8.0 Best Management Practices

A wide variety of practices are available for on-the-ground implementation. Many of these practices will address the stakeholder concerns and result in the reduction of sediment, nutrient, and E.coli loading to the Iroquois River and tributaries. A master list of potential best management practices was reviewed by the project steering committee and project partners. From this list, the following list of practices were deemed most appropriate and most likely to successfully meet loading reduction targets, be feasible to implement, and address stakeholder concerns.

8. 1 Agricultural:

- Alternate Watering Systems
- Bioreactors
- Buffer Strip (Shrub/Tree)
- Conservation Tillage (No till end goal)
- Cover Crop
- Drainage Water Management
- Filter Strip (grass)
- Livestock Restriction or Rotational Grazing
- Manure Management Planning
- Nutrient/Pest Management Planning
- Prairie Restoration
- Two Stage Ditch
- Septic System Upgrades
- Streambank Stabilization
- Wetland Construction or Restoration

8.2 Urban:

Development and the spread of impervious surfaces are occurring throughout the watershed. The highest concentrations of development are located around the towns and outskirts of towns. As impervious surfaces continue to spread throughout the watershed, the volume and velocity of storm water entering the Iroquois River will also increase. The best way to mitigate storm water impacts is to infiltrate, store, and treat storm water onsite before it can run off. Urban best management practices designed to complete these actions are as follows:

- Bioretention Practices
- Concrete Grid Pavement
- Detention Basin Retrofit
- Grass Swale
- Green Roof
- Infrastructure Retrofit
- Pet Waste Control
- Phosphorus-free Fertilizers
- Porous Pavement
- Rain Barrel
- Rain Garden

- Street Sweeping
- Trash Control and Removal

Appendix 10 has each practice defined in more detail. No practice list is exhaustive and additional techniques may be both possible and necessary to reach water quality goals.

8.3 Fish Habitat and Recreational System-Wide Practices

The protection of open space, preservation of habitat corridors, and mitigation of impacts from watershed-wide impacts are important management practices, particularly to protect fish habitat and encourage recreational use. These practices can be used throughout the Upper Iroquois River watershed in locations where specific conditions occur. Potential management practices designed to address these issues are as follows:

- Greenways and Trails
- Habitat Corridor Identification and Improvement
- Low-impact Development
- Point Source Discharge Reduction
- Septic System Care and Maintenance
- Smart Growth/Livable Communities Practices
- Streambank Stabilization
- Threatened and Endangered Species Protection

9.0 Appropriate BMPs for Goals

Table 73 details selected agricultural best management practices by critical area, while Table 74 lists urban best management practices by critical area. Each critical area and the selected best management practices are based on subwatershed characteristics and available water quality data.

Table 73 Agricultural best management practices suggested for each critical area by parameter

Agricultural best management practices for each critical area.

Critical Area/Source	Reason for Being Critical	Suggested BMP
Livestock Access points	e.coli, TSS, nutrients, fish habitat, IBI	Alternative watering system
		Education and outreach
		Livestock exclusion fencing
		Nutrient/manure management
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch, Carpenter Creek, Headwaters Carpenter Creek	e.coli	Livestock restriction fencing
		Septic system maintenance
		Manure management planning
		Point-source discharge reduction
		Alternative watering system
		Education and outreach
		Cover Crops with manure application
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch	Nitrate	Cover Crops (100 acres)
		Filter strips, field border
		Nutrient management planning
		Pesticide management
		Manure mangement
		Streambank stabilization
		Conservation Tillage (100 acres)
		Prairie Restoration
		Two-stage Ditch
		Bio reactor installation
		Drainage Water Management
		Education and outreach
		Septic system maintenance
		Floodplain Management
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch, Carpenter Creek, Headwaters Carpenter Creek, Jordan Ditch-Slough Creek	Phosphorus	Cover Crops
		Filter strips, field border
		Nutrient management planning
		Pesticide management
		Manure mangement
		Streambank stabilization
		Conservation Tillage
		Prairie Restoration
		Two-stage Ditch
		Bio reactor installation
		Drainage Water Management
		Education and outreach
		Septic system maintenance
		Floodplain Management
		Smart Growth Practices
		Low-Impact Development

Agricultural best management practices for each critical area.		
Critical Area/Source	**Reason for Being Critical**	**Suggested BMP**
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch, Carpenter Creek, Headwaters Carpenter Creek, Jordan Ditch-Slough Creek	Cloudiness (Total Suspended Solids)	Cover Crops
		Filter strips, field border
		Pesticide management
		Streambank stabilization
		Conservation Tillage
		Prairie Restoration
		Two-stage Ditch
		Bio reactor installation
		Education and outreach
		Wetland Restoration
		Floodplain Management
		Smart Growth Practices
		Low-Impact Development
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch, Carpenter Creek, Jordan Ditch-Slough Creek	Fish Habitat	Filter strips, field border
		Wetland Restoration
		Corridor ID and Restoration
		Education and outreach
		Streambank stabilization
		Restore Stream Hydrology

Table 74 Urban best management practices suggested for each critical area by parameter.

Critical Area/Source	Reason for Being Critical	Suggested BMP
Rensselaer CSO Outlets	e.coli, TSS, nutrients, fish habitat, IBI	Pet Waste Control
		Ordinance/Education of local planners
		Point Source Discharge reduction
		CSO Reduction
		Raingardens/Rain Barrels
		Low Impact Development
Urban Areas-Renselaer, Kentland, Remington, Brook	Nitrate	Grass Swale
		Green roof
		Raingardens/Rain Barrels
		Point Source Discharge reduction
Urban Areas-Renselaer, Kentland, Remington, Brook	Phosphorus	Detention Basin Retrofits
		Pet Waste Control
		Ordinance/Education of local planners
		CSO Reduction
		Green roof
		Grass Swale
		Raingardens/Rain Barrels
		Porous Pavement
		Phosphorus-Free Fertilizer
		Low Impact Development
		Smart Growth Practices
Urban Areas-Renselaer,Kentland, Remington, Brook	diness (total suspended s	Detention Basin Retrofits
		Ordinance/Education of local planners
		Green roof
		Grass Swale
		Raingardens/Rain Barrels
		Porous Pavement
		Low Impact Development
		Smart Growth Practices
Urban Areas-Renselaer, Kentland, Remington, Brook	Fish Habitat	Low Impact Development
		Smart Growth Practices
		Filter Strips/Buffers
		Habitat Corridor Improvement

10.0 Expected Load Reduction from BMPs

Load reduction calculations were estimated for nitrogen, phosphorus and sediment based on the potential best management practices to be implemented. Individual BMPs' estimated values were taken from Region 5, STEPL modeling, PREDict Models, and Watershed Treatment Models and summarized in Table 75 and Table 76 . It is known that implementation of multiple BMPs usually has a synergistic impact, so that the value of the whole is greater than the sums of individual practices.

Table 75 Load reductions achieved by unit installation amount.

Agricultural best management practices for each critical area.			Estimated Load Reduction by units of BMP		
Critical Area/Source	**Reason for Being Critical**	**Suggested BMP**	Nitrogen lb/yr	Phosphorus lb/yr	Sediment ton/yr
Livestock Access points	e.coli, TSS, nutrients, fish habitat, IBI	Alternative watering system (100 acres)	380	40	2
		Education and outreach	N/A	N/A	N/A
		Livestock exclusion fencing (100 acres)	380	40	2
		Nutrient management (100 acres)	365	29	N/A
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch, Carpenter Creek, Headwaters Carpenter Creek	e.coli	Livestock restriction fencing	380	40	2
		Septic system maintenance	N/A	N/A	N/A
		Manure management (100 acres)	365	29	N/A
		Alternative watering system	380	40	2
		Education and outreach	N/A	N/A	N/A
		Cover Crops with manure (100 acres)	185	37	77
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch	Nitrate	Cover Crops (100 acres)	185	37	77
		Filter strips, field border (1 acre)	3.34	0.54	2.72
		Nutrient management (100 acres)	365	29	N/A
		Split application of N (100 acres)	28	N/A	N/A
		Precision Ag: VRT (100 acres)	28	2	N/A
		Irrigation Water Management (100 acres)	240	N/A	N/A
		Precision Ag: Autoswath (100 acres)	15	2	N/A
		Streambank stabilization 1 mile	N/A	N/A	73
		Conservation Tillage (100 acres)	120	60	12
		Prairie Restoration	N/A	N/A	N/A
		Two-stage Ditch 1/2 mile section	N/A	N/A	53
		Bio reactor installation (50)acres	750	N/A	N/A
		Drainage Water Management (50 acres)	750	N/A	N/A
		Education and outreach	N/A	N/A	N/A
		Septic system maintenance	N/A	N/A	N/A
		Floodplain Management	N/A	N/A	N/A
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch, Carpenter Creek, Headwaters Carpenter Creek, Jordan Ditch-Slough Creek	Phosphorus	Cover Crops (100 acres)	185	370	77
		Filter strips, field border (1 acre)	3.34	0.54	2.72
		Nutrient management (100 acres)	365	29	N/A
		Manure management (100 acres)	365	29	N/A
		Streambank stabilization 1 mile	N/A	N/A	73
		Conservation Tillage (100 acres)	120	60	12
		Prairie Restoration	N/A	N/A	N/A
		Two-stage Ditch 1/2 mile section	N/A	N/A	53
		Bio reactor installation (50)acres	750	N/A	N/A
		Drainage Water Management (50 acres)	750	N/A	N/A
		Education and outreach	N/A	N/A	N/A
		Septic system maintenance	N/A	N/A	N/A
		Floodplain Management	N/A	N/A	N/A
		Smart Growth Practices	N/A	N/A	N/A
		Low-Impact Development (see urban practice	N/A	N/A	N/A

Agricultural best management practices for each critical area.			Estimated Load Reduction by		
Critical Area/Source	**Reason for Being Critical**	**Suggested BMP**	Nitrogen lb/yr	Phosphorus lb/yr	Sediment ton/yr
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch, Carpenter Creek, Headwaters Carpenter Creek, Jordan Ditch-Slough Creek	Cloudiness (Total Suspended Solids)	Cover Crops (100 acres)	185	370	77
		Livestock exclusion fencing (100 acres)	380	40	2
		Filter strips, field border (1 acre)	334	54	2.72
		Streambank stabilization 1 mile	N/A	75	73
		Conservation Tillage (100 acres)	120	60	12
		Prairie Restoration	N/A	N/A	N/A
		Two-stage Ditch 1/2 mile section	N/A	N/A	53
		Bio reactor installation (50)acres	750	N/A	N/A
		Education and outreach	N/A	N/A	N/A
		Wetland Restoration (100 acres)	475	43	75
		Floodplain Management	N/A	N/A	N/A
		Smart Growth Practices	N/A	N/A	N/A
		Low-Impact Development	N/A	N/A	N/A
Headwaters Curtis Creek, Hickory Branch-Iroquois River, Hunter Ditch, Carpenter Creek, Jordan Ditch-Slough Creek	Fish Habitat	Filter strips, field border (1 acre)	3.34	0.54	2.72
		Wetland Restoration (100 acres)	475	43	N/A
		Corridor ID and Restoration	N/A	N/A	N/A
		Education and outreach	N/A	N/A	N/A
		Streambank stabilization 1 mile	N/A	N/A	73
		Restore Stream Hydrology	N/A	N/A	N/A
Sources of Load Reductions					
STEP-L and PRedICT models					
Watershed Treatment Model, STEP-L and PRedICT models)					
Region 5 model					

Table 76 Urban BMP load reduction estimates

Urban best management practices for each critical area			Estimated Load Reduction per square mile		
Critical Area/Source	**Reason for Being Critical**	**Suggested BMP**	Nitrogen	Phosphorus	Sediment
Rensselaer CSO Outlets	e.coli, TSS, nutrients, fish habitat, IBI	Pet Waste Control	N/A	N/A	N/A
		Ordinance/Education of local planners	N/A	N/A	N/A
		Point Source Discharge reduction	N/A	N/A	N/A
		CSO Reduction	95%	95%	95%
		Pourous Pavement	85%	65%	90%
		Concrete Grid Pavement	90%	90%	90%
		Raingardens	20%	20%	80%
		Rainbarrel	0	0	0
		Street Sweeping	UNK	6%	16%
		Detention Basin Retrofits	UNK	52%	82%
		Grass Swale	30%	30%	60%
Urban Areas- Renselaer, Brook, Remington, Mt. Ayr, Goodland	Nitrate	Grass Swale	30%	30%	60%
		Pourous Pavement	85%	65%	90%
		Concrete Grid Pavement	90%	90%	90%
		Green roof	N/A	N/A	N/A
		Raingardens	20%	20%	80%
		Rainbarrel	0	0	0
		Point Source Discharge reduction	N/A	N/A	N/A
Urban Areas- Renselaer, Brook, Remington, Mt. Ayr, Goodland	Phosphorus	Detention Basin Retrofits	UNK	52%	82%
		Pet Waste Control	N/A	N/A	N/A
		Ordinance/Education of local planners	N/A	N/A	N/A
		CSO Reduction	95%	95%	95%
		Green roof	N/A	N/A	N/A
		Grass Swale	30%	30%	60%
		Raingardens	20%	20%	80%
		Rainbarrel	0	0	0
		Pourous Pavement	85%	65%	90%
		Concrete Grid Pavement	90%	90%	90%
		Phosphorus-Free Fertilizer	N/A	N/A	N/A
		Smart Growth Practices	N/A	N/A	N/A
Urban Areas- Renselaer, Brook, Remington, Mt. Ayr, Goodland	diness (total suspended s	Detention Basin Retrofits	UNK	52%	82%
		Ordinance/Education of local planners	N/A	N/A	N/A
		Green roof	N/A	N/A	N/A
		Grass Swale	30%	30%	60%
		Raingardens	20%	20%	80%
		Rainbarrel	0	0	0
		Pourous Pavement	85%	65%	90%
		Concrete Grid Pavement	90%	90%	90%
		Smart Growth Practices	N/A	N/A	N/A
Urban Areas- Renselaer, Brook, Remington, Mt. Ayr, Goodland	Fish Habitat	Pourous Pavement	85%	65%	90%
		Concrete Grid Pavement	90%	90%	90%
		Smart Growth Practices	N/A	N/A	N/A
		Filter Strips/Buffers	70%	75%	65%
		Habitat Corridor Improvement	47%	59%	76%
Sources of Load Reductions					
STEP-L and PRedICT models					
Watershed Treatment Model, STEP-L and PRedICT models)					
Region 5 model					

10.1 STEPL Modeling Predictions

To set realistic goals and the action register timeline to achieve WQ target goals the Spreadsheet Tool for Estimating Pollutant Load (STEPL) tool was utilized STEPL employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs).

STEPL computes watershed surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices. For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies.

The estimated pollutant load reduction based on STEPL modeling using selected BMP's in Table 73 and Table 74 was calculated under the following 3 scenarios- minimal BMP (within 5yrs), average BMP (10yrs), and excellent BMP implementation (30yrs). Minimal BMP implementation (10% of acres/unit treated), with an expected load reduction of 17% for N, 17% for P, and 17 % for sediment. Average BMP implementation (25% of acres/units treated), with an expected load reduction of 38% for N, 38% for P, and 40% for Sediment. For excellent BMP implementation- (50%of acres/units), with an expected load reduction of 65% for N, 66% for P, and 70% for Sediment. Achieving excellent BMP implementation will almost meet (within 3%) the reduction goals needed to meet WQ targets, as set in Table 67 Loads and Load Reductions.

E.coli loading is not available in the STEPL model. We will calculate pathogen load reductions for BMPs when applicable and as new models are available. The TMDL % reduction needed for E.coli in the Carpenter-Denton Creek HUC 10 is 74% and in the Curtis Hunter Creek HUC 10, an 81% reduction is needed.