Section XI: Monitoring Indicators

Success in Watershed Planning requires a long-term, multi-faceted, and integrated approach, involving the dedicated involvement of all stakeholders: citizens, landowners, managers, researchers, and businesses that depend on a healthy watershed. Measuring success, therefore, involves tracking several indicators which have been divided into two major categories: Water Quality Improvements (Goals 1 – 4) and Education and Outreach Achievements (Goal 5). While these two categories are not exclusive – benefits from one will affect the other, they are separated for clarity.

Measuring Water Quality Improvements (Goals 1 – 4)

Water quality improvements will be measured using two categories of indicators: Administrative and Ground Truth Indicators.

Administrative Indicators of Success

Administrative Indicators of success track the successful development of an infrastructure for improving water quality in the Watershed. This includes locating areas for best management practice implementation, contacting homeowners amenable to best management practice implementation, and installing best management practices.

Ground Truth Indicators of Success

Ground Truth Indicators of success track the successful improvement of water quality in the Watershed. The success of implemented best management practices will be measured mainly by monitoring water quality (Criteria 1) and documenting changes in land-use/land cover (Criteria 2) in the subwatersheds. Water quality monitoring will begin soon after Criteria 3 Feasibility evaluations have been completed and specific stream reaches have been identified as Critical Areas. This will give the ECWA a baseline (or before remediation) data. Monitoring will continue after installation of the recommended best management practices. While monitoring efforts will focus on Contaminants of Concern, namely, *E. coli*, Atrazine, Total Suspended Solids, and nutrients (Total P, Total N, and Total Organic Carbon), several other water quality parameters will be measured in the streams. These include nitrate, ortho-P, chloride, and dissolved organic carbon. *In-situ* water quality parameters such as pH, dissolved oxygen, conductivity, specific conductance, temperature, total dissolved solids, and salinity will be measured with a YSI multiparameter probe. At the time of sample collection, stream discharge will be measured with a Doppler flow meter while continuously measuring level loggers positioned near the implementation site will record continuous stream stage. These data will allow for the calculation of contaminant loads in the stream and a determination of longitudinal changes in water quality before and after best management implementation.

To determine how effective the implemented best management practice is at reducing contaminants, riparian zone efficiency will be monitored using wells and piezometers placed along a transect of the riparian zone (Vidon and Hill, 2004b). Water samples from these wells will be measured for contaminants (e.g., nitrate, ortho-P, Total P, sulfate, and chloride), water quality parameters such as pH, conductivity, specific conductance, temperature, total dissolved solids, and salinity which will be measured using a YSI multiparameter probe, and dissolved oxygen which will be measured using a Hanna DO meter. These data will be used to determine how efficient riparian zone best management practices are at removing contaminants of concern and will help to guide future decisions on best management practice implementation in the Watershed.

Goal 1: Reduce E. coli loads in Eagle Creek Watershed to meet water quality standards.

Objective 1: Reduce *E. coli* load from livestock with access to streams.

Indicator	How Tracked	Responsible Party
◆ Sufficient number of landowners amenable to fencing installation.	Create a list of landowners whose land overlaps a Critical Area and maintain a list of partners and possible partners.	Coordinator and Farm Promoter
◆ Miles of fencing installed.	Track length of fencing purchased and length of fencing installed in Critical Areas.	Coordinator and Farm Promoter
▸ Reduction in sites with animal access to stream.	Compare before and after visual assessments of sites with animal access to stream.	Coordinator
▸ Reduction in number of event flows with *E.coli* concentrations higher than 10,000 CFU/100 mL.	Event flow water quality sampling upstream and downstream of cited fencing installation to track *E. coli* concentrations will begin as soon as the Critical Area is determined and will be maintained as long as funding is available. These data will be used to create a best management practice database for Eagle Creek Watershed and for further scientific research on and publication.	CEES Research Scientists

◆ Water Quality Administrative Indicator of Success
▸ Water Quality Ground Truth Indicator of Success

Objective 2: Reduce *E. coli* load from event flow run-off.

Indicator	How Tracked	Responsible Party
◆ Sufficient number of landowners amenable to buffer installation.	Create a list of landowners whose land overlaps a Critical Area and maintain a list of partners and possible partners.	Coordinator, Farm Promoter and SWCDs
◆ Number of implemented buffers and a decrease in the amount of stream bank with inadequate riparian buffers.	Document the area of stream bank land converted from inadequate buffer to adequate buffer	Coordinator and CEES Research Scientists
▸ Reduction in number of event flows with *E.coli* concentrations higher than 10,000 CFU/100 mL.	Event flow sampling upstream and downstream of cited fencing installation to track *E. coli* concentrations and loads will begin as soon as the Critical Area is determined and will be maintained as long as funding is available. These data will be used to create a best management practice database for Eagle Creek Watershed and for further scientific research and publication..	CEES Research Scientists, Veolia Water Indianapolis, and Coordinator

◆ Water Quality Administrative Indicator of Success
▸ Water Quality Ground Truth Indicator of Success

Objective 3: Reduce *E. coli* load from malfunctioning septic systems

Indicator	How Tracked	Responsible Party
◆ Location of unsewered areas in Watershed.	Create a timeline toward the development of a map showing the location of the unsewered areas and a list of addresses of homes with septic systems.	Coordinator and ECWA Technical Subcommittee
◆ Reduction in the number of malfunctioning septic systems.	Document the number of homes whose septic systems have been improved due to education and outreach efforts.	Coordinator and ECWA Education Subcommittee
▸ Reduction in *E. coli* concentrations greater than 1,000 CFU/100mL.	Continued water quality monitoring of stream reaches upstream and downstream of unsewered communities for *E. coli* concentrations.	CEES Research Scientists, Veolia Water Indianapolis, and Coordinator
■ Development of septic system informational brochure and the number of copies printed and distributed to the public.	Document the number of copies printed and disseminated.	Coordinator and ECWA Education Subcommittee
■ Number of attendees to educational events.	Document the number of attendees at educational events.	Coordinator and ECWA Education Subcommittee

◆ Water Quality Administrative Indicator of Success
▸ Water Quality Ground Truth Indicator of Success
■ Education and Outreach Indicator of Success

Objective 4: Reduce *E. coli* load from agricultural stormwater run-off.

Indicator	How Tracked	Responsible Party
◆ Increase in the amount of agricultural fields using Whole Farm Planning practices.	Document the number of farmers who have adopted Whole Farm Planning practices	Farm Promoter, SWCDs, ECWA Education Subcommittee, and Coordinator
▸ Reduction in *E. coli* concentrations greater than 1,000 CFU/100mL.	Continued water quality monitoring of stream reaches upstream and downstream of agricultural land-uses for *E. coli* concentrations.	CEES Research Scientists, Veolia Water Indianapolis, and Coordinator

◆ Water Quality Administrative Indicator of Success
▸ Water Quality Ground Truth Indicator of Success

Goal 2: Reduce Atrazine loads in Eagle Creek Watershed.

Objective 1: Reduce Atrazine run-off from agricultural fields from entering the trunk streams of Eagle Creek Watershed.

Indicator	How Tracked	Responsible Party
◆ Sufficient number of landowners amenable to buffer and/or constructed wetland installation.	Create a list of landowners whose land overlaps a Critical Area and maintain a list of partners and possible partners.	Coordinator, Farm Promoter and SWCDs
◆ Number of implemented buffers and a decrease in the amount of stream bank with inadequate riparian buffers.	Document the area of stream bank land converted from inadequate buffer to adequate buffer. Document the number of projects initiated and completed.	Coordinator and CEES Research Scientists
◆ Increase in the amount of agricultural fields using Whole Farm Planning practices.	Document the number of farmers who have adopted Whole Farm Planning practices	Farm Promoter, SWCDs, ECWA Education Subcommittee, and Coordinator
▸ Reduction in Atrazine loading to Eagle Creek Reservoir	Continued monitoring of Atrazine concentrations and loads upstream and downstream of the cited riparian buffer and/or constructed wetland installation will begin as soon as the Critical Area is determined and will be maintained as long as funding is available. These data will be used to create a best management practice database for Eagle Creek Watershed and for further scientific research and publication. Continued monitoring of Atrazine concentrations in Eagle Creek Reservoir will occur on a bi-weekly bases at the raw water intake for the T.W. Moses Drinking Water plant as a part of Veolia Water Indianapolis monitoring of Eagle Creek Reservoir.	CEES Research Scientists, Veolia Water Indianapolis, and Coordinator

◆ Water Quality Administrative Indicator of Success
▸ Water Quality Ground Truth Indicator of Success

Objective 2: Reduce application of Atrazine in Eagle Creek Watershed.

Indicator	How Tracked	Responsible Party
◆ Developed database on Atrazine application rates specific to agricultural land in Eagle Creek Watershed	Create a timeline toward the development of an Atrazine usage database for Eagle Creek Watershed.	Farm Promoter and SWCDs
◆ Creation of list showing Atrazine alternatives with their costs and benefits.	Create a timeline toward the development of Atrazine Alternatives for Eagle Creek Watershed.	Farm Promoter and SWCDs
■ Development of Atrazine informational brochure and the number of copies printed and distributed to the public.	Document the number of copies printed and disseminated.	Farm Promoter and ECWA Education Subcommittee
▸ Reduction in Atrazine application in Eagle Creek Watershed	Document the number of farmers who change Atrazine application practices and maintain Atrazine usage database for Eagle Creek Watershed.	Farm Promoter and SWCDs

◆ Water Quality Administrative Indicator of Success
▸ Water Quality Ground Truth Indicator of Success
■ Education and Outreach Indicator of Success

Objective 3: Reduce Atrazine run-off from agricultural stormwater run-off.

Indicator	How Tracked	Responsible Party
◆ Increase in the amount of agricultural fields using Whole Farm Planning practices.	Document the number of farmers who have adopted Whole Farm Planning practices	Farm Promoter, SWCDs, ECWA Education Subcommittee, and Coordinator
▸ Reduction in Atrazine loading to Eagle Creek Reservoir	Continued monitoring of Atrazine concentrations in Eagle Creek Reservoir will occur on a bi-weekly bases at the raw water intake for the T.W. Moses Drinking Water plant as a part of Veolia Water Indianapolis monitoring of Eagle Creek Reservoir.	CEES Research Scientists, Veolia Water Indianapolis, and Coordinator

◆ Water Quality Administrative Indicator of Success
▸ Water Quality Ground Truth Indicator of Success

Goal 3: Reduce Total Suspended Sediment loads in Eagle Creek Watershed to meet water quality standards.

Objective 1: Reduce fine grain sediment load from headwater erosion.

Indicator	How Tracked	Responsible Party
◆ Development of common goals between NRCS, County Drainage Board, and ECWA.	Create a timeline toward the development of common goals between NRCS, County Drainage Board, and ECWA.	Coordinator, Farm Promoter, and ECWA
◆ Sufficient number of landowners amenable to buffer installation.	Create a list of landowners whose land overlaps a Critical Area and maintain a list of partners and possible partners.	Coordinator, Farm Promoter and SWCDs
◆ Development of a detailed baseline map showing headwater erosion.	Create a timeline toward the development of a baseline map showing headwater erosion.	Coordinator and Farm Promoter
◆ Number of implemented or enhanced buffers and a decrease in the amount of stream bank with inadequate riparian buffers.	Document the area of stream bank land converted from inadequate buffer to adequate buffer.	Coordinator and CEES Research Scientists
▸ Reduction in total suspended sediment loading	Monitoring of Total Suspended Solids concentrations and loads upstream and downstream of cited buffers will begin as soon as the Critical Area is determined and will be maintained as long as funding is available. These data will be used to create a best management practice database for Eagle Creek Watershed and for further scientific research and publication. .	CEES Research Scientists, Veolia Water Indianapolis, and Coordinator

◆ Water Quality Administrative Indicator of Success
▸ Water Quality Ground Truth Indicator of Success

Objective 2: Reduce sediment load from agricultural run-off.

Indicator	How Tracked	Responsible Party
◆ Increase in the amount of agricultural fields using Whole Farm Planning practices.	Document the number of farmers who have adopted Whole Farm Planning practices	Farm Promoter, SWCDs, ECWA Education Subcommittee, and Coordinator

◆ Water Quality Administrative Indicator of Success

Objective 3: Reduce sediment load from stormwater run-off from impervious surfaces and urbanized areas.

Indicator	How Tracked	Responsible Party
▪ Increase in public awareness of whole community planning and low impact development.	Document the number of visitors (hits) to the ECWA website over the course of the grant period. Document the number of ECWA newsletter mailings and e-mailings sent over the course of the grant period. Document the number of educational material distributed over the course of the grant period.	Farm Promoter, SWCDs, ECWA Education Subcommittee, and Coordinator
▪ Number of watershed and stormwater markers installed.	Document the number of signs and markers installed.	Coordinator, ECWA Education Subcommittee

▪ Education and Outreach Indicator of Success

Objective 6: Reduce sediment load from bank erosion in the lower reaches of Eagle Creek Watershed.

Indicator	How Tracked	Responsible Party
◆ Development of common goals between land developers, Indiana Green Building Council and ECWA	Create a timeline toward the development of common goals between land developers, Indiana Green Building Council, and ECWA	Coordinator and ECWA
◆ Number of land developers using sustainable development practices.	Conduct a baseline visual survey on-going developments and the proper use of sediment traps then maintain and update database.	Coordinator and ECWA
▸ Improvements in visually assessed HHEI[13] and QHEI[14] scores.	Measure and document changes in HHEI and QHEI scores at least once each year during the growing season..	Coordinator and ECWA Technical Subcomittee
■ Number of educational events focused on sustainable development practices held	Document the number of educational events held.	Coordinator and ECWA Education Subcommittee
■ Number of attendees at educational events focused on sustainable development.	Document the number of attendees at educational events.	Coordinator and ECWA Education Subcommittee

◆ Water Quality Administrative Indicator of Success
▸ Water Quality Ground Truth Indicator of Success

[13] HHEI = Headwater Habitat Evaluation Index
[14] QHEI = Qualitative Habitat Evaluation Index

Goal 4: Reduce nutrient loads in Eagle Creek Watershed to meet water quality standards.

Objective 1: Reduce nutrient loads from agricultural run-off.

Indicator	How Tracked	Responsible Party
◆ Sufficient number of landowners amenable to buffer and/or constructed wetland installation.	Create a list of landowners whose land overlaps a Critical Area and maintain a list of partners and possible partners.	Coordinator, Farm Promoter and SWCDs
◆ Decrease in the amount of agricultural fertilizers applied in Eagle Creek Watershed.	Create a timeline toward the development of a nutrient usage database for Eagle Creek Watershed	Farm Promoter and SWCDs
◆ Increase in the amount of agricultural fields using Whole Farm Planning practices.	Document the number of farmers who have adopted Whole Farm Planning practices	Farm Promoter, SWCDs, ECWA Education Subcommittee, and Coordinator
▸ Reduction in nutrient loading	Monitoring of nutrient concentrations and loads upstream and downstream of cited buffers will begin as soon as the Critical Area is determined and will be maintained as long as funding is available. These data will be used to create a best management practice database for Eagle Creek Watershed and for further scientific research and publication.	CEES Research Scientists, Veolia Water Indianapolis, and Coordinator

◆ Water Quality Administrative Indicator of Success
▸ Water Quality Ground Truth Indicator of Success

Objective 2: Reduce nutrient load from tile drainage.

Indicator	How Tracked	Responsible Party
◆ Increase in the amount of agricultural fields using Whole Farm Planning practices.	Document the number of farmers who have adopted Whole Farm Planning practices	Farm Promoter, SWCDs, ECWA Education Subcommittee, and Coordinator

◆ Water Quality Administrative Indicator of Success

Objective 3: Reduce nutrient loading from point sources.

Indicator	How Tracked	Responsible Party
◆ Development of common goals between point source dischargers, CAFOs[15], and ECWA.	Create a timeline toward the development of common goals between point source dischargers, CAFOs and ECWA and the implementation of those common goals.	Coordinator, ECWA, point source dischargers, and CAFOs

◆ Water Quality Administrative Indicator of Success

[15] CAFO = Confined Animal Feeding Operation

Objective 4: Reduce nutrient loading from non-point sources other than agricultural run-off.

Indicator	How Tracked	Responsible Party
◆ Sufficient number of landowners amenable to buffer and/or constructed wetland installation.	Create a list of landowners whose land overlaps a Critical Area and maintain a list of partners and possible partners.	Coordinator and ECWA
◆ Number of implemented or enhanced buffers and a decrease in the amount of stream bank with inadequate riparian buffers.	Document the area of stream bank land converted from inadequate buffer to adequate buffer.	Coordinator and CEES Research Scientists
▸ Reduction in nutrient loading	Monitoring of nutrient concentrations and loads upstream and downstream of cited buffers will begin as soon as the Critical Area is determined and will be maintained as long as funding is available. These data will be used to create a best management practice database for Eagle Creek Watershed and for further scientific research and publication. .	CEES Research Scientists, Veolia Water Indianapolis, and Coordinator

◆ Water Quality Administrative Indicator of Success
▸ Water Quality Ground Truth Indicator of Success

Objective 5: Reduce nutrient load from stormwater run-off from impervious surfaces and urbanized areas.

Indicator	How Tracked	Responsible Party
■ Increase in public awareness of whole community planning and low impact development.	Document the number of visitors (hits) to the ECWA website over the course of the grant period. Document the number of ECWA newsletter mailings and e-mailings sent over the course of the grant period. Document the number of educational material distributed over the course of the grant period.	Coordinator, ECWA Education Subcommittee
■ Number of watershed and stormwater markers installed.	Document the number of signs and markers installed.	Coordinator, ECWA Education Subcommittee

■ Education and Outreach Indicator of Success

Objective 6: Reduce and eventually eliminate suburban and urban lawn phosphorous fertilizer application.

Indicator	How Tracked	Responsible Party
▪ Increase in public awareness of their impacts on watershed and reservoir water quality.	Document the number of visitors (hits) to the ECWA website over the course of the grant period. Document the number of ECWA newsletter mailings and e-mailings sent over the course of the grant period. Document the number of educational material distributed over the course of the grant period.	Farm Promoter, SWCDs, ECWA Education Subcommittee, and Coordinator
▪ Number of watershed and stormwater markers installed.	Document the number of signs and markers installed.	Coordinator, ECWA Education Subcommittee

▪ Education and Outreach Indicator of Success

Measuring Education and Outreach Achievements

Education and outreach indicators of success track the successful development of an infrastructure for improving public awareness and education about water quality and water quality issues in the Watershed. This includes placing watershed boundary signs in the watershed, creating educational programs and workshops, developing a website for disseminating information about the watershed to the public, and producing educational material such as brochures and newsletters.

Goal 5: Increase education and outreach in Eagle Creek Watershed.

Objective 1: Educate farmers on Whole Farm Planning practices.

Indicator	How Tracked	Responsible Party
▪ Number of educational materials created for and disseminated to farmers regarding Whole Farm Planning practices.	Document the number of visitors (hits) to the ECWA website page on Whole Farm Planning over the course of the grant period. Document the number of ECWA educational material sent regarding Whole Farm Planning over the course of the grant period.	Farm Promoter, ECWA Education Subcommittee
◆ Increase in the amount of agricultural fields using Whole Farm Planning practices.	Document the number of farmers who have adopted Whole Farm Planning practices	Farm Promoter, SWCDs, ECWA Education Subcommittee, and Coordinator

▪ Education and Outreach Indicator of Success
◆ Water Quality Administrative Indicator of Success

Objective 2: Raise public awareness of watersheds and the public's role in water quality.

Indicator	How Tracked	Responsible Party
▪ Number of storm drain markers installed	Document the number of storm drain markers installed.	Coordinator, ECWA Education Subcommittee
▪ Number of watershed boundary signs installed	Document the number of watershed boundary signs installed.	Coordinator, ECWA Education Subcommittee

- Education and Outreach Indicator of Success

Objective 3: Raise public awareness of watershed and water quality issues.

Indicator	How Tracked	Responsible Party
▪ Number of hits on ECWA website.	Document the number of visitors (hits) to the ECWA website over the course of the grant period.	Coordinator, ECWA Education Subcommittee
▪ Number of residents receiving ECWA newsletter.	Document the number of ECWA newsletter mailings and e-mailings sent over the course of the grant period.	Coordinator, ECWA Education Subcommittee
▪ Number of educational materials distributed.	Document the number of educational material distributed over the course of the grant period.	Coordinator, ECWA Education Subcommittee
▪ Number of outreach events hosted.	Document the number of outreach events hosted over the course of the grant period.	Coordinator, ECWA Education Subcommittee
▪ Number of residents attending outreach events.	Document the number of attendees at each outreach event over the course of the grant period.	Coordinator, ECWA Education Subcommittee

- Education and Outreach Indicator of Success

Objective 4: Continue to build on and expand watershed outreach activities.

Indicator	How Tracked	Responsible Party
▪ Increase in environmental stewardship.		Coordinator, ECWA Education Subcommittee

- Education and Outreach Indicator of Success