to maximize the usable data given available funding and personnel. Monitoring programs should be flexible and subject to change to collect additional information or use newer equipment or technology when available.

Physical Parameters

Many different parameters can be included in physical monitoring of water quality in streams. Measurements of temperature, pH (typically not done in field by the volunteer monitoring programs or Racine Health Department), dissolved oxygen, and turbidity should be collected in the field for any future tributary monitoring done within Wind Point watershed. Where available, the use of properly maintained and calibrated portable instruments is recommended. Field measurements should be recorded directly on data sheets or, if using portable testing equipment with this feature, download data at the laboratory.

Chemical Parameters

There are a variety of chemical components that can be quantified in streams but it is recommended that testing only be completed for the parameters outlined in Table 50. Unlike physical monitoring, chemical monitoring requires grab samples analyzed at certified labs. Future monitoring of chemical components in Wind

Point watershed should be done following significant precipitation (≥ 1.5 inches within the 24-hour period prior to sample collection) in order to capture storm event data, which can in turn be compared to baseline data and the target pollutant values summarized in Section 4.0. This same monitoring protocol can be used to determine pollutant removal efficiencies resulting from implementation of some Management Measures. In conjunction with chemical component assessment, it is also important to obtain stream discharge calculations so that pollutant loads can be calculated. Stream discharge is calculated by measuring the stream width, average depth, and flow rate (ft/sec) at the sample location. It is recommended that future nutrient samples (nitrogen and phosphorous) be sent to the University of Wisconsin – Oshkosh Environmental Research Innovation Center (ERIC).

Microbiological Parameters

The primary microbiological component recommended for assessment in future water quality monitoring is *E. coli*. Presence of this organism is determined with laboratory analysis of a water sample collected at the sampling site using proper protocols. Analysis for *Bacteroides*, a human specific marker, is also recommended on samples collected at RHD-I. Samples assessed for *Bacteroides* must be collected using the proper protocol, filtered, and analyzed using polymerase chain reaction (PCR) in the laboratory.

Table 50. Stream monitoring water quality parameters, collection, and handling procedures.

Parameter	Statistical, Numerical, or General Use Guideline	Container	Volume	Preservative	Max. Hold Time
Physical Parameters Measured in Field					
Dissolved Oxygen	>5.0 mg/l	These parameters are measured in the field			
Temperature	<90° F				
Chemical, Microbial, & Physical Parameters Analyzed in Lab					
Total Suspended Solids	<19 mg/l	Plastic or glass	32 oz	Cool 4° C	7 days
Nitrate-Nitrite Nitrogen	<1.798 mg/l (optional sampling with Oakton ionchromoroghapher)	Plastic or glass	4 oz	Cool 4°C 20% Sulfuric Acid	28 days
Total Phosphorus	<0.075 mg/l	Plastic or glass	4 oz	Cool 4° C 20% Sulfuric Acid	28 days
Chloride	<230 mg/l	Plastic or glass	32 oz	Cool 4° C	28 days
<i>E. Coli</i>	> 235 MPN is advisory > 1,000 MPN is beach closure	Plastic or glass	16 oz	Cool 4° C	24 hours
pH	>6.0 or <9.0	Plastic or glass	16 oz	Cool 4° C	immediately
Conductivity	<1,500 µmhos/cm	Plastic or glass	16 oz	Cool 4° C	24 hours
Turbidity	<14 NTU	Plastic or glass	16 oz	Cool 4° C	24 hours

Additional Recommendations

Expanded monitoring

If additional funding becomes available, the number of monitored tributary and stormwater outfall sites could be expanded. A more comprehensive understanding of water quality within Wind Point watershed can be achieved by not only sampling all sites included in the original monitoring project, but also upstream tributaries that have not previously been monitored. This would introduce at least three sites upstream of existing sampling locations on the Rifle Range Ravine (RHD-5), Cliffside Park Tributary (RHD-7), and RHD-15. Exceedances of the state standard for *E. coli* (at RHD-7 and RHD-15) and recommended guideline for turbidity (at RHD-5 and RHD-7), in at least 50% of samples collected at downstream sites, indicates additional upstream monitoring may prove beneficial for the identification of the pollutant sources.

Expanding Estimations of Sediment Loading

Additional monitoring should include either bed load testing or a stream cross section in order to monitor ongoing sediment loading on Wind Point tributaries. Bed load testing should be completed by USGS and/or an engineering consultant firm to measure flow-related sediment levels; unfortunately, this testing can often be a cost-prohibitive and time consuming program. Alternately, stream cross sections can possibly be used to assess sediment loads, as developed by the WDNR's technical services division.

Evaluation Criteria

Water Quality Evaluation Criteria

Water quality criteria (expressed as measurable indicators & targets) need to be developed so that water quality objectives can be evaluated over time. The criteria are designed to be compared against data gathered from the Water Quality Monitoring Plan as well as other data and analyzed to determine the success of the watershed plan in terms of protecting and improving water quality. These criteria also support an adaptive management approach by providing ways to reevaluate the implementation process if adequate progress is not being made toward achieving water quality objectives.

Section 2.0 of this plan includes a water quality goal (Goal 3) with

seven objectives. Criteria are selected for each water quality objective to determine whether components of the water quality goal are being met (Table 51). Criteria are based on WDNR water quality criteria, data analysis, reference conditions, literature values, and/or expert examination. Criteria are also designed to address potential or known sources of water quality impairment identified in Section 5.0. Future evaluation of the criteria will allow the Wind Point Watershed Implementation Committee to gauge plan implementation success or determine if there is a need for adaptive management. Note: evaluation criteria are included for the water quality goal only; criteria for other plan goals are examined within the appropriate progress evaluation "Report Cards" in Section 9.2.

Table 51. Set of criteria related to water quality objectives.

GOAL 3: Improve surface water quality to meet applicable standards.	
Water Quality Objective	Criteria: Indicators and Targets
1) Stabilize 8,685 linear feet of highly eroded streambanks & ravines located along four "High Priority Critical Areas". This includes stabilizing four stream headcuts as identified along Tributaries B, E, and F.	• <u># of Restored Stream & Ravine Reaches</u>: All "High Priority Critical Area" streams, ravines, and headcuts stabilized and/or restored. • <u>Chemical Water Quality Standards</u>: <19 mg/l TSS, <0.075 mg/l TP, <1.798 mg/l TN, and <235 MPN/100 ml mg/l <i>E. coli</i> • <u>Biotic Indexes</u>: Biological communities achieve at least "Fair" resource quality. • <u>Social Indicator</u>: >50% of surveyed residents know that bank erosion is a problem in the watershed and support bank stabilization efforts.
2) Stabilize 4,500 linear feet of highly eroded bluff located along on "High Priority Critical Area".	• <u>% Reduction in Bluff Erosion</u>: >95% reduction in erosion compared to existing conditions. • <u>Social Indicator</u>: >75% of surveyed residents know the importance of stabilizing eroded bluffs.
3) Restore 14,541 linear feet of riparian buffer along two "High Priority Critical Areas."	• <u># of Riparian Area Restorations</u>: Two "High Priority Critical Area" riparian areas are restored. • <u>Chemical Water Quality Standards</u>: <19 mg/l TSS, <0.075 mg/l TP, <1.798 mg/l TN, and <235 MPN/100 ml mg/l <i>E. coli</i> • <u>Social Indicator</u>: >50% of surveyed residents know the importance of restoring riparian areas.
4) Restore 270 acres of wetland at nine "High Priority Critical Areas."	• <u># of Wetland Restorations</u>: All nine "High Priority Critical Area" wetland restoration projects are implemented. • <u>Chemical Water Quality Standards</u>: <19 mg/l TSS, <0.075 mg/l TP, <1.798 mg/l TN, and <235 MPN/100 ml mg/l <i>E. coli</i> • <u>Social Indicator</u>: >50% of surveyed residents know the importance of restoring wetlands.
5) Retrofit eight "High Priority Critical Area" detention basins.	• <u># of Detention Basin Retrofits</u>: All eight "High Priority Critical Area" detention basins are retrofitted. • <u>Chemical Water Quality Standards</u>: <19 mg/l TSS, <0.075 mg/l TP, <1.798 mg/l TN, and <235 MPN/100 ml mg/l <i>E. coli</i> • <u>Social Indicator</u>: >50% of surveyed stakeholders understand the water quality and habitat benefits created by retrofitting detention basins with native vegetation.
6) Implement agricultural best management practices on seven sites totaling 975 acres identified as "High Priority Critical Areas".	• <u># of Sites in No Till</u>: Farmers at all seven "High Priority Critical Area" agricultural areas implement no till farming practices. • <u>Social Indicator</u>: >75% of surveyed farmers understand the water quality benefits created by implementing no till farming practices.
7) Continue water quality monitoring programs, specifically including Nitrogen, Phosphorus, Total Suspended Solids, and <i>E. coli</i> .	• <u>Monitoring Program</u>: Racine Health Department, Prairie School, WDNR, and local health departments implement the outlined water quality plan.

Biological Indicators of Water Quality

Biological data can be used alone or in conjunction with physical-chemical data to make an impairment assessment on a waterbody in Wisconsin. A Fish Index of Biotic Integrity (Fish IBI) is one method of assessing biological health and water quality through several attributes of fish communities found in streams. The WDNR uses biological data to determine water quality conditions of streams because fish and macroinvertebrates are relatively easy to sample/identify and reflect specific and predictable responses to human induced changes to the landscape, stream habitat, and water quality.

Indices have been developed that measure water quality using fish (fish Index of Biotic Integrity (fIBI)) and macroinvertebrates

(Macroinvertebrate Index of Biological Integrity (M-IBI) and Family Biotic Indexing (FBI)). These indices are best applied prior to a project such as a stream restoration to obtain baseline data and again following restoration to measure the success of the project. Or, they can be conducted to simply assess resource quality in a stream reach.

Fish Indices of Biotic Integrity (fIBI)

The fIBI is designed to assess water quality and biological health directly through several attributes of fish communities in streams. After the fish have been collected using electrofishing equipment and identified, the data is used to evaluate 12 metrics and a rating is assigned to each metric based on whether it deviates strongly from, somewhat from, or closely approximates the expected values found in high quality reference stream reaches. The sum of these

ratings gives a total IBI score for the site. The best possible IBI score is 100. The WDNR has determined that a score less than 30 indicates a stream is not fully supporting for *Warm Water Sport Fish*.

Macroinvertebrate Indices of Biological Integrity (M-IBI) and Family Biotic Indexing (FBI)

The M-IBI is designed to rate water quality using aquatic macroinvertebrate samples. An M-IBI score of 0-2.5 is considered grounds for 303(d) listing a stream.

The FBI is performed by collecting macroinvertebrates samples and sorting specimens by taxonomic order and family. The number of organisms within each Family and their respective tolerance to organic pollution is used to determine the FBI score. Higher scores are indicative of a higher degree of organic pollution and poor water quality.

Social Indicators of Water Quality

Quantifying social indicators of success in a watershed planning initiative is difficult. It is subjective to a large degree and complaints about poor conditions are often heard rather than compliments on improvements. The Great Lakes Regional Water Program (GLRWP), a leading organization that addresses water quality research, education, and outreach in Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin, defines social indicators as standards of comparison that describe the context, capacity, skills, knowledge, values, beliefs, and behaviors of individuals, households, organizations, and communities at various geographic scales. The GLRWP suggests that social indicators used in water quality management plans and outreach efforts are effective for several reasons including:

- Help watershed committee evaluate projects related to education and outreach;
- Help support improvement of water quality projects by identifying why certain groups install Management Measures while other groups do not;
- Measure changes that take place within grant and project timelines;
- Help watershed committee with information on policy, demographics, and other social factors that may impact water quality;
- Measure outcomes of water quality programs not currently examined.

GLRWP has developed a Social Indicators Data Management and

Figure 76. Steps to measure social indicators. Source: GLRWP.



Analysis Tool (SIDMA) to assist watershed stakeholders with consistent measures of social change by organizing, analyzing, and visualizing social indicators related to non-point source (NPS) management efforts. The SIDMA tool uses a seven step process to measure social indicators as shown in Figure 76. Detailed information about GLRWP's social indicator tool can be found at <http://35.8.121.111/si/Home.aspx>.

Several potential social indicators could be evaluated by the Wind Point Watershed Implementation Committee using different strategies to assess changes in water quality. For example, surveys, public meetings, and establishment of interest groups

can give an indication of the public knowledge about the water quality in the watershed. It is important to involve the public in the water quality improvement process at an early stage through public meetings delineating the plans for improvement and how it is going to be monitored. Table 52 includes a list of potential social indicators and measures that can be used by the watershed committee to evaluate the social changes related to water quality issues. Then thank you letters should be sent to those that responded, while those that did not respond should be sent a second survey. The results of the survey can be used to develop appropriate media, citizen awareness, and watershed management activities to improve social behavior.

Table 52. Social indicators related to understanding behavior toward water quality issues.

Social Indicator	Measure
1) Media Coverage	• # of radio broadcasts related to water quality protection • # of newspaper articles related to water quality protection
2) Citizen Awareness	• # of informational flyers distributed per given time period • % of citizens who are able to identify where pollution is originating from • % change in volunteer participation to protect water quality • % change in attendance at water quality workshops • # of requests to create public use areas with interpretive signage • % of stakeholders who are aware of watershed management information
3) Watershed Management Activities	• # of stream miles cleaned up per year • # of linear feet or miles of trails created or maintained each year • # of municipalities adopting watershed management plan • # of watershed groups implementing plan recommendations

9.2 Goal Milestones/ Implementation & Progress Evaluation “Report Cards”

Milestones are essential when determining if Management Measures are being implemented and how effective they are at achieving plan goals over given time periods. Tracking milestones allows for adaptive management whereby periodic plan updates and changes can be made if milestones are not being met.

Watersheds are complex systems with varying degrees of interaction and interconnection between physical, chemical, biological, hydrological, habitat, and social characteristics. Criteria that reflect these characteristics may be used as a measure of watershed health. Goals and objectives in the watershed plan determine which criteria should be monitored to evaluate the success of the watershed plan.

A successful watershed plan involves volunteer stakeholder participation to get projects completed, and must include a feedback mechanism to measure progress toward meeting goals. Watershed “Report Cards,” developed specifically for each goal in this plan, provide this information.

Each Report Card provides:

- Summaries of current conditions for each goal to set the stage for what efforts are needed
- Most important performance criteria related to goal objectives (see Section 2.0)
- Milestones to be met for various time frames
- Monitoring needs and efforts required to evaluate milestones
- Remedial actions to take if milestones are not met
- Notes section

Report Cards were developed for each of the five plan goals and are located at the end of this section. The milestones are generally based on “Short Term” (1-10 years; 2015-2025), “Medium Term” (10-20 years; 2025-2035), and “Long Term” (20+ years; 2035+) objectives. Grades for each milestone term should be calculated using the following scale: 80%-100% of milestones met = A; 60%-79% of milestones met = B; 40%-59% of milestones met = C; and < 40% of milestones met = failed.

Report Cards should be used to identify and track plan implementation to ensure that progress is being made towards achieving the plan goals and to make corrections as necessary.

Lack of progress could be demonstrated in factors such as monitoring that shows no improvement, new environmental problems, lack of technical assistance, or lack of funds. In these cases the Report Card user should explain why other factors resulted in milestones not being met in the notes section of the Report Card.

Early on in the plan implementation process, the Watershed Planning Committee should fund a Watershed Implementation Coordinator such as Root-Pike WIN to update the committee on plan implementation progress by way of the Report Cards. If needed, adaptive management should be implemented accordingly by referencing the adaptive management recommendations on each Report Card then developing a strategy to either change the milestone(s) or decide how to implement projects or actions to achieve the milestone(s).

Report Cards can be evaluated at any time. However, it is recommended that they be evaluated every five years to determine if sufficient progress is being made toward achieving milestones or if adaptive management is needed.

Goal 1 Report Card

Manage cultural and ecological components of the Green Infrastructure Network.

Historic and Current Condition:

- The historic landscape was a mix mostly forested prior to European settlement in the 1830s.
- In 2012, residential areas were most common (3,927 acres; 33%) followed by vacant land (1,649 acres; 14%).
- The largest change of a land use/land cover is predicted to occur on agricultural land (-968 acres; -83%) in the next 30 years.
- A parcel level inventory found that open space comprises over 4,939 acres or nearly 41% of the watershed.
- Important Natural Areas comprise 2,188 acres in the watershed.
- Future development patterns will likely continue to degrade watershed conditions if Green Infrastructure is not protected.

Criteria/Targets to Meet Goal Objectives:

- All six municipalities incorporate Green Infrastructure Plan into Comprehensive Plans and development review maps.
- Develop and adopt watershed-wide Conservation or Low Impact Design standards.
- 100% of developments on "Critical Green Infrastructure Protection Areas" use Conservation/Low Impact Design.
- All thirteen publically/private owned Important Natural Areas have/implement management plans.
- Shoop Park Golf Course incorporates natural landscaping into rough areas.

Goal/Objective Milestones:

Grade

1-10 Yrs: (Short)	1. Green Infrastructure Network is incorporated into all 6 municipal Comp Plans & development reviews. 2. Watershed-wide Conservation/Low Impact Design standards developed. 3. 100% of developments on "Critical Green Infrastructure Protection Areas" follow plan recommendations. 4. Management plans developed/implemented at Bender Park, Cliffside Park, North Beach Park, & Tabor Woods, Oak Creek Power Plant Woods, and Power Plant Ravine Woods. 5. Native landscaping designs developed for rough areas at Shoop Park Golf Course.	
10-20 Yrs: (Medium)	1. 100% of developments on "Critical Green Infrastructure Protection Areas" follow plan recommendations. 2. Management plans are developed/implemented at MMSD Beach, Clay Ravine Woods, Oak Creek Bluffs & Beach, Neighborhood Central Walk, Dominican Ravine, Wind Point Ravine Woods, & North Bay Ravine. 3. 50% of rough areas at Shoop Park Golf Course are retrofitted with native vegetation.	
20+ Yrs: (Long)	1. 100% of developments on "Critical Green Infrastructure Protection Area" follow plan recommendations. 2. All thirteen Important Natural Area management plans are updated and implemented. 3. Remaining 50% of rough areas at Shoop Park Golf Course are retrofitted with native vegetation.	

Monitoring Needs/Efforts:

- Track number of communities that incorporate Green Infrastructure Network into Comp Plans and development reviews.
- Track developments on "Critical Green Infrastructure Protection Areas" that incorporate Conservation/Low Impact Design.
- Track number of management plans that are created & implemented on Important Natural Areas.
- Track number and type of natural landscaping incorporated at Shoop Golf Course.

Remedial Actions:

- Meet with municipalities that do not include the Green Infrastructure Network in Comp Plans and development reviews.
- Investigate via FOIA reasons/decisions that were made for developments that did not incorporate GI recommendations.
- Determine limits of funding where management plans are not developed/implemented on Important Natural Areas.
- Meet with golf course representatives to discuss possible low cost natural landscaping options.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

Goal 2 Report Card

Implement watershed educational, stewardship, and recreational opportunities.

Current Condition:

Many of the stakeholders in Wind Point watershed have been active in the creation and leadership of the Root-Pike Watershed Initiative Network (Root-Pike WIN). The key stakeholders include the City of Racine, City of Oak Creek, City of South Milwaukee, Village of Caledonia, Village of Wind Point and the WDNR. The Root-Pike WIN is actively engaging the public in watershed activities such as: educational seminars, research grants, paddling outings, rain garden demonstration areas and plants, beach clean-up days and extensive public education programs and a media campaign. The watershed planning process for Wind Point watershed began in 2013 with educational sessions. The watershed planning process has allowed watershed partnerships to form that will help with implementing the watershed plan and initiating projects.

Criteria/Targets to Meet Goal Objectives:

- Number of land stewardship volunteers recruited.
- Number of public officials that support conservation development and ordinance language changes.
- Number of landowners adjacent to tributaries and lakeshore that are informed about healthy land management.
- Number of environmental interpretation signs posted throughout the watershed.
- Number of people attending public education events regarding fertilizer, road salt, and pet waste disposal.
- Number of people attending public education events regarding shallow aquifer water quality and quantity.

Goal/Objective Milestones:

Grade

1-10 Yrs: (Short)	1. Each municipality recruits at least one land stewardship volunteer. 2. At least one public official representing each municipality support conservation development. 3. At least 25% of landowners adjacent to tributaries and lakeshore are educated about healthy land management. 4. Watershed signage is installed on at least two major roads as they enter Wind Point watershed. 5. At least 30 people attend fertilizer, road salt, and pet waste disposal education campaigns. 6. At least 30 people attend shallow aquifer water quality and quantity education campaigns.	
10-20 Yrs: (Medium)	1. Each municipality recruits at least two land stewardship volunteers. 2. At least two public officials representing each municipality support conservation development. 3. At least 50% of landowners adjacent to tributaries and lakeshore are educated about healthy land management. 4. Watershed signage is installed on at least two additional major roads as they enter Wind Point watershed. 5. At least 30 people attend fertilizer, road salt, and pet waste disposal education campaigns. 6. At least 30 people attend shallow aquifer water quality and quantity education campaigns.	
20+ Yrs: (Long)	1. Each municipality recruits at least three land stewardship volunteers. 2. At least three public officials representing each municipality support conservation development. 3. At least 75% of landowners adjacent to tributaries and lakeshore are educated about healthy land management. 4. At least 30 people attend fertilizer, road salt, and pet waste disposal education campaigns. 5. At least 30 people attend shallow aquifer water quality and quantity education campaigns.	

Monitoring Needs/Efforts:

- Track number of volunteers recruited by each municipality.
- Track number of public officials with each municipality that support conservation development.
- Track amount of information sent to landowners adjacent to tributaries and lakeshore.
- Track number of watershed signs that are installed along major roads in the watershed.
- Track number of people that attend education campaigns related to management of fertilizer, road salt use, and pet waste.
- Track number of people that attend education campaigns related to shallow aquifer water quality and quantity.

Remedial Actions:

- Meet with municipalities to help find avenues to recruit land stewardship volunteers.
- Meet with public officials to discuss the importance of conservation development and ordinance changes.
- Ask municipalities for funding related to creating and installing watershed signage.
- Actively recruit public to attend watershed education campaigns.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

Goal 3 Report Card

Improve surface water quality to meet applicable standards.

Current Conditions:

- The findings of this report suggest moderate water quality impairment caused by channelization, streambank erosion, draining of wetlands, and high phosphorus and *E. coli* in agricultural and urban stormwater runoff.
- Biological data suggests that tributaries in the watershed are substantially affected by organic pollution.
- There are two wastewater treatment plants in the watershed: South Milwaukee Wastewater Treatment Facility & South Shore Wastewater Treatment Plant.
- 14 industrial WPDES Permit sites are located in the watershed.
- Zoo Beach and North Beach, located along Lake Michigan in the south portion of the watershed, are not impaired.

Criteria/Targets to Meet Goal Objectives:

- Four (TRB2, TRD2, TRE2, & TRF4 totaling 8,685 lf) "High Priority-Critical Area" stream/ravine reaches stabilized.
- One "High Priority-Critical Area" bluff erosion (B1: 4,500 linear feet) studied, designed, & stabilized if determined necessary.
- Two "High Priority-Critical Area" riparian areas (TRE1 & TRG5:14,541 linear feet) restored.
- Nine "High Priority-Critical Area" wetlands totaling 270 acres restored.
- Eight "High Priority-Critical Area" detention basins retrofitted.
- 975 acres at seven "High Priority-Critical Area" agricultural areas use conservation tillage (no till) farming.
- Implement future water quality monitoring program to measure success of completed water quality improvement projects.

Goal/Objective Milestones:

Grade

1-10 Yrs: (Short)	1. Designs developed to stabilize all four "High Priority-Critical Area" stream/ravine reaches. 2. Study and design (if determined necessary) plans to stabilize "High Priority-Critical Area" bluff erosion. 3. "High Priority-Critical Area" riparian areas along TRE1 & TRG5 are restored. 4. At least 2 of 9 "High Priority-Critical Area" wetlands are restored. 5. At least 2 of 8 "High Priority-Critical Area" detention basins are retrofitted. 6. At least 2 of 7 "High Priority-Critical Area" agricultural sites in no till farming unless land use changes. 7. Implement water quality monitoring program recommendations included in Section 9.1.	
10-20 Yrs: (Medium)	1. At least two of four "High Priority-Critical Area" stream/ravine reaches stabilized. 2. 4,500 lf of "High Priority-Critical Area" bluff erosion is stabilized if determined necessary. 3. At least 4 of 9 "High Priority-Critical Area" wetlands are restored. 4. At least 4 of 8 "High Priority-Critical Area" detention basins are retrofitted. 5. At least 4 of 7 "High Priority-Critical Area" agricultural areas in no till farming unless land use changes. 6. Implement water quality monitoring program recommendations included in Section 9.1.	
20+ Yrs: (Long)	1. All four "High Priority-Critical Area" stream/ravine reaches are stabilized. 2. All nine "High Priority-Critical Area" wetlands are restored. 3. All eight "High Priority-Critical Area" detention basins are retrofitted. 4. All seven "High Priority-Critical Area" agricultural areas in no till farming unless land use changes. 5. Implement water quality monitoring program recommendations included in Section 9.1.	

Monitoring Needs/Efforts:

- Track stream/ravine, riparian area, and bluff restoration & stabilization projects.
- Track wetland restoration project implementation and success.
- Track detention basin retrofit project implementation and success.
- Track acres of agricultural areas in no till farming.
- Monitor water quality per the "Monitoring Plan" in this report.

Remedial Actions:

- Locate USEPA 319 and other grants that are being submitted for recommended stream/ravine, riparian, buffer, wetland, and detention basin projects and determine success rate.
- NRCS contact farmers to determine why they are not implementing no till management practices.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

Goal 4 Report Card

Increase communication and coordination among stakeholders

Current Condition:

- A limited number of watershed stakeholders are currently pursuing grant funds to implement watershed improvement projects. Root-Pike WIN is the leading entity pursuing grant money and implementing watershed improvement projects.
- A number of practices and projects will require multi-jurisdictional and public-private participation/cooperation.
- Municipal decision-makers have not always worked collectively in the past to develop productive multijurisdictional partnerships related to funding, grant proposals, cost sharing ideas, and green infrastructure/open space protection.

Criteria/Targets to Meet Goal Objectives:

- All six municipalities in the watershed that adopt the Wind Point Watershed-Based Plan.
- Develop a "Watershed Planning Council" that meets quarterly.
- One workshop is held every ten years to teach municipal stakeholders how to use and implement the Plan at part of Phase III.
- Number of municipalities that amend current comp plans, codes, and ordinances to include watershed plan recommendations.
- Number of planning, funding, and implementation mechanisms implemented by multi-jurisdictional and/or public-private partnerships.

Goal Milestones:

Grade

1-10 Yrs: (Short)	1. All six municipalities adopt the Wind Point Watershed-Based Plan. 2. A "Watershed Planning Council" is developed and meets quarterly to implement Phase III. 3. One workshop is held to teach stakeholders how to use the watershed plan to implement projects. 4. Three of six municipalities amend comprehensive plans/codes/ordinances and implement projects that support the Plan. 5. At least three multi-jurisdictional and/or public-private projects are implemented.	
10-20 Yrs: (Medium)	1. The "Watershed Planning Council" continues to meet quarterly to implement Phase III. 2. One workshop is held to teach stakeholders how to use the watershed plan to implement projects. 3. All six municipalities amend comprehensive plans/codes/ordinances and implement projects that support the Plan. 4. At least three multi-jurisdictional and/or public-private projects are implemented.	
20+ Yrs: (Long)	1. The "Watershed Planning Council" continues to meet quarterly to implement Phase III. 2. One workshop is held to teach stakeholders how to use the watershed plan to implement projects. 3. At least three multi-jurisdictional and/or public-private projects are implemented.	

Monitoring Needs/Efforts:

- Track number of municipal and other governing bodies that adopt the Wind Point Watershed-Based Plan and implement recommendations.
- Track number of "Watershed Planning Council" meetings.
- Track number of multijurisdictional and/or public-private projects implemented during each milestone time period.

Remedial Actions:

- Watershed Council conduct meetings with government officials to adopt the watershed plan if it is not adopted in years 1-10.
- Track number of workshops related to Phase III plan implementation for municipal stakeholders.
- Watershed Council recommend multi-jurisdictional projects by bringing representatives to the table.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

Goal 5 Report Card

Improve groundwater recharge to maintain shallow aquifers and reduce stormwater runoff.

Current Conditions:

- The upper aquifers found beneath Wind Point watershed consists of the sandstone and dolomite of the Ancell and Prairie du Chien Groups; the lower sandstone aquifer is made up of thick sedimentary sequences of the Cambrian sandstone.
- SEWRPC studies suggest that deep water aquifers are experiencing drawdowns in the area exceeding 400 feet.
- There are currently seven groundwater wells in the watershed; four are active.
- "Traditional" development over the past 20 years generally did not incorporate groundwater infiltration practices.

Criteria/Targets to Meet Goal Objectives:

- 10 rain gardens and 10 rain barrels installed at homes or businesses every 10 years.
- All six municipalities in the watershed implement groundwater recharge policies for development located in "High" and "Very High" groundwater recharge potential areas.
- Stormwater Treatment Train designs are used in all new and redevelopment.

Goal/Objective Milestones:

Grade

<i>1-10 Yrs: (Short)</i>	1. At least 10 rain gardens and 10 rain barrels are installed as homes or businesses. 2. All six municipalities implement groundwater recharge policies. 3. Stormwater Treatment Train designs are used in all new and redevelopment.	
<i>10-20 Yrs: (Medium)</i>	1. At least 10 rain gardens and 10 rain barrels are installed as homes or businesses. 2. Stormwater Treatment Train designs are used in all new and redevelopment.	
<i>20+ Yrs: (Long)</i>	1. At least 10 rain gardens and 10 rain barrels are installed as homes or businesses. 2. Stormwater Treatment Train designs are used in all new and redevelopment.	

Monitoring Needs/Efforts:

- Track number of rain gardens and rain barrels installed each year.
- Track development that uses stormwater infiltration when located within sensitive groundwater recharge areas.
- Track number of municipalities that adopt policy requiring stormwater infiltration.

Remedial Actions:

- Municipalities develop funding sources for homeowners and businesses to install rain gardens and rain barrels.
- Conduct FOIA requests when developments in sensitive recharge areas do not incorporate stormwater infiltration practices.
- Meet with municipalities to review policy changes related to developments.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

10.0

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11.0 Glossary of Terms

100-year floodplain: A 100-year flood is a flood that has a 1-percent chance of being equaled or exceeded in any given year. A base flood may also be referred to as a 100-year storm and the area inundated during the base flood is called the 100-year floodplain.

303(d) (CWA Section 303d): The Federal Clean Water Act requires states to submit a list of impaired waters to the USEPA for review and approval using water quality assessment data from the Section 305(b) Water Quality Report. States are then required to develop total maximum daily load analyses (TMDLs) for waterbodies on the 303(d) list.

ADID wetlands: Advanced identification of wetland disposal areas (ADID) studies conducted by the United States Environmental Protection Agency (USEPA) in conjunction with the United States Army Corps

of Engineers (USACE) and the Wisconsin Department of Natural Resources (WDNR), with further technical assistance provided by Southeastern Wisconsin Regional Planning Commission (SEWRPC). Both the regional and ADID wetland inventories were completed in 2005. The wetland features were delineated according to the definitions of the Wisconsin Wetland Inventory Classification Guide, with the addition of special features such as drained wetlands and drainage ditches. ADID wetlands and waters include all aquatic resources located within primary environmental corridors and natural areas as identified by SEWRPC and categorized as either wetlands, lakes/ponds, or natural area wetlands.

Applied Ecological Services Inc. (AES): A broad-based ecological consulting, contracting, and restoration firm that was founded in 1978. The company consists of

consulting ecologists, engineers, landscape architects, planners, and contracting staff. The mission of AES is to bring wise ecological decisions to all land use activities.

Aquatic habitat: Structures such as stream substrate, woody debris, aquatic vegetation, and overhanging vegetation that is important to the survival of fish and macroinvertebrates.

Base Flood Elevation (BFE): The elevation delineating the level of flooding resulting from the 100-year flood frequency elevation. (See also **Floodplain**.)

Base flow: The flow that a perennially flowing stream reduces to during the dry season. It is often supported by groundwater seepage into the channel.

Bedrock: The solid rock that underlies loose material, such as soil, sand, clay, or gravel.

Best Management Practices (BMPs):
See **Management Measure**

Biodiversity: The variety of organisms (plants, animals and other life forms) that includes the totality of genes, species and ecosystems in a region.

Rain gardens: Excavated depressional areas where stormwater runoff is directed and allowed to infiltrate back into groundwater rather than allowing to runoff. Infiltration areas are planted with appropriate vegetation.

Biological Oxygen Demand (BOD):
The amount of dissolved oxygen that is required by microscopic organism (e.g. bacteria) to decompose organic matter in waterbodies.

Biological Stream Characterization (BSC): A multi-tiered stream quality classification based primarily on the attributes of lotic (living in moving water) fish communities. The predominant

stream quality indicator used in this process is the Index of Biotic Integrity (IBI), comprised of 12 metrics, which form a basis for describing the health or integrity of the fish community. When insufficient fishery data are available for calculating an IBI value, BSC criteria allow the use of sport fishing information or macroinvertebrate data to rate streams. BSC provides a uniform process of characterizing streams statewide and is used by a variety of sources for stream protection, restoration and planning efforts.

Bioengineering (or Soil Bioengineering): Techniques for stabilizing eroding or slumping stream banks that rely on the use of plants and plant materials such as live willow posts, brush layering, coconut logs and other “greener” or “softer” techniques. This is in contrast to techniques that rely on creating “hard” edges with riprap, concrete and sheet piling (metal and plastic).

Center for Watershed Protection (CWP): Non-profit 501(c)3 corporation founded in 1992 that provides local governments, activists, and watershed organizations around the country with the technical tools for protecting some of the nation's most precious natural resources such as streams, lakes and rivers.

Channelized stream: A stream that has been artificially straightened, deepened, or widened to accommodate increased stormwater flows, to increase the amount of adjacent land that can be developed or used for urban development, agriculture or for navigation purposes. In addition to being unsightly, channelized streams have a uniform gradient, no riffle and pool development, no meanders (curves) and very steep banks. The vegetation is frequently removed and replaced with riprap, concrete or other hard surfaces. During low flow periods in the summer, many channelized streams have low

dissolved oxygen levels, in part due to shallow, slow-moving water. Under these conditions, they provide poor habitat for fish or other stream organisms such as benthic macroinvertebrates.

Channel: Any river, stream, creek, brook, branch, natural or artificial depression, ponded area, lakes, flowage, slough, ditch, conduit, culvert, gully, ravine, swale, wash, or natural or man-made drainageway, in or into which surface or groundwater flows, either perennially or intermittently.

Conservation development: A development designed to protect open space and natural resources for people and wildlife while at the same time allowing building to continue. Conservation design developments designate half or more of the buildable land area as undivided permanent open space.

Conservation easement: The transfer of land use rights without the transfer of land ownership. Conservation easements can be attractive to property owners who do not want to sell their land now, but would support perpetual protection from further development. Conservation easements can be donated or purchased.

Clean Water Act (CWA): The CWA is the basic framework for federal water pollution control and has been amended in subsequent years to focus on controlling toxics and improving water quality in areas where compliance with nationwide minimum discharge standards is insufficient to meet the CWA's water quality goals.

Debris Jam: Natural and man-made debris in a stream channel including leaves, logs, lumber, trash and sediment.

Designated Use: EPA requirements that states and authorized Indian Tribes specify appropriate water uses to be achieved and

protected. Appropriate uses are identified by taking into consideration the use and value of the water body for public water supply, for protection of fish, shellfish, and wildlife, and for recreational, agricultural, industrial, and navigational purposes. In designating uses for a water body, States and Tribes examine the suitability of a water body for the uses based on the physical, chemical, and biological characteristics of the water body, its geographical setting and scenic qualities, and economic considerations. Each water body does not necessarily require a unique set of uses. Instead, the characteristics necessary to support a use can be identified so that water bodies having those characteristics can be grouped together as supporting particular uses.

Detention basin: A man-made structure for the temporary storage of stormwater runoff with controlled release during or immediately following a storm.

Discharge (streamflow): The volume of water passing through a channel during a given time, usually measured in cubic feet per second.

Digital Elevation Model (DEM): Regularly spaced grid of elevation points used to produce elevation maps.

Dissolved oxygen (DO): The amount of oxygen in water, usually measured in milligrams/liter.

Downcutting: The action of a stream to deepen itself, often as a result from channelization.

Drainage basin: Land surface region drained by a length of stream channel; usually 1,000 to 10,000 square miles in size.

Ecosystem: An ecological community together with its environment, functioning as a unit.

Erosion: Displacement of soil particles on the land surface due to water or wind action.

European settlement: A period in the early 1800s when European settlers moved across the United States in search of better lives. During this movement, much of the historical communities were altered for farming and other types of development.

Federal Emergency Management Agency (FEMA): Government agency within the Department of Homeland Security that responds to, plans for, recovers from, and mitigates against disasters/emergencies, both natural and man-made.

Fee in lieu: Defined by the USACE and EPA as a payment "to a natural resource management entity for implementation of either specific or general wetland or other aquatic resource development projects" for projects that "do not typically provide compensatory mitigation in advance of project impacts."

Filter strip: A long narrow portion of vegetation used to retard water flow and collect sediment for the protection of watercourses, reservoirs or adjacent properties.

Flash hydrology/flooding: A quickly rising and falling overflow of water in stream channels that is usually the result of increased amounts of impervious surface in the watershed.

Flood Insurance Rate Map (FIRM): A map prepared by the Federal Emergency Management Agency that depicts the special flood hazard area (SFHA) within a community. The FIRM includes zones for the 100-year and 500-year floodplains and may or may not depict Regulatory Floodways.

Floodplain (100-year): Land adjoining the channel of a river, stream, watercourse, lake or wetland that has been or may be

inundated by floodwater during periods of high water that exceed normal bank-full elevations. The 100-year floodplain has a probability of 1% chance per year of being flooded.

Floodway: The floodway is the portion of the stream or river channel that includes the adjacent land areas to that must be reserved to discharge the 100-year flood without increasing the water surface.

Geographic Information System (GIS): A computer-based approach to interpreting maps and images and applying them to problem-solving.

Glacial Drift: Earth and rocks which have been transported by moving ice or land ice.

Global Positioning System (GPS): Satellite mapping systems that enables locators and mapping to be created via satellite.

Green infrastructure: An interconnected network of waterways, wetlands, woodlands, wildlife habitats, and other natural areas; greenways, parks and other conservation lands, farms, and forests of conservation value; and wilderness and other open spaces that support native species, maintain natural ecological processes, sustain air and water resources and contribute to the health and quality of life.

Greenways: A protected linear open space area that is either landscaped or left in its natural condition. It may follow a natural feature of the landscape such as a river or stream, or it may occur along an unused railway line or some other right of way. Greenways also provide wildlife corridors and recreational trails.

Groundwater recharge: Primary mechanism for aquifer replenishment which ensures future sources of groundwater for commercial and residential use.

Headcut: A headcut is an erosional feature of both intermittent and perennial streams where an abrupt vertical drop, also known as a knickpoint in the stream bed occurs following hydrologic disturbances in the contributing watershed. As erosion of the knickpoint and the streambed continues, the headcut migrates upstream. This can cause significant streambank erosion and often results in a disconnected floodplain that then increased channel incision.

Headwaters: Upper reaches of tributaries in a drainage basin.

Hydraulic and Hydrologic modeling: Engineering analysis that predicts expected flood flows and flood elevations based on land characteristics and rainfall events.

Hydraulic structures: Low head dams, weirs, bridges, levees, and any other structures along the course of the river.

Hydric inclusion soil: A soil unit (usually adjacent to hydric soils) that are not wet enough to form hydric properties but do have some hydric properties.

Hydric soil: Soil units that are wet frequently enough to periodically produce anaerobic conditions, thereby influencing the species composition or growth, or both, of plants on those soils.

Hydrograph: A way of measuring and graphing stream flow, or discharge, as it varies with time.

Hydrologic Soil Groups (HSG): Soils are classified by the Natural Resource Conservation Service into four Hydrologic Soil Groups based on the soil's runoff potential. The four Hydrologic Soils Groups are A, B, C and D. A's generally have the smallest runoff potential and D's the greatest.

Hydrology: The scientific study of the properties, distribution, and effects of water on the earth's

surface, in the soil and underlying rocks, and in the atmosphere.

Hydrophytic vegetation: Plant life growing in water, soil or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content; one of the indicators of a wetland.

Impervious cover/surface: An area covered with solid material or that is compacted to the point where water cannot infiltrate underlying soils (e.g. parking lots, roads, houses, patios, swimming pools, tennis courts, etc.). Stormwater runoff velocity and volume can increase in areas covered by impervious surfaces.

Impervious Cover Model: Simple urban stream classification model based on impervious cover and stream quality. The classification system contains three stream categories, based on the percentage of impervious cover that predicts the existing and future quality of streams based on the measurable change in impervious cover. The three categories include sensitive, impacted, and non-supporting.

Incised channel: A stream that has degraded and cut its bed into the valley bottom. Indicates accelerated and often destructive erosion.

Index of Biotic Integrity (IBI): The IBI is based on fish surveys with the rating dependent on the abundance and composition of the fish species in a stream. Fish communities are useful for assessing stream quality because fish represent the upper level of the aquatic food chain and therefore reflect conditions in the lower levels of the food chain. Fish population characteristics are dependent on the physical habitat, hydrologic and chemical conditions of the stream, and are considered good indicators of overall stream quality because they reflect stress from both

chemical pollution and habitat perturbations. For example, the presence of fish species that are intolerant of pollution are an indicator that water quality is good. The IBI is calculated on a scale of 12 to 60, the higher the score the better the stream quality.

Infiltration: That portion of rainfall or surface runoff that moves downward into the subsurface soil.

Invasive vegetation/plant: Plant species that are not native to an area and tend to out-compete native species and dominate an area (e.g. European buckthorn or garlic mustard).

Loess: A fine-grained unstratified accumulation of clay and silt deposited by wind.

Macroinvertebrates: Invertebrates that can be seen by the unaided eye (macro). Most benthic invertebrates in flowing water are aquatic insects or the aquatic stage of insects, such as stonefly nymphs, mayfly nymphs, caddisfly larvae, dragonfly nymphs and midge larvae. They also include such things as clams and worms. The presence of benthic macroinvertebrates that are intolerant of pollutants is a good indicator of good water quality.

Macroinvertebrate Index of Biotic Integrity (MBI): Data derived from aquatic macroinvertebrate samples, which can be combined with stream habitat and fish assemblages, to provide valuable information on the physical, chemical and biological condition of streams. Most aquatic macroinvertebrates live for one or more years in streams, reflecting various environmental stressors over time. Since the majority of aquatic invertebrates are limited in mobility, they are good indicators of localized conditions, upstream land use impacts and water quality degradation.

Management Measures: Also known as Best Management

Practices (BMPs) are non-structural practices such as site planning and design aimed to reduce stormwater runoff and avoid adverse development impacts - or structural practices that are designed to store or treat stormwater runoff to mitigate flood damage and reduce pollution. Some BMPs used in urban areas may include stormwater detention ponds, restored wetlands, vegetative filter strips, porous pavement, silt fences and biotechnical streambank stabilization.

Marsh: An area of soft, wet, low-lying land, characterized by grassy vegetation and often forming a transition zone between water and land.

Meander (stream): A sinuous channel form in flatter river grades formed by the erosion on one side of the channel (pools) and deposition on the other (point bars).

Mitigation: Measures taken to eliminate or minimize damage from development activities, such as construction in wetlands or Regulatory Floodplain filling, by replacement of the resource.

Moraine: see **Terminal Moraine**.

National Wetland Inventory (NWI): U.S. Fish and Wildlife Service study that provides information on the characteristics, extent, and status of U.S. wetlands and deepwater habitats and other wildlife habitats.

Native vegetation/plants: Plant species that have historically been found in an area.

Natural community: an assemblage of plants and animals interacting with one another in a particular ecosystem.

Natural divisions: Large land areas that are distinguished from each other by bedrock, glacial history, topography, soils, and distribution

of plants and animals.

No-net-loss: A policy for wetland protection to stem the tide of continued wetland losses. The policy has generated requirements for wetland mitigation so that permitted losses due to filling and other alterations are replaced and the net quality wetland acreage remains the same.

Nonpoint source pollution (NPS or NPSP): Refers to pollutants that accumulate in waterbodies from a variety of sources including runoff from the land, impervious surfaces, the drainage system and deposition of air pollutants.

Nutrients: Substances needed for the growth of aquatic plants and animals such as phosphorous and nitrogen. The addition of too many nutrients (such as from sewage dumping and over fertilization) will cause problems in the aquatic ecosystem through excess algae growth and other nuisance vegetation.

Open space: Any land that is not developed and is often set aside for conservation or recreation purposes. It can be either protected or unprotected. Protected open space differs from unprotected in that it is permanently preserved by outright ownership by a body chartered to permanently save land, or by a permanent deed restriction such as a conservation easement. Open space is important to a watershed's hydrology, habitat, water quality, and biodiversity.

Outwash: Sand and gravel deposits removed or washed out from a glacier.

Partially open parcel: Parcels that have been developed to some extent, but still offer some opportunities for open space and Best Management Practice (BMP) implementation. They typically include private

residences with acreage exceeding the surrounding minimum zoning, partly developed industrial sites, or institutions (churches, schools, etc.) with extensive grounds.

Point source pollution: Refers to discharges from a single source such as an outfall pipe conveying wastewater from an industrial plant or wastewater treatment facility.

Pollutant load: The amount of any pollutant deposited into waterbodies from point source discharges, combined sewer overflows, and/or stormwater runoff.

Pool: A location in an active stream channel usually located on the outside bends of meanders, where the water is deepest and has reduced current velocities.

Prairie: A type of grassland characterized by low annual moisture and rich black soil characteristics.

Preventative measures: Actions that reduce the likelihood that new watershed problems such as flooding or pollution will arise, or that those existing problems will worsen. Preventative techniques generally target new development in the watershed and are geared toward protecting existing resources and preventing degradation.

Regulatory floodplain: Regulatory Floodplains may be either riverine or non-riverine depressional areas. Projecting the base flood elevation onto the best available topography delineates floodplain boundaries. A floodprone area is Regulatory Floodplain if it meets any of the following descriptions:

1. Any riverine area inundated by the base flood where there is at least 640 acres of tributary drainage area.
2. Any non-riverine area with a storage volume of 0.75 acre-foot or more when inundated by the base flood.
3. Any area indicated as a Special

Flood Hazard Area on the FEMA Flood Insurance Rate Map expected to be inundated by the base flood located using best available topography.

Remedial measures: Used to solve known watershed problems or to improve current watershed conditions. Remedial measures include retrofitting drainage system infrastructure such as detention basins and stormsewer outfalls to improve water quality, adjust release rates, or reduce erosion.

Remnant: a small fragmented portion of the former dominant vegetation or landscape which once covered the area before being cleared for human land use.

Retrofit: Refers to modification to improve problems with existing stormwater control structures such as detention basins and conveyance systems such as ditches and stormsewers. These structures were originally designed to improve drainage and reduce flood risk, but they can also be retrofitted to improve water quality.

Ridge: A line connecting the highest points along a landscape and separating drainage basins or small-scale drainage systems from one another.

Riffle: Shallow rapids, usually located at the crossover in a meander of the active channel.

Riparian: Referring to the riverside or riverine environment next to the stream channel, e.g., riparian, or streamside, vegetation.

Runoff: The portion of rain or snow that does not percolate into the ground and is discharged into streams by flowing over the ground instead.

Savanna: A type of woodland characterized by open spacing between its trees and by intervening grassland.

Section 319: see U.S. Environmental Protection Agency Section 319.

Sediment: Soil particles that have been transported from their natural location by wind or water action.

Sedimentation: The process that deposits soils, debris and other materials either on other ground surfaces or in bodies of water or watercourses.

Silt: Fine mineral particles intermediate in size between clay and sand.

Southeastern Wisconsin Regional Planning Commission (SEWRPC): Established in 1960 as the official areawide planning agency for the southeastern region of the State, SEWRPC serves the seven counties of Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington, and Waukesha. It was created to provide objective information and professional planning initiatives to help solve problems and to focus regional attention on key issues of regional consequence.

Stakeholders: Individuals, organizations, or enterprises that have an interest or a share in a project. (see also **Watershed Stakeholders**).

State Natural Areas (Program): The Wisconsin Department of Natural Resources manages the State Natural Areas Program which works to identify ecological communities that remain predominantly untouched from pre-European settlement times. These areas have been assessed according to field inventories conducted by WDNR staff and account for the quality, diversity, extent of past disturbance, context within the greater landscape, and rarity of features.

State Scientific Areas: Areas that meet the qualifications of a State Natural Area and have also been identified as areas of statewide significance.

Stormwater management: A set of actions taken to control stormwater runoff with the objectives of providing controlled surface drainage, flood control and pollutant reduction in runoff.

Stormsewershed: An area of land whose stormwater drains into a common storm sewer system.

Stream corridor: The area of land that runs parallel to a stream.

Stream reach: A stream segment having fairly homogenous hydraulic, geomorphic and riparian cover and land use characteristics (such as all ditched agriculture or all natural and wooded). Reaches generally should not exceed 2,000 feet in length.

Streambank stabilization: Techniques used for stabilizing eroding streambanks.

Stream monitoring: Chemical, biological and physical monitoring used to identify the causes and sources of pollution in the river and to determine the needs for reduction in pollutant loads, streambank stabilization, debris removal and habitat improvement.

Substrate (stream): The composition of the bottom of a stream such as clay, silt or sand.

Subwatershed: Any drainage basin within a larger drainage basin or watershed.

Subwatershed Management Unit (SMU): Small unit of a watershed or subwatershed that is delineated and used in watershed planning efforts because the effects of impervious cover are easily measured, there is less chance for confounding pollutant sources, boundaries have fewer political jurisdictions, and monitoring/mapping assessments can be done in a relatively short amount of time.

Swale: A vegetated channel, ditch or low-lying or depressional

tract of land that is periodically inundated by conveying stormwater from one point to another. Swales are often used in natural drainage systems instead of stormsewers.

Threatened and Endangered

Species (T&E): An “endangered” species is one that is in danger of extinction throughout all or a significant portion of its range. A “threatened” species is one that is likely to become endangered in the foreseeable future.

Tax increment financing (TIF):

Public financing method that is used as a subsidy for redevelopment, infrastructure, and other community-improvement projects in many countries, including the United States.

Till: A heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders deposited directly by and underneath a glacier without stratification.

Terminal moraines: A ridge-like accumulation of till and other types of drift that was produced at the outer margin or farthest advance, of a retracting glacier.

Topography: The relative elevations of a landscape describing the configuration of its surface.

Total suspended solids (TSS):

The organic and inorganic material suspended in the water column and greater than 0.45 micron in size.

Treatment Train:

Several Management Measures/Best Management Practices (BMPs) used together to improve water quality, infiltration and reduce sedimentation.

Turbidity: Refers to the clarity of the water, which is a function of how much material including sediment is suspended in the water.

United States Environmental Protection Agency Section 319

(Section 319): Section 319 of the Clean Water Act encourages and funds nonpoint source pollution control projects (any indirect pollution, like runoff, stormwater discharge, road salt, sediment, etc.) or NPS reduction at the source.

United States Geological Survey

(USGS): Government agency established in 1879 with the responsibility to serve the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

United States Army Corps of

Engineers (USACE): Federal group of civilian and military engineers and scientists that provide services to the nation including planning, designing, building and operating water resources and other Civil Works projects. These also include navigation, flood control, environmental protection, and disaster response.

USDA TR55 Document: A single event rainfall-runoff hydrologic model designed for small watersheds and developed by the USDA, NRCS, and EPA.

Urban runoff: Water from rain or snow events that runs over surfaces such as streets, lawns, parking lots and directly into storm sewers before entering the river rather than infiltrating the land upon which it falls.

Vegetated buffer: An area of vegetated land to be left open adjacent to drainageways, wetlands, lakes, ponds or other such surface waters for the purpose of eliminating or minimizing adverse impacts to such areas from adjacent land areas.

Vegetated swale: An open channel drainageway used along residential streets and highways

to convey stormwater and filter pollutants in lieu of conventional storm sewers.

Velocity (of water in a stream): The distance that water can travel in a given direction during a period of time expressed in feet per second.

Water Quality Standards (State):

WDNR developed four general Designated Uses which define the goals for a waterbody for all Wisconsin surface waters: Fish and Aquatic Life, Recreational Use, Public Health and Welfare, and Wildlife. Each designated use is associated with particular water quality criteria that are either numeric or narrative in nature and set the standards a waterbody must meet in order to protect the intended use.

Waters of the United States

(WOUS): For the purpose of this Ordinance the term Waters of the United States refers to those water bodies and wetland areas that are under the U. S. Army Corps of Engineers jurisdiction.

Watershed: An area confined by topographic divides that drains to a given stream or river. The land area above a given point on a waterbody (river, stream, lake, wetland) that contributes runoff to that point is considered the watershed.

Watershed partner(s): Key watershed stakeholders who take an active role in the watershed management planning process and implementing the watershed plan.

Watershed stakeholder: A person who has a personal, professional, legal or economic interest in the watershed and the outcome of the watershed planning process.

Watershed Vulnerability Analysis:

Rapid planning tool for application to watersheds and subwatersheds that estimates future and impervious cover and provides guidance on

factors that might alter the initial classification or diagnosis of a watershed or subwatershed.

Wetland: A wetland is considered a subset of the definition of the Waters of the United States. Wetlands are land that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, under normal conditions, a prevalence of vegetation adapted for life in saturated soil conditions (known as hydrophytic vegetation). A wetland is identified based upon the three attributes: 1) hydrology, 2) hydric soils and 3)

hydrophytic vegetation.

Wet meadow: A type of wetland away from stream or river influence with water made available by general drainage and consisting of non-woody vegetation growing in saturated or occasionally flooded soils.

Wisconsin Department of Natural Resources (WDNR): A government agency established to manage, protect and sustain Wisconsin's natural and cultural resources; provide resource-compatible recreational opportunities and to promote natural resource-related issues for

the public's safety and education.

Wisconsin Pollutant Discharge Elimination System (WPDES): The Wisconsin Department of Natural Resources (WDNR) developed the Wisconsin Pollutant Discharge Elimination System (WPDES) Storm Water Discharge Permit Program which is administered under the authority of ch. NR 216, Wis. Adm. Code. The WPDES Storm Water Program regulates the discharge of storm water from construction sites, industrial facilities, and municipal separate storm sewer systems (MS4s).



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ADDENDUM SUMMARY

ELEMENT A CLARIFICATIONS

1) Additional water quality clarifications and data collection results were added.

Table 1: Comparison of Beach Monitoring Data: 2013 Plan vs. New Data Collected

Table 2: Summer 2016 Weekly Bacteria Counts (MPN/100 mL) by Sampling Location

2) Pollutant reduction goals were revised to better reflect MS4 treatment practices.

Figure 1: Urban Storm Water Pollutant Load Adjustment for Existing Treatment Practices

Table 3: Original and Updated TSS Results based on MS4 Reduction Efficiencies

ELEMENT B CLARIFICATIONS

3) Revisions were made to reflect additional water quality sampling data and new interpretations were made with regard to the plan's original load reduction estimates.

Table 4: Revised eColi Data from Wind Point Watershed Beach Monitoring Sites

Table 5: Revised Wind Point Watershed Agricultural Parcels and Estimated Acres Farmed

Table 6: Estimated Unidentified Farmland Still in Production, Out of Production and Totals

Table 7: STEPL Report 1 - Reduced Pollutant Loads from Less Ag Acres in Watershed (rev. 07-2017),
Total Load by Subwatershed(s)

Table 8: STEPL Report 1 - Reduced Agricultural Acres and Pollutant Loads (rev. 07-2017),
Total Load by Land Uses (with BMP)

Table 9: STEPL Report 2 - Reduced Ag Acres and Pollutant Loads (rev. 07-2017),
Total Load by Subwatershed(s)

Table 10: STEPL Report 2 - Reduced Ag Acres and Pollutant Loads (rev. 07-2017),
Total Load by Land Uses (w/ BMP)

Figure 2: Root-Pike WIN's Nine Element Plan Recommendations Database

ELEMENT C CLARIFICATIONS

4) Updates were made as to municipal involvement, plan adoption, site specific management measures, and Racine county land conservation and NRCS on-going involvement.

Table 11: Wind Point Plan Projects in Planning, Design or Implementation as of July 2017

ELEMENT H CLARIFICATIONS

5) The EPA Technical Memo on BMP Depreciation is included for future reference and guidance.



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ELEMENT A CLARIFICATIONS

1. **WDNR/EPA Comments 1: Page 239 of plan describes the City of Racine Health Department WQ assessments were completed in 2013, which was a relatively dry year and then recommends completing an additional year of WQ monitoring to establish a more representative baseline of water quality and understanding of the watershed's pollutant inputs to Lake Michigan. We contacted City of Racine Health Department and Dr. Julie Kinzelman to confirm what additional WQ sampling has been completed since 2013. They explained some WQ sampling has been completed, but not at the scope/frequency completed in 2013 for this watershed plan. Please explain how/when plan will be revised to reflect the additional WQ sampling data since 2013. Specifically, what does the additional WQ data indicate and explain if the plan's load reduction estimates (Element B) and number/extent of practices (Element C) need to be revised (increase, decrease or remain the same)?**
 - i) Additional water quality data, similar in effort, scale and location to the data collected by Julie Kinzelman of the City of Racine, beyond 2013, has not been collected for the completed version of Wind Point Watershed Restoration Plan. While we fully support the concept of on-going water quality data collection and analysis, Root-Pike WIN did not, and does not, have the designated resources or funding to collect and analyze significant additional data beyond 2013. Root-Pike WIN has built into our implementation strategy the means to collect data with each project recommendation that is funded. In other words, we will build water quality monitoring into the design and implementation budget at the site specific level to gauge before and after success. Furthermore, it is our hope that the DNR and/or EPA will provide Root-Pike WIN with the necessary funding to implement a multi-year, basin-wide monitoring program. Since no additional data has been collected in the same locations and at the same frequency for TN, TP and TSS, as was done in the completed plan (2013), Root-Pike WIN cannot comment on how the load estimates and extent of practices should be revised. Some additional E.coli monitoring by the City of Racine has occurred in six beaches in the Wind Point watershed, and the analysis of that new data is provided in the additional responses to follow.
 - ii) Led by Julie Kinzelman, on-going E.coli water quality monitoring has been collected by the City of Racine's Health Department for the beaches along Lake Michigan in the Wind Point watershed. The E.coli data was compiled for five of the six beaches from October 2013 through December 2016. The E.coli number listed represents the average of all of the individual test dates. Table 1 below shows how those new results compare to the data that exists in the existing Wind Point Watershed Restoration Plan and found on page 136. Bender Park, Parkway Beach and North Beach saw significant drops in the E.coli average from the 2013 data. Zoo Beach now exceeds the DNR's criteria and North Beach still exceeds the criteria despite the 54% drop in the average.



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Table 1: Wind Point Watershed Beach Monitoring Data: Complete Plan and New Data

BEACH	Bender Park	Light House	Shoop Park	Parkway Beach	Zoo Beach	North Beach
eColi (plan)***	200 AVG	95	106	68	172	522
eColi (new)	93 AVG	91	116	44	306	238
% change	-53%	-4	+9%	-35%	+78%	-54%
New samples taken	96	46	29	46	574	768

*** <235 MPN/100mL WI DNR NR 102.12 (1); (Clayton et al. 2012)

- iii) In addition to the new data collected by the City of Racine's Health Department, additional data from the Wind Point area beaches was also collected by The Great Lakes Community Conservation Corps (Great Lakes CCC). Great Lakes CCC conducted six bacteria and water quality monitoring events at five locations in Wind Point along the shoreline between the Wind Point Lighthouse and Cliffside Park. Corps members are part of a national network of more than 20,000 young people at 150 service and conservation corps around the country.

Beachgoers and water recreation enthusiasts are frequently swimming in Lake Michigan at areas of Wind Point that are not regularly monitored for E.coli and other harmful bacteria. These informal beaches were identified as the public right-of-way at 5 ½ Mile Road, the shoreline at Olympia Brown School, and the beach frontage at the Siena Center. With longshore currents generally flow from North to South, the results in Table 2 below may directly impact residences along the entire stretch of Wind Point shoreline where sampling has been done by both Great Lakes CCC and the City of Racine. Since the monitoring only occurred over six weeks, we suggest that more monitoring at these sites occur before any bacteria proclamations are made about these areas.



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Table 2: Summer 2016 Weekly Bacteria Counts (MPN/100 mL) by Sampling Location

	5 ½ Mile Road	Outfall South of 5 ½ Mile	Olympia Brown	Siena Center	Siena Ravine
Week 1	272	695	292	332	763
Week 2	10	706	98	10	1,723
Week 3	10	552	10	10	836
Week 4	213	3,652	63	279	145
Week 5	10	24,192	10	10	262
Week 6	31	12,997	20	31	1,309
Week 7	109	1,723	41	97	12,033
AVG	94	6,360	76	110	2,439

Great Lakes CCC data (2016)

- iv) The State of Wisconsin uses a threshold of 235 MPN/mL to evaluate beaches and other surface water bodies. Table 2 indicates the water flowing into Lake Michigan from the outfall located south of the beach at 5½ Mile Road has consistently exceeded the threshold value. Great Lakes CCC found that the highest levels of bacteria were occurring during dry weather durations when minimal rain had fallen. The Siena Center Ravine flowing into Lake Michigan at the north end of the Siena Center parcel has also frequently exceeded the threshold. The most recent sampling event in 2016 that identified a significantly high bacteria count occurred after a heavy rainfall. In a January 23, 2017 trip to the area, Root-Pike WIN noted that adjacent neighborhoods have numerous swale and culvert drainage systems that lead directly into Lake Michigan. Targeted Respect Our Waters campaigns regarding source issues in these neighborhoods could reduce these E.coli hot spots over time. Other green infrastructure projects prescribed in the plans would also help.
- v) One final consideration that is not reflected in the Nine Element process is the degree of likelihood of a project moving forward. Root-Pike WIN has learned this through the implementation of the Pike and Root River Watershed Restoration Plans. The landowner priority isn't necessarily the priority designated in the plan and driven by the pollutant load reduction estimates. The major determining factor as to whether or not the project moves forward is the approval of the landowner to conduct a restoration effort. The pollutant load reduction estimates help that conversation, but the landowner's propensity to want to see improvement from a personal and often symbolic level, is what moves these recommendation into action. If a recommendation moves from a low-priority to a medium priority for instance, we believe the result would have very little effect on the landowner's decision-making about the project.



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- 2) **WDNR/EPA Comments 2:** In addition, we consulted with Pete Wood, DNR Stormwater Specialist, during our review of this plan to evaluate the WINSLAAM modeling results, which identify some of the plans causes and sources of pollutants. Pete provided the following comments. We request you provide a response to the questions posed re: existing MS4 treatment practices and municipal-wide MS4 TSS removal efficiencies. Specifically, does the plan's pollutant reduction goals need to be revised to reflect this new information on the existing MS4 treatment practices?

From Pete Wood:

The WINSLAAM pollutant loading numbers seem reasonable. However, I think the issue is that the effectiveness of existing MS4 treatment practices doesn't appear to be considered. SMU 23 is a good example. Attached is the actual City of Racine storm sewer system map for this general area. 167 of the assumed 274 acres for SMU 23 drains to a large regional treatment facility near the Lake. This facility provides 50% TSS reduction for the 167 acre contributing drainage area and this reduction would likely impact the "Hot Spot" ranking for SMU 23. There are other existing MS4 treatment practices within the Wind Point Watershed that may have similar circumstances.

Here are the municipal-wide MS4 TSS removal efficiencies reported by the municipalities in the Wind Point watershed: Racine = 20%, Wind Point = 50%, Caledonia = 75%, Oak Creek = 35%, South Milwaukee = 20%

For Wind Point, Caledonia and Oak Creek, the swale conveyance systems (road ditches) are a major factor in the pollutant reduction. The actual MS4 TSS removals in the Wind Point Watershed could be more or less than these overall values.

- i) The following map (Fig. 1) entitled "Urban Storm Water Pollutant Load Adjustment for Existing Treatment Practices" provides the WINSLAM correction factor/equation for dry year. This map was supplied by Pete Wood, P.E. at the Department of Natural Resources and should be referenced when using the modeled pollutant load reduction estimates in the Section 8 Recommendations.



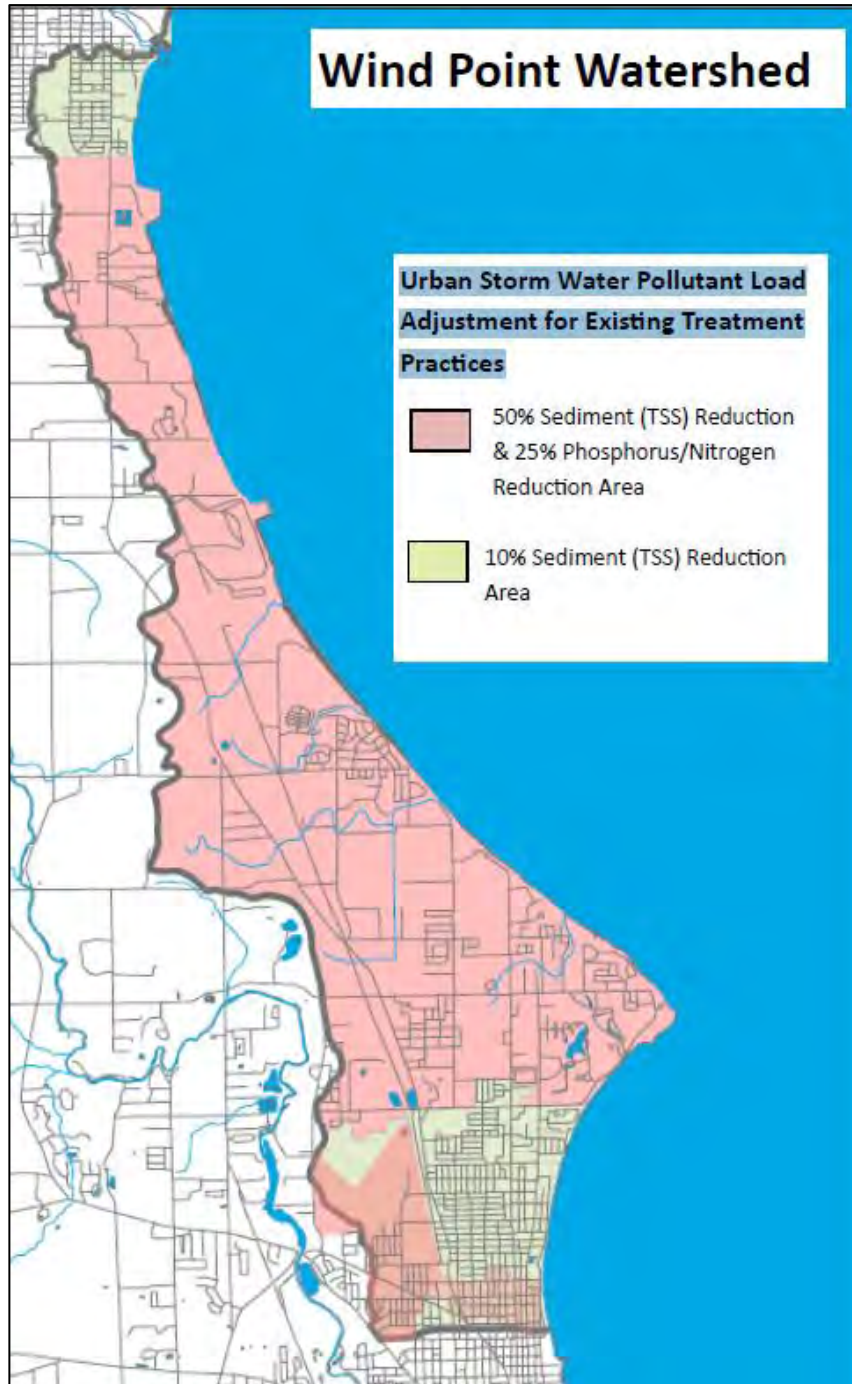
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Figure 1 - Urban Storm Water Pollutant Load Adjustment for Existing Treatment Practices



(Pete Wood, P.E., Department of Natural Resources, 2017)



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- ii) In January 2017, Root-Pike WIN re-analyzed the original monitoring results and recalculated them based on the MS4 TSS removal efficiencies that Pete Wood referenced. 17 of the TSS sites that exceeded criteria in the completed plan would be reduced to 10 using the removal efficiencies. Four of the 23 SMUs, with new aggregated TSS data from the adjusted sites, could now be considered below criteria for TSS. These SMU's were considered "hot spots" in the plan (Fig. 50) and were also adjusted for this change, but all of the SMU's can still be considered "hot spots" as the TP data still exceeded criteria. These results are shown in Table 3 and summarized by SMU below. It should be noted that SMU 16 was listed as exceeding the TSS criteria for sediment, but based on the data from site RHD-17, this SMU is below the average for TSS. SMU-16 is still a "hot spot" for TP.
- (1) SMU-10: TSS is now below criteria, but TP still exceeds criteria
 - (2) SMU-11: TSS is now below criteria
 - (3) SMU-12: TSS: 3 of 5 sites are now below criteria for TSS, However, RHD-12 still has a TSS average of 523, which exceeds the criteria by almost 10 times, so this SMU could still be considered a TSS hotspot. In addition, the SMU has TP averages that exceed criteria
 - (4) SMU-17: TSS is now below criteria, but TP still exceed criteria



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Table 3 – Original and Updated TSS Results based on MS4 Reduction Efficiencies

Site	Municipality	SMU	Old TSS	MS4 Factor	New TSS	Conclusion
RHD-1	South Milwaukee	1	9.7	0.8	7.76	still below
RHD-2	South Milwaukee	2	692.1	0.8	553.68	Still hot
RHD-A	Oak Creek	3	38.7	0.65	25.155	Still hot
RHD-3	Oak Creek	6	0	0.65	0	still below
RHD-3s	Oak Creek		0	0.65	0	still below
RHD-B	Oak Creek		229.3	0.65	149.045	Still hot
RHD-C	Oak Creek	7	0	0.65	0	still below
DNR-4	Wind Point	8	185	0.5	92.5	Still hot
RHD-4	Oak Creek		997.3	0.65	648.245	Still hot
DNR-5	Wind Point	10	17	0.5	8.5	still below
DNR-6	Wind Point		10	0.5	5	still below
RHD-5	Caledonia		54.1	0.25	13.525	Now below
RHD-6	Caledonia		0	0.25	0	still below
RHD-7	Caledonia	11	26.1	0.25	6.525	Now below
RHD-7s	Caledonia		0	0.25	0	still below
DNR-1	Caledonia	12	10	0.25	2.5	still below
RHD-10	Caledonia		73.6	0.25	18.4	Now below
RHD-11	Caledonia		121.2	0.25	30.3	Still hot
RHD-12	Caledonia		2180.4	0.25	545.1	Still hot
RHD-13	Caledonia		20	0.25	5	Now below
RHD-8	Caledonia		13.4	0.25	3.35	still below
RHD-9	Caledonia		69.7	0.25	17.425	Now below
RHD-D	Caledonia		3.8	0.25	0.95	still below
DNR-2	Caledonia	13	10	0.25	2.5	still below
RHD-14	Caledonia		80.1	0.25	20.025	Still hot
DNR-3	Caledonia	14	10	0.25	2.5	still below
RHD-15	Caledonia		78	0.25	19.5	Still hot
RHD-16	Wind Point	15	20.6	0.5	10.3	Now below
RHD-17	Wind Point	16	11.5	0.5	5.75	still below
RHD-E	Wind Point	17	26.1	0.5	13.05	Now below
RHD-18	Racine	19	267.3	0.8	213.84	Still hot
RHD-19	Racine		17	0.8	13.6	still below
RHD-F	Racine		0	0.8	0	still below
RHD-G	Racine	21	0	0.8	0	still below
RHD-H	Racine	22	17.7	0.8	14.16	still below
RHD-I	Racine		0	0.8	0	still below
RHD-J	Racine	23	10.1	0.8	8.08	still below
RHD-K	Racine		2.3	0.8	1.84	still below



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ELEMENT B CLARIFICATIONS

- 3) **WDNR/EPA Comments 3:** While we concur with many of the plans critical area management measures/project, we do not concur with the plan's load reduction estimates for reasons described below; additional information is required for consistency with element B.
- a) The plan's pollutant load reduction estimates are based upon City of Racine Health Department WQ assessments completed in 2013. Page 152 describes an important assumption with the estimates are the percent decrease in sample concentration (mg/L) from the 2013 baseline data needed to meet state or federal WQ standards, correlates to the percent reduction in annual pollutant load reduction targets. As stated above, the plan describes 2013 was a relatively dry year and then recommends completing an additional year of WQ monitoring to establish a more representative baseline of water quality and understanding of the watershed's pollutant inputs to Lake Michigan. We contacted City of Racine Health Department and Dr. Julie Kinzleman to confirm what additional WQ sampling has been completed since 2013. Since additional samples have been collected, please explain how/when plan will be revised to reflect additional WQ sampling data. Specifically, what does the additional WQ data indicate and does the plan's load reduction estimates (Element B) and number/extent of practices (Element C) need to increase, decrease or remain the same?
- i) Additional samples were collected by Julie Kinzleman for the six beaches listed in the plan. The samples were collected from October 2013 to December 2016. The sampling effort did not test for TSS, TP or TN – only E.coli. Based on the fact the sampling did not occur at a majority of the sampling sites, just for the beaches, we don't believe this data would indicate any major shifts in watershed-wide pollutant loading and therefore changes in the plan's recommendations. There are some changes that may affect assumptions about a particular outfall or runoff area adjacent to the beaches. For example, the data for Bender Park suggests a significant decrease in the E.coli, and a shift in E.coli loading in the areas around Zoo Beach and North Beach. The following is a summary of the results:



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Table 4 – Revised eColi Data from Wind Point Watershed Beach Monitoring Sites

BEACH	Bender Park	Light House	Shoop Park	Parkway Beach	Zoo Beach	North Beach
eColi (plan)***	200 AVG	95	106	68	172	522
eColi (new)	93 AVG	91	116	44	306	238
% change	-53%	-4	+9%	-35%	+78%	-54%
New samples taken	96	46	29	46	574	768

*** <235 MPN/100mL WI DNR NR 102.12 (1); (Clayton et al. 2012)

- b) Please see comments related comments above re: re: existing MS4 treatment practices and municipal-wide MS4 TSS removal efficiencies, as they related to the plan's load reduction estimates.
- i) There is no new additional data regarding TSS (or TN and TP) as the cost and time needed to conduct additional sampling exceeded the capabilities of our organization and essential support from the funding community. Root-Pike WIN would welcome additional support and funding from our partners to conduct additional sampling. Adjustments to MS4 TSS removal efficiencies would not affect the new E.coli data shown below with regard to the six beaches if the MS4 treatment practices have no effect on E.coli reduction.
- c) The pollutant reduction estimates for management practices (i.e., conservation tillage and filter strips– section 6.1.13) for the 7 critical agricultural areas, derived using USEPA's region 5 model, are modeled incorrectly and overestimate N, P and Sediment reductions. After review of Appendix E, the contributing area used for each agricultural critical area is the total acreage of a field. This is unlikely. Typically only a percentage of a field contributes runoff towards a stream, due to topography and other factors. Revision/reduction of the contributing area values is necessary to reflect the actual contributing area of each field (and may be accomplished using topographic maps and/or on site evaluation of contributing area). Also two of agricultural area modeled calculations do not contain any values, they are set at zero. Please revise these files with field specific information.



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- i) In the spring of 2017, Andrew Craig of the Department of Natural resources and Dave Giordano of Root-Pike WIN reanalyzed a majority of agricultural parcels listed in the completed Wind Point Plan from 2013. Root-Pike WIN used Racine and Milwaukee GIS sites and Google Maps when imagery was dated after 2013, to recalculate the estimated number and size of the agricultural parcels. These websites were used to clarify whether or not the agricultural parcels were still in production. Since 2013, it was also determined other areas of the identified parcels contained a percentage of trees, wetlands, and other non-agricultural features, which reduced the total number of acres being farmed.

Root-Pike WIN estimated that that of the 1,311 total acres of agricultural land defined in the Plan submitted for review in 2016, 845 were actually still being farmed. The Department of Natural Resources also determined not all agriculture acres modeled in STEPL were or have remained in agricultural production and, accordingly the STEPL model results in the plan completed in 2013 overestimated baseline agricultural loading in watershed. It is clear that from 2013 to 2017 there are fewer agricultural acres in production in the watershed, and therefore the STEPL pollutant baseline loads and load reductions estimates are less than what is currently shown in Wind Point Watershed Restoration Plan.

Consequently, Root-Pike WIN and the WDNR have determined that the acres now farmed and types of crops farmed have changed from what is described in the completed plan from 2013. Based on the data from 2014-2017, visual observations of the parcels from the aforementioned websites in 2017, and the new modeling data and analysis from the Department of Natural Resources, new analysis has been provided in this addendum. Root-Pike WIN will continue to evaluate the status of the agricultural acres in watershed every two years – because some agricultural acres could go back into production or fall out of production. As expected, these changes will impact the plan's pollutant load reduction goals for agriculture and restoration project pursuits.

The results from Root-Pike WIN's and the Department of Natural Resources' findings can be found in Table 5 (Farmed Acres), Table 6 (Acres in Production) and Table 7 on the following pages:



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Table 5 – Revised Wind Point Watershed Agricultural Parcels and Estimated Acres Farmed

Parcel	County	Total Acres	% Farmed*	Acres Farmed*	2017 Est.		Type*
					Acres Farmed	2015*	
9139993000	Milwaukee	14.53	70.00%	10.17	10.17	Yes	Unknown
9129930000	Milwaukee	5.34	70.00%	3.73	3.73	Yes	Unknown
9129929000	Milwaukee	3.96	50.00%	1.98	1.98	Yes	Unknown
104042317077000	Racine	14.83	90.00%	13.35	13.35	Yes	Row & Tree
104042317081000	Racine	12.57	90.00%	11.31	11.31	Yes	Row & Tree
104042318204000	Racine	5.77	40.00%	2.31	2.31	Yes	Row & Tree
104042307027000	Racine	10.39	60.00%	6.23	6.23	Yes	Row & Cover
104042317082000	Racine	28.81	90.00%	25.93	25.93	Yes	Row
104042320123000	Racine	23.95	90.00%	21.56	21.56	Yes	Row
104042320132000	Racine	9.30	80.00%	7.44	7.44	Yes	Row
104042307024000	Racine	7.74	90.00%	6.97	6.97	Yes	Row
104042320033000	Racine	4.47	80.00%	3.58	3.58	Yes	Row
104042328074000	Racine	59.12	80.00%	47.30	47.30	Yes	Row
9139999001	Milwaukee	124.29	30.00%	37.29	37.29	Yes	Row
104042307013000	Racine	35.91	70.00%	25.14	25.14	Yes	Row
104042201057005	Racine	28.40	70.00%	19.88	19.88	Yes	Row
104042317072000	Racine	50.18	30.00%	15.05	15.05	Yes	Row
104042307018010	Racine	29.84	50.00%	14.92	14.92	yes	Row
104042318192000	Racine	20.32	70.00%	14.22	14.22	Yes	Row
104042328071000	Racine	14.69	90.00%	13.22	13.22	Yes	Row
104042329193000	Racine	14.25	80.00%	11.40	11.40	Yes	Row
104042201046000	Racine	11.60	90.00%	10.44	10.44	Yes	Row
104042316015010	Racine	14.71	60.00%	8.83	8.83	Yes	Row
104042328009000	Racine	8.01	90.00%	7.21	7.21	Yes	Row
104042307024000	Racine	7.74	90.00%	6.97	6.97	Yes	Row
104042318300111	Racine	9.97	60.00%	5.98	5.98	Yes	Row
104042321098000	Racine	5.80	90.00%	5.22	5.22	Yes	Row
104042318008000	Racine	4.98	60.00%	2.99	2.99	Yes	Row
104042307004090	Racine	5.94	50.00%	2.97	2.97	Yes	Row
104042307004070	Racine	5.94	20.00%	1.19	1.19	Yes	Row
104042307009000	Racine	39.73	60.00%	23.84	23.84	Yes	Cover & Row
104042307007000	Racine	37.77	40.00%	15.11	15.11	Yes	Cover & Row
104042318008000	Racine	13.22	50.00%	6.61	6.61	Yes	Cover & Row
104042201048000	Racine	31.33	80.00%	25.06	25.06	Yes	Cover
104042317043000	Racine	13.91	70.00%	9.74	9.74	Yes	Cover
104042307032000	Racine	8.61	90.00%	7.75	7.75	Yes	Cover
104042317084000	Racine	13.51	30.00%	4.05	4.05	Yes	Cover
104042307008000	Racine	9.07	40.00%	3.63	3.63	Yes	Cover
104042317085000	Racine	11.47	30.00%	3.44	3.44	Yes	Cover
9629995001	Milwaukee	10.52	20.00%	2.10	2.10	Yes	Cover
		782.49	64.75%	466.09			
		total	farmed	adjusted			



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Table 6 – Estimated Unidentified Farmland Still in Production, Out of Production and Totals*

Estimated Unidentified Farmland Still in Production*						
Parcel	County	Total Acres	% Farmed*	Acres Farmed*	2017 Est.- Total Acres Farmed	2015*
Based on the original plan total (1,310.95) and adjusted for the percent used based on the 64.75 average above						
1,310.95 - 782.49 - 299.96		228.50	64.75%	147.96		
		total	farmed	adjusted		
Farmland that Appears to be Out of Production after 2013*						
Parcel	County	Total Acres	% Farmed*	Acres Farmed*	2017 Est.- Total Acres Farmed	2015*
104042307004010	Racine	5.94	90.00%	5.35	0.00	No
104042306007000	Racine	31.88	50.00%	15.94	0.00	No
104042306008000	Racine	29.09	50.00%	14.55	0.00	No
104042306003050	Racine	33.14	60.00%	19.88	0.00	No
104042306006000	Racine	46.43	70.00%	32.50	0.00	No
104042307014000	Racine	67.16	80.00%	53.73	0.00	No
104042213042000	Racine	39.58	90.00%	35.62	0.00	No
9179999001	Milwaukee	40.08	60.00%	24.05	0.00	No
09558060	Milwaukee	6.66	90.00%	5.99	0.00	No
		299.96	71.11%	207.61		
		total	farmed	adjusted		
TOTAL FROM 2013 PLAN		1,310.95	65.92%	824.51		
		total	farmed	adjusted		
TOTAL STILL IN PRODUCTION*		1,010.99	64.75%	614.05		
		total	farmed	adjusted		

* These values are estimates taken after 2013 from the GIS sites for Racine and Milwaukee and Google Maps/Streetview.



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Andrew Craig, the Nonpoint Source Planning Coordinator and NMP Specialist from the Department of Natural Resources, has provided revised STEPL modeled data for the Wind Point Plan. Table 7 represents the STEPL report with the WDNR revision of Soil P Concentration to 0.066 % for sub-watersheds 6, 10, 11, 12, 13, 15 and 17 and reflects 1,301 total agricultural acres in the watershed.

**Table 7 –STEPL Report 1 - Reduced Pollutant Loads from Less Ag Acres in Watershed (rev. 07-2017):
Total Load by Subwatershed(s)**

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (w/BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	lb/yr	%	%	%	%
W1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W2	42.4	16.3	84.9	26.5	0.0	0.0	0.0	0.0	42.4	16.3	84.9	26.5	0.0	0.0	0.0	0.0
W3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W4	309.8	36.7	940.1	12.4	0.0	0.0	0.0	0.0	309.8	36.7	940.1	12.4	0.0	0.0	0.0	0.0
W5	72.5	7.6	227.1	2.1	0.0	0.0	0.0	0.0	72.5	7.6	227.1	2.1	0.0	0.0	0.0	0.0
W6	509.9	233.5	1166.6	103.4	0.0	0.0	0.0	0.0	509.9	233.5	1166.6	103.4	0.0	0.0	0.0	0.0
W7	10.3	4.0	20.7	6.5	0.0	0.0	0.0	0.0	10.3	4.0	20.7	6.5	0.0	0.0	0.0	0.0
W8	375.0	144.4	750.1	234.4	0.0	0.0	0.0	0.0	375.0	144.4	750.1	234.4	0.0	0.0	0.0	0.0
W9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W10	8168.0	5699.9	16682.1	3765.5	0.0	0.0	0.0	0.0	8168.0	5699.9	16682.1	3765.5	0.0	0.0	0.0	0.0
W11	2419.8	1310.1	5105.5	705.1	0.0	0.0	0.0	0.0	2419.8	1310.1	5105.5	705.1	0.0	0.0	0.0	0.0
W12	5891.6	3323.8	12634.8	1805.5	0.0	0.0	0.0	0.0	5891.6	3323.8	12634.8	1805.5	0.0	0.0	0.0	0.0
W13	649.2	282.2	1360.3	90.7	0.0	0.0	0.0	0.0	649.2	282.2	1360.3	90.7	0.0	0.0	0.0	0.0
W14	471.7	125.4	1035.9	86.7	0.0	0.0	0.0	0.0	471.7	125.4	1035.9	86.7	0.0	0.0	0.0	0.0
W15	346.7	151.4	818.4	74.6	0.0	0.0	0.0	0.0	346.7	151.4	818.4	74.6	0.0	0.0	0.0	0.0
W16	8.5	2.4	17.3	1.4	0.0	0.0	0.0	0.0	8.5	2.4	17.3	1.4	0.0	0.0	0.0	0.0
W17	756.4	356.6	1569.5	120.0	0.0	0.0	0.0	0.0	756.4	356.6	1569.5	120.0	0.0	0.0	0.0	0.0
W18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W19	20.2	7.8	40.4	14.8	0.0	0.0	0.0	0.0	20.2	7.8	40.4	14.8	0.0	0.0	0.0	0.0
W20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W24	1.5	0.4	3.2	0.3	0.0	0.0	0.0	0.0	1.5	0.4	3.2	0.3	0.0	0.0	0.0	0.0
Total	20053.7	11702.5	42456.9	7049.8	0.0	0.0	0.0	0.0	20053.7	11702.5	42456.9	7049.8	0.0	0.0	0.0	0.0



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Table 8 below is Andrew Craig's revised STEPL report that reflects the revision of the reduced ag acres and total load from land uses with BMP from 1,310 to 614 acres and adoption of reduced tillage and filter strips on 75% of cropland acres within sub-watersheds 6, 10, 11, 12, 13, 15 and 17.

Table 8 – STEPL Report 2 - Reduced Agricultural Acres and Pollutant Loads (rev. 07-2017)

Total Load by Land Uses (with BMP)

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (tons/yr)
Urban	0.00	0.00	0.00	0.00
Cropland	9,603.42	4,396.24	19,750.98	1,385.68
Pastureland	1,593.72	214.52	4,992.75	46.71
Forest	0.00	0.00	0.00	0.00
Feedlots	0.00	0.00	0.00	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	0.00	0.00	0.00	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	8,856.60	7,091.78	1,7713.21	5,617.43
Groundwater	0.00	0.00	0.00	0.00
Total	20,053.75	11,702.53	4,2456.94	7,049.82

2015 Total Cropland Acres in Watershed = 1,301				
Load /acre/year	7.38	3.38	15.18	1.07
2017 Cropland Acres in Watershed = 614				
2017 Crop Load	4,532.28	2,074.78		653.96
2017 Reduction (after less ag acres)	5,071.14	2,321.46		731.72
2015 Cropland Reduction Goal	0	2,442	0	1573
Remaining Reduction Need	0	120.54	0	841.28



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Table 9 below is Andrew Craig's revised STEPL report that reflects the WDNR revision of total load by subwatershed from 1,310 to 614 acres and adoption of reduced tillage and filter strips on 75% of cropland acres within sub-watersheds 6, 10, 11, 12, 13, 15 and 17.

**Table 9 – STEPL Report 2 - Reduced Ag Acres and Pollutant Loads (rev. 07-2017):
Total Load by Subwatershed(s)**

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (w/ BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W2	42.4	16.4	84.9	26.5	0.0	0.0	0.0	0.0	42.4	16.4	84.9	26.5	0.0	0.0	0.0	0.0
W3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W4	313.7	38.4	948.0	13.6	0.0	0.0	0.0	0.0	313.7	38.4	948.0	13.6	0.0	0.0	0.0	0.0
W5	73.2	7.8	228.5	2.3	0.0	0.0	0.0	0.0	73.2	7.8	228.5	2.3	0.0	0.0	0.0	0.0
W6	662.0	312.3	1478.2	129.1	303.7	149.8	305.4	47.7	358.3	162.5	1172.8	81.4	45.9	48.0	20.7	37.0
W7	10.3	4.0	20.7	6.5	0.0	0.0	0.0	0.0	10.3	4.0	20.7	6.5	0.0	0.0	0.0	0.0
W8	375.0	145.3	750.1	234.4	0.0	0.0	0.0	0.0	375.0	145.3	750.1	234.4	0.0	0.0	0.0	0.0
W9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W10	6854.7	5105.6	13978.3	3584.2	833.7	411.3	838.3	131.0	6021.0	4694.4	13140.0	3453.2	12.2	8.1	6.0	3.7
W11	1832.7	1052.3	3895.6	627.7	690.8	340.8	694.6	108.5	1141.9	711.5	3201.0	519.2	37.7	32.4	17.8	17.3
W12	4428.3	2667.8	9621.3	1606.5	1131.5	558.1	1137.7	177.8	3296.9	2109.7	8483.6	1428.7	25.6	20.9	11.8	11.1
W13	492.3	221.2	1035.6	73.7	299.5	137.2	269.5	42.1	192.8	84.1	766.2	31.6	60.8	62.0	26.0	57.1
W14	277.9	69.7	636.9	59.9	0.0	0.0	0.0	0.0	277.9	69.7	636.9	59.9	0.0	0.0	0.0	0.0
W15	252.8	109.2	624.9	61.8	59.6	29.4	59.9	9.4	193.2	79.8	565.0	52.4	23.6	26.9	9.6	15.1
W16	8.9	2.6	18.3	1.6	0.0	0.0	0.0	0.0	8.9	2.6	18.3	1.6	0.0	0.0	0.0	0.0
W17	402.1	196.6	840.1	71.2	244.2	120.4	245.5	38.4	158.0	76.2	594.5	32.9	60.7	61.3	29.2	53.9
W18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W19	20.2	7.8	40.4	14.8	0.0	0.0	0.0	0.0	20.2	7.8	40.4	14.8	0.0	0.0	0.0	0.0
W20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W24	1.6	0.5	3.3	0.3	0.0	0.0	0.0	0.0	1.6	0.5	3.3	0.3	0.0	0.0	0.0	0.0
Total	16048.4	9957.6	34205.0	6514.1	3562.9	1747.0	3550.9	554.8	12485.5	8210.6	30654.1	5959.3	22.2	17.5	10.4	8.5



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Table 10 below is Andrew Craig's revised STEPL report that reflects the WDNR revision of total agricultural acres in watershed from 1,310 to 614 acres and adoption of reduced tillage and filter strips on 75% of cropland acres within sub-watersheds 6, 10, 11, 12, 13, 15 and 17.

**Table 10 – STEPL Report 2 - Reduced Ag Acres and Pollutant Loads (rev. 07-2017):
Total Load by Land Uses (with BMP)**

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (tons/yr)
Urban	0.00	0.00	0.00	0.00
Cropland	2,020.26	893.80	7,918.38	290.52
Pastureland	1,608.60	225.02	5,022.52	51.36
Forest	0.00	0.00	0.00	0.00
Feedlots	0.00	0.00	0.00	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	0.00	0.00	0.00	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	8,856.60	7,091.79	1,7713.21	5,617.43
Groundwater	0.00	0.00	0.00	0.00
Total	12,485.47	8,210.61	3,0654.11	5,959.31

2015 Ag Acres = 1301			
2015-2017 Reduced Ag Acres = 687			
2017 Total Cropland Acres in Watershed = 614			
2015 Watershed Baseline Cropland Load	4,396.00		1,385.68
2017 Cropland Load = 614 Acres	2,640.78		845.35
Reduction from No Till and Filter Strips on 75% Cropland Acres	1,746.98		554.83
Reduction from 687 Less Ag Acres	2,321.46		731.72
TOTAL REDUCTION	4,068.44		1,286.55
Wind Point Plan Reduction GOAL For Agriculture Land	2242		1,573
Remaining Reduction Need	-1,826.44		286.45

Additional cropland or pasture BMPs or reduced cropland/pasture acres are needed to meet the original (2015) Wind Point Plan's agriculture sediment goal.



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Root-Pike WIN has built an Access database of all the Wind Point Watershed Restoration Plan's project recommendations, which includes the pollution reduction estimates (see Fig. 1 below). The adjusted values will be populated into the database and will continue to be the system of record for all basin projects.

Figure 2 – A Screen Root-Pike WIN's Nine Element Plan Recommendations Database

WRP ID	18	Existing Condition	Updates	
Plan	WIND POINT WRP	Existing naturalized wetland bottom detention basin servicing adjacent business park. Much of the prairie buffer planting has failed and there is a severely eroded swale near the inlet.	1/29/17 - Talked about the project with Mayor Brooks. He will connect me with City Engineer to see if there has been any communication with the landowner about this project.	
Municipality	City of South Milwaukee			
Restoration C	Detention Basin Retrofits & Maintenance	Recommendation		
Priority	Medium	Design and implement project to replant prairie buffer and fix eroded swale near inlet. Project would expand and enhance on surrounding green infrastructure.		
Project Status	In-progress - Awareness			
Location	Behind Grant Park Plaza	GIS Image		
Location Link	https://www.google.com/maps/place/Grant+Park+Plaza,+Milwaukee,+WI			
Responsible Entity	Business Association			
Owner	Business Park	Total Nitrogen (TS) Reduction - lbs/yr	0	
Owner Address		Total Phosphorus (TP) Reduction - lbs/yr	0	
Sources of Technical Assistance	Ecological Consultant/	Total Suspended Solids (TSS) Reduction - tons/yr	0	
Size	0.50 acres	Bacteria Reduction %	0.78	
Design / Build Estimate		Nitrogen Reduction %	0.2	
Construction Notes	\$12,000 to replant prairie	Phosphorus Reduction %	0.44	
Construction Estimate	\$12,000.00	Suspended Solids Reduction %	0.775	
Design / Build Notes		Fecal Coliform Bacteria (trillion cells)	0	
Maintenance Notes	/year maintenance	Possible Funding Sources		
Maintenance Estimate	\$1,000.00			
Implementation Schedule (Yea	1-10 Years			
WRP PROJECT GRANTS - Subform				
Grant	Administrator	Use	Grant Frequency	Criteria
8 8	08 - Great Lakes Protection Fund - Grants Program	Both - Public & Private	Continuous Cycle	We scan the horizon for opportunities

Finally, it is rare that stakeholders will use the physical copies of the Nine Element plans, so the electronic files and associated reports with these adjusted reductions can still revised, updated in the database and printed off for various communication uses. While the pollution reduction estimates are good "proof points" for project outcomes, the vast majority of stakeholders look to other determining factors such as habitat improvement or visual enhancements as the reason to proceed with a project.



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- d) **The predicted ag practice reductions for TP and TSS (90%) in the plan significantly exceed the pollutant reduction efficiencies used with EPA STEPL model (65-75%) or SnapPlus model (www.snapplus.net) (60-70%). Please explain how the agricultural practice reductions were calculated (were they a cumulative estimated or individually calculated and then averaged?); what source(s) of information was used to derive the pollutant reduction efficiencies and were the reductions derived from soil data relevant to Wisconsin or another state? To obtain a more accurate estimate of pollutant reduction from the agricultural practices, we recommend the plan's agricultural reduction estimates be revised and calculated using EPA STEPL model or SnapPlus model (www.snapplus.net).**
- i) Please refer to Table 7, 8, 9, and 10 in the previous section (Element B-3 Clarifications). These tables contain recalculated pollutant load reduction numbers based on Andrew Craig's (WDNR) July 2017 EPA STEPL modeling. This new modeled data was produced with new information on the agricultural parcels in the watershed. Specifically, the 2015 agricultural parcels were reanalyzed in 2017 by Root-Pike WIN to see which were still in production and what percentage of the parcel was actually being farmed. Root-Pike WIN, to the best of their ability and with mapping imagery from 2014-2017, compiled a new list and assessment of all of the current agricultural parcels in the watershed. This updated information can be found on Table 5 and 6 referenced in Element B-3 Clarifications.
- e) **EPA's STEPL model was used to calculate baseline pollutant loading for each SMU in plan. The soil P concentration used within the STEPL model was set at 0.03 (default value). This is not correct soil P concentration for the soils within this watershed. The correct value is 0.066 (determined using STEPL P concentration map average $0.15 \times 0.44 = 0.066$). Amending the soil P concentration within STEPL nearly doubles the baseline P loading for all watersheds. This difference in soil P concentration is critical for determining agricultural pollutant P reductions within SMU 6, 7, 12,13,14,15 and 17. These SMU's correspond to the 7 critical agricultural areas in plan.**
- i) Please refer to Table 7, 8, 9, and 10 in the previous section (Element B-3 Clarifications). These tables contain recalculated pollutant load reduction numbers based on Andrew Craig's (WDNR) July 2017 EPA STEPL modeling. This new modeled data was produced with new information on the agricultural parcels in the watershed. Specifically, the 2015 agricultural parcels were reanalyzed in 2017 by Root-Pike WIN to see which were still in production and what percentage of the parcel was actually being farmed. Root-Pike WIN, to the best of their ability and with mapping imagery from 2014-2017, compiled a new list and assessment of all of the current agricultural parcels in the watershed. This updated information can be found on Table 5 and 6 referenced in Element B-3 Clarifications.



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- f) **We are not sure why the plan uses STEPL to calculate baseline pollutant loading for each SMU and Region 5 model was used to determine agricultural pollutant reductions by SMU. Region 5 model is site/field specific and STEPL model calculates pollutant reductions at a watershed scale. Given the different scale of each model, it may not be accurate to compare their outputs to one another. Using one model, STEPL to calculate pollutant reductions, is recommended.**
- i) Please refer to Table 7, 8, 9, and 10 in the previous section (Element B-3 Clarifications). These tables contain recalculated pollutant load reduction numbers based on Andrew Craig's (WDNR) July 2017 EPA STEPL modeling. This new modeled data was produced with new information on the agricultural parcels in the watershed. Specifically, the 2015 agricultural parcels were reanalyzed in 2017 by Root-Pike WIN to see which were still in production and what percentage of the parcel was actually being farmed. Root-Pike WIN, to the best of their ability and with mapping imagery from 2014-2017, compiled a new list and assessment of all of the current agricultural parcels in the watershed. This updated information can be found on Table 5 and 6 referenced in Element B-3 Clarifications.
- g) **We question the plans modeled pollutant load estimates for streambank erosion, calculated using STEPL, because the 2012 stream/ravine inventory results, summarized in figure 38, do not match up with predicted areas of high sediment and pollutant loads (e.g., SMU's 10, 11 and 12; only SMU 8 has some streambank inventory observations that match up with the STEPL model prediction of significant streambank erosion). Figure 38 shows a substantial majority of areas with high to moderate streambank erosion correspond to the ravine/bluff areas, which the plan identifies as critical areas, because they are actively contributing sediment loads to Lake Michigan. The upland stream sections, however, show very little or no streambank erosion. It's a bit unclear as to how the Bluffs are considered a critical area if it's not currently known how much of the erosion is due to natural causes versus runoff from impervious surfaces and/or channelized stormwater. Can the plan be revised to reflect the loading from natural versus impervious stormwater runoff caused erosion? Furthermore, it may be a stronger approach to use the proposed funds to implement some of the more low cost methods utilized at Bender Park then to simply conduct a feasibility study for bluff restoration. We agree with the plan's holistic approach to increase detention time within the entire watershed as well as reduce streambank stabilization (where necessary) to reduce sediment and nutrient loads.**



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- i) Root-Pike WIN cannot speak for all of the ravines in the watershed, but we can speak to four of the major ones leading into and within Cliffside Park. These are listed as streams TRF-1, 2, 3 and 4. We have had four site visits to Cliffside Park with various engineers and experts, and it clear there are three, possibly four distinct issues with this particular part of the watershed (SMU-11).



The first erosion issue is the natural decay of the clay seepage bluffs right along the shoreline of Lake Michigan and along some sections of the ravines in proximity to the shoreline. It would take a significant amount of time and effort, certainly beyond the budget and scope of this plan, to determine how significant the natural processes of the eroding bluffs are having on the pollutant loading. However, the North ravine, or TRF-3, overlaps our theory of two distinct issues and warrants more attention. TRF-4 flows South into the main ravine approximately 300' feet from the mouth. One visit followed the waterway back almost to the upland area – now a recovering wetland. At one point the stream came very close to the Lake Michigan bank, which was roughly 30-40 feet, at which point the eroded Lake Michigan bank dropped approximately 50' to the lake shore. It was clear, that with higher lake levels that we are seeing again on Lake Michigan, one large event could erode enough of the bank to disconnect TRF-4 from TRF-3 and start discharging directly down the slope. This would be an erosion issue that would dump hundreds of tons of newly eroded soil directly into Lake Michigan as it erodes down the bank shoreline.



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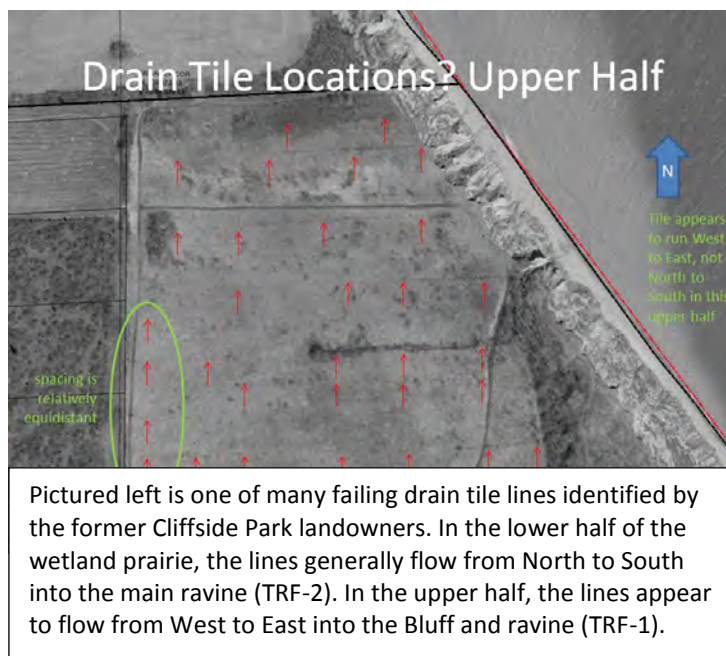
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- ii) The second issue in this SMU is urban runoff from various sources in and around the park. Many different factors are combining, which aggregate along various points within the upper and middle reaches of the eroding ravine. The drainage area demonstrated numerous immediate erosion issues as well as the long term geomorphology of an incising stream. Still, it is probably the most feature-rich streams in the Wind Point watershed. Here are some specific contributing factors and observations associated with the main ravine (TRF-2 and 3). We are confident that the overall situation here is repeated in a number of locations up and down the Lake Michigan shoreline.
- (1) Concrete lined swales in the neighborhoods to the South of the park feed into TRF-2
 - (2) Turf in and around the park drains directly into TRF-2
 - (3) Paved drives and lots in the park slope toward TRF-2 with very little buffer to the ravine
 - (4) Turf and paved lots at St. Mary's Church (South of the park) are causing smaller ravines to erode
 - (5) Turf from an unused field to the South of the park slopes toward the park adding more volume
 - (6) Two arrested headcuts, anchored by willows, are stopping significant erosion from moving upstream. The willows are dying and therefore the headcut is very fragile. When it moves, the stable banks upstream will become incised and hundreds of tons of sediment will flush out.
 - (7) The middle portion of the ravine is severely eroded up to this headcut, but recovered from the mouth where the headcut has been moving back over the last 50 years (local report)
 - (8) Salmon, brown trout, steelhead and even a sturgeon have been sighted in the ravine up to where TRF-3 flows into TRF-4 near the mouth, but cannot make it past the first headcut.
 - (9) The overall health and stability of the stream seemed pretty good. Yes, there was bank erosion (minor), bluff sloughing (minor), head cutting (moderate to significant, but not throughout), and terrestrial invasive species issues. The good news is that there are opportunities to do improvements, but they would be generally at individual spot locations and would likely to be within a project scope and expense that make them very feasible (swales, RSCs and BMPs).
 - (10) There is also a vegetation issue as the ravine is highly invaded with Tatarian honeysuckle and buckthorn. If the invasives could open up the understory, this would allow for the re-establishment of vegetation that could help fight the erosion and sloughing issues. This is likely in other ravine areas and should be considered in the overall strategy for management.
 - (11) Root-Pike WIN has already begun discussions with Racine County and their Parks Department to begin pursuing grants to address these issues in and around Cliffside Park. Our plan includes the restoration near the headcut in TRF-2, Green Infrastructure in and around the park, and restored wetlands to the West and North of TRF-4 to buffer the ravine from more runoff.

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- iii) The third issue may involve the drain tile that once drained the farmland that predominately filled the parcel prior to the County's purchase decades ago. Two landowners who own parcels to the West of the park, and once owned the majority of the land that is now Cliffside Park, have come forward and have provided significant information about the area. The family farmed the majority of the land for three generations. In a recent site survey with Root-Pike WIN, they helped identify the drain tile locations and pointed out that much of that tile from pre-1950 is now failing. Visual inspection of these claims where proven to be true and can be seen in the image below, which resides in the wetland/prairie area of the Western half of the parcel.



- iv) The fourth issue may involve the Oak Creek power plant to the North of Cliffside Park. They also gave accounts of how much of the 11 acre farmland that was present pre-1960 and directly adjacent to the bluffs has eroded into the lake. Finally, they also commented that additions and improvements to the Oak Creek power plant shoreline infrastructure brought the most noticeable changes to the littoral shift, which may be creating an eddy that enhances the erosion to the Cliffside Park shoreline. None of these observations have been scientifically researched or challenged to date.



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ELEMENT C CLARIFICATIONS

4) WDNR/EPA Comments 4: We concur with these findings. However, please respond to the following management measures comments:

- a) Section 6.1 of plan describes several programmatic management measures that are applicable throughout the watershed. The top priority of the described measures is for the Watershed partners adopt the plan and incorporate the plans goals, objectives and recommended actions into comprehensive plans and ordinances. Have any of the municipalities described in plan (i.e., Caledonia, North Bay, Oak Creek, Racine, South Milwaukee and Wind Point) discussed and adopted sections of the plan. Specifically have any municipalities incorporated the plan's site specific management measures for Streambank, Ravine and Channel Restoration and Agricultural Management Practices which correspond to (as shown in Table 40 in plan) the management measure categories that address 90% of the watersheds estimated TSS and TP loads?**
- i) The Village of Wind Point has proactively adopted the plan in mid-2016 and is cooperative in exploring the implementation of a handful of recommendations. None of the other municipalities have been approached by Root-Pike WIN regarding the adoption of the Wind Point Plan as we are awaiting approval from the DNR and EPA. To our knowledge, none of the municipalities have adopted the site specific management measures like the ones shown in Table 40. We believe approval of the plan will expedite that process of moving these management measures forward.
- ii) Consequently, starting in 2017, Pete Wood and Root-Pike WIN will be working together more to meld the goals and requirements of the Southeastern Wisconsin Clean Water Network (SWCWN) with the recommendations contained within the Nine Element Plans – including the Wind Point Plan. There are three four different ways we intend to incorporate them into the SWCWN and Respect Our Waters campaign education and public outreach.
- (1) We will begin meeting with each municipal representative from SWCWN to bring awareness, plan and implement plan recommendations to include. Many don't know these plans even exist.
 - (2) We will continue to hold quarterly events with SWCWN members where we bring awareness to best management practices and successful projects that involve on-site installations and expert presentations of many of the management measure categories.
 - (3) We are exploring the use of the Respect Our Waters campaign to better target pollutant hot spots in each of the municipalities, which include those in the Wind Point Plan.



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- b) The critical areas for agricultural management practices described in plan (i.e., section 6.1.13 - conservation tillage and filter strips) nearly all reside with the town of Caledonia Municipality and Racine County. The plan describes federal (USDA and NRCS) agricultural programs can help farmers implement these measures. The plan, however, fails to describe the Racine County Land and Water Conservation Department - <http://racinecounty.com/government/public-works-and-development-services/land-conservation> can also help to implement the agricultural measures. The Land Conservation Division implements and administers County and State Soil and Water Conservation Program and provides technical assistance regarding soil erosion, animal waste management, and water quality. The July-Sept 2016 issue of the Racine County Land and Water Conservation Newsletter <http://racinecounty.com/home/showdocument?id=5993> – describes cost sharing @ \$3,000/acre for implementation of grassed buffers along waterways, via grant from Fund for Lake Michigan, and 28\$/acre for NM plans. Have any of the agricultural practices with the plan's high priority agricultural critical areas (as shown in figure 73) been implemented by the agricultural landowners? Have the landowners been contacted by Racine County Land Conservation or NRCS staff about their interest in switching to the new agricultural practices?
- i) From an overall perspective, it should be noted that Root-Pike WIN is working closely with Chad Sampson, Racine County Conservationist to advance project recommendations within the Wind Point Plan as well as with the Root and Pike River Plans. On a monthly basis, we are coordinating efforts and sharing information on a variety of priority parcels and involved landowners. Root-Pike WIN has built a database of the Plans' recommendations and we use often to coordinate efforts with Racine County (and all of the other municipalities). Only a few agricultural practices defined in the plan have been implemented as the effort to start implementing the Wind Point Plan did not begin until late 2016.
- ii) As of January 15, 2017, Racine County Land Conservation staff has not used any of the Fund for Lake Michigan grassed waterways grant, referenced in the comments above, to address the agricultural issues in the Wind Point watershed.



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- iii) As of January 15, 2017, Racine County reports a few agricultural practices within the plan's high priority agricultural critical areas (as shown in figure 73) have been implemented by the agricultural landowners. They include the following actions:
 - (1) Abandoned old farm wells, or old unused wells at:
 - (a) 8200 Botting Rd
 - (b) 42xx 3 Mile Rd
 - (c) 6205 Hwy 31
 - (d) 4503 N Main St
 - (e) 1913 5 Mile Rd
 - (2) Installed grassed waterways at:
 - (a) 7425 Botting Road (500 linear feet)
 - (b) 5915 – 7 Mile Road (250 linear feet and 475 linear feet)
 - (3) Conservation Reserve Program native prairie planting and pond at:
 - (a) 7500 Hwy 31 (67 acres on west side of Hwy 31)
 - (4) As of January 15, 2017, it can be reported that landowners have not been contacted by Racine County Land Conservation about their interest in switching to the new agricultural practices. We have not heard back from NRCS about any contact they have made with landowners in this area. Racine County Land Conservation staff is familiar with some of the key parcels and have some knowledge of the existing practices and landowner preferences. Root-Pike WIN has yet to contact any landowners, but it is our goal to begin contacting landowners, as much as possible, in priority parcels in 2017. Again, some of these efforts will be advanced through the Southeastern Wisconsin Clean Water Network.
- iv) In summary, Root-Pike WIN will begin contacting landowners in critical areas in 2018 with the help of Racine County Land Conservation Staff and NRCS. Our cooperative efforts will use the information in Figure 73 of the Plan to initiate and prioritize our coordinated efforts with regard to targeting agricultural issues in the watershed.
- v) It should be also noted that Root-Pike WIN has advanced the following projects through our own efforts and in collaboration with other partners. Table 11 that follows represents the projects Root-Pike WIN has already begun planning and designing:



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Table 11 – Wind Point Plan Projects in Planning, Design or Implementation as of July 2017

Status	Restoration Category	Priority	Updates	ID	Owner
Planning	Wetland Restoration	High: Critical Area	5/1/17 - applied for WDNR Wetland In-lieu Fee program, walked site with Joshua and Sally	22	Racine County
Planning	Streambank & Channel Restoration	High: Critical Area	7/1/17 - Toured site with Fund for Lake Michigan, and tour planned with USACE 8/15/17	TRF 4	Racine County
Planning	Wetland Restoration	Medium	3/23/17: Met with Phil at Oak Creek. This parcel is under City control and is being restored to become a park. RPW could possibly help with grants here.	24	DuPont (private)
Planning	Priority Green Infrastructure Protection Areas	High: Critical Area	3/23/17: Met with Phil at Oak Creek. This parcel is under City control and is being restored to become a park. RPW could possibly help with grants here. Some work has been done on the South side of the shoreline bluffs. Eroding bluffs to the North still need to get done. This will be millions of dollars	GI3	City of Oak Creek
Planning	Detention Basin Retrofits & Maintenance	High: Critical Area	3/29/17: Met with Julie K. and Mark Y. At CoR. RPW and CoR agreed to work together on grants for design phase work. Need to talk to Mark to see if a stormwater plan is already in place here.	39B	City of Racine
Implementation	Priority Green Infrastructure Protection Areas	High: Critical Area	3/20/17: Met with Chad at the City and there is a natural space plan for this area. Work has already begun on an ADA ramp. Future plans include a natural area and ravine restoration. 1/30/17 - Met with Mayor Brooks regarding the project and he is interested. He is going to connect me with the City Engineer to see what might be next. There is a plan that calls for more public green space vs. Private development. Lots of options here to be explored per the Mayor.	GI1	City of South Milwaukee
Planning	Other Management Measures	Medium	1/30/17 - Met with Mayor Brooks regarding the project and he is interested. RPW to help coordinate with South Milwaukee on a cleanup with citizen groups.	1	City of South Milwaukee



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ELEMENT H CLARIFICATIONS

- 5) **WDNR/EPA: We concur with these findings. However, we recommend the plan include the following EPA Technical Memo on BMP depreciation. Pollutant reduction efficiencies associated with some management practices do not remain constant; in general they decline over time, unless appropriate O&M is completed. The plan partially addresses O&M of practices, via retrofitting of detention basins.**
- i) The following pages contain the EPA's Technical Memo on BMP Depreciation.

Technical Memorandum #1

Adjusting for Depreciation of Land Treatment When Planning Watershed Projects

Introduction

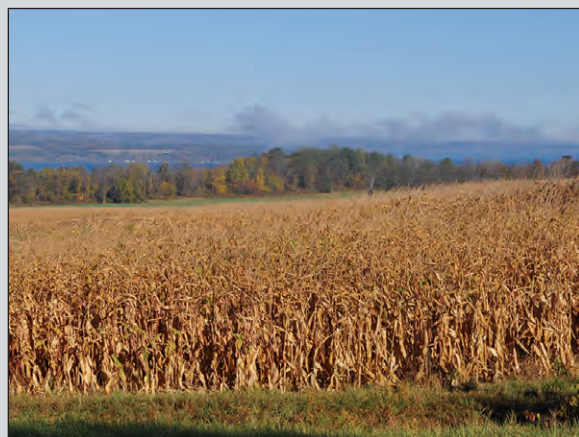
Watershed-based planning helps address water quality problems in a holistic manner by fully assessing the potential contributing causes and sources of pollution, then prioritizing restoration and protection strategies to address the problems (USEPA 2013). The U.S. Environmental Protection Agency (EPA) requires that watershed projects funded directly under section 319 of the Clean Water Act implement a watershed-based plan (WBP) addressing the nine key elements identified in EPA's [*Handbook for Developing Watershed Plans to Restore and Protect our Waters* \(USEPA 2008\)](#). EPA further recommends that all other watershed plans intended to address water quality impairments also include the nine elements. The first element calls for the identification of causes and sources of impairment that must be controlled to achieve needed load reductions. Related elements include a description of the nonpoint source (NPS) management measures—or best management practices (BMPs)—needed to achieve required pollutant load reductions, a description of the critical areas in which the BMPs should be implemented, and an estimate of the load reductions expected from the BMPs.

Once the causes and sources of water resource impairment are assessed, identifying the appropriate BMPs to address the identified problems, the best locations for additional BMPs, and the pollutant load reductions likely to be achieved with the BMPs depends on accurate information on the performance levels of both BMPs already in place and BMPs to be implemented as part of the watershed project. All too often, watershed managers and Agency staff have assumed that, once certified as installed or adopted according to specifications, a BMP continues to perform its pollutant reduction function at the same efficiency (percent pollutant reduction) throughout its design or contract life, sometimes longer. An important corollary to this assumption is that BMPs in place during project planning are performing as originally intended. Experience in NPS watershed projects across the nation, however, shows that, without diligent operation and maintenance, BMPs and their effects probably will depreciate over time, resulting in less efficient pollution reduction. Recognition of this fact is important at the project planning phase, for both existing and planned BMPs.

This Technical Memorandum is one of a series of publications designed to assist watershed projects, particularly those addressing nonpoint sources of pollution. Many of the lessons learned from the Clean Water Act Section 319 National Nonpoint Source Monitoring Program are incorporated in these publications.

October 2015

Donald W. Meals and Steven A. Dressing. 2015. Technical Memorandum #1: Adjusting for Depreciation of Land Treatment When Planning Watershed Projects, October 2015. Developed for U.S. Environmental Protection Agency by Tetra Tech, Inc., Fairfax, VA, 16 p.
Available online at www.epa.gov/xxx/tech_memos.htm.



Fields near Seneca Lake, New York.

Knowledge of land treatment depreciation is important to ensure project success through the adaptive management process (USEPA 2008). BMPs credited during the planning phase of a watershed project will be expected to achieve specific load reductions or other water quality benefits as part of the overall plan to protect or restore a water body. Verification that BMPs are still performing their functions at anticipated levels is essential to keeping a project on track to achieve its overall goals. Through adaptive management, verification results can be used to inform decisions about needs for additional BMPs or maintenance or repair of existing BMPs. In a watershed project that includes short-term (3–5 years) monitoring, subtle changes in BMP performance level might not be detect-

able or critical, but planners must account for catastrophic failures, BMP removal or discontinuation, and major maintenance shortcomings. Over the longer term, however, gradual changes in BMP performance level can be significant in terms of BMP-specific pollutant control or the role of single BMPs within a BMP system or train. The weakest link in a BMP train can be the driving force in overall BMP performance.

Application of and methods for BMP tracking in NPS watershed projects are described in detail in [Tech Notes 11](#) (Meals et al. 2014).

This technical memorandum addresses the major causes of land treatment depreciation, ways to assess the extent of depreciation, and options for adjusting for depreciation. While depreciation occurs throughout the life of a watershed project, the emphasis is on the planning phase and the short term (i.e., 3–5 years).

Causes of Depreciation

Depreciation of land treatment function occurs as a result of many factors and processes. Three of the primary causes are natural variability, lack of proper maintenance, and unforeseen consequences.

Natural Variability

Climate and soil variations across the nation influence how BMPs perform. Tiessen et al. (2010), for example, reported that management practices designed to improve water quality by reducing sediment and sediment-bound nutrient export from agricultural fields can be less effective in cold, dry regions where nutrient export is primarily snowmelt driven and in the dissolved form, compared to similar practices in warm, humid regions. Performance levels of vegetation-based BMPs in both agricultural and urban settings can vary significantly through the year due to seasonal dormancy. In a single locale, year-to-year variation in precipitation affects both agricultural management and BMP performance levels. Drought, for example, can suppress crop yields, reduce nutrient uptake, and result in nutrient surpluses left in the soil after harvest where they are vulnerable to runoff or leaching loss despite careful nutrient management. Increasing incidence of extreme weather and intense storms can overwhelm otherwise well-designed stormwater management facilities in urban areas.

Lack of Proper Maintenance

Most BMPs—both structural and management—must be operated and maintained properly to continue to function as designed. Otherwise, treatment effectiveness can depreciate over time. For example, in a properly functioning detention pond, sediment typically accumulates in the forebay. Without proper maintenance to remove accumulated sediment, the capacity of the BMP to contain

and treat stormwater is diminished. Similarly, a nutrient management plan is only as effective as its implementation. Failure to adhere to phosphorus (P) application limits, for example, can result in soil P buildup and increased surface and subsurface losses of P rather than the loss reductions anticipated.

Jackson-Smith et al. (2010) reported that over 20 percent of implemented BMPs in a Utah watershed project appeared to be no longer maintained or in use when evaluated just 5 years after project completion. BMPs related to crop production enterprises and irrigation systems had the lowest rate of continued use and maintenance (~75 percent of implemented BMPs were still in use), followed by pasture and grazing planting and management BMPs (81 percent of implemented BMPs were still in use). Management practices (e.g., nutrient management) were found to be particularly susceptible to failure.

Practices are sometimes simply abandoned as a result of changes in landowner circumstances or attitudes. In a Kansas watershed project, farmers abandoned a nutrient management program because of perceived restrictive reporting requirements (Osmond et al. 2012).

In the urban arena, a study of more than 250 stormwater facilities in Maryland found that nearly one-third of stormwater BMPs were not functioning as designed and that most needed maintenance (Lindsey et al. 1992). Sedimentation was a major problem and had occurred at nearly half of the facilities; those problems could have been prevented with timely maintenance.



Abandoned waste storage structure.

Hunt and Lord (2006) describe basic maintenance requirements for bioretention practices and the consequences of failing to perform those tasks. For example, they indicate that mulch should be removed every 1–2 years to both maintain available water storage volume and increase the surface infiltration rate of fill soil. In addition, biological films might need to be removed every 2–3 years because they can cause the bioretention cell to clog.

In plot studies, Dillaha et al. (1986) observed that vegetative filter strip-effectiveness for sediment removal appeared to decrease with time as sediment accumulated within the filter strips. One set of the filters was almost totally inundated with sediment during the cropland experiments and filter effectiveness dropped 30–60 percent between the first and second experiments. Dosskey et al. (2002) reported that up to 99 percent of sediment was removed from cropland runoff when uniformly distributed over a buffer area, but as concentrated flow paths developed over time (due to lack of maintenance), sediment removal dropped to 15–45 percent. In the end, most structural BMPs have a design life (i.e., the length of time the item is expected to work within its specified parameters). This period is measured from when the BMP is placed into service until the end of its full pollutant reduction function.

Unforeseen Consequences

The effects of a BMP can change directly or indirectly due to unexpected interactions with site conditions or other activities. Incorporating manure into cropland soils to reduce nutrient runoff, for example, can increase erosion and soil loss due to soil disturbance, especially in comparison

to reduced tillage. On the other hand, conservation tillage can result in accumulation of fertilizer nutrients at the soil surface, increasing their availability for loss in runoff (Rhoton et al. 1993). Long-term reduction in tillage also can promote the formation of soil macropores, enhancing leaching of soluble nutrients and agrichemicals into ground water (Shipitalo et al. 2000). Stutter et al. (2009) reported that establishment of vegetated buffers between cropland and a watercourse led to enhanced rates of soil P cycling within the buffer, increasing soil P solubility and the potential for leaching to watercourses.

Despite widespread adoption of conservation tillage and observed reductions in particulate P loads, a marked increase in loads of dissolved bioavailable P in agricultural tributaries to Lake Erie has been documented since the mid-1990s. This shift has been attributed to changes in application rates, methods, and timing of P fertilizers on cropland in conservation tillage not subject to annual tillage (Baker 2010; Joosse and Baker 2011). Further complicating matters, recent research on fields in the St. Joseph River watershed in northeast Indiana has demonstrated that about half of both soluble P and total P losses from research fields occurred via tile discharge, indicating a need to address both surface and subsurface loads to reach the goal of 41 percent reduction in P loading for the Lake Erie Basin (Smith et al. 2015).

Several important project planning lessons were learned from the White Clay Lake, Wisconsin, demonstration projects in the 1970s, including the need to accurately assess pollutant inputs and the performance levels of BMPs (NRC 1999). Regarding unforeseen consequences, the project learned through monitoring that a manure storage pit built according to prevailing specifications actually caused ground water contamination that threatened a farmer's well water. This illustrates the importance of monitoring implemented practices over time to ensure that they function properly and provide the intended benefits.

Control of urban stormwater runoff (e.g., through detention) has been widely implemented to reduce peak flows from large storms in order to prevent stream channel erosion. Research has shown, however, that although large peak flows might be controlled effectively by detention storage, stormflow conditions are extended over a longer period of time. Duration of erosive and bankfull flows are increased, constituting channel-forming events. Urbonas and Wulliman (2007) reported that, when captured runoff from a number of individual detention basins in a stream system is released over time, the flows accumulate as they travel downstream, actually increasing peak flows along the receiving waters. This situation can diminish the collective effectiveness of detention basins as a watershed management strategy.

Assessment of Depreciation

The first—and possibly most important—step in adjusting for depreciation of implemented BMPs is to determine its extent and magnitude through BMP verification.

BMP Verification

At its core, BMP verification confirms that a BMP is in place and functioning properly as expected based on contract, permit, or other implementation evidence. A BMP verification process that documents the presence and function of BMPs over time should be included in all NPS watershed projects.

At the project planning phase, verification is important both to ensure accurate assessment of existing BMP performance levels and to determine additional BMP and maintenance needs. Verification over time is necessary to determine if BMPs are maintained and operated during the period of interest.

Documenting the presence of a BMP is generally simpler than determining how well it functions, but both elements of verification must be considered to determine if land treatment goals are being met and whether BMP performance is depreciating. Although land treatment goals might not be highly specific in many watershed projects, it is important to document what treatment is implemented. Verification is described in detail in [Tech Notes 11](#) (Meals et al. 2014). This technical memorandum focuses on specific approaches to assessing depreciation within the context of an overall verification process.

Methods for Assessing BMP Presence and Performance Level

Whether a complete enumeration or a statistical sampling approach is used, methods for tracking BMPs generally include direct measurements (e.g., soil tests, onsite inspections, remote sensing) and indirect methods (e.g., landowner self-reporting or third-party surveys). Several of these methods are discussed in [Tech Notes 11](#) (Meals et al. 2014). Two general factors must be considered when verifying a BMP: the presence of the BMP and its pollutant removal efficiency. Different types of BMPs require different verification methods, and no single approach is likely to provide all the information needed in planning a watershed project.

Certification

The first step in the process is to determine whether BMPs have been designed and installed/adopted according to appropriate standards and specifications. Certification can either be the final step in a contract between a landowner and a funding agency or be a component of a permit requirement.

Certification provides assurance that a BMP is fully functional for its setting at a particular time. For example, a stormwater detention pond or water and sediment control basin must be properly sized for its contributing area and designed for a specific retention-and-release performance level. A nutrient management plan must account for all sources of nutrients, consider current soil nutrient levels, and support a reasonable yield goal. A cover crop must be planted in a particular time window to provide erosion control and/or nutrient uptake during a critical time of year. Some jurisdictions might apply different nutrient reduction efficiency credits for cover crops based on planting date. Some structural BMPs like parallel tile outlet terraces require up to 2 years to fully settle and achieve full efficiency; in those cases, certification is delayed until full stability is reached. Knowledge that a BMP has been applied according to a specific standard supports an assumption that the BMP will perform at a certain level of pollutant reduction efficiency, providing a baseline against which future depreciation can be compared. Practices voluntarily implemented by landowners without any technical or financial assistance could require special efforts to determine compliance with applicable specifications (or functional equivalence). Pollution reduction by practices not meeting specifications might need to be discounted or not counted at all even when first installed.

Depreciation assessment indicators

Ideally, assessment of BMP depreciation would be based on actual measurement of each BMP's performance level (e.g., monitoring of input and output pollutant loads for each practice). Except in very rare circumstances, this type of monitoring is impractical. Rather, a watershed project generally must depend on the use of indicators to assess BMP performance level.

The most useful indicators for assessing depreciation are determined primarily by the type of BMP and pollutants controlled, but indicators might be limited by the general verification approach used. For example, inflow and outflow measurements of pollutant load can be used to determine the effectiveness of constructed wetlands, but a verification effort that uses only visual observations will not provide that data or other information about wetland functionality. A central challenge, therefore, is to identify meaningful indicators of BMP performance level that can be tracked under different verification schemes. This technical memorandum provides examples of how to accomplish that end.

Nonvegetative structural practices

Performance levels of nonvegetative structural practices—such as animal waste lagoons, digesters, terraces, irrigation tailwater management, stormwater detention ponds, and pervious pavement—can be assessed using the following types of indicators:

- Measured on-site performance data (e.g., infiltration capacity of pervious pavement),
- Structural integrity (e.g., condition of berms or other containment structures), and
- Water volume capacity (e.g., existing pond volume vs. design) and mass or volume of captured material removed (e.g., sediment removed from stormwater pond forebay at cleanout).

In some cases, useful indicators can be identified directly from practice standards. For example, the Natural Resources Conservation Service lists operation and maintenance elements for a water and sediment control basin (WASCoB) ([USDA-NRCS 2008](#)) that include:

- Maintenance of basin ridge height and outlet elevations,
- Removal of sediment that has accumulated in the basin to maintain capacity and grade,
- Removal of sediment around inlets to ensure that the inlet remains the lowest spot in the basin, and
- Regular mowing and control of trees and brush.

These elements suggest that ridge and outlet elevations, sediment accumulation, inlet integrity, and vegetation control would be important indicators of WASCoB performance level.

Required maintenance checklists contained in stormwater permits also can suggest useful indicators. For example, the [Virginia Stormwater Management Handbook](#) (VA DCR 1999) provides an extensive checklist for annual operation and maintenance inspection of wet ponds. The list includes many elements that could serve as BMP performance level indicators:

- Excessive sediment, debris, or trash accumulated at inlet,
- Clogging of outlet structures,

- Cracking, erosion, or animal burrows in berms, and
- More than 1 foot of sediment accumulated in permanent pool.

Assessment of these and other indicators would require on-site inspection and/or measurement by landowners, permit-holders, or oversight agencies.

Vegetative structural practices

Performance levels of vegetative structural practices—such as constructed wetlands, swales, rain gardens, riparian buffers, and filter strips—can be assessed using the following types of indicators:

- Extent and health of vegetation (e.g., measurements of soil cover or plant density),
- Quality of overland flow filtering (e.g., evidence of short-circuiting by concentrated flow or gullies through buffers or filter strips),
- On-site capacity testing of rain gardens using infiltrometers or similar devices, and
- Visual observations (e.g., presence of water in swales and rain gardens).



Parking lot rain garden.

As for non-vegetative structural practices, assessment of these indicators would require on-site inspection and/or measurement by landowners, permit-holders, or oversight agencies.

Nonstructural vegetative practices

Performance levels of nonstructural vegetative practices—such as cover crops, reforestation of logged tracts, and construction site seeding—can be assessed using the following types of indicators:

- Density of cover crop planting (e.g., plant count),
- Percent of area covered by cover crop, and
- Extent and vitality of tree seedlings.

These indicators could be assessed by on-site inspection or, in some cases, by remote sensing, either from satellite imagery or aerial photography.

Management practices

Performance levels of management practices—such as nutrient management, conservation tillage, pesticide management, and street sweeping—can be assessed using the following types of indicators:

- Records of street sweeping frequency and mass of material collected,
- Area or percent of cropland under conservation tillage,

- Extent of crop residue coverage on conservation tillage cropland, and
- Fertilizer and/or manure application rates and schedules, crop yields, soil test data, plant tissue test results, and fall residual nitrate tests.



Illustration of line-transect method for residue.

Assessment of these indicators would generally require reporting by private landowners or municipalities, reporting that is required under some regulatory programs. Visual observation of indicators such as residue cover, however, can also be made by on-site inspection or windshield survey.

Data analysis

Data on indicators can be expressed and analyzed in several ways, depending on the nature of the indicators used. Indicators reporting continuous numerical data—such as acres of cover crop or conservation tillage, manure application rates, miles of street sweeping, mass of material removed from

catch basins or detention ponds, or acres of logging roads/landings revegetated—can be expressed either in the raw form (e.g., acres with 30 percent or more residue cover) or as a percentage of the design or target quantity (e.g., percent of contracted acres achieving 30 percent or more of residue cover). These metrics can be tracked year to year as a measure of BMP depreciation (or achievement). During the planning phase of a watershed project, it might be appropriate to collect indicator data for multiple years prior to project startup to enable calculation of averages or ranges to better estimate BMP performance levels over crop rotation cycles or variable weather conditions.

Indicators reporting categorical data—such as maintenance of detention basin ridge height and outlet elevations, condition of berms or terraces, or observations of water accumulation and flow—are more difficult to express quantitatively. It might be necessary to establish an ordinal scale (e.g., condition rated on a scale of 1–10) or a binary yes/no condition, then use best professional judgment to assess influence on BMP performance.

In some cases, it might be possible to use modeling or other quantitative analysis to estimate individual or watershed-level BMP performance levels based on verification data. In an analysis of stormwater BMP performance levels, Tetra Tech (2010) presented a series of BMP performance curves based on monitoring and modeling data that relate pollutant removal efficiency to depth of runoff treated (Figure 1). Where depreciation indicators track changes in depth of runoff treated as the capacity of a BMP decreases (e.g., from sedimentation), resulting changes in pollutant removal could be determined from a performance curve. This type of information can be particularly useful during the planning phase of a watershed project to estimate realistic performance levels for existing BMPs that have been in place for a substantial portion of their expected lifespans.

The performance levels of structural agricultural BMPs in varying condition can be estimated by altering input parameters in the [Soil and Water Assessment Tool](#) (SWAT) model (Texas A&M University 2015a); other models such as the [Agricultural Policy/Environmental eXtender](#) (APEX) model (Texas A&M

University 2015b) also can be used in this way (including application to some urban BMPs). For urban stormwater, engineering models like [HydroCAD](#) (HydroCAD Software Solutions 2011) can be used to simulate hydrologic response to stormwater BMPs with different physical characteristics (e.g., to compare performance levels under actual vs. design conditions). Even simple spreadsheet models such as the Spreadsheet Tool for Estimating Pollutant Load ([STEPL](#)) (USEPA 2015) can be used to quantify the effects of BMP depreciation by varying the effectiveness coefficients in the model.

Data from verification efforts and analysis of the effects of depreciation on BMP performance levels must be qualified based on data confidence. “Confidence” refers mainly to a quantitative assessment of the accuracy of a verification result. For example, the number of acres of cover crops or the continuity of streamside buffers on logging sites determined from aerial photography could be determined by ground-truthing to be within +10 percent of the true value at the 95 percent confidence level. Confidence also can refer to the level of trust that BMPs previously implemented continue to function (e.g., the proportion of BMPs still in place and meeting performance standards). For example, reporting that 75 percent of planned BMPs have been verified is a measure of confidence that the desired level of treatment has been applied.

While specific methods to evaluate data confidence are beyond the scope of this memo, it is essential to be able to express some degree of confidence in verification results—both during the planning phase and over time as the project is implemented. For example, an assessment of relative uncertainty of BMP performance during the planning phase can be used as direct follow-up to verification efforts to those practices for which greater quantification of performance level is needed. In addition, plans to implement new BMPs also can be developed with full consideration of the reliability of BMPs already in place.

Adjusting for Depreciation

Information on BMP depreciation can be used to improve both project management and project evaluation.

Project Planning and Management

Establishing baseline conditions

Baseline conditions of pollutant loading include not only pollutant source activity but also the influence of BMPs already in place at the start of the project. Adjustments based on knowledge of BMP depreciation can provide a more realistic estimate of baseline pollutant loads than assuming that existing land treatment has reduced NPS pollutant loads by some standard efficiency value.

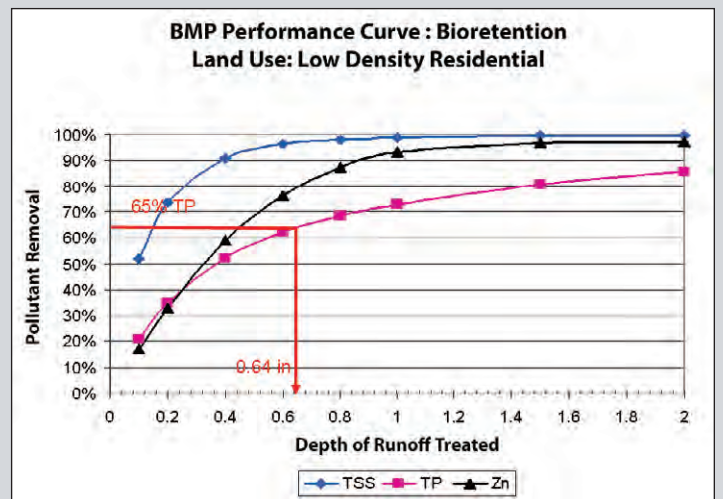


Figure 1. BMP Performance Curve for Bioretention BMP (Tetra Tech 2010).

Establishing an accurate starting point will make load reduction targets—and, therefore, land treatment design—more accurate. Selecting appropriate BMPs, identifying critical source areas, and prioritizing land treatment sites will all benefit from an accurate assessment of baseline conditions. Knowledge of depreciation of existing BMPs can be factored into models used for project planning (e.g., by adjusting pollutant removal efficiencies), resulting in improved understanding of overall baseline NPS loads and their sources.

While not a depreciation issue per se, when a BMP is first installed—especially a vegetative BMP like a buffer or filter strip—it usually takes a certain amount of time before its pollutant reduction capacity is fully realized. For example, Dosskey et al. (2007) reported that the nutrient reduction performance of newly established vegetated filter strips increased over the first 3 years as dense stands of vegetation grew in and soil infiltration improved; thereafter, performance level was stable over a decade. When planning a watershed project, vegetative practices should be examined to determine the proper level of effectiveness to assume based on growth stage. Also, because of weather or management conditions, some practices (e.g., trees) might take longer to reach their full effectiveness or might never reach it. The Stroud Preserve, Pennsylvania, section 319 National Nonpoint Source Monitoring Program (NNPSMP) project (1992–2007) found that slow tree growth in a newly established riparian forest buffer delayed significant $\text{NO}_3\text{-N}$ (nitrate) removal from ground water until about 10 years after the trees were planted (Newbold et al. 2008).

The performance of practices can change in multiple ways over time. For example, excessive deposition in a detention pond that is not properly maintained could reduce overall percent removal of sediment because of reduced capacity as illustrated in Figure 1. The relative and absolute removal efficiencies for various particle size fractions (and associated pollutants) also can change due to reduced hydraulic retention time. Fine particles generally require longer settling times than larger particles, so removal efficiency of fine particles (e.g., silt, clay) can be disproportionately reduced as a detention pond or similar BMP fills with sediment and retention time deteriorates. Expert assessment of the condition and likely current performance level of existing BMPs, particularly those for which a significant amount of pollutant removal is assumed, is essential to establishing an accurate baseline for project planning.

Adaptive watershed management

Watershed planning and management is an iterative process; project goals might not all be fully met during the first project cycle and management efforts usually need to be adjusted in light of ongoing changes. In many cases, several cycles—including mid-course corrections—might be needed for a project to achieve its goals. Consequently, EPA recommends that watershed projects pursue a dynamic and adaptive approach so that implementation of a watershed plan can proceed and be modified as new information becomes available (USEPA 2008). Measures of BMP implementation commonly used as part of progress assessment should be augmented with indicators of BMP depreciation. Combining this information with other relevant project data can provide reliable progress assessments that will indicate gaps and weaknesses that need to be addressed to achieve project goals.

BMP design and delivery system

Patterns in BMP depreciation might yield information on systematic failures in BMP design or management that can be addressed through changes to standards and specifications, contract terms, or permit requirements. This information could be particularly helpful during the project planning phase when both the BMPs and their implementation mechanisms are being considered. For example, a cost-sharing schedule that has traditionally provided all or most funding upon initial installation of a BMP could be adjusted to distribute a portion of the funds over time if operation and maintenance are determined to be a significant issue based on pre-project information. Some BMP components, on the other hand, might need to be dropped or changed to make them more appealing to or easier to manage by landowners. Within the context of a permit program, for example, corrective actions reports might indicate specific changes that should be made to BMPs to ensure their proper performance.

Project Evaluation

Monitoring

Although short-term (3–5 year) NPS watershed projects will not usually have a sufficiently long data record to evaluate incremental project effects, data on BMP depreciation might still improve interpretation of collected water quality data. Even in the short term, water quality monitoring data might reflect cases in which BMPs have suffered catastrophic failures (e.g., an animal waste lagoon breach), been abandoned, or been maintained poorly. Meals (2001), for example, was able to interpret unexpected spikes in stream P and suspended sediment concentrations by walking the watershed and discovering that a landowner had over-applied manure and plowed soil directly into the stream.

Longer-term efforts (e.g., total maximum daily loads¹) might engage in sustained monitoring beyond individual watershed project lifetime(s). The extended monitoring period will generally allow detection of more subtle water quality impacts for which interpretation could be enhanced with information on BMP depreciation. While not designed as BMP depreciation studies, the following two examples illustrate how changes in BMP performance can be related to water quality.

In a New York dairy watershed treated with multiple BMPs, Lewis and Makarewicz (2009) reported that the suspension of a ban on winter manure application 3 years into the monitoring study led to dramatic increases in stream nitrogen and phosphorus concentrations. First and foremost, knowledge of that suspension provided a reasonable explanation for the observed increase in nutrient levels. Secondly, the study was able to use data from the documented depreciation of land treatment to determine that the winter spreading ban had yielded 60–75 percent reductions in average stream nutrient concentrations.

The Walnut Creek, Iowa, Section 319 NNPSMP project promoted conversion of row crop land to native prairie to reduce stream NO₃-N levels and used simple linear regression to show association of two monitored variables: tracked conversion of row crop land to restored prairie vegetation and stream NO₃-N concentrations (Schilling and Spooner 2006). Because some of the restored prairie was plowed back into cropland during the project period—and because that change was

¹ “Total maximum daily loads” as defined in §303(d) of the Clean Water Act.

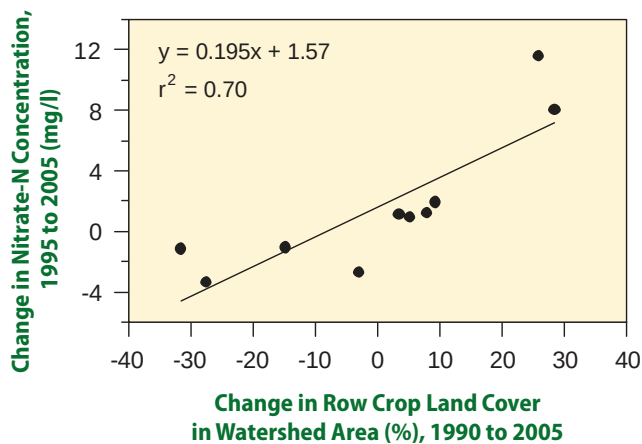


Figure 2. Relating Changes in Stream Nitrate Concentrations to Changes in Row Crop Land Cover in Walnut Creek, Iowa (Schilling and Spooner 2006).

documented—the project was able to show not only that converting crop land to prairie reduced stream $\text{NO}_3\text{-N}$ concentrations but also that increasing row crop land led to increased $\text{NO}_3\text{-N}$ levels (Figure 2).

Modeling

When watershed management projects are guided or supported by modeling, knowledge of BMP depreciation should be part of model inputs and parameterization.

The magnitude of implementation (e.g., acres of treatment) and the spatial distribution of both annual and structural BMPs should be part of model input and should not be static parameters. Where BMPs are represented by

pollutant reduction efficiencies, those percentages can be adjusted based on verification of land treatment performance levels in the watershed. Incorporating BMP depreciation factors into models might require setting up a tiered approach for BMP efficiencies (e.g., different efficiency values for BMPs determined to be in fair, good, or excellent condition) rather than the currently common practice of setting a single efficiency value for a practice assumed to exist. This approach could be particularly important for management practices such as agricultural nutrient management or street sweeping, in which degree of treatment is highly variable. For structural practices, a depreciation schedule could be incorporated into the project, similar to depreciating business assets. In the planning phase of a watershed project, multiple scenarios could be modeled to reflect the potential range of performance levels for BMPs already in place.

Recommendations

The importance of having accurate information on BMP depreciation varies across projects and during the timeline of a single project. During the project planning phase, when plans for the achievement of pollutant reduction targets rely heavily on existing BMPs, it is essential to obtain good information on the level of performance of the BMPs to ensure that plan development is properly informed. If existing BMPs are a trivial part of the overall watershed plan, knowledge of BMP depreciation might not be critical during planning. As projects move forward, however, the types of BMPs implemented, their relative costs and contributions to achievement of project pollutant reduction goals, and the likelihood that BMP depreciation will occur during the period of interest will largely determine the type and extent of BMP verification required over time. The following recommendations should be considered within this context:

- For improved characterization of overall baseline NPS loads, better identification of critical source areas, and more effective prioritization of new land treatment during project planning, collect accurate and complete information about:
 - Land use,

- Land management, and
- The implementation and operation of existing BMPs. This information should include:
 - Original BMP installation dates,
 - Design specifications of individual BMPs,
 - Data on BMP performance levels if available, and
 - The spatial distribution of BMPs across the watershed.
- Track the factors that influence BMP depreciation in the watershed, including:
 - Variations in weather that influence BMP performance levels,
 - Changes in land use, land ownership, and land management,
 - Inspection and enforcement activities on permitted practices, and
 - Operation, maintenance, and management of implemented practices.
- Develop and use observable indicators of BMP status/performance that:
 - Are tailored to the set of BMPs implemented in the watershed and practical within the scope of the watershed project's resources,
 - Can be quantified or scaled to document the extent and magnitude of treatment depreciation, and
 - Are able to be paired with water quality monitoring data.
- After the implementation phase of the NPS project, conduct verification activities to document the continued existence and function of implemented practices to assess the magnitude of depreciation and provide a basis for corrective action. The verification program should:
 - Identify and locate all BMPs of interest, including cost-shared, non-cost-shared, required, and voluntary practices;
 - Capture information on structural, annual, and management BMPs;
 - Obtain data on BMP operation and maintenance activities; and
 - Include assessment of data accuracy and confidence.
- To adjust for depreciation of land treatment, apply verification data to watershed project management and evaluation by:
 - Applying results directly to permit compliance programs,
 - Relating documented changes in land treatment performance levels to observed water quality,
 - Incorporating measures of depreciated BMP effectiveness into modeling efforts, and
 - Using knowledge of treatment depreciation to correct problems and target additional practices as necessary to meet project goals in an adaptive watershed management approach.

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