Section VIII: Critical Areas Identification and Prioritization

Based on the concerns and problem statements elucidated in the previous sections, the ECWA has developed a Critical Areas Evaluation tool and created a list of Priorities for Eagle Creek Watershed. Based on the Critical Areas Evaluation, and developed Priorities, subwatersheds were chosen for best management implementation. This listing is called the Subwatershed Prioritization.

Critical Areas Identification

Citing Critical Areas was accomplished through a Critical Areas Evaluation Tool. For this evaluation, Critical Areas were defined as specific stream reaches within a subwatershed that showed a high level of water quality degradation, and/or showed a high level of vulnerability to on-going and future degradation, and were practical for remediation implementation. As water quality degradation and vulnerability are equally important in deciding remediation type, these criteria were considered equally important but not exclusive, meaning that a subwatershed with a high level of water quality degradation and vulnerability, a subwatershed with a high level of water quality but low level of vulnerability, and a subwatershed with a low level of water quality degradation but a high level of vulnerability could be designated as a Critical Area given the feasibility of remediation. Thus, Critical Areas Evaluation was determined by:

(1) the level of water quality degradation based on benchmark assessment of water quality; *and/or*
(2) the identification of land-use/land cover assessments that showed specific areas particularly vulnerable to on-going and future degradation (vulnerability); and
(3) the feasibility of remediation (Figure VIII-1).

Criteria 1 and Criteria 2: Level of Degradation and Level of Vulnerability

The first two criteria, (1) the level of water quality degradation and (2) vulnerability were determined by the Subwatershed Assessment (Section VI: Subwatershed Assessment). The third criterion was determined by a Feasibility Assessment (Figure VIII-1). This method allowed the ECWA to weigh the need for remediation, the practicality of remediation, and the efficacy of remediation in determining Areas of Concern.

After Criteria 1 Evaluation to identify the major contaminants of concern and Criteria 2 Evaluation to identify possible sources of the contaminants for the subwatersheds, the ECWA discerned the feasibility of remediation. Through literature reviews of best management practices, the ECWA determined what type of remediation (e.g., fencing, increased stream buffer, created wetland, and/or education and outreach) was necessary to reduce or control the contaminant from its respective source. Once a type of remediation was selected, visual assessments were used to determine the best possible stream reach locations for the proposed remediation. Once these areas have been mapped, discussions with landowners or stakeholders will be held to determine those landowners and stakeholders most amenable to work with the ECWA to implement best management practices on their land. Therefore, while the Feasibilty Assessment is not complete as talks with landowners and stakeholders have not yet been held, the ECWA has mapped out areas for which remediation is practical and would have short-term and long-term benefits.

For example, Criteria 1 Evaluation of Fishback Creek (Eagle Creek Reservoir) showed that the major contaminants of concern for the subwatershed are *E. coli*, TSS, Total P, and Total Organic Carbon. Criteria 2 Evaluation showed that this subwatershed is vulnerable to contamination from agricultural run-off, impervious surfaces, stream bank erosion, an unsewered community, a confined animal feeding operation, tiles and/or pipe discharges directly into the stream, and land-use perturbation (Table VIII-1). Based on these contaminants of concern and the possible sources of contamination, remediation using conventional best management practices in Fishback Creek is plausible. However, best management practice implementation must be an integrated effort, comprising whole farm planning, grass strips in stream bottoms, woody riparian buffers, constructed wetlands, stormwater management, whole community planning (e.g., low impact development practices), education and outreach, and point source reductions (page 129) which require the participation of landowners and stakeholders. Therefore, while remediation in Fishback Creek is plausible, the feasibility of implementing remediation will depend upon the identification of landowners and stakeholders amenable to participating in remediation efforts.

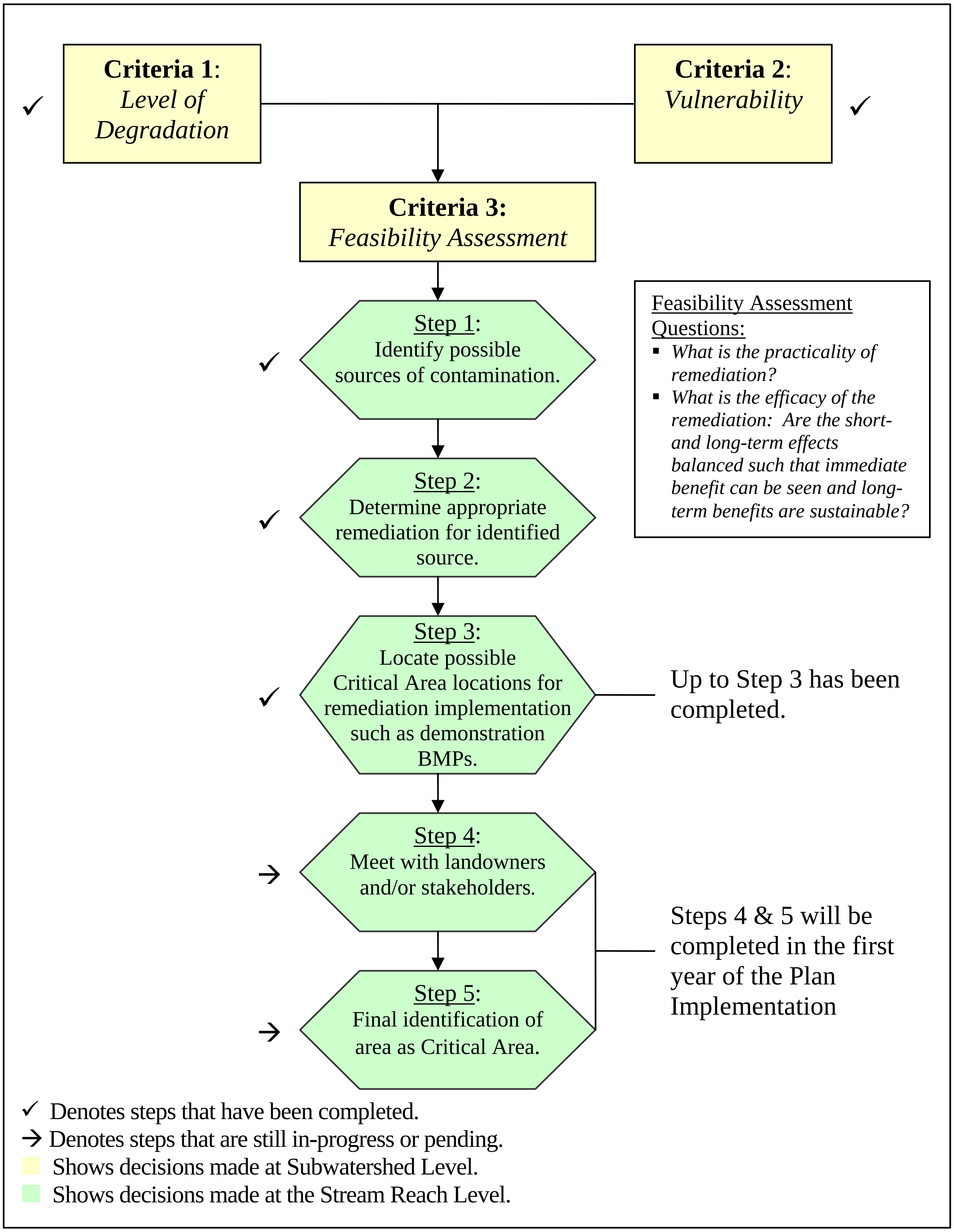


Figure VIII-1: Determination of Critical Areas Evaluation Tool (Flow Chart)

Table VIII-1: Identifying Critical Areas Based on Criteria 1 and Criteria 2

Subwatershed	Criteria 1: Level of Degradation*	Criteria 2: Vulnerability[†]	Possible Remediation Type(s)[‡]
Eagle Creek - Dixon Branch	▪ *E. coli* ▪ Atrazine (1) ▪ TSS (4) ▪ Total N (1) ▪ Total Organic Carbon (1)	▪ Agricultural Run-off (84%) ▪ An NPDES Processed Water Point Source ▪ CAFO (1) ▪ Tile and/or Pipes into Stream (9)	⇒ Whole Farm Planning ⇒ Grass Strips in Channel Bottom ⇒ Point Source Reduction ⇒ Education/Outreach ⇒ Grass and Tree Buffers ⇒ Constructed Wetlands
Eagle Creek - Finley Creek	▪ *E.coli* ▪ Atrazine (4)	▪ Agricultural Run-off (71%)	⇒ Whole Farm Planning ⇒ Grass Strips in Channel Bottom ⇒ Education/Outreach ⇒ Constructed Wetlands
Eagle Creek - Kreager Ditch	▪ *E. coli* ▪ TSS (4) ▪ Total P (4) ▪ Total N (1) ▪ Total Organic Carbon (4)	▪ Agricultural Run-off (76%) ▪ Livestock Access ▪ Unsewered Communities (2) ▪ CAFO (2) ▪ Tile and/or Pipes into Stream (6)	⇒ Whole Farm Planning ⇒ Grass Strips in Channel Bottom ⇒ Stream Protection (Fencing) ⇒ Education/Outreach ⇒ Grass and Tree Buffers ⇒ Constructed Wetlands
Little Eagle Branch - Headwaters	▪ *E. coli* ▪ TSS (3) ▪ Total P (2) ▪ Total N (2) ▪ Total Organic Carbon (2)	▪ Agricultural Run-off (70%) ▪ NPDES Sanitary Point sources (4) ▪ Unsewered Communities (2)	⇒ Whole Farm Planning ⇒ Grass Strips in Channel Bottom ⇒ Grass and Tree Buffers ⇒ Point Source Reduction ⇒ Constructed Wetlands
Mounts Run - Neese Ditch	▪ *E. coli* ▪ Atrazine (2) ▪ Total N (1) ▪ Total Organic Carbon (4)	▪ Agricultural Run-off (84%) ▪ Livestock Access ▪ Tile and/or Pipes into Stream (10)	⇒ Whole Farm Planning ⇒ Grass Strips in Channel Bottom ⇒ Education/Outreach ⇒ Grass and Tree Buffers ⇒ Stream Protection (Fencing) ⇒ Constructed Wetlands

Table VIII-1: Identifying Critical Areas Based on Criteria 1 and Criteria 2 (continued)

Subwatershed	Criteria 1: Level of Degradation*	Criteria 2: Vulnerability†	Possible Remediation Type(s)‡
Little Eagle Branch - Woodruff Branch	▪ *E. coli* ▪ Atrazine (2) ▪ TSS (1) ▪ Total P (1) ▪ Total N (4) ▪ Total Organic Carbon (1)	▪ Agricultural Run-off (54%) ▪ Impervious Surfaces (1.7 mi^2) ▪ NPDES Stormwater Run-off Point Sources (2) ▪ Tile and/or Pipes into Stream (6) ▪ Unsewered Communities (2)	⇒ Whole Farm Management ⇒ Grass Strips in Channel Bottom ⇒ Education/Outreach ⇒ Grass and Tree Buffers ⇒ Point Source Reduction ⇒ Whole Community Planning (e.g., low impact development practices and stormwater management) ⇒ Constructed Wetlands
Eagle Creek - Jackson Run	▪ *E. coli* ▪ TSS (1) ▪ Total P (1) ▪ Tot N (4) ▪ Total Organic Carbon (1)	▪ Agricultural Run-off (55%) ▪ Impervious Surfaces (2.4 mi^2) ▪ Land-use Perturbation ▪ NPDES Sanitary Point Source (2)	⇒ Whole Farm Management ⇒ Grass Strips in Channel Bottom ⇒ Education/Outreach ⇒ Tree and Shrub Buffer ⇒ Point Source Reduction ⇒ Whole Community Planning (e.g., low impact development practices and stormwater management) ⇒ Constructed Wetlands
Fishback Creek (Eagle Creek Reservoir)	▪ *E. coli* ▪ TSS (2) ▪ Total P (3) ▪ Total N (3) ▪ Total Organic Carbon (3)	▪ Agricultural Run-off (59%) ▪ Impervious Surfaces (2.1 mi^2) ▪ Stream Bank Erosion (moderate) ▪ Unsewered Community (1) ▪ CAFO (1) ▪ Tiles and/or Pipes into Stream (11) ▪ Land-use Perturbation	⇒ Whole Farm Management ⇒ Grass Strips in Channel Bottom ⇒ Grass and Tree Buffers ⇒ Education/Outreach ⇒ Point Source Reduction ⇒ Whole Community Planning (e.g., low impact development practices and stormwater management) ⇒ Constructed Wetlands

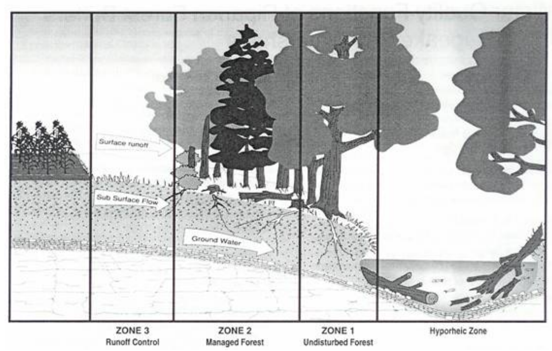
Subwatershed	Criteria 1: Level of Degradation*	Criteria 2: Vulnerability†	Possible Remediation Type(s)‡
Eagle Creek - Long Branch/Irishman Run	▪ *E. coli*	▪ Agricultural Run-off (25%) ▪ Impervious Surfaces (5.2 mi^2) ▪ Stream Bank Erosion (moderate) ▪ NPDES Sanitary Point Sources (2) ▪ Tiles and/or Pipes into Stream (6) ▪ Land-use Perturbation	⇒ Whole Community Planning (e.g., low impact development practices and stormwater management) ⇒ Whole Farm Management ⇒ Grass Strips in Channel Bottom ⇒ Education/Outreach ⇒ Grass and Tree Buffers ⇒ Point Source Reduction ⇒ Constructed Wetlands
Eagle Creek Reservoir - School Branch	▪ *E. coli*	▪ Agricultural Run-off (41%) ▪ Impervious Surfaces (3.0 mi^2) ▪ Stream Bank Erosion (moderate) ▪ Tiles and/or Pipes into Stream (7) ▪ Land-use Perturbation	⇒ Whole Community Planning (e.g., low impact development practices and stormwater management) ⇒ Whole Farm Management ⇒ Grass Strips in Channel Bottom ⇒ Education/Outreach ⇒ Grass and Tree Buffers ⇒ Constructed Wetlands

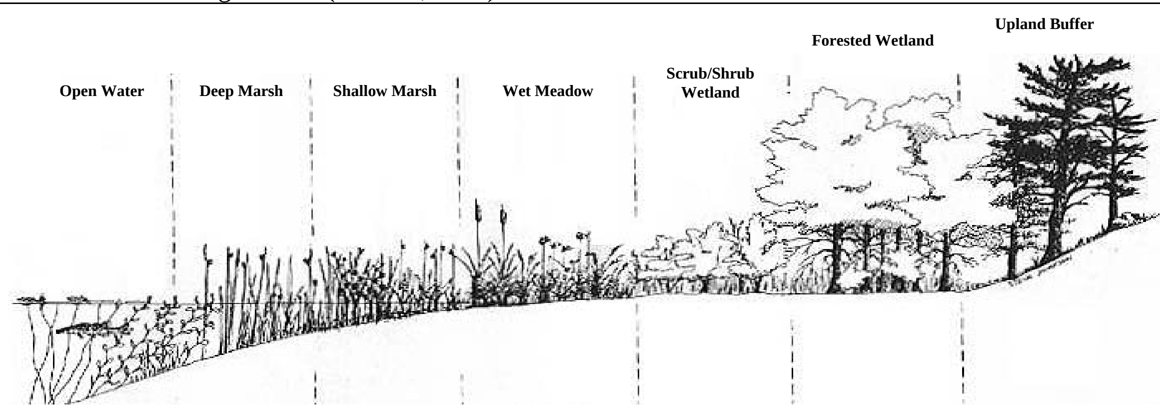
* Based on Subwatershed Assessment: All subwatersheds are listed as impaired by *E. coli* by IDEM 303(d) listings except Eagle Creek Reservoir – School Branch; however, *E. coli* concentrations in School Branch often exceed 235 CFU/100 mL (page 98). TSS, Total P, Total N, and Total Organic Carbon were listed if loads from the Subwatershed exceeded the average load for the entire Eagle Creek Watershed (Table VI-6 and Table VI-7). Parenthetical note after Atrazine, TSS, Total P, Total N, and Total Organic Carbon represents Rank for that parameter assessment.

† Based on a land-use/land cover and point source identification data. Parenthetical note after possible source refers to: % of agricultural land-use; mi^2 of impervious surfaces; number of NPDES point sources; visually assessed level of stream bank erosion; number of unsewered communities; number of CAFOs; and number of tiles and/or pipes found discharging directly into the stream.

Table VIII-1: Identifying Critical Areas Based on Criteria 1 and Criteria 2 (continued – notes)

‡ <u>Remediation Type Explanations (Alphabetical Order)</u>

Buffers	Buffers are areas or bands of natural or planted vegetation located between agricultural land and water bodies. These zones of permanent vegetation are generally covered with grasses or with a combination of grasses, shrubs, and trees. They help to reduce flooding, serve as areas for ground water recharge and discharge, reduce sedimentation and conserve topsoil, and retain nutrients and curb their transport into water bodies. Buffers have been shown to reduce sediment loads by 50 – 90% , Total P by 20 – 90% , Total N by 63 – 76%, Atrazine by 32% – 68%, depending on the type and width of installed buffer (Coote and Gregorich, 2000), and nitrate in subsurface flow by more than 90% in most riparian zones (Vidon and Hill, 2004).   (Reproduced from Lowrance *et al*., 1997)
Education and Outreach	Education through public speaking, open discussions, BMP demonstrations, service programs, and literature dissemination that raises public awareness of environmental issues to promote informed environmental decision-making and stewardship, which is critical to modern urban development and community well-being. By combining research, education, and service, citizens gain the knowledge, skills and experience they need to make a positive impact on their natural surroundings.
Grass Strips in Channel Bottom (Grassy Swales)	Swales are natural or man-made low lying areas (depressions) where surface run-off collects before entering the stream. These areas intermittently flood. Planting grass or other permanent vegetation in these areas helps to slow surface water run-off from agricultural land and impervious surfaces, allowing infiltration of surface water into the ground and reducing sediment and nutrient export into streams.  Grassy swale in a corn field.
Point Source Reduction	Point source reduction is the concerted effort by users and dischargers to decrease the amount (load) of contaminants released into streams.

Stream Protection (Fencing)	Protecting the stream from livestock entails the use of physical barriers that curtail the movement of livestock into the stream. Livestock can disrupt the natural vegetation along the stream bank and increase erosion. For example, fencing is a simple barrier that decreases livestock access to the stream.  www.epa.gov/watertrain Livestock in stream.  Livestock damage to stream.
Wetlands (natural and constructed)	Wetlands are areas saturated with water for long enough periods to significantly alter soils and vegetation such that aquatic processes are the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface (EPA Regulations listed at 40 CFR 230.3(t)). They provide wildlife habitat, act as biological filters and allow for mechanical settling and filtering which help to remove contaminants from water, recharge groundwater, augment low flow in streams and buffer against droughts, reduce risk and damage of flooding by storing water during heavy rainfall, rapid thaws, or other run-off events, and stabilize shorelines (Coote and Gregorich, 2000). Wetlands have been found beneficial in reducing nutrient and *E. coli* concentrations to flowing streams (DeBusk, 1999).
	

Whole Farm Planning	Whole farm planning is a holistic approach to farm management which encourages land stewardship and sustainable practices. These practices include conservation tillage, crop nutrient management, pest management, conservation buffers, irrigation water management, grazing management, animal feeding operations management, and erosion and sediment control. US EPA recognizes these practices as a method for water quality protection.
Whole Community Planning (Low Impact Development and Stormwater Management)	Whole community planning is a holistic approach to urban planning which encourages land stewardship and sustainable practices (also called "smart growth" strategies). These practices include a comprehensive stormwater program, such as conservation based zoning decisions; minimizing impacts before, during, and after building; protecting and maintaining natural areas (e.g., riparian buffers and wetlands) and/or restoring natural areas; directing run-off to natural areas; using small-scale controls (e.g., rain gardens, vegetated swales, cisterns, greenroofs, and amended soils for better infiltration); and pollution prevention and education. These practices are aimed at mitigating flooding and reducing pollution (Northern Virginia Regional Commission, 2005 and US EPA, 2000).

Feasibility Evaluation

The Area of Concern Evaluation has been completed to the subwatershed level for all Eagle Creek Subwatersheds (Figure VIII-1 and Table VIII-1). Results showed that remediation in all Subwatersheds must be multi-faceted as most subwatersheds had multiple (Criteria 1) contaminants of concern and multiple (Criteria 2) vulnerabilities. However Criteria 3 Feasibility evaluation to determine specific stream reaches for remediation is on-going. As feasibility is dependent upon the type of remediation, it is necessary to determine what types of remediation would result in the greatest benefit to the Watershed. As benefit is a relative measure, benefits were based on Priorities developed through stakeholder meetings. Furthermore, as location of specific remediation methods that alter the landscape (e.g. buffers, fencing, and wetlands) would determine the success of the remediation, feasibility evaluations also took into account the areas of the subwatersheds that would result in the best possible outcomes. For instance, while erosion is a source of total suspended sediments in the lower watershed, it is not always feasible to place woody riparian buffers on some lower watershed streambanks as slopes are too great to allow successful planting of woody and herbaceous plants.

Priorities

To determine the types of remediation projects which would result in the greatest benefit to the Watershed, goals and objectives were developed based on Concerns and Problem Statements. These goals were formulated to address *E. coli*, Atrazine, Total Suspended Solids, Nutrients, and Education and Outreach issues in the Watershed: (These Goals and Objectives are explained in greater detail in Section IX: Watershed Management Goals on page 136.)

Goals and Objectives for Eagle Creek Watershed:

(1) Reduce *E. coli* load in Eagle Creek Watershed.
   a. Reduce *E. coli* load from livestock with access to streams. (ST)[9]
   b. Reduce *E. coli* load from event flow run-off. (ST)
   c. Reduce *E. coli* load from malfunctioning septic systems. (LT)[10]
   d. Reduce *E. coli* load from agricultural stormwater run-off. (LT)
   e. Reduce *E. coli* load from unsewered communities. (LT)

(2) Reduce Atrazine loads in Eagle Creek Watershed.
   a. Reduce Atrazine run-off from agricultural fields from entering the trunk streams of Eagle Creek Watershed. (ST)
   b. Reduce Atrazine usage on agricultural fields. (LT)
   c. Reduce Atrazine load from agricultural stormwater run-off. (LT)

(3) Reduce sediment loads in Eagle Creek Watershed.
   a. Reduce fine-grain sediment load from headwater erosion. (ST)
   b. Reduce sediment load from agricultural run-off. (ST)

[9] (ST) – Short-term Objective
[10] (LT) – Long-term Objective

   c. Reduce sediment load from stormwater run-off from impervious surfaces and urbanized areas. (LT)
   d. Reduce sediment load from bank erosion in lower reaches of Eagle Creek Watershed. (LT)

(4) Reduce nutrient loads in Eagle Creek Watershed.
   a. Reduce nutrient load from agricultural run-off. (ST)
   b. Reduce nutrient load from tile drainage. (LT)
   c. Reduce nutrient load from point sources. (LT)
   d. Reduce nutrient load from non-point sources other than agricultural run-off. (LT)
   e. Reduce nutrient load from stormwater run-off from impervious surfaces and urbanized areas. (LT)
   f. Reduce suburban and urban phosphorous lawn fertilizer application. (LT)

(5) Increase watershed education and outreach in Eagle Creek Watershed.
   a. Raise public awareness of watersheds and their role in water quality. (ST)
   b. Raise public awareness of watershed and water quality issues. (ST)
   c. Continue to build on and expand watershed outreach activities. (LT)

As goals can be parsed into short-term (ST) and long-term (LT) objectives, priorities were developed based on timelines necessary to achieve the outcomes within a reasonable time frame. These priorities were then ranked by the amount of goals they would address: the greater number of goals an objective addressed, the higher its priority rank (Table VIII-2). These priorities were then used in Criteria 3: Feasibility evaluations for the subwatersheds to determine which subwatersheds would be the focus for remediation implementation.

Table VIII-2: Priorities for Eagle Creek Watershed

Rank	Priority	Goal(s)
1	Implement demonstration riparian buffers.	1, 2, 3, 4, and 5
1	Implement other demonstration best management practices (e.g., stream protection – fencing, grass strips in channel bottom, and constructed wetlands).	1, 2, 3, 4, and 5
1	Promote implementation of Whole Farm Planning.	1, 2, 3, 4, and 5
2	Develop and distribute septic system educational brochure.	1, 4, and 5
2	Promote implementation of Whole Community Planning (Low Impact Development and stormwater management).	3, 4, and 5
3	Create watershed education programs.	3 and 5
4	Work with point source dischargers to reduce nutrient loading.	4
4	Develop watershed education plan (e.g., ECWA website, semi-annual paper, activities, and Water Quality Awareness Day program).	5

Locating Sites for Remediation

Due to their inherent importance to stream ecosystem health, headwater stream vulnerability is a threat to the entire watershed's health. Therefore, remediation efforts concentrated in vulnerable headwater streams will affect and benefit the whole watershed. In Eagle Creek Watershed, subwatersheds with the most miles of headwater streams (1st and 2nd order streams) were compared using Criteria 1 and Criteria 2 Evaluations to determine Subwatershed Prioritization.

Subwatershed Prioritization

Based on the Critical Areas Evaluation and given the identified Priorities, subwatersheds were prioritized for remediation implementation (Table VIII-3).

Table VIII-3: Subwatershed Prioritization

Priority Rank	Subwatershed	Remediations
1	Little Eagle Branch – Headwaters % Headwater Streams: **100%** Level of Degradation: **High** Level of Vulnerability: **High**	(1) Promote implementation of BMPs (2) Promote Whole Farm Planning (3) Education/Outreach (specifically septic system maintenance) (4) Work with point source dischargers to reduce nutrient loading
2	Fishback Creek (Eagle Creek Reservoir) % Headwater Streams: **100%** Level of Degradation: **Moderate** Level of Vulnerability: **High**	(1) Grass and Tree Buffers (Demonstration BMP) along 1 mile on each side of stream (2) Grass Strips in Channel Bottom (Demonstration BMP) (3) Whole Farm Planning (4) Whole Community Planning (5) Education/Outreach (specifically development suspended sediment prevention and septic system maintenance) (6) Point Source Reduction (7) Constructed Wetlands
3	Mounts Run – Neese Ditch % Headwater Streams: **100%** Level of Degradation: **High** Level of Vulnerability: **Low**	(1) Grass and Tree Buffers (Demonstration BMP) along 1 mile on each side of stream (2) Fencing (Demonstration BMP) (3) Grass Strips in Channel Bottom (Demonstration BMP) (4) Whole Farm Planning (5) Whole Community Planning (6) Education/Outreach (7) Constructed Wetlands
4	Eagle Creek Reservoir – School Branch % Headwater Streams: **100%** Level of Degradation: **Low** Level of Vulnerability: **High**	(1) Grass and Tree Buffers (Demonstration BMP) along 1 mile on each side of stream. (2) Fencing (Demonstration BMP) (3) Grass Strips in Channel Bottom (Demonstration BMP) (4) Whole Farm Planning (5) Whole Community Planning (6) Education/Outreach (specifically development suspended sediment prevention)

Table VIII-3: Subwatershed Prioritization (continued)

Priority Rank	Subwatershed	Remediation
5	Eagle Creek – Dixon Branch % Headwater Streams: **84%** Level of Degradation: **High** Level of Vulnerability: **Moderate**	(1) Promote implementation of BMPs (2) Promote Whole Farm Planning (3) Education/Outreach (4) Work with point source dischargers and CAFO to reduce nutrient loading
6	Little Eagle Branch – Woodruff Branch % Headwater Streams: **71%** Level of Degradation: **High** Level of Vulnerability: **Moderate**	(1) Promote implementation of BMPs (2) Promote Whole Farm Planning (3) Promote Whole Community Planning (4) Education/Outreach (specifically septic system maintenance) (5) Work with point source dischargers to reduce nutrient loading
7	Eagle Creek – Jackson Run % Headwater Streams: **73%** Level of Degradation: **Moderate** Level of Vulnerability: **Moderate**	(1) Promote implementation of BMPs (2) Promote Whole Farm Planning (3) Promote Whole Community Planning (4) Education/Outreach (specifically development suspended sediment prevention) (5) Work with point source dischargers to reduce nutrient loading
8	Eagle Creek – Kreager Ditch % Headwater Streams: **68%** Level of Degradation: **Moderate** Level of Vulnerability: **Moderate**	(1) Promote implementation of BMPs (2) Promote Whole Farm Planning (3) Work with CAFOs to reduce loading (4) Education/Outreach (specifically septic system maintenance)
9	Eagle Creek – Finley Creek % Headwater Streams: **100%** Level of Degradation: **Low** Level of Vulnerability: **Low**	(1) Promote implementation of BMPs (2) Promote Whole Farm Planning (3) Education/Outreach
10	Eagle Creek – Long Branch/Irishman Run % Headwater Streams: **55%** Level of Degradation: **Low** Level of Vulnerability: **Low**	(1) Work with point source dischargers to reduce loading (2) Promote implementation of BMPs (3) Promote Whole Farm Planning (4) Promote Whole Community Planning (5) Education/Outreach (specifically development suspended sediment prevention)