CHAPTER 14 IMPLEMENTATION TASKS AND EVALUATION

14.1 SUMMARY OF NINE MINIMUM ELEMENTS

This chapter was added to the existing Muskegon River Watershed Management Plan to fulfill the requirements of the United States Environmental Protection Agency (EPA) to have all watershed projects funded under Section 319 of Clean Water Act be supported by a watershed plan that includes the nine minimum elements. These requirements include (a) an identification of the causes and sources that will need to be controlled to achieve the load reductions estimated in the plan, (b) an estimate of load reductions expected for the management measures, (c) a description of the management measures that will need to be implemented to achieve load reductions, (d) an estimate of the amounts of technical and financial assistance needed to implement the plan, (e) an information/education component, (f) a schedule for implementing the management measures, (g) a description of measurable milestones for determining if the management measures are being implemented, (h) a set of criteria that can be used to determine whether load reductions are being achieved over time and, (i) a monitoring component to evaluate the effectiveness of the implementation efforts over time. Without such information to provide focus and direction to the project's implementation, the EPA believes it is much less likely that the project can efficiently and effectively address nonpoint sources of water quality impairments.

14.2 SOURCES THAT NEED TO BE CONTROLLED TO ACHIEVE LOAD REDUCTIONS AND THEIR PRESENCE IN THE WATERSHED (CRITERIA A)

The pollutants and their sources for each designated use in the Muskegon River Watershed have been identified in Section 4-7 Table 19 of the management plan. Further explanation of the watershed pollutants can also be found in this section. Table 47 expands on this information by quantifying the pollutants' presence in the Muskegon River Watershed.

TABLE 47: POLLUTANT, SOURCES, CAUSES, AND THEIR PRESENCE FOR EACH DESIGNATED USE IN THE MUSKEGON RIVER WATERSHED

Designated Use to be Protected	Pollutant	Sources	Causes	Presence in Watershed
Warm Water Fishery Cold Water Fishery Other Indigenous Life	Thermal Pollution	Dams/Lake-level Control Structures (k)	Holding back water to create a pond or lake environment (k)	There are approximately 100 dams/ lake-level control structures (MDEQ 1999(2)).
		Stormwater/Urban Runoff (k)	Impervious surfaces (k)	See Appendix J
		Lack of Streamside Canopy (k)	Land use change (development, agriculture) (k)	See Appendix K
		Water Withdrawals (k)	Reduction in stream depth and base flow (s)	In the MRW there are 49,392 acres of urban or built-up land and 484,656 acres of agricultural land (394,513 acres of cropland and 40,144 acres of pasture) that could be contributing to thermal pollution by way of water withdrawals in the watershed (1983 and 1998 land use information).
		Water Inputs from Drainage Networks (k)	Shallow water with nonvegetated banks which increase water temperatures (k)	There are approximately 1,300 miles of intermittent streams/drains in the MRW which could be contributing to thermal pollution (Michigan Center for Geographic Information base framework data version 6b).
		Climate Change (s)	Global activities (s)	---
	Nutrients	Stormwater/Surface Runoff (k)	Impervious surfaces (k)	See Appendix J
		Commercial Fertilizer Use (k)	Improper application (s)	Agriculture - Liquid or fluid fertilizer use in Michigan has increased steadily over the last 25 years. In 1965, 9% of the total fertilizer sales in Michigan consisted of liquids. In 1988, liquid fertilizers accounted for 28% of the market. Dry fertilizers (solids) still constitute the major part of the fertilizers sold in Michigan. In 1988, 92% of the total dry fertilizer was sold as bulk material, with only 8% in bags (Vitosh 1996). Residential - In a survey of resident attitudes in the Rouge River, about 75%of residents applied fertilizer every year and only 9% conducted soil testing *(*DeYoung, 1997*).* In the MRW there are 49,392 acres of urban or built-up land and 484,656 acres of agricultural land (394,513 acres of cropland and 40,144 acres of pasture) that could be contributing to nutrients in the watershed through the use of commercial fertilizers (1983 and 1998 land use information).
		Agricultural Runoff (k) Animal Waste Runoff (k) Biosolids (s)	Feed lots, improper application of agricultural fertilizer, poor irrigation practices (k)	There are approximately 484,656 acres of agricultural land (394,513 acres of cropland and 40,144 acres of pasture) in the MRW which could be contributing to nutrients from agricultural runoff (1983 and 1998 land use information). There are an estimated 8,911 beef cattle, 24,478 dairy cattle, 21,203 hog, 3,899 sheep, and 6,000 poultry in the MRW which could be contributing to nutrients through animal waste runoff (Tetra Tech STEPL Model).

TABLE 47: POLLUTANT, SOURCES, CAUSES, AND THEIR PRESENCE FOR EACH DESIGNATED USE IN THE MUSKEGON RIVER WATERSHED (CONT.)

Designated Use to be Protected	Pollutant	Sources	Causes	Presence in Watershed
Warm Water Fishery Cold Water Fishery Other Indigenous Life (cont.)	Nutrients (cont.)	Internal Loading from Sediments (s)	Diffusive flux and resuspension of sediment in lakes (s)	Further studies need to be conducted to quantify internal loadings in lakes in the MRW. Previous studies in neighboring watersheds show different results. In White Lake the internal phosphorus loading accounted for approximately 7.4% of the total phosphorus load entering White Lake (Steinman and Ogdahl 2006) when compared to an estimated external total phosphorus load of 15.48 tons/year (Mark Luttenton, GVSU, unpublished data). In Spring Lake, internal phosphorus loads were approximately double that of previously estimated external phosphorus loads, and accounted for between 56 and 66% of the total phosphorus load to Spring Lake (Steinman et al. 2004).
		Septic Systems (s)	Improperly designed and maintained septic systems (s)	Approximately 52,000 septic systems in the MRW with a septic failure rate of 1.14% (based on information from Muskegon County Health Department, District 10 Health Department, Mid-Michigan Health Department, and Central Health Department, 1990 Census Data, and Tetra Tech STEPL Model).
	Hydrologic Flow	Stormwater Runoff (k)	Impervious surfaces (k)	See Appendix J
		Water Withdrawals (k)	Reduction in stream depth and base flow (s)	In the MRW there are 49,392 acres of urban or built-up land and 484,656 acres of agricultural land (394,513 acres of cropland and 40,144 acres of pasture) that could be contributing to thermal pollution by way of water withdrawals in the watershed (1983 and 1998 land use information).
		Dams/Lake Level Control Structures (k)	Holding back water to create a pond or lake environment (k)	There are approximately 100 dams/ lake-level control structures (MDEQ 1999).
		Channelization/Ditching (k)	Conduit for water to get off land quickly (k)	There are approximately 1,300 miles of intermittent streams/drains in the MRW which could be disturbing hydrologic flow (Michigan Center for Geographic Information base framework data version 6b).
	Sediment	Road Stream Crossings (k)	Undersized culverts, gravel roads with high gradient road approaches, nonvegetated embankments, nonvegetated shoulder/ditches (k)	There are approximately 2,641 road stream crossing in MRW which could be contributing sediment (Michigan Center for Geographic Information base framework data version 6b). In inventories of subwatersheds in the MRW there have a been 35,200 feet and 14 culvert replacements identified in Middle Branch, Tamarack Creek, Lower Clam, and West Branch Clam Subwatersheds that need replacing and 20 crossings identified in the Bear Creek Subwatershed (Jarvis et al. 2004).
		Stream Bank Erosion (k)	Poorly maintained public access points, ORV Traffic, boat traffic/wakes, livestock in streams, natural watershed characteristics, historic logging practices (k)	There is approximately 720 miles of stream bank that has been identified as eroding in the MRW (RC&D 1991, Nobes 1998).
		Stormwater/Surface Runoff (k)	Impervious surfaces (k)	See Appendix J

TABLE 47: POLLUTANT, SOURCES, CAUSES, AND THEIR PRESENCE FOR EACH DESIGNATED USE IN THE MUSKEGON RIVER WATERSHED (CONT.)

Designated Use to be Protected	Pollutant	Sources	Causes	Presence in Watershed
Warm Water Fishery Cold Water Fishery Other Indigenous Life (cont.)	Sediment (cont.)	Construction (k)	Poor site preparation practices (s)	About 35% of construction areas have poor site preparation practices (personal communication with soil erosion officers 2007).
	Toxic Substances	Stormwater/Urban Runoff (k)	Impervious surfaces (k)	See Appendix J
		Polluted Sediments (k)	Historical industrial input (k)	High levels of cadmium, copper, chromium, lead, and mercury were found at several locations in Muskegon Lake, Higgins Lake, Cadillac Lake, Ryerson Creek, and Ruddiman Creek (MDNR 1989, MDNR 1990, MDEQ 1999(1), MSU 2000, MSU 2002, Rediske et al. 2002).
		Landfill Leachate (s)	Improperly designed and maintained disposal areas (s)	There are 9 landfills in the MRW which could be a source of toxic substances (MDEQ Report of Solid Waste Land filled in Michigan October 1, 2005 – September 30, 2006, MDEQ Waste and Hazardous Materials Division Significant and Recently Resolved Cases 2003 to Date).
		Industrial Discharges (s)	Improper filtering/cleaning (s)	There are 53 water discharge permits issued in the MRW (EPA Water Discharge Permits 2007).
		Underground Storage Tanks (s)	Improperly maintained storage tanks (s)	There are approximately 2,330 underground storage tanks in the MRW which could be a source of toxic substances (MDEQ).
	Invasive species	Connected Waterways (k) Boat Hulls and Bilges (k) Purposeful/Accidental Human Introduction (k) Other Biota (k)	Improper cleaning of boats and bilges (k) Improper knowledge of organism (s)	Rusty crayfish - spotted in sections of the main trunk of the Muskegon River and some tributaries (Tamarack, Little Muskegon River, Middle Branch River) Zebra mussels - located in lakes throughout the Muskegon River Watershed (Muskegon, Fremont, Houghton, and Higgins Lakes) also downstream from Croton Dam in vicinity of the City of Newaygo (Luttenton 2001, McCrimmon 2002, Carman and Goforth 2003). Eurasian watermilfoil - located in lakes throughout the Muskegon River Watershed (Muskegon, Fremont, Houghton, and Higgins Lakes) (Luttenton 1995, McCrimmon 2002, ReMetrix LLC 2004). Sea lamprey - found all the way from Muskegon Lake and Muskegon River up to Croton Dam (McCrimmon 2002). Purple Loosestrife – spotted in Muskegon State Game Area and at several locations throughout the watershed (Rediske and VanOoteghem 2000, McCrimmon 2002).
Partial and Total Body Contact	*E. Coli* and Fecal Coliform	Wastewater Treatment Plants (s)	Improperly designed and maintained plants (s)	There are 10 WWTP in the MRW which could be a source of *E. coli* and Fecal Coliform (EPA Water Discharge Permits 2007).
		Septic Systems (s)	Improperly designed and maintained septic systems (s)	There are approximately 52,000 septic systems in the MRW with a septic failure rate of 1.14% (based on information collected from Muskegon County Health Department, District 10 Health Department, Mid-Michigan Health Department, and Central Health Department, 1990 Census Data, and Tetra Tech STEPL Model).

TABLE 47: POLLUTANT, SOURCES, CAUSES, AND THEIR PRESENCE FOR EACH DESIGNATED USE IN THE MUSKEGON RIVER WATERSHED (CONT.)

Designated Use to be Protected	Pollutant	Sources	Causes	Presence in Watershed
Partial and Total Body Contact (cont.)	*E. Coli* and Fecal Coliform (cont.)	Animal Waste Runoff (s)	Livestock in stream and off ag fields (s)	There are an estimated 8,911 beef cattle, 24,478 dairy cattle, 21,203 hog, 3,899 sheep, and 6,000 poultry in the MRW which could be contributing to *E. coli* and Fecal Coliform through animal waste runoff (Tetra Tech STEPL Model).
	Toxic Substances	Stormwater/Urban Runoff (k)	Impervious surfaces (k)	See Appendix J
		Polluted Sediments (k)	Historical industrial input (k)	High levels of cadmium, copper, chromium, lead, and mercury were found at several locations in Muskegon Lake, Higgins Lake, Cadillac Lake, Ryerson Creek, and Ruddiman Creek (MDNR 1989, MDNR 1990, MDEQ 1999(1), MSU 2000, MSU 2002, Rediske et al. 2002).
		Landfill Leachate (s)	Improperly designed and maintained disposal areas (s)	There are 9 landfills in the MRW which could be a source of toxic substances (MDEQ Report of Solid Waste Land filled in Michigan October 1, 2005 – September 30, 2006, MDEQ Waste and Hazardous Materials Division Significant and Recently Resolved Cases 2003 to Date).
		Industrial Discharges (s)	Improper filtering/cleaning (s)	There are 53 water discharge permits issued in the MRW (EPA Water Discharge Permits 2007).
		Underground Storage Tanks (s)	Improperly maintained storage tanks (s)	There are approximately 2,330 underground storage tanks in the MRW which could be a source of toxic substances (MDEQ).

(k) – known pollutants
(s) – suspected pollutants

14.3 MANAGEMENT MEASURES AND ASSOCIATED POLLUTANT REDUCTION ESTIMATES (CRITERIA B &C)

Management Measures
Best Management Practices (BMPs) are any structural, vegetative, or managerial practices used to protect and improve our surface water and groundwater (MDEQ 1999(3)). For BMPs to be effective, the correct method, installation, and maintenance need to be considered for each site. Addressing each of these factors will result in a conservation practice that can prevent or reduce nonpoint source pollution.

Suggested BMPs to be implemented in the entire Muskegon River Watershed are listed in Section 10-2. The list is a partial list of BMPs because more inventorying and planning is needed in the watershed to determine where specific BMPs are necessary. Additional non-structural BMPs that need to be added to the list to address all the pollutants of concern are protective management activities such as establishment of conservation easements and implementation of ordinances that protect and regulate natural resources.

Although these protective management activities were not originally listed as managerial practices in the Muskegon River Watershed Management Plan, the Muskegon River Watershed Assembly has been working to implement these techniques. The Muskegon River Watershed Assembly and the Annis Water Resources Institute are currently working (2004-2007) with local farmers on a project to establish permanent conservation easements on established filter strips along Tamarack Creek and its tributaries. By creating these easement areas, pollutant loadings off of these farm fields will be decreased.

Another protective practice is to incorporate language into master plans and zoning ordinances that protects natural resources. Ordinances and master plans can be updated to preserve farmland, protect open space, preserve environmental sensitive areas, and protect surface water quality (wetlands, phosphorus bans, etc.). As part of the watershed management plan project, model ordinances were developed for selected townships in the Muskegon River Watershed wishing to improve upon their existing regulations to improve and protect water quality. More information on this update can be found in Chapter 9. The Muskegon River Watershed Assembly and the Annis Water Resources are currently working (2006-2007) with townships in the Brooks Creek subwatershed (Fremont Area, Newaygo County) to update their existing master plan and zoning ordinances to include natural resource protection. These townships include Sherman, Dayton, Garfield, and Bridgeton. Conservation easements and master plan and ordinance review have been added to Table 49 as additional managerial practices.

To identify locations to implement these suggested BMPs, a critical areas analysis was completed. This information is found in Chapter 5 of the management plan. Three factors were chosen to determine critical areas and were assessed on a subwatershed basis. These three factors include in-stream temperature fluctuation, surface water runoff, and the percentage of developed land use (agricultural and urban) in each subwatershed. These factors were chosen because the Technical Task Force believed that this information would best characterize the existence of, or potential for, the pollutants perceived as the greatest threat to the Muskegon

River Watershed (i.e., temperature, nutrients, changes to hydrologic flow, sedimentation, toxic substances, invasive species, and *E. coli* and Fecal Coliform). The temperature ranking identified the percentage of stream length sensitive to temperature fluctuations (addresses temperature). The surface runoff ranking identified the percentage of stream length sensitive to surface water runoff (addresses temperature, nutrients, hydrologic flow, sedimentation, toxic substances, and *E. coli* and Fecal Coliform). The land use identified the percentages of agricultural and urban land use in the subwatershed (addresses temperature, nutrients, changes to hydrologic flow, sedimentation toxic substances, invasive species (which can thrive in disturbed areas), and *E. coli* and Fecal Coliform). The higher the ranking of all of these factors, the higher ranked the subwatershed as a critical area. Figure 25 in the management plan represents all of these three factors together and classifies the subwatersheds as having a low, moderate, or high critical area sensitivity ranking.

To verify areas that are possibly contributing pollutants to the watershed and to gather more in-depth information about specific areas of the watershed, two pilot project areas were chosen from the critical areas map. These subwatersheds are the Middle Branch River and the Tamarack Creek subwatershed. Inventory information is listed in Chapter 7 of the management plan. Two additional subwatersheds were inventoried after the management plan was created and the subwatershed information was put into separate reports. These reports are for the West Branch of the Clam River and the Lower Clam River subwatershed. Unlike the other three subwatersheds, the Lower Clam River was ranked as a low critical area subwatershed but a top ranked high quality area (Section 5-5, Figure 28). This subwatershed was inventoried to see how it compared with high ranked critical areas and as an opportunity to identify areas where possible conservation efforts might be focused.

Estimated Pollutant Load Reductions

To determine how well the BMPs identified in the Muskegon River Watershed will work, pollutant reductions were estimated. The estimated load reductions in Table 48 were determined for structural and vegetative practices identified in inventoried subwatersheds using the load estimation tools specified by MDEQ that included "The Simple Method to Calculate Urban Stormwater Loads" by the Stormwater Center and the "Region 5 Load Estimation Spreadsheet Model" developed by Tetra Tech for the EPA. An additional resource used was the Guidance Manual for Total Maximum Daily Load Implementation Plans (DEQ 2003). To quantify pollutant load reductions for the managerial practices in the entire Muskegon River Watershed (Table 49), information from the Rocky River Watershed Management Plan (VanDelfzijl 2002), the Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (EPA 1993), and the Guidance Manual for Total Maximum Daily Load Implementation Plans (DEQ 2003) were used. It should be noted that specific measurements to quantify BMP effectiveness should be taken before and after implementation of the practice and for a sufficient length of time to account for natural variability.

TABLE 48. ESTIMATED POLLUTANT LOAD REDUCTIONS FOR ALL IDENTIFIED STRUCTURAL AND VEGETATIVE BMPS IN INVENTORIED SUBWATERSHEDS

Structural and Vegetative Practices	Quantity	Pollutant Addressed	Estimated Loads and Load Reductions
Buffer Strips	2,316 acres	Temperature, nutrients, hydrologic flow, sediment, toxic substances, *E. coli* and Fecal Coliform	Temperature – stable water temperature by controlling the quantity and quality of solar radiation reaching the water surface in lower order streams Nutrients – nitrogen load 4,261 (lbs/yr), nitrogen reduction 3,622 (lbs/yr); phosphorus load 17,085 (lbs/yr), phosphorus reduction 6,834 (lbs/yr) Hydrologic Flow – stable flows because the buffer strips function is to slow flood flow which allows water to spread and soak into the soil thereby recharging local groundwater and extending the baseflow through the summer season Sediment – load 2,494 (tons/yr), reduction 2,120 (tons/yr) Toxic Substances – load 1,245 (lbs/yr), reduction 747 (lbs/yr) *E. coli* and fecal coliform - 43 – 57 % efficiency
Filter Strips	1,321 acres	Nutrients, hydrologic flow, sediment, toxic substances, *E. coli* and Fecal Coliform	Nutrients – nitrogen load 7,496 (lbs/yr), nitrogen reduction 4,123 (lbs/yr); phosphorus load 3,974 (lbs/yr), phosphorus reduction 2,186 (lbs/yr) Hydrologic Flow – stable flows because the buffer strips function to slow flood flow which allows water to spread and soak into the soil thereby recharging local groundwater and extending the baseflow through the summer season Sediment – load 1,995 (tons/yr), reduction 1,297 (tons/yr) Toxic substances – load 112 (lbs/yr), reduction 56 (lbs/yr) *E. coli* and fecal coliform – 75% efficiency
Grassed Waterway	4,228 acres	Nutrients, sediment, toxic substances	Nutrients – nitrogen load 3,200 (lbs/yr), nitrogen reduction 1,600 (lbs/yr); phosphorus load 2,000 (lbs/yr), phosphorus reduction 800 (lbs/yr) Sediment – load 1,430 (tons/yr), reduction 1,000 (tons/yr) Toxic substances – load 475 (lbs/yr), reduction 190 (lbs/yr)
Fencing & Watercourse Crossings	32,900 feet 22 crossings	Nutrients, sediment, *E. coli* and Fecal Coliform	Nutrients – nitrogen load and reduction 2,507 (lbs/yr); phosphorus load and reduction 1,254 (lb/yr) Sediment – load and reduction 1,090 tons/yr *E.coli* and fecal coliform – 100% efficiency
Streambank Stabilization	355,564 feet	Sediment	Sediment – load 164,700 (tons/yr), reduction 140,000 (tons/yr)
Road Stream Crossing Improvement	35,200 feet 14 culvert rep.	Sediment	Sediment – load 7,885 (tons/yr), reduction 5,520 (tons/yr)

TABLE 48. ESTIMATED POLLUTANT LOAD REDUCTIONS FOR ALL IDENTIFIED STRUCTURAL AND VEGETATIVE BMPS IN INVENTORIED SUBWATERSHEDS (CONT.)

Structural and Vegetative Practices	Quantity	Pollutant Addressed	Estimated Load Reductions
Rain Gardens	3 gardens (.05 acres each)	Temperature, nutrients, hydrologic flow, sediment, toxic substances, *E. coli* and Fecal Coliform	Temperature – stable water temperature through infiltration where runoff is allowed to cool before entering surface water Nutrients – load 5 (lbs/yr), reduction 3 (lbs/yr) Hydrologic Flow – stable flows because the rain gardens function is to slow flood flow which allows water to spread and soak into the soil thereby recharging local groundwater and extending the baseflow through the summer season Sediment – load 2 (tons/yr), reduction 1.2 (tons/yr) Toxic substances – load 6.5 (lbs/yr), reduction 6 (lbs/yr) *E. coli* and fecal coliform – 40% efficiency
Recreation walkway/ canoe ramp	350 feet	Sediment	Sediment – load and reduction 37 tons/yr
Crop and Green Manure Cover	34,840 acres	Nutrients and sediment	Nutrients – nitrogen load 81,956 (lbs/yr), nitrogen reduction 45,076 (lbs/yr); phosphorus load 49,882 (lbs/yr), phosphorus reduction 22,447 (lbs/yr) Sediment – load 27,092 (tons/yr), reduction 20,319 (tons/yr)

(DEQ 2003, EPA 2007, Schueler and Holland 2000, The Stormwater Center 2007)

TABLE 49. ESTIMATED POLLUTANT LOAD REDUCTIONS FOR IDENTIFIED MANAGERIAL PRACTICES FOR THE ENTIRE MUSKEGON RIVER WATERSHED

Managerial Practices	Quantity	Pollutant Addressed	Estimated Load Reduction
Agricultural Producers/Stakeholders			
Nutrient Management Field Day	Formation of group to discuss ag issues – 4 field days	Nutrients	Exposure to new practices and the personal testimonies of colleagues is expected to result in a portion of the attendees changing their current practices. This change in behavior is expected to improve and maintain water quality. Nutrient management can reduce nutrients by 13 – 25 %.
Michigan Lake and Stream Associations with MSU;USDA-NRCS Programs and Trainings	4 programs/trainings 4 follow-up tours	Temperature, nutrients, hydrologic flow, sediment, *E. coli* and Fecal Coliform	Exposure to new practices and the personal testimonies of colleagues is expected to result in a portion of the attendees changing their current practices. This is expected to improve and maintain water quality. Nutrient management can reduce nutrients by 13 – 25%; animal waste management and fencing can reduce nutrients and bacteria by 75%; range and pasture management can reduce nutrients by 25 - 50%, cover crops and rotation can reduce nutrients by 15 – 35% and sediment by 15%; livestock water crossing facilities can reduce bacteria by 100%.
Conservation Easements	4 informational meetings	Temperature, nutrients, hydrologic flow, sediment, invasive species, *E. coli* and Fecal Coliform	Targeted mailing of conservation easement information and meetings is expected to generate interest and result in personal contact with several watershed agricultural producers. The pollutant removal efficiency of a conservation area will depend on how much is conserved, the techniques used to conserve it, and the specific nature of the easement.
Riparians/Stakeholders			
Coordinate Residential Shoreline and Streamside Buffers and BMP Training	4 landscape-based trainings/yr (in Spring)	Temperature, nutrients, sediment	BMP trainings to protect shoreline and streamside buffers will change landowner practices and encourage participation in programs that protect water quality and is expected to improve and maintain current water quality. Riparian buffer zones can decrease sediment by 70%.
Homeowners Advertising Campaign	Variety of media outputs	Temperature and nutrients	It is expected that some homeowners exposed to information and education campaigns will change their practices based on a greater awareness of water quality issues. This is expected to improve and/or maintain water quality. Septic system pump-out can reduce bacteria and nutrients by 5%; rain gardens can reduce bacteria by 40%, nutrients by 40 – 60%, and sediment by 85%.
Presentations/ Workshops/ Training for Riparian Homeowners	8 riparian homeowner trainings/yr (4 in Fall & 4 in Spring)	Temperature , sediment, and nutrients	Attendees of the workshop are expected to come away with a better understanding of how the management of their property can protect water quality. Some of the attendees will change their management practices accordingly. This is expected to result in an improvement to water quality. Rain gardens can reduce sediment by 85%.

TABLE 49. ESTIMATED POLLUTANT LOAD REDUCTIONS FOR IDENTIFIED MANAGERIAL PRACTICES FOR THE ENTIRE MUSKEGON RIVER WATERSHED (CONT.)

Managerial Practices	Quantity	Pollutant Addressed	Estimated Load Reduction
Riparians/Stakeholders (cont.)			
Storm Drain Stenciling Program	Stenciling in 6 urban centers over 5 years	Toxic substances	Stenciling the drains is expected to result in increased awareness of landowner impacts to surface water. This should result in a change in practices that will improve and/or maintain water quality.
Septic System Maintenance Program	Establishment of one maintenance program	Nutrients and *E. coli* and fecal coliform	It is expected that some landowners exposed to the septic system maintenance program will change their practices based on a greater awareness of water quality issues. This change in behavior is expected to improve and/or maintain water quality. Septic system pump-out can reduce bacteria and nutrients by 5%.
Conservation Easements	4 informational meetings	Temperature, nutrients, hydrologic flow, sediment, invasive species, *E. coli* and Fecal Coliform	Targeted mailing of conservation easement information and meetings is expected to generate interest and result in greater personal contact with several watershed landowners. The pollutant removal efficiency of a conservation area will depend on how much is conserved, the techniques used to conserve it, and the specific nature of the easement.
Recreational Users of the Watershed/Stakeholders			
Series of Educational Workshops	2 workshops/yr	Temperature, nutrients, sediment, invasive species, *E. coli* and fecal coliform	Attendees of the workshop are expected to come away with a better understanding of how their use of the resource can affect water quality and some of the attendees will change their practices accordingly. This can be expected to improve or maintain water quality.
Local Government Officials/Stakeholders			
Storm Water Policy and Management	MRWA official stormwater policy	Temperature, nutrients, hydrologic flow, sediment, and toxic substances	The adoption of stormwater policies by affected municipalities is expected to improve and/or maintain water quality through the change in practices outlined by the ordinance. Detention ponds can reduce nutrients by 5-10%, bacteria by 25%, and sediment by 10%; grassed swales can reduce nutrients by 40-60%; infiltration basins /trenches can reduce nutrients by 50-70%, bacteria by 50%, and sediment by 90%; porous pavement can reduce nutrients by 50-70% and bacteria by 50%; rain gardens can reduce bacteria by 40%, nutrients by 40 – 60%, and sediment by 85%; wetland creation/enhancement can reduce bacteria by 30% and sediment by 80%.
Workshops/ Presentations for Local Boards and Planning commissions	5 workshops/yr (spread throughout watershed)	Temperature, nutrients, hydrologic flow, sediment, toxic substances, *E. coli* and Fecal Coliform	Attendees of the workshop are expected to come away with a better understanding of how the management decisions they make at the local level affect water quality and some of the attendees will change their master plan and zoning ordinances accordingly. This is expected to improve or maintain water quality.

TABLE 49. ESTIMATED POLLUTANT LOAD REDUCTIONS FOR IDENTIFIED MANAGERIAL PRACTICES FOR THE ENTIRE MUSKEGON RIVER WATERSHED (CONT.)

Managerial Practices	Quantity	Pollutant Addressed	Estimated Load Reduction
Local Government Officials/Stakeholders (cont.)			
Master Plan and Zoning Ordinance Review		Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and Fecal Coliform	For each municipality adopting the revised language it is expected that water quality will be improved and/or maintained through the change in practices outlined by the revised master plan and zoning ordinance.
Commercial Businesses and Industries/Stakeholders			
Training Programs Directed at the Construction Business	4 trainings and/or site tours each year	Temperature, nutrients, hydrologic flow, sediment	Workshop attendees are expected to come away with an increased knowledge of soil erosion best management practices and the steps involved in complying with soil erosion permits. This should result in a change of practices that will improve and/or maintain water quality. An appropriately installed silt fence can have trapping efficiencies for total suspended solids of 70%, for sand of 80 to 90%, for silt loam of 50 to 80%, and for silty clay loam of 0 to 20%.
K-12 Educators, Students, & Community Educators/Stakeholders			
Educator Workshops	2 workshops/year	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and Fecal Coliform	Attendees of the workshop are expected to come away with a better understanding of the watershed, how nonpoint source pollutants affect the watershed, and what can be done to control these pollutants. This information received by the educator will then be taught to students. This is expected to improve or maintain water quality.

(DEQ 2003, EPA 1993, VanDelfzijl 2002)

14.4 TECHNICAL AND FINANCIAL ASSISTANCE NEEDED TO IMPLEMENT MANAGEMENT PLAN AND INFORMATION AND EDUCATION COMPONENT (CRITERIA D & E)

When considering management practices for the Muskegon River Watershed it is important to put together a plan before implementation to account for all of the appropriate technical and financial assistance needed. This will result in an effective management strategy that will address the sources of nonpoint source pollution in the watershed. Table 50 lists practices that were identified for the entire watershed in Chapter 10 along with the additional practices listed in Section 14.2. Where possible, estimated costs to implement these practices are included. Table 51 lists structural practices for the inventoried subwatersheds, with associated costs and necessary technical support to implement the practice. Non-structural (managerial and information/education) practices are listed in Table 52. The practices in Table 52 apply to the whole Muskegon River Watershed and also list associated costs and necessary technical support. Costs were based on past implementation projects, Natural Resources Conservation Service estimates, Center for Environmental Study estimates, and the Bear Creek Subwatershed, Mill Creek Watershed, and the Grand Traverse Bay Watershed management plans.

A Muskegon River Watershed Information and Education (I & E) Strategy was developed by the Muskegon Conservation District as part of the Muskegon River Watershed Planning Project. Information on the I & Strategy can be found in Chapter 8 and the document is included in Appendix E of the management plan. The strategy lays the foundation for the collaborative development of natural resources programs and educational activities for subwatershed target audiences, community members, and residents. To provide focus to the information and education tasks, Table 52 lists each task in order of importance for each target audience. These tasks were prioritized based on results from a Muskegon River I & E Needs Survey conducted in 2001. This survey provided information on how each target audience likes to receive information and what strategies they would support to address watershed issues. Priority pollutants are also listed for each target audience, excluding the General Public/Stakeholders and K-12 Educators, Students, & Community Educators/Stakeholders, where a general approach to education on watershed pollutants is more appropriate. With the change in land use and increasing development pressure in the watershed, BMPs need to be implemented in conjunction with an I & E Strategy.

TABLE 50. ASSOCIATED COSTS AND TECHNICAL SUPPORT FOR RECOMMENDED STRUCTURAL AND VEGETATIVE PRACTICES IN THE ENTIRE MUSKEGON RIVER WATERSHED

Structural and Vegetative Practices	Estimated Cost	Technical Support for Implementation
Construction Areas		
Access Road	---	County enforcing agency for soil erosion and sedimentation control (Road Commissioners, Drain Commissioners, Conservation Districts), MDEQ
Construction Barriers	$2.00/lf	County enforcing agency for soil erosion and sedimentation control (Road Commissioners, Drain Commissioners, Conservation Districts), MDEQ
Grading	---	County enforcing agency for soil erosion and sedimentation control (Road Commissioners, Drain Commissioners, Conservation Districts), MDEQ
Staging	---	County enforcing agency for soil erosion and sedimentation control (Road Commissioners, Drain Commissioners, Conservation Districts), MDEQ
Scheduling	---	County enforcing agency for soil erosion and sedimentation control (Road Commissioners, Drain Commissioners, Conservation Districts), MDEQ
Managerial Practices		
Critical Area Stabilization	$1,000/acre	County enforcing agency for soil erosion and sedimentation control (Road Commissioners, Drain Commissioners, Conservation Districts), MDEQ
Fertilizer Management	$20/sample (basic analysis)	NRCS, Conservation Districts, MSU Extension, MDEQ
Lawn Maintenance	$9/sample (basic analysis)	NRCS, Conservation Districts, MSU Extension, MDEQ
Slope/Shoreline Stabilization	$50/lf	NRCS, Conservation Districts, MDEQ, Timberland RC&D, Conservation Resource Alliance, local Recreational Organizations
Stream Bank Stabilization	$50/lf	NRCS, Conservation Districts, MDEQ, Timberland RC&D, Conservation Resource Alliance, local Recreational Organizations
Runoff Conveyance and Outlets		
Check Dams	$100/dam	USDA, NRCS, Conservation Districts, Road Commissions, City Offices, local engineers, MDEQ
Diversion	$1,100/acre of drainage	USDA, NRCS, Conservation Districts, Road Commissions, City Offices, local engineers, MDEQ
Grade Stabilization Structure	Geotextile: $5-6,000 Fabricated: $8,500-9,500 each structure	USDA, NRCS, Conservation Districts, Road Commissions, City Offices, local engineers, MDEQ
Grassed Waterway	$4,500/acre	USDA, NRCS, Conservation Districts, Road Commissions, City Offices, local engineers, MDEQ
Riprap	$70/$yd^3$	USDA, NRCS, Conservation Districts, Road Commissions, MDEQ, local contractors, local engineers, MDEQ
Runoff Storage		
Extended Detention Basin	$1.30/ ft^3	USDA, NRCS, Conservation Districts, Road Commissions, Price and Company, City Offices, local engineers, MDEQ
Infiltration Basin	$2/$ft^3$	USDA, NRCS, Conservation Districts, Road Commissions, City Offices, local engineers, MDEQ

TABLE 50. ASSOCIATED COSTS AND TECHNICAL SUPPORT FOR RECOMMENDED STRUCTURAL AND VEGETATIVE PRACTICES IN THE ENTIRE MUSKEGON RIVER WATERSHED (CONT.)

Structural and Vegetative Practices	Estimated Cost	Technical Support for Implementation
Sedimentation Control Structures		
Buffer/Filter Strip	$1000/acre buffer $80/acre filter	USDA, MDA, USFS, MDNR, NRCS, Conservation Districts, MDEQ, MSU-Extension, Pheasants Forever, Drain Commissioners, watershed greenhouses and native plant dealers
Filters	$5/ft^3	Price and Company, City Offices, local engineers, MDEQ
Sediment Basin	$3,500 each	USDA, NRCS, Conservation Districts, Road Commissions, Price and Company, City Offices, local engineers, MDEQ
Watercourse Crossings	$3,700 each	USDA, NRCS, Conservation Districts, Road Commissions, City Offices, local engineers, MDEQ
Vegetative Establishments		
Mulching & Seeding	$1,500/acre	USDA, MDNR, NRCS, Conservation Districts, MDEQ, MSU-Extension, watershed greenhouses and native plant dealers
Soil Management	$9/sample (basic analysis)	USDA, MDNR, NRCS, Conservation Districts, MDEQ, MSU-Extension, watershed greenhouses and native plant dealers
Wetlands		
Constructed Wetland Use in Storm Water Control	$1,500/acre	USDA, MDNR, Conservation Districts, Drain Commissioners, Price and Company, local engineers, MDEQ
Agricultural Best Management Practices		
Fencing	$2/lf	USDA, MDA, NRCS, Conservation Districts, MDEQ
Planned Grazing System	---	USDA, MDA, NRCS, Conservation Districts, MDEQ
Manure Storage	$100-250,000 each	USDA, MDA, NRCS, Conservation Districts, MDEQ
Manure Testing	$20/sample (basic analysis)	USDA, MDA, NRCS, Conservation Districts, MDEQ
Critical Area Planting	$1,000/acre	USDA, MDA, NRCS, Conservation Districts, MDEQ
Contour Buffer Strip	$1,000/acre	USDA, MDA, NRCS, Conservation Districts, MDEQ
Contour Farming	---	USDA, MDA, NRCS, Conservation Districts, MDEQ
Field Border	$1,000/acre	USDA, MDA, NRCS, Conservation Districts, MDEQ
Crop Residue Management	$10/acre	USDA, MDA, NRCS, Conservation Districts, MDEQ
Cover and Green Manure Crop	$20/acre	USDA, MDA, NRCS, Conservation Districts, MDEQ
Road Stream Crossing Improvements	$90/lf	Road Commission, MDOT, MDEQ
Recreation Trail and Walkway	$50/lf	NRCS, MDEQ, Conservation Districts, Rails to Trails, MDNR, Local Recreational Organizations
Protective Measures		
Conservation Easements	$3,000/acre	Local conservancy's (Chippewa Watershed Conservancy), NRCS, Drain Commissioners, MDEQ

(AWRI 2000, Jarvis and Auch 2004, Riggs 2003, U'Ren 2002, U'Ren 2005)

TABLE 51. ASSOCIATED COSTS AND TECHNICAL SUPPORT FOR RECOMMENDED STRUCTURAL AND VEGETATIVE PRACTICES IN INVENTORIED SUBWATERSHEDS

Structural and Vegetative Practices	Quantity	Estimated Cost for Each	Estimated Material Cost	Estimated Labor Costs	Total Costs	Technical Support for Implementation
Buffer Strips	2,316 acres	$1000/acre	$2,316,000	$370,560	$2,686,560	USDA, MDA, USFS, MDNR, Conservation Districts, MDEQ, watershed greenhouses and native plant dealers
Filter Strips	1,321 acres	$80/acre	$105,680	$211,360	$317,040	USDA, NRCS, USFS, Conservation Districts, Pheasants Forever, MDNR, MDEQ, Drain Commissioners
Grassed Waterway	4,228 acres	$4500/acre	$19,026,000	$676,480	$19,702,480	USDA, MDA, NRCS, Conservation Districts, MDEQ
Fencing & Watercourse Crossings	32,900 feet 22 crossings	$2/lf (fencing) $2500/crossing	$65,800 $55,000	$52,640 $3,520	$118,440 $58,520	USDA, MDA, NRCS, Conservation Districts, MDEQ
Streambank Stabilization	355,564 feet	$50/lf	$17,778,200	$162,500	$17,940,700	NRCS, Conservation Districts, MDEQ, Timberland RC&D, Conservation Resource Alliance, local Recreational Organizations
Road Stream Crossing Improvement	35,200 feet 14 culvert replacements	$90/lf $55000/ replacement	$3,168,000 $770,000	$16,100 $5,000	$3,184,100 $775,000	Road Commission, MDOT
Rain Gardens	3 gardens (.05 acres each)	$3000/rain garden	$9,000	$1,440	$10,440	WMEAC, MRWA, MDEQ, watershed greenhouses and native plant dealers
Recreation walkway/canoe ramp	350 feet	$50/lf	$17,500	$3,300	$20,800	NRCS, MDEQ, Conservation Districts, Rails to Trails, MDNR, Local Recreational Organizations
Crop and Green Manure Cover	34,840 acres	$20/acre	$696,800	$1,600	$698,400	USDA, NRCS, Conservation Districts

(AWRI 2000, Jarvis and Auch 2004, Riggs 2003, U'Ren 2005)

TABLE 52. ASSOCIATED COSTS AND TECHNICAL SUPPORT FOR RECOMMENDED MANAGERIAL AND INFORMATION AND EDUCATION PRACTICES IN THE ENTIRE MUSKEGON RIVER WATERSHED

Managerial and I/E Practices	Quantity	Pollutants Addressed	Estimated Material Cost	Estimated Labor Costs	Total Costs	Technical Support for Implementation
General Public/Stakeholders						
Watershed I&E Committee Mtgs.	12 mtg/yr	---	---	$4,800	$4,800	MRWA & MDEQ
Watershed Stakeholder Meetings	4 meetings/yr	---	---	$9,200	$9,200	MRWA & MDEQ
Newsletter	Quarterly River View Newsletter	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$10,000	$12,000	$22,000	MRWA
Stakeholders Outreach/Communications	Quarterly Stakeholder Newsletter	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$5,000	$12,000	$17,000	MRWA, Conservation Districts, Lake Associations, newspapers
Enhancement of MRWA Website		Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	---	$8,000	$8,000	MRWA, AWRI, CES, other watershed councils
Develop a Set of Fun Facts	---	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	---	$800	$800	MRWA & AWRI
Muskegon River Media	5 Signs/Billboards	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$25,000	---	$25,000	MRWA & CES
	Newspaper: 1 insert/yr x 2 papers x 5 yrs 10,000 color copies	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$150,000	---	$150,000	MRWA, Muskegon Chronicle, Conservation Districts

TABLE 52. ASSOCIATED COSTS AND TECHNICAL SUPPORT FOR RECOMMENDED MANAGERIAL AND INFORMATION AND EDUCATION PRACTICES IN THE ENTIRE MUSKEGON RIVER WATERSHED (CONT.)

Managerial and I/E Practices	Quantity	Pollutants Addressed	Estimated Material Cost	Estimated Labor Costs	Total Costs	Technical Support for Implementation
General Public/Stakeholders (cont.)						
Muskegon River Media (cont.)	Video: 1 30-minute video	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$60,000	---	$60,000	MRWA & WGVU Broadcasting
	Radio: Series of radio spots	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$80,000	---	$80,000	CES, WGVU Radio and other local radio stations
Magnets, other Giveaways and Saleable Items	Prep time	---	---	$2,000	$2,000	---
	10,000 magnets	---	$2,000	---	$2,000	MRWA, AWRI, Midwest Printing & Promotions
	1,000 tote bags	---	$2,000	---	$2,000	MRWA, AWRI, Midwest Printing & Promotions
	1,000 calendars	---	$9,000	---	$9,000	MRWA, AWRI, Midwest Printing & Promotions
Muskegon River Traveling Display	Graphics	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$1,500	$800	$2,300	MRWA, AWRI, Midwest Printing & Promotions
MRWA Information Sheets	2 information sheets (10,000 copies, 2-3 color, 8.5x11)	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$20,000	$1,600	$21,600	MRWA, AWRI, Muskegon Chronicle

TABLE 52. ASSOCIATED COSTS AND TECHNICAL SUPPORT FOR RECOMMENDED MANAGERIAL AND INFORMATION AND EDUCATION PRACTICES IN THE ENTIRE MUSKEGON RIVER WATERSHED (CONT.)

Managerial and I/E Practices	Quantity	Pollutants Addressed	Estimated Material Cost	Estimated Labor Costs	Total Costs	Technical Support for Implementation
General Public/Stakeholders (cont.)						
Watershed Libraries	3 sites at public libraries & 1 online	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$9,000	$14,200	$23,200	MRWA (data repository) and watershed libraries
EnviroScape	EnviroScape	Temperature, nutrients, hydrologic flow, sediment, toxic substances, *E. coli* and fecal coliform	$750	$1,600	$2,350	MRWA
Volunteer Monitoring	2 monitoring & training days/yr	Temperature, nutrients, hydrologic flow, sediment, toxic substances, *E. coli* and fecal coliform	$5,000	$35,200	$40,200	MRWA, MDEQ, WMEAC
Stewardship Month Activities	Annual MRW Stewardship Month	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$25,000	$100,000	$125,000	MRWA, Conservation Districts, MSU-E, Lake Associations
BMP Site Tours	3 tours/yr	Temperature, nutrients, hydrologic flow, sediment, toxic substances, *E. coli* and fecal coliform	$2,250	$4,500	$6,750	MRWA, NRCS, Conservation Districts, MSU - E
MRWA Recognition Program	6 plaques/yr x 5 yrs	---	$900	$4,200	$5,100	MRWA, USDA, Conservation Districts, NRCS
MRWA Survey I, II, & III	3 surveys and results	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$60,000	$60,000	$120,000	MRWA, Conservation Districts, CES

TABLE 52. ASSOCIATED COSTS AND TECHNICAL SUPPORT FOR RECOMMENDED MANAGERIAL AND INFORMATION AND EDUCATION PRACTICES IN THE ENTIRE MUSKEGON RIVER WATERSHED (CONT.)

Managerial and I/E Practices	Quantity	Pollutants Addressed	Estimated Material Cost	Estimated Labor Costs	Total Costs	Technical Support for Implementation
Agricultural Producers/Stakeholders						
Cost-share promotional mailer	1 mailer 11x6 5,000 color copies	Nutrients and *E. coli* and fecal coliform	$6,000	$1,500	$7,500	MRWA, USDA, MDA, NRCS, Conservation Districts, Drain Commissioners, MSU-E
Partnerships with Agricultural Service Providers	2 co-sponsored meetings / yr	Nutrients and *E. coli* and fecal coliform	$3,000	$9,000	$12,000	MRWA, USDA, MDA, NRCS, Conservation Districts, Drain Commissioners, MSU-E
Show Participation	Estimate 3 shows/yr	Nutrients and *E. coli* and fecal coliform	$2,250	$6,750	$9,000	MRWA, USDA, MDA, NRCS, Conservation Districts, Drain Commissioners, MSU-E
Articles in Specialty Publications	Min. of 5 articles/yr	Nutrients and *E. coli* and fecal coliform	$2,500	$7,500	$10,000	MRWA
Nutrient Management Field Day	Formation of group to discuss ag issues. 4 field days	Nutrients and *E. coli* and fecal coliform	$1,000	$3,000	$4,000	MRWA, USDA, MDA, NRCS, Conservation Districts, Drain Commissioners, MSU-E
Michigan Lake and Stream Associations with MSU;USDA-NRCS Programs and Trainings	4 programs /trainings 4 follow-up tours	Nutrients and *E. coli* and fecal coliform	---	$6,600	$6,600	MRWA, MSU-E, Lake Associations
Coffee Talk	9 groups (1 each county) x 1mtg/yr x 5 yrs = 45 mtgs	Nutrients and *E. coli* and fecal coliform	$18,000	$54,000	$72,000	MRWA, USDA, MDA, NRCS, Conservation Districts, Drain Commissioners, MSU-E

TABLE 52. ASSOCIATED COSTS AND TECHNICAL SUPPORT FOR RECOMMENDED MANAGERIAL AND INFORMATION AND EDUCATION PRACTICES IN THE ENTIRE MUSKEGON RIVER WATERSHED (CONT.)

Managerial and I/E Practices	Quantity	Pollutants Addressed	Estimated Material Cost	Estimated Labor Costs	Total Costs	Technical Support for Implementation
Agricultural Producers/Stakeholders (cont.)						
Demonstration Farms for Education	5 demonstration days	Nutrients and *E. coli* and fecal coliform	$2,500	$7,500	$10,000	MRWA, USDA, MDA, NRCS, Conservation Districts, MSU-E
Conservation Easements	1 informational meeting/yr	Nutrients and *E. coli* and fecal coliform	$500	$1,000	$1,500	Local Conservancy's (Chippewa Watershed Conservancy), NRCS, Drain Commissioners, MDEQ
Riparians/Stakeholders						
Print Muskegon River Watershed Information in Newsletters	Articles written for other newsletters	Temperature and nutrients	$2,500	$7,500	$10,000	MRWA
Homeowners Advertising Campaign	Variety of media outputs	Temperature and nutrients	$75,000	---	$75,000	MRWA, MSU-E, CES, Lake Associations, Conservation Districts, Local Recreation Groups
Support Local Volunteer Monitoring Efforts and Involvement	2 sampling days/year	Temperature and nutrients	$2,500	$7,500	$10,000	MRWA, MDEQ, WMEAC
Support the establishment of Local Stewardship Teams	Local stewardship teams established in watershed	Temperature and nutrients	$2,500	$7,500	$10,000	MRWA, MDEQ, WMEAC
Develop a MRW Riparian Landowner's Guide	Currently in production by AWRI	Temperature and nutrients	$125,000	$2,500	$127,500	MRWA & AWRI
Coordinate Residential Shoreline & Streamside Buffers and BMP Training	4 landscape-based trainings/yr (in Spring)	Temperature and nutrients	$15,000	$25,000	$40,000	MRWA, AWRI, MSU-E, Lake Associations

TABLE 52. ASSOCIATED COSTS AND TECHNICAL SUPPORT FOR RECOMMENDED MANAGERIAL AND INFORMATION AND EDUCATION PRACTICES IN THE ENTIRE MUSKEGON RIVER WATERSHED (CONT.)

Managerial and I/E Practices	Quantity	Pollutants Addressed	Estimated Material Cost	Estimated Labor Costs	Total Costs	Technical Support for Implementation
Riparians/Stakeholders (cont.)						
Storm Drain Stenciling Program	Drain stenciling in 6 urban centers over 5 years	Toxic substances	$3,400	$20,000	$23,400	MRWA, Conservation Districts, Watershed Municipalities, Road Commissions
Septic System Maintenance Program	one maintenance program	Nutrients and *E. coli* and fecal coliform	$5,000	$5,000	$10,000	MRWA, AWRI, MSU-E, Health Departments
Information Kiosk	10 kiosks throughout watershed	Temperature and nutrients	$54,000	$11,000	$65,000	MRWA, AWRI, MSU-E, Conservation Districts, Lake Associations, Local Recreational Groups
Presentations/ Workshops/ Training for Riparian Homeowners	8 riparian homeowner trainings/yr (4 in Fall & 4 in Spring)	Temperature and nutrients	$30,000	$50,000	$80,000	MRWA, MSU-E, Lake Associations, Conservation Districts, Local Recreational Groups
Conservation Easements	1 informational meeting/yr	Temperature and nutrients	$500	$1,000	$1,500	Local conservancy's (Chippewa Watershed Conservancy), NRCS, Drain Commissioners, MDEQ
Recreational Users of the Watershed/Stakeholders						
Integrate Information with Existing Publications	Publish information in recreational and tourism pubs.	Sediment and invasive species	$2,500	$7,500	$10,000	MRWA
Partnering with Recreational Businesses & Tourism Outlets	Activities toward recreational & tourism outlets	Sediment and invasive species	$2,500	$7,500	$10,000	MRWA, Chamber of Commerce, Rotary Clubs, Recreational Org.

TABLE 52. ASSOCIATED COSTS AND TECHNICAL SUPPORT FOR RECOMMENDED MANAGERIAL AND INFORMATION AND EDUCATION PRACTICES IN THE ENTIRE MUSKEGON RIVER WATERSHED (CONT.)

Managerial and I/E Practices	Quantity	Pollutants Addressed	Estimated Material Cost	Estimated Labor Costs	Total Costs	Technical Support for Implementation
Recreational Users of the Watershed/Stakeholders (cont.)						
Muskegon River Greenways and Walking Trails and Riverwalks	Signage and Maps along Trailways	Sediment and invasive species	$7,000	$6,000	$13,000	MRWA, Rails to Trails, Land Conservancy, Local Recreational Organizations
Watershed Information Signage	Signage at various access points (20 signs over 5 yrs)	Sediment and invasive species	$20,000	$6,000	$26,000	MRWA, Local Recreational Groups, MDEQ, MDNR, Rails to Trails, Conservation Districts, canoe liveries
Increase Access to Conservation Management Products & Plants	2 Vendor Fairs/yr	Sediment and invasive species	$30,000	$20,000	$50,000	MRWA, watershed greenhouses and native plant growers, MSU-E
Series of Educational Workshops	2 workshops/yr	Sediment and invasive species	$15,000	$20,000	$35,000	MRWA, Conservation Districts, MSU-E
Implement Conservation Practices	Promote various NRCS programs throughout the project period	Sediment and invasive species	$4,000	$12,000	$16,000	MRWA, Conservation Districts, Local Recreational Orgs., canoe liveries
Local Government Officials/Stakeholders						
Master Plan and Zoning Ordinance Review	1 community/year	Hydrologic flow (stormwater)	---	---	$13,000/ comm.	LSL Planning, MRWA Resource Committee, MDEQ
Storm Water Policy and Management	MRWA official stormwater policy	Hydrologic flow (stormwater)	$5,000	$15,000	$20,000	Langworthy, Strader, & LeBlanc, AWRI, local municipalities
Promote the Establishment of Funds at Community Foundations for Municipalities	Promote throughout the project period	---	$5,000	$15,000	$20,000	MRWA
Partner with Michigan Townships Association	Project period	---	$1,250	$3,750	$5,000	MRWA

TABLE 52. ASSOCIATED COSTS AND TECHNICAL SUPPORT FOR RECOMMENDED MANAGERIAL AND INFORMATION AND EDUCATION PRACTICES IN THE ENTIRE MUSKEGON RIVER WATERSHED (CONT.)

Managerial and I/E Practices	Quantity	Pollutants Addressed	Estimated Material Cost	Estimated Labor Costs	Total Costs	Technical Support for Implementation
Local Government Officials/Stakeholders (cont.)						
GIS Development Activities	3meetings/year with local government officials	Hydrologic flow (stormwater)	$5,000	$15,000	$20,000	AWRI
Ecological Services and Economic Benefits	2 information dissemination based meetings	Hydrologic flow (stormwater)	$1,000	$2,000	$3,000	MRWA, AWRI, other universities involved in Muskegon Watershed
Critical "Sensitive" Areas Maps	Training for local gov't officials & map printing	Hydrologic flow (stormwater)	$3,000	$10,000	$13,000	AWRI
Stewardship Month Activities/Participation/Sponsorship	One/year	Hydrologic flow (stormwater)	$3,750	$11,250	$15,000	MRWA, Conservation Districts, MSU-E
Local Government Recognition Campaign	One campaign/year	---	$1,250	$3,750	$5000	MRWA, Conservation Districts, municipalities
Promote Distribution of Key Information through Municipal Zoning and Building Offices	Project period	Hydrologic flow (stormwater)	$1,250	$3,750	$5,000	MRWA, AWRI, Langworthy, Strader, & LeBlanc
Workshops/Presentations for Local Boards and Planning commissions	5 workshops/yr (spread throughout watershed)	Hydrologic flow (stormwater)	$7,500	$22,500	$30,000	MRWA, AWRI, universities, Langworthy, Strader, & LeBlanc
Demonstration Site Tours	3 tours/yr	Hydrologic flow (stormwater)	$ 2,250	$9,000	$11,250	MRWA, USDA, NRCS, Conservation Districts
Commercial Business and Industry/Stakeholders						
Articles in Specialty Publications	Articles written for publications as needed	Hydrologic flow and toxic substances	$2,500	$7,500	$10,000	MRWA
Partnerships with area builders	Project period	---	$2,500	$7,500	$10,000	MRWA
Partnerships with community leaders	Project period	---	$2,500	$7,500	$10,000	MRWA

TABLE 52. ASSOCIATED COSTS AND TECHNICAL SUPPORT FOR RECOMMENDED MANAGERIAL AND INFORMATION AND EDUCATION PRACTICES IN THE ENTIRE MUSKEGON RIVER WATERSHED (CONT.)

Managerial and I/E Practices	Quantity	Pollutants Addressed	Estimated Material Cost	Estimated Labor Costs	Total Costs	Technical Support for Implementation
Commercial Business and Industry/Stakeholders (cont.)						
Communications Industry Partnerships	Project period	---	$3,750	$11,250	$15,000	MRWA
Event Participation	Participation in 1 Home Builders' Show/ yr	Hydrologic flow and toxic substances	$1,250	$3,750	$5,000	MRWA & Home Builders Association
Watershed Stewardship Opportunities	Promote throughout the project period	Hydrologic flow and toxic substances	$5,000	$15,000	$20,000	MRWA, Chamber of Commerce, newspapers
Training Programs Directed at the Construction Business	4 trainings and/or site tours each year	Sediment	$3,000	$16,000	$19,000	MRWA, Home Builders Association, MDEQ
K-12 Educators, Students, & Community Educators/Stakeholders						
Enviroscape Training	5 Enviroscape training sessions with volunteers	Temperature, nutrients, hydrologic flow, sediment, toxic substances, *E. coli* and fecal coliform	$2,000	$6,000	$8,000	MRWA, Conservation Districts
Educator Workshops	2 workshops/year	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$2,500	$7,500	$10,000	MRWA & AWRI
Watershed Lessons	Quarterly Advisory Committee Meetings	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$5,000	$15,000	$20,000	MRWA
Muskegon River Science Festival	Annual Science Festival	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$25,000	$50,000	$75,000	MRWA, AWRI, Conservation Districts, MSU-E, FSU
Michigan Envirothon	1 program / year	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$3,500	$10,500	$14,000	MRWA, AWRI, MSU-E, Conservation Districts

TABLE 52. ASSOCIATED COSTS AND TECHNICAL SUPPORT FOR RECOMMENDED MANAGERIAL AND INFORMATION AND EDUCATION PRACTICES IN THE ENTIRE MUSKEGON RIVER WATERSHED (CONT.)

Managerial and I/E Practices	Quantity	Pollutants Addressed	Estimated Material Cost	Estimated Labor Costs	Total Costs	Technical Support for Implementation
K-12 Educators, Students, & Community Educators/Stakeholders (cont.)						
The Watershed Classroom	Various water quality activities with students each year.	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$1,000	$50,000	$51,000	MRWA, AWRI, MSU-E
Community College Watershed Courses	One college watershed course	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$2,500	$7,500	$10,000	MRWA, GVSU, MCC
Science/ Wetland Curriculum	One curriculum produced	Temperature, nutrients, hydrologic flow, sediment, toxic substances, and invasive species	$5,000	$22,000	$27,000	MRWA, AWRI, Conservation Districts, MSU-E
Student Involvement	1 Summit/yr	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$5,000	$20,000	$25,000	MRWA & AWRI
Conservation District Water Quality Action Teams (WAT)	Teams created throughout the project period.	Temperature, nutrients, hydrologic flow, sediment, toxic substances, and invasive species	$5,000	$22,000	$27,000	MRWA, Conservation Districts, MSU-E
Muskegon River Watershed Camps	One camp held/every other year	Temperature, nutrients, hydrologic flow, sediment, toxic substances, invasive species, *E. coli* and fecal coliform	$5,000	$15,000	$20,000	MRWA, Conservation Districts, MSU-E, FSU

(AWRI 2000, Jarvis and Auch 2004, Riggs 2003, U'Ren 2005)

14.5 SCHEDULE FOR IMPLEMENTING MANAGEMENT PRACTICES AND INTERIM MEASURES OF SUCCESS (CRITERIA F & G)

A key consideration when planning the implementation of management practices to address various watershed management goals is how to phase or sequence activities in relation to one another over time. Determining which actions will need to take place before other actions will be important in achieving the full potential of each activity. The best order in which to implement management practices can be based on a number of factors such as ecological factors, length of time for developing the practice, and/or the ranked priority concerns within the watershed.

Table 53 and 54 lists BMPs identified in inventoried subwatersheds, and managerial practices and information/education tasks for the entire Muskegon River Watershed. Listed below are three major activity phases under which the recommended practices can be categorized. A phase (I, II, or III) is indicated for each type of management practice described below. This phasing sequence is a recommendation only and individual circumstances may require alternative staging and phasing periods and timelines.

Phase I: Phase I will address practices that can be initiated right away, require minimal cost or planning, usually non-structural practices. Examples include information and education programs, standards adoption, and some master plan revisions/updates. Actions under this category may be completed in 1 to 3 years; however, certain actions may involve continual implementation.

Phase II: Phase II will address practices that require significant planning and development, design specifications, require major additional costs (permits), address sources/causes of a problem, can be structural or non-structural practices. Examples include new projects/programs, ordinances, pilot projects or demonstration sites, studies, and design and construction of structural BMPs. Actions under this category may be completed in 3 to 7 years; however, certain actions may involve continual implementation.

Phase III: Phase III will address practices for which success may depend on the success of a previously implemented practice, mostly structural BMPs. Examples include instream and streambank restoration projects, lake treatment techniques, and nutrient/sedimentation reduction techniques such as dredging. Actions under this category may be completed in 7 to 15 years; however, certain actions may require continual implementation.

Interim Measures of Activity Success
To ensure project completion, interim measures are listed as a guide to determine whether the management practices are being implemented on schedule and in a timely manner. The interim measures will provide a dated checklist to refer to as project implementation begins and occurs. Tables 53 & 54 illustrate the implementation activities with the associated project phase for implementation and the associated interim measures of success.

TABLE 53. IMPLEMENTATION SCHEDULE FOR STRUCTURAL AND VEGETATIVE PRACTICES IN INVENTORIED SUBWATERSHEDS AND INTERIM MEASURES OF ACTIVITY SUCCESS

Structural and Vegetative Practices	Quantity	Activity Phase	Interim Measures of Activity Success
Buffer Strips	2,316 acres	II	Initial planning of sites completed by year three.
			Fifty percent of plantings completed by the end of year five.
			One hundred percent of plantings completed by the end of year seven.
Filter Strips	1,321 acres	II	Initial planning of sites completed by year three.
			Fifty percent of plantings completed by the end of year five.
			One hundred percent of plantings completed by the end of year seven.
Grassed Waterway	4,228 acres	II	Initial planning of sites completed by year three.
			Fifty percent of plantings completed by the end of year five.
			One hundred percent of plantings completed by the end of year seven.
Fencing & Watercourse Crossings	32,900 feet 22 crossings	II	Initial planning of sites completed by year three.
			Fifty percent of fencing and crossings completed by the end of year five.
			One hundred percent of fencing and crossings completed by year seven.
Streambank Stabilization	355,564 feet	III	Initial planning completed by year six.
			Twenty five percent of stabilizations completed by year eight.
			One hundred percent of stabilizations completed by year fifteen.
Road Stream Crossing Improvement	35,200 feet 14 culvert replace-ments	III	Initial planning completed by year six.
			Twenty five percent of improvements completed by year eight.
			One hundred percent of improvements completed by year fifteen.
Rain Gardens	3 gardens (.05 acres each)	III	Initial planning completed by year four.
			All three gardens installed by year seven.
Recreation walkway/canoe ramp	350 feet	II	Initial planning of sites completed by year three.
			Fifty percent of walkways and ramps completed by the end of year five.
			One hundred percent of walkways and ramps completed by year seven.
Crop and Green Manure Cover	34,840 acres	II	Initial planning of sites completed by year three.
			Fifty percent of acres practicing technique by the end of year five.
			One hundred percent of acres practicing technique by the end of year seven.

TABLE 54. IMPLEMENTATION SCHEDULE FOR MANAGERIAL AND INFORMATION AND EDUCATION PRACTICES AND INTERIM MEASURES OF ACTIVITY SUCCESS

Managerial and I/E Practices	Quantity	Activity Phase	Interim Measures of Activity Success
General Public/Stakeholders			
Watershed Stakeholder Meetings	4 meetings/yr	I, II, III	Initiated in year one – ongoing meetings.
Watershed Information and Education Committee Meetings	12 mtg/yr	I, II, III	Initiated in year one – ongoing meetings.
BMP Site Tours	3 tours/yr	II	Initial planning of tours completed by year three. Planning of tours will continue as new BMPs are installed.
			Fifty percent of the tours completed by the end of year five.
			One hundred percent of the tours completed by the end of year seven.
Volunteer Monitoring	2 monitoring days/yr 2 training days/yr	I, II, III	Initiated in year one – ongoing monitoring.
			Two monitoring days and two training days held every year.
Annual Meeting	1 meeting/yr	I, II, III	Initiated in year one – ongoing meetings.
Newsletter	Quarterly River View Newsletter	I, II, III	Initiated in year one – ongoing newsletter.
			Four newsletters produced every year.
Stakeholders Outreach/Communications	Quarterly Stakeholder Newsletter	I, II, III	Initiated in year one – ongoing articles produced for stakeholder newsletters.
			Four newsletter articles produced every year.
Stewardship Month Activities	Annual MRW Stewardship Month	I, II, III	Initiated in year one – ongoing stewardship month activities.
			Stewardship activities organized one month out of every year.
MRWA Survey I, II, & III	3 surveys and results	II	Survey I created in year one, survey II created in year three, survey III created in year five.
			Survey I issued in year two, survey II issued in year four, survey III issued in year six.
			Results from survey I, II, & III put into a final report in year seven.
Watershed Libraries	3 sites at public libraries & 1 online library	II	Initial planning for watershed libraries completed by year three.
			Two public library sites established by the end of year five.
			One public library site and online library established by the end of the year seven.
Enhancement of MRWA Website		I, II, III	Initiated in year one – ongoing enhancement.
Muskegon River Watershed Assembly Recognition Program	6 plaques/yr x 5 yrs	II	Initial planning for recognition program completed by year two.
			Eighteen plaques awarded by year five.
			Twelve plaques awarded by year seven.

TABLE 54. IMPLEMENTATION SCHEDULE FOR MANAGERIAL AND INFORMATION AND EDUCATION PRACTICES AND INTERIM MEASURES OF ACTIVITY SUCCESS (CONT.)

Managerial and I/E Practices	Quantity	Activity Phase	Interim Measures of Activity Success
General Public/Stakeholders (cont.)			
MRWA Information Sheets	2 information sheets (10,000 copies, 2-3 color, 8.5x11)	I	Initial planning for information sheets completed by year one.
			Printing and distribution of information sheets completed by the end of year three.
EnviroScape	EnviroScape	I, II, III	Initiated in year one – ongoing education using the EnviroScape.
Magnets, other Giveaways and Saleable Items	10,000 magnets	I	A distribution plan created by the end of year one.
			Design and production of magnets completed by year three.
	1000 tote bags	I	A distribution plan created by the end of year one.
			Design and production of tote bags completed by year three.
	1000 calendars	I	A distribution plan created by the end of year one.
			Design and production of calendars completed by year three.
Muskegon River Traveling Display	Graphics	I	Design and production of traveling display completed by year one.
Develop a Set of Fun Facts	---	I	Development of fun facts completed by year one.
Muskegon River Media	5 Signs/ Billboards	II	Initial planning for signs/billboards completed by year three.
			Three signs/billboards established by the end of year five.
			Two signs/billboards established by the end of year seven.
	Newspaper: 1 insert/yr x 2 papers x 5 yrs 10,000 color copies	II	Initial planning of newspaper inserts completed by year three.
			Three newspaper inserts included in two papers by the end of year five.
			Two newspaper inserts included in two papers by the end of year seven.
	Video: 1 30-minute watershed video	II	A distribution plan created by the end of year two.
			Initial planning of video completed by the end of year four.
			Creation of video completed by the end of year seven.
	Radio: Series of radio spots	II	A distribution plan created by the end of year two.
			Initial planning of radio spots completed by the end of year four.
			Creation of radio spots completed by the end of year seven.

TABLE 54. IMPLEMENTATION SCHEDULE FOR MANAGERIAL AND INFORMATION AND EDUCATION PRACTICES AND INTERIM MEASURES OF ACTIVITY SUCCESS (CONT.)

Managerial and I/E Practices	Quantity	Activity Phase	Interim Measures of Activity Success
Agricultural Producers/Stakeholders			
Cost-share promotional mailer	1 mailer 11x6 5,000 color copies	I	A distribution plan created by the end of year one.
			Initial planning of cost-share promotional mailer completed by year two.
			Cost-share promotional mailer completed by the end of year three.
Articles in Specialty Publications	A minimum of 5 articles/yr	I	Initiated in year one – ongoing articles produced for specialty publications.
			Five specialty publications produced every year.
Partnerships with Agricultural Service Providers		I, II, III	Initiated in year one – ongoing partnerships established.
Show Participation	Estimate 3 shows/yr	I, II, III	Initiated in year one – ongoing show participation.
			Three shows every year.
Coffee Talk	9 groups (1 each county) x 1mtg/yr x 5 yrs = 45 mtgs	II	Initial planning of coffee talk groups completed by year two.
			Thirty coffee talks held by the end of year five.
			Fifteen more coffee talks held by the end of year seven.
Nutrient Management Field Day	Formation of group to discuss ag issues. 4 field days	II	Initial planning of nutrient management field day completed by year three.
			Two field days held by end of year five.
			Two field days held by end of year seven.
Michigan Lake and Stream Association with MSU;USDA-NRCS Programs and Trainings	4 programs/ trainings 4 follow-up tours	II	Initial planning of programs and trainings completed by year three.
			Four programs/trainings held by the end of year five.
			Four follow-up tours held by the end of year seven.
Demonstration Farms for Education	5 demo. days	II	Initial planning of demonstration days completed by year three.
			Two demonstration days held by the end of year five.
			Three demonstration days held by the end of year seven.
Conservation Easements	1 informational meeting/year	I, II, III	Initial planning of educational workshops completed by year four.
			Educational workshops held once a year.
Riparian/Stakeholders			
Support Volunteer Monitoring Efforts and Involvement	---	I, II, III	Initiated in year one – ongoing support of local volunteer monitoring efforts.
Support the establishment of Local Stewardship Teams	---	I, II, III	Initiated in year one – ongoing support of local stewardship teams.

TABLE 54. IMPLEMENTATION SCHEDULE FOR MANAGERIAL AND INFORMATION AND EDUCATION PRACTICES AND INTERIM MEASURES OF ACTIVITY SUCCESS (CONT.)

Managerial and I/E Practices	Quantity	Activity Phase	Interim Measures of Activity Success
Riparian/Stakeholders (cont.)			
Print Muskegon River Watershed Information in Newsletters	Articles for other newslt.	I, II, III	Initiated in year one – ongoing articles written for other newsletters.
Develop a MRW Riparian Landowner's Guide	Currently in production by AWRI	I	A distribution plan created by the end of year one.
Coordinate Residential Shoreline & Streamside Buffers and BMP Training	4 landscape-based trainings/yr (in Spring)	I, II, III	Initial planning of landscape-based trainings completed by year two.
			Four landscape-based trainings held every year in the spring.
Information Kiosk	10 kiosks throughout watershed	I	Initial planning of information kiosk completed by year one.
			Creation of information kiosk completed by year two.
Homeowners Advertising Campaign	Variety of media outputs	II	Initial planning of homeowners advertising campaign completed by year four.
			Creation of a variety of media outputs completed by the end of year seven.
Presentations/ Workshops/ Training for Riparian Homeowners	8 riparian homeowner trainings/yr (4 in Fall & 4 in Spring)	II	Initial planning of homeowner trainings completed by year two.
			Eight homeowner trainings held every year in the spring and fall.
Storm Drain Stenciling Program	Drain stenciling in 6 urban centers over 5 years	II	Initial planning of storm drain stenciling program completed by year three.
			Three urban centers stenciled by the end of year five.
			Three urban centers stenciled by the end of year seven.
Septic System Maintenance Program		I, II, III	Initial planning of septic system maintenance program completed by year four.
			Creation of septic system maintenance materials by the end of year seven.
Conservation Easements	1 informational meeting/year	I, II, III	Initial planning of educational workshops completed by year four.
			Educational workshops held once a year.
Recreational Users of the Watershed/Stakeholders			
Watershed Information Signage	Signage at various access points (20 signs over 5 yrs)	II	A distribution plan created by the end of year two.
			Initial planning of watershed signage completed by the end of year three.
			Ten watershed information signs established by the end of year five.
			Ten more watershed information signs established by the end of year seven.

TABLE 54. IMPLEMENTATION SCHEDULE FOR MANAGERIAL AND INFORMATION AND EDUCATION PRACTICES AND INTERIM MEASURES OF ACTIVITY SUCCESS (CONT.)

Managerial and I/E Practices	Quantity	Activity Phase	Interim Measures of Activity Success
Recreational Users of the Watershed/Stakeholders (cont.)			
Implement Conservation Practices		I, II, III	Initiated in year one – ongoing implementation of conservation practices.
Provide a Series of Educational Workshops	2 workshops/yr	I, II, III	Initial planning of educational workshops completed by year four.
			Series of educational workshops held twice a year.
Increase Access to Conservation Products & Plant Materials	2 Vendor Fairs/yr	I, II, III	Initiated in year one – ongoing show participation.
			Two vendor shows every year.
Muskegon River Greenways and Walking Trails	Signage and Maps along Trail ways	III	Distribution plan by end of year three.
			Initial planning of watershed signage completed by the end of year four.
			Watershed signage & maps posted along trail ways by the end of year fifteen.
Partnering with Recreational Businesses & Tourism Outlets	---	I, II, III	Initiated in year one – ongoing partnerships with recreational businesses and tourism outlets.
Integrate Information with Existing Publications	---	I, II, III	Initiated in year one – ongoing integration of information with existing publications.
Local Government Officials/Stakeholders			
Local Government Recognition Campaign		I, II, III	Initiated in year one – ongoing recognition campaign.
			Governments recognized every year.
Demonstration Site Tours	3 tours/yr	I, II, III	Initiated in year one – ongoing demonstration site tours.
			Three demonstration site tours every year.
GIS Development Activities		I, II, III	Initiated in year one – ongoing GIS development activities.
Storm Water Policy and Management	MRWA official stormwater policy	I, II, III	Initiated in year one – ongoing Storm Water Policy and Management.
Ecological Services and Economic Benefits	2 information meetings	I	Initial planning of meetings completed by year two.
			Two meetings completed by year three.
Promote the Establishment of Funds at Community Foundations for Municipalities	---	I, II, III	Initiated in year one – ongoing promotion of the establishment of funds at foundations for municipalities.
Stewardship Month Activities/Participation/Sponsorship	---	I, II, III	Initiated in year one – ongoing stewardship month preparation.
Critical "Sensitive" Areas Maps	---	I	Initial planning of critical areas maps completed by year one.
			Fifty percent of critical area maps distributed by year two.
			One hundred percent of critical area maps distributed by year three.

TABLE 54. IMPLEMENTATION SCHEDULE FOR MANAGERIAL AND INFORMATION AND EDUCATION PRACTICES AND INTERIM MEASURES OF ACTIVITY SUCCESS (CONT.)

Managerial and I/E Practices	Quantity	Activity Phase	Interim Measures of Activity Success
Local Government Officials/Stakeholders (cont.)			
Workshops/Presentations for Local Boards and Planning commissions	5 workshops/yr	I, II, III	Initiated in year one – ongoing workshops/presentations.
			Five workshops/presentations every year.
Promote Distribution of Watershed Information through Municipal Zoning and Building Offices	---	I, II, III	Initiated in year one –distribution of watershed information through municipal zoning & building offices.
Partner with Michigan Township Associations	---	I, II, III	Initiated in year one – ongoing partnerships with MI Township Associations and Michigan Municipal League (MML).
Master Plan and Zoning Ordinance Review	1 community/yr	I, II, III	Initiated in year one – ongoing workshops/presentations.
			Working with one community every year.
Commercial Businesses and Industries/Stakeholders			
Watershed Stewardship Opportunities	---	I, II, III	Initiated in year one – ongoing watershed stewardship opportunities.
Articles in Specialty Publications	Articles written for publications	I, II, III	Initiated in year one – ongoing articles written for specialty publications.
Event Participation	Participation in 1 Show/ yr	I, II, III	Initiated in year one – ongoing event participation.
			Participation in one show every year.
Training Programs Directed at the Construction Business	4 trainings and/or site tours each year	I, II, III	Initiated in year one – ongoing trainings/tours.
			Four trainings/tours every year.
Partnerships with area builders	---	I, II, III	Initiated in year one – ongoing partnerships with area builders.
Partnerships with community leaders	---	I, II, III	Initiated in year one – ongoing partnerships with community leaders and Chamber of Commerce.
Communications Industry Partnerships	---	I, II, III	Initiated in year one – ongoing communications with industry partners.
K-12 Educators, Students, & Community Education/Stakeholders			
Educator Workshops	---	I, II, III	Initiated in year one – ongoing educator workshops.
			Educator workshops held every year.
Michigan Envirothon	---	I, II, III	Initiated in year one – ongoing participation in Michigan Envirothon.
			Participation in Michigan Envirothon every year.
The Watershed Classroom	Water quality activities each year.	I, II, III	Initiated in year one – ongoing water quality activities.
			Water quality activities involving students held every year.

TABLE 54. IMPLEMENTATION SCHEDULE FOR MANAGERIAL AND INFORMATION AND EDUCATION PRACTICES AND INTERIM MEASURES OF ACTIVITY SUCCESS (CONT.)

Managerial and I/E Practices	Quantity	Activity Phase	Interim Measures of Activity Success
K-12 Educators, Students, & Community Education/Stakeholders (cont.)			
Watershed Lessons	Quarterly Advisory Committee Meetings	I, II, III	Initiated in year one – ongoing committee meetings.
			Four advisory committee meetings every year.
Student Involvement	1 Summit/yr	I, II, III	Initiated in year one – ongoing student involvement.
			Participation in one summit every year.
Muskegon River Science Festival	Annual Science Festival	I, II, III	Initial planning of Muskegon River Science Festival completed in year three.
			Festival held every year.
Science/ Wetland Curriculum	---	I, II, III	Initiated in year one – ongoing development of science/wetland curriculum.
Conservation District Water Quality Action Teams (WAT)	---	I, II, III	Initiated in year one – ongoing organization of water quality teams.
Enviroscape Training	5 Enviroscape training sessions with volunteers	I	Initial planning of Enviroscape training completed by the end of year one.
			Two Enviroscape training sessions completed by the end of year two.
			Three Enviroscape training sessions completed by the end of year three.
Community College Watershed Courses	---	I, II, III	Initiated in year one – ongoing development of college courses.
			One community college watershed course held every year by the end of year seven.
Muskegon River Watershed Camps	---	I, II, III	Initiated in year one – ongoing coordination of Muskegon River Watershed Camps.
			One Muskegon River Watershed Camp held every year by the end of year ten.

14.6 SET OF CRITERIA TO DETERMINE WHETHER LOADING REDUCTIONS ARE BEING ACHIEVED (CRITERIA H)

To evaluate whether loading reductions are being achieved over time, a set of criteria (indicators) was determined for each structural, vegetative, and managerial practice. By using these indicators, we can see if substantial progress is being made towards water quality standards. Table 55 lists structural and vegetative practices that are recommended for the inventoried subwatersheds and combined quantities to be implemented for all four subwatersheds. Table 56 lists managerial practices that are to be implemented throughout the entire watershed. The indicators to be used to determine whether the loading reductions are being achieved are listed for each practice.

If progress is not being made towards water quality standards, the management approaches listed in the table below will be revised. The MRWA Resource Committee will evaluate the existing practices and see if the quantities of practices implemented needs to be increased or if alternative practices need to be proposed.

Suggested Water Quality Strategy

Establish a long-term monitoring program so that progress and the effectiveness of the implementation efforts can be measured over time, which includes the following:

- Increase stream flow monitoring to determine baseflows and track stormwater management and other hydrological restoration activities. Include as physical and hydrological indicators: stream widening / downcutting, physical habitat monitoring, increased flooding frequency, amount of stormwater infiltration projects, and stream temperature monitoring.

- Increase biological data monitoring (fish, macroinvertebrates, and algal communities) and use these as indicators of the integrity of the stream ecosystem. Include as biological indicators: coldwater fishery, warmwater fishery, macroinvertebrate diversity, single species indicators, and other biological indicators.

- Increase surveying of the watershed for endangered, threatened, and special concern plants and animals. These unique organisms are an indicator of biodiversity and watershed ecological integrity.

- Increase the regular collection of land use and cover data to allow change analysis and the identification of potential problem areas.

- Increase inventorying of major riparian corridors and other natural areas in order to plan for recreational opportunities, restoration and linkages.

- Increase the use of volunteers where possible for monitoring programs (habitat, macroinvertebrates) and independent implementation of

conservation practices to encourage involvement and stewardship.

Based on the goals of the watershed plan, the water quality monitoring plan will measure Phosphorus (P) and Nitrogen (N), total suspended solids and sediments (TSS), stream flow rates, water temperature, fisheries and aquatic macroinvertebrates diversity, bacteria (*E. coli*) abundance, invasive species abundance, physical habitat, and the public recreation potential in the watershed.

Establishing Targets

Measuring parameters to evaluate progress toward a goal requires the establishment of targets against which observed measurements are compared. These targets are not necessarily goals themselves, because some of them may not be realistically obtainable. However, the targets define Water Quality Standards, as set forth by the State of Michigan, or scientifically supported limits that suggest measurements for achieving water quality, quantity, and biological parameters. Using these scientifically-based targets to measure success will assist watershed stakeholders in deciding how to improve programs to reach both restoration and preservation goals and know when these goals have been achieved. These targets are described below.

The state requires that "**nutrients** shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria which are or may become injurious to the designated uses of the waters of the state." Monitoring frequency and number of sites for phosphorous and nitrogen needs to be increased throughout the watershed. A target would be to significantly reduce all anthropogenic (human caused) nutrient contamination sources in the Muskegon River Watershed.

Numerical standards for **Total suspended solids** (TSS) in Michigan's surface water have not yet been established. However, the state requires that "The addition of any dissolved solids shall not exceed concentrations which are or may become injurious to any designated use." To protect the designated uses there are recommended targets established on a scientific basis. From an aesthetics standpoint it is recommended that TSS less than 25 mg/l is "good", TSS 25-80 mg/l is "fair" and TSS greater than 80 mg/l is "poor" (Riggs 2003). The TSS target, therefore, will be to maintain TSS below 25 mg/l in dry weather conditions. Another measurement that can be used to determine sediment load is to determine the extent of embeddedness of the substrate (how much of the stream bottom is covered with sediment) and the bottom deposition (what percentage of the bottom is covered with soft muck, indicating deposition of fine silts). These are measurements taken by the GLEAS protocol habitat assessment conducted by MDEQ every five years. Rating categories are from "poor" to "excellent." The target for this measurement is to maintain the current ratings and improve ratings where possible.

Stream flow, or discharge, for surface waters does not have a numerical standard set by the state. Using the health of fish and macroinvertebrate communities as an indicator of stream and river integrity is helpful in assessing appropriate flow. Peak flow data is needed to more accurately compare observed flow to the target flow. Data generated at the USGS stream gauges on Bear Creek, the Little Muskegon River, the Clam River, and the Muskegon River should be used to assist in reviewing these suggested targets and establishing an appropriate target for the downstream end of the watershed. Information provided by hydrological studies in the Cedar

Creek and Tamarack Creek subwatersheds should be used to establish targets in those particular subwatersheds. The Muskegon River Ecological Modeling System (MREM) being developed by University of Michigan, Michigan State University, Grand Valley State University, and the Michigan Department of Natural Resources can provide a system-wide model that can be used to evaluate progress towards target goals and understand trends and dynamics occurring across the watershed.

The only water **temperature** standards available for the state are for point source discharges and mixing zones and are not intended for use with ambient surface water. However, recommendations for water temperature can be generated by assessing fish species' tolerance to temperature change. Temperature studies need to be conducted for the Muskegon River Watershed system in order to determine the average monthly water temperatures and whether increased temperatures are a problem for stream health. In tributaries that support coldwater fish communities, such as the brook trout, warmer temperatures are especially a concern. These representative species cannot tolerate extreme temperature fluctuations or higher summer temperature increases.

Numerical or **fish community** standards have not been set by the state. However, the Michigan Department of Environmental Quality has developed a system to estimate the health of the predicted fish communities through the GLEAS 51 (Great Lakes Environmental Assessment Section) sampling protocol. This method collects fish at various sites and based on whether or not certain expected fish species are present, as well as other habitat parameters, fish communities are assessed as poor, fair, good, or excellent. The target will be to maintain GLEAS 51 scores of "excellent" at sites where they are attained currently, "good" at sites where they are attained currently, and improve "fair" to "poor" sites to "good" through implementation of this plan. Certain species are especially useful for demonstrating improving conditions. These species tend to be sensitive to turbidity and prefer cleaner, cooler water. The target is to continue to find species currently found, assuming that stable or increasing numbers mean that habitat and water quality is maintained or improved.

Similar to the assessment of fish communities, the state employs the GLEAS 51 protocol for assessing **macroinvertebrate communities** on a five-year cycle for Michigan Watersheds. The Muskegon River Watershed Assembly will use their existing volunteer monitoring program to collect data on the quality of macroinvertebrate populations and physical habitat following MiCorps guidelines. The monitoring target for macroinvertebrate communities will be to increase MDEQ and volunteer monitoring sites to improve the existing database and attain GLEAS 51 scores of at least "fair" at sites that currently are "poor", and improve "fair" sites to "good", and maintain "good" and "excellent" conditions at the remaining sites.

State standards are established for **bacteria (*E. coli*)** in surface waters by the MDEQ. For the designated use of total body contact, the state requires measurements of no more than 130 *E. coli* per 100 milliliters as a 30-day geometric mean during 5 or more sampling events representatively spread over a 30-day period. For partial body contact (wading, fishing, and canoeing) the state requires measurements of no more than 1000 *E. coli* per 100 milliliters based on the geometric mean of 3 or more samples, taken during the same sampling event. These uses and standards will

be appropriate for and applied to the river and those tributaries with a base flow of, or greater than, 2 cubic feet per second.

There are no state standards that deal with **non-native invasive species**. Non-native invasive plants and animals can have a dramatic effect on the ecological integrity of a natural balanced system. Invasive species degrade habitat suitability for native species and decrease overall biodiversity. Current comprehensive inventorying of the abundance of these pests will set baseline criteria for future comparison. As a target, volunteer management, biological, and other control techniques should help stem the tide of non-native species immigration to the watershed and should reduce any future expansion by limiting their impact on the watershed system. GIS mapping of infected areas will guide managers effectively in the effort to reduce the negative impacts of non-native species. An additional target would be to increase educational signage placement at public access areas (i.e. boat launches).

State standards do not exist for **aesthetics or recreation potential**. However, an area with high aesthetic qualities will add recreational opportunities for the public and a greater appreciation and awareness of the watershed's natural resources. A study of the watershed should be done to determine where opportunities and access can be improved. The goal is to identify areas in the watershed, both along the riparian corridor and on the landscape, which can provide a variety of public recreation activities. Within the watershed, these areas should be linked where possible to provide linear corridors that connect, or greenways, for both people (hiking, biking trails) and wildlife. This activity would begin with mapping existing areas dedicated to recreation or preservation, and then completing a stream walk to record information including: evidence of current public use, potential for public access, linkages to other natural areas (greenways potential), ownership of property, vegetation types (forested, wetland area, in need of riparian cover, etc.), excessive woody debris, etc. This survey would include photographs of potential recreation areas and would assist communities and the watershed in prioritizing new areas for preservation and recreation for the public, offering the public more opportunity for using and appreciating the natural resources of the Muskegon River Watershed. Finally, these activities should lead to the identification of funding mechanisms for the purchase of land and conservation easements as well as any necessary infrastructure (construction of trails, boardwalks, canoe livery, etc.) that would support new or improved recreational opportunities. The preservation of the high quality areas in the watershed is of highest priority as it will satisfy both desired and designated uses.

Details regarding responsible parties, monitoring procedures, sampling sites, and frequency of monitoring for the qualitative and quantitative evaluation techniques will need to be defined in project work plans as funding resources are secured.

TABLE 55. RECOMMENDED STRUCTURAL AND VEGETATIVE PRACTICES FOR INVENTORIED SUBWATERSHEDS WITH ASSOCIATED SET OF CRITERIA TO DETERMINE WHETHER LOADING REDUCTIONS ARE BEING ACHIEVED

Structural and Vegetative Practices	Quantity	Set of Indicators
Buffer Strips	2,316 acres	Decreased frequency and degree of sediment trap maintenance (USFS).
		Increases in the abundance of coldwater fish, and diversity of macroinvertebrates demonstrated by Volunteer Monitoring, MDEQ stream surveys, USFS surveys, and future academic research.
		To maintain TSS below 25 mg/l in dry weather conditions.
		To maintain the current ratings and improve ratings where possible of embeddedness of the substrate and the bottom deposition measurements taken by the GLEAS protocol habitat assessment conducted by MDEQ.
		Nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria.
		A minimum of 7 milligrams per liter of dissolved oxygen shall be maintained in inland waters protected for coldwater fish.
		Toxic substances shall not exceed the "aquatic maximum for protection of aquatic life in ambient water values" specified in the Water Quality and Pollution Control in Michigan Sections 303(d), 305(b), and 314 Integrated Report.
		No *E.Coli* levels exceeding Michigan and USEPA water quality standards for both single day measurement (>300 *E. coli* per 100mL of water) and 30-day geometric mean measurement (> 130 *E. coli* per 100mL of water in 5 samples over 30 days).
Filter Strips	1,321 acres	Decreased frequency and degree of dredging of agricultural ditches.
		Increases in the abundance of coldwater fish, and diversity of macroinvertebrates demonstrated by Volunteer Monitoring, MDEQ stream surveys, USFS surveys, and future academic research.
		To maintain TSS below 25 mg/l in dry weather conditions.
		To maintain the current ratings and improve ratings where possible of embeddedness of the substrate and the bottom deposition measurements taken by the GLEAS protocol habitat assessment conducted by MDEQ.
		Nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria.
		Toxic substances shall not exceed the "aquatic maximum for protection of aquatic life in ambient water values" specified in the Water Quality and Pollution Control in Michigan Sections 303(d), 305(b), and 314 Integrated Report.
		No *E.Coli* levels exceeding Michigan and USEPA water quality standards for both single day measurement (>300 *E. coli* per 100mL of water) and 30-day geometric mean measurement (> 130 *E. coli* per 100mL of water in 5 samples over 30 days).

TABLE 55. RECOMMENDED STRUCTURAL AND VEGETATIVE PRACTICES FOR INVENTORIED SUBWATERSHEDS WITH ASSOCIATED SET OF CRITERIA TO DETERMINE WHETHER LOADING REDUCTIONS ARE BEING ACHIEVED (CONT.)

Structural and Vegetative Practices	Quantity	Set of Indicators
Grassed Waterway	4,228 acres	Nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria.
		Increases in the abundance of coldwater fish and diversity of macroinvertebrates demonstrated by Volunteer Monitoring, MDEQ stream surveys, USFS surveys, and future academic research.
		To maintain TSS below 25 mg/l in dry weather conditions.
		Toxic substances shall not exceed the "aquatic maximum for protection of aquatic life in ambient water values" specified in the Water Quality and Pollution Control in Michigan Sections 303(d), 305(b), and 314 Integrated Report.
Fencing & Watercourse Crossings	32,900 feet 22 crossings	Increases in the abundance of coldwater fish and diversity of macroinvertebrates demonstrated by Volunteer Monitoring, MDEQ stream surveys, USFS surveys, and future academic research.
		To maintain TSS below 25 mg/l in dry weather conditions.
		To maintain the current ratings and improve ratings where possible of embeddedness of the substrate and the bottom deposition measurements taken by the GLEAS protocol habitat assessment conducted by MDEQ.
		Nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria.
		Toxic substances shall not exceed the "aquatic maximum for protection of aquatic life in ambient water values" specified in the Water Quality and Pollution Control in Michigan Sections 303(d), 305(b), and 314 Integrated Report.
		No *E.Coli* levels exceeding Michigan and USEPA water quality standards for both single day measurement (>300 *E. coli* per 100mL of water) and 30-day geometric mean measurement (> 130 *E. coli* per 100mL of water in 5 samples over 30 days).
Streambank Stabilization	355,564 feet	Increases in the abundance of coldwater fish, and diversity of macroinvertebrates demonstrated by Volunteer Monitoring, MDEQ stream surveys, USFS surveys, and future academic research.
		To maintain TSS below 25 mg/l in dry weather conditions.
		To maintain the current ratings and improve ratings where possible embeddedness of the substrate and the bottom deposition measurements taken by the GLEAS protocol habitat assessment conducted by MDEQ.
Road Stream Crossing Improvement	35,200 feet 14 culvert replacements	Increase in fish passage in the Muskegon River and its tributaries demonstrated by MDEQ stream surveys and future academic research.
		Increases in the abundance of coldwater fish and diversity of macroinvertebrates demonstrated by Volunteer Monitoring, MDEQ stream surveys, USFS surveys, and future academic research.
		To maintain TSS below 25 mg/l in dry weather conditions.
		To maintain the current ratings and improve ratings where possible of embeddedness of the substrate and the bottom deposition measurements taken by the GLEAS protocol habitat assessment conducted by MDEQ.

TABLE 55. RECOMMENDED STRUCTURAL AND VEGETATIVE PRACTICES FOR INVENTORIED SUBWATERSHEDS WITH ASSOCIATED SET OF CRITERIA TO DETERMINE WHETHER LOADING REDUCTIONS ARE BEING ACHIEVED (CONT.)

Structural and Vegetative Practices	Quantity	Set of Indicators
Rain Gardens	3 gardens (.05 acres each)	Increases in the abundance of coldwater fish, and diversity of macroinvertebrates demonstrated by Volunteer Monitoring, MDEQ stream surveys, USFS surveys, and future academic research.
		To maintain TSS below 25 mg/l in dry weather conditions.
		To maintain the current ratings and improve ratings where possible of embeddedness of the substrate and the bottom deposition measurements taken by the GLEAS protocol habitat assessment conducted by MDEQ.
		Nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria.
		A minimum of 7 milligrams per liter of dissolved oxygen shall be maintained in inland waters protected for coldwater fish.
		Toxic substances shall not exceed the "aquatic maximum for protection of aquatic life in ambient water values" specified in the Water Quality and Pollution Control in Michigan Sections 303(d), 305(b), and 314 Integrated Report.
		No *E.Coli* levels exceeding Michigan and USEPA water quality standards for both single day measurement (>300 *E. coli* per 100mL of water) and 30-day geometric mean measurement (> 130 *E. coli* per 100mL of water in 5 samples over 30 days).
Recreation walkway/ canoe ramp	350 feet	Increases in the abundance of coldwater fish, and diversity of macroinvertebrates demonstrated by Volunteer Monitoring, MDEQ stream surveys, USFS surveys, and future academic research.
		To maintain TSS below 25 mg/l in dry weather conditions.
		To maintain the current ratings and improve ratings where possible of embeddedness of the substrate and the bottom deposition measurements taken by the GLEAS protocol habitat assessment conducted by MDEQ.
Crop and Green Manure Cover	34,840 acres	Increases in the abundance of coldwater fish, and diversity of macroinvertebrates demonstrated by Volunteer Monitoring, MDEQ stream surveys, USFS surveys, and future academic research.
		To maintain TSS below 25 mg/l in dry weather conditions.
		Nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria.
		To maintain the current ratings and improve ratings where possible of embeddedness of the substrate and the bottom deposition measurements taken by the GLEAS protocol habitat assessment conducted by MDEQ.

TABLE 56. RECOMMENDED MANAGERIAL PRACTICES FOR THE ENTIRE MUSKEGON RIVER WATERSHED WITH ASSOCIATED SET OF CRITERIA TO DETERMINE WHETHER LOADING REDUCTIONS ARE BEING ACHIEVED

Managerial Practices	Quantity	Set of Indicators
Agricultural Producers/Stakeholders		
Nutrient Management Field Day	Formation of group to discuss ag issues – 4 field days	An increase in participation in Farm Bill programs and an increase in the development of manure management plans.
Michigan Lake & Stream Associations with MSU;USDA-NRCs Programs	4 programs/trainings 4 follow-up tours	An increase in the participants attending workshops and an increase in the number of practices implemented.
Conservation Easements	4 informational meetings	An increase in the number of easements secured.
Riparians/Stakeholders		
Coordinate Residential Shoreline & Streamside Buffers and BMP Training	4 landscape-based trainings/yr (in Spring)	An increase in the participants attending the training and an increase in the acres of adequately protected riparian areas.
Presentations/ Workshops/ Training for Riparian Homeowners	8 riparian homeowner trainings/yr	An increase in the participants attending the training and an increase in the acres of adequately protected riparian areas.
Homeowners Advertising Campaign	Variety of media outputs	An increase in knowledge and use of hazardous waste collection and other homeowner practices that can be done to protect water quality.
Storm Drain Stenciling Program	Stenciling in 6 urban areas	An increase in the number of storm drains that are stenciled in the watershed.
Septic System Maintenance Program	1 maintenance program	An increase in the identification of failing or faulty septic systems.
Conservation Easements	4 informational meetings	An increase in the number of easements secured.
Recreational Users of the Watershed/Stakeholders		
Series of Educational Workshops	2 workshops/yr	An increase in the participants attending workshops and an increase in the number of practices implemented.
Local Decision Makers/Stakeholders		
Storm Water Policy and Management	MRWA stormwater policy	An increase in the implementation of ordinance language that addresses storm water management.
Workshops/Presentations for Local Boards and Planning commissions	5 workshops/yr (spread throughout watershed)	An increase in the participants attending the workshops and an increase in the number of municipalities that go through the process of master plan and zoning ordinance review to include language that protects natural resources.
Master Plan and Zoning Ordinance Review	---	An increase in implementation of ordinances and overlay districts to protect water features and riparian land.
Commercial Businesses and Industries/Stakeholders		
Training Programs Directed at the Construction Business	4 trainings and/or site tours each year	A reduction in the number of project violations and a reduction of erosion and sedimentation from construction sites.
K-12 Educators, Students, & Community Education/Stakeholders		
Educator Workshops	2 workshops/year	An increase in the educators attending the workshops and an increase in the number of schools in the watershed having water quality curriculum.

14.7 EVALUATION METHODS FOR MONITORING SUCCESS OF IMPLEMENTATION EFFORTS (CRITERIA I)

Significant amounts of time and money are dedicated to implementing watershed management plans. Without a well-planned evaluation process, the success of these implementation efforts is unknown. Establishing monitoring methods allows for a clear picture of whether or not the goals and objectives for water quality improvement are being attained. Results of the evaluation will provide a feedback loop to improve project management and implementation of project tasks, which in turn will gain support from watershed stakeholders. Monitoring and measuring progress in the watershed will likely be conducted at the local level by individual agencies, entities and communities as well as at the watershed and sub-watershed levels (i.e., educational institutions / watershed organization / groups) in order to assess the ecological affects of the community and agency actions on the overall health of the Muskegon River Watershed.

Evaluation is difficult, however, due to the social and technical complexity of watershed projects. Evaluations usually take either a qualitative or quantitative approach, with the two approaches often viewed as alternatives (Kerr and Chung 2001). Qualitative approaches deal with how people understand their experiences (i.e. qualities). An example of using a qualitative approach is sending watershed stakeholders a survey which asks them to provide feedback on water quality in their area. By contrast, quantitative approaches deal with numerical outcomes (i.e. quantities). A quantitative approach would be to select a site in the watershed where macroinvertebrate data are collected and analyzed over a set period of time to determine water quality in that area. Although these methods are presented as if they were in opposition to one another, these approaches can be combined to deal with the complexity inherent in watershed projects. The rising interest in combining methods comes from the recognition that purely qualitative and purely quantitative approaches to evaluation each have limitations, and that the strengths of one often compensate the weaknesses of the other (Kerr and Chung 2001).

A long-term water quality monitoring program that measures qualitative as well as quantitative parameters is essential to determine where resources should be focused and to move towards watershed goals and objectives. Throughout the three major activity phases, continual evaluation methods will be implemented to measure project successes and failures. This will allow for intervention if project goals are not being achieved. Below is a description of quantitative and qualitative methods that will be used to evaluate the effectiveness of implementing the watershed plan and achieving its goals.

Quantitative Evaluation Methods

Quantitative evaluation begins with the premise that the analyst fully understands the nature and determinants of a program's success and/or problem issues and can obtain the data needed to measure and relate them statistically (Kerr and Chung 2001). Statistical analysis also requires a sufficient sample size, generated by some form of randomization, rather than a "convenience sample" of a few sites. But measuring improvements in natural resource conditions is difficult. First, the conditions of the project site are not likely to be replicated exactly in other sites. Differences in physical, economic and social factors may lead to changes in program outcomes.

Second, many watersheds projects do not deal with sample sizes that make randomization a feasible strategy for study design. To ensure project success in the long term, the type, frequency, and number of locations of parameters monitored needs to be more clearly defined. It should be noted that the parameters and associated targets listed below are suggestions and that new programs will likely begin when a specific plan has been determined and funding is secured.

Table 57 lists evaluation methods that should be used to determine if implemented structural and vegetative practices are successful.

Qualitative Evaluation Methods

Qualitative methods aim to uncover the perspectives of multiple stakeholder groups, learning first hand about the incentives, motivations, and dynamics behind decisions and actions taken as a result of a project. The objective is not to obtain a numerical estimate, but to develop an in-depth understanding of an issue by probing, clarifying, and listening to stakeholders talk about a topic in their own words (Kerr and Chung 2001). The data gathered are the perceptions of the people living in the watershed and the individual resident is the primary collection instrument. An advantage to qualitative evaluation methods is that it produces in-depth, comprehensive information that focuses on a holistic picture (Key 1997). Qualitative methods can be used to investigate issues and can explore how well project programs are addressing these issues.

Table 58 lists evaluation methods that should be used to determine the success of implemented managerial and information/education efforts. Another resource that should be used in implementing and evaluating these practices is the "Getting in Step – A Guide for Conducting Watershed Outreach Campaigns" prepared by Tetra Tech, Inc under a contract with the U.S. Environmental Protection Agency. This guide provides the tools needed to develop and implement an effective outreach campaign. It will help understand the audiences in the watershed, create messages that resonate with them, find appropriate ways to communicate the message, and prompt changes in behavior to reduce water pollution. To provide background data on the communities in the Muskegon River Watershed, U.S. Census Bureau data for each watershed county are provided in Appendix L.

To determine if water quality standards are being met on a watershed level, data collected by the MDEQ and MDNR will be used. This basin-wide monitoring will provide information on the status of macroinvertebrate and fish communities, habitat quality, water chemistry, TMDLs in the watershed, and road stream crossings.

TABLE 57. RECOMMENDED EVALUATION TECHNIQUES TO MONITOR SUCCESS OF IMPLEMENTATION EFFORTS

Monitoring Site	Parameter Target	Type of Analysis	Protocol	Frequency	Test Agent
Inventoried Subwatersheds					
Middle Branch Upper – 80th Ave. at confluence of Franz Crk. & Middle Branch Midstream – downstream from Village of Marion Lower – Middle Branch at M-115	Temperature, Hydrologic flow, Sediment	Avg Max Daily Summer Temp	HOBO Data Logger	3 yr interval: summer	MRWA with assistance from Resource Committee Board Members
		Bank Erosion Hazard Index	SOP Assessing Bank Erosion Potential using Rosgen's Bank Erosion Hazard Index – prepared by Joe Rathbun, MDEQ	1 time/year	MRWA – volunteer monitors
		Stream Habitat Assessment	Volunteer Monitoring Program - MICorps	1 time/year	MRWA – volunteer monitors
		Benthic Macroinvertebrate Assessment	Volunteer Monitoring Program - MICorps	2 times/year	MRWA – volunteer monitors
Tamarack Creek Upper – Tamarack at Tamarack Rd. Midstream – Tamarack at Deaner Rd. Lower – Tamarack at M-82	Temperature, Hydrologic flow, Sediment	Avg Max Daily Summer Temp	HOBO Data Logger	3 yr interval: summer	MRWA with assistance from Resource Committee Board Members
		Bank Erosion Hazard Index	SOP Assessing Bank Erosion Potential using Rosgen's Bank Erosion Hazard Index – prepared by Joe Rathbun, MDEQ	1 time/year	MRWA – volunteer monitors
		Hydrologic Assessment	MDEQ	Done in 2007	MRWA in partnership with AWRI
		Stream Habitat Assessment	Volunteer Monitoring Program - MICorps	1 time/year	MRWA – volunteer monitors
		Benthic Macroinvertebrate Assessment	Volunteer Monitoring Program - MICorps	2 times/year	MRWA – volunteer monitors
West Branch of the Clam River Upper – confluence of Middle and North Branch of the Clam at Meyering Rd.	Temperature, Hydrologic flow, Sediment	Avg Max Daily Summer Temp	HOBO Data Logger	3 yr interval: summer	MRWA with assistance from Resource Committee Board Members
		Bank Erosion Hazard Index	SOP Assessing Bank Erosion Potential using Rosgen's Bank Erosion Hazard Index – prepared by Joe Rathbun, MDEQ	1 time/year	MRWA – volunteer monitors
		USGS Gage Station at Vogel Center	Application of the Richards – Baker Flashiness Index to Gaged Michigan Rivers and Streams	3 yr interval	MRWA with assistance from Resource Committee Board Members

TABLE 57. RECOMMENDED EVALUATION TECHNIQUES TO MONITOR SUCCESS OF IMPLEMENTATION EFFORTS (CONT.)

Monitoring Site	Parameter Target	Type of Analysis	Protocol	Frequency	Test Agent
Inventoried Subwatersheds (cont.)					
West Branch of the Clam River (cont.) Midstream – West Branch of the Clam at Kirby Road Lower – West Branch of the Clam at Cook Ave.	Temperature, Hydrologic flow, Sediment	Stream Habitat Assessment	Volunteer Monitoring Program - MICorps	1 time/year	MRWA – volunteer monitors
		Benthic Macroinvertebrate Assessment	Volunteer Monitoring Program - MICorps	2 times/year	MRWA – volunteer monitors
Lower Clam River Upper – Clam at Stoney Corners Rd. Midstream – Clam at Keehn Rd. Lower – Clam at Haskell Lake Rd.	Temperature, Hydrologic flow, Sediment	Avg Max Daily Summer Temp	HOBO Data Logger	3 yr interval: summer	MRWA with assistance from Resource Committee Board Members
		Bank Erosion Hazard Index	SOP Assessing Bank Erosion Potential using Rosgen's Bank Erosion Hazard Index – prepared by Joe Rathbun, MDEQ	1 time/year	MRWA – volunteer monitors
		USGS Gage Station at Vogel Center	Application of the Richards – Baker Flashiness Index to Gaged Michigan Rivers and Streams	3 yr interval	MRWA with assistance from Resource Committee Board Members
		Stream Habitat Assessment	Volunteer Monitoring Program - MICorps	1 time/year	MRWA – volunteer monitors
		Benthic Macroinvertebrate Assessment	Volunteer Monitoring Program - MICorps	2 times/year	MRWA – volunteer monitors
Watershed - Wide					
Upper Watershed – Roscommon Cty. to Twin Creek and City of Evart	Temp, Hydro. flow, Sediment, Nutrients, Toxic Substances, *E. coli*/fecal coliform	Stream Habitat Assessment	EPA Rapid Bioassessment	5 yr. interval	MDEQ Water Bureau Staff
		Benthic Macroinvertebrates	EPA Rapid Bioassessment	5 yr. interval	MDEQ Water Bureau Staff
		USGS Gage Station throughout watershed	Application of the Richards – Baker Flashiness Index to Gaged Michigan Rivers and Streams	3 yr interval	MRWA with assistance from Resource Committee Board Members

TABLE 57. RECOMMENDED EVALUATION TECHNIQUES TO MONITOR SUCCESS OF IMPLEMENTATION EFFORTS (CONT.)

Monitoring Site	Parameter Target	Type of Analysis	Protocol	Frequency	Test Agent
Watershed – Wide (cont.)					
Middle Watershed – Twin Crk. and city of Evart to Newaygo Cty. at Sand Crk. Lower Watershed – Newaygo Cty. at Sand Crk. to outlet of Muskesgon Lake to Lake MI	Temp, Hydro. flow, Sediment, Nutrients, Toxic Substances, *E. coli*/fecal coliform	Temperature	Cooperative Lakes Monitoring Program	1 time/year	Michigan Lakes and Stream Association Members
		Dissolved Oxygen	Cooperative Lakes Monitoring Program	1 time/year	Michigan Lakes and Stream Association Members
		Total Phosphorus	Cooperative Lakes Monitoring Program	1 time/year	Michigan Lakes and Stream Association Members
		Chlorophyll a	Cooperative Lakes Monitoring Program	1 time/year	Michigan Lakes and Stream Association Members
		Sediment Contamination Remedial Investigation	MDEQ	5 yr interval (when funds available)	MDEQ
		Beach Monitoring	MDEQ	1 time/year: summer	Muskegon County Health Department in partnership with AWRI, Central Michigan District Health Department, District Health Department No. 10

TABLE 58. RECOMMENDED MANAGERIAL AND INFORMATION/EDUCATION PRACTICES FOR THE ENTIRE MUSKEGON RIVER WATERSHED WITH EVALUATION TECHNIQUES TO MONITOR SUCCESS OF IMPLEMENTATION EFFORTS

Managerial and I/E Practices	Quantity	Evaluation Measures
General Public/Stakeholders		
Watershed Stakeholder Meetings	4 meetings/yr	Sign up sheet to record members present and their organizations – if not a diverse group of stakeholders present than organize a plan to get diverse watershed stakeholders to the table.
Watershed Information and Education Committee Meetings	12 mtg/yr	Sign up sheet to record members present and their organizations – if not a diverse group of stakeholders present than organize a plan to get diverse watershed stakeholders to the table.
BMP Site Tours	3 tours/yr	Before and after knowledge surveys of tour participants.
Volunteer Monitoring	2 monitoring days/yr 2 training days/yr	Survey volunteers before and after, record the number of monitoring stations before and after, record findings and track over time.
Annual Meeting	1 meeting/yr	Sign up sheet to record members present and their organizations – if not a diverse group of stakeholders present than organize a plan to get diverse watershed stakeholders to the table.
Newsletter	Quarterly River View Newsletter	Number of people on the mailing list; create a "map" to determine gaps in the watershed where people aren't receiving the newsletter and add them to the mailing list; record number of new entries and their locations in the watershed.
Stakeholders Outreach/Communications	Quarterly Stakeholder Newsletter	Record number of newspapers that the information is going to; create a "map" to determine gaps in the watershed where people aren't receiving information on the watershed and find out their media outlets; record number of new stakeholder outreach tools that are used.
Stewardship Month Activities	Annual MRW Stewardship Month	Record number of stewardship month activities every year; record the number of participants; identify areas where there is a lot of participation and expand on this area to develop new programs for the following years.
MRWA Survey I, II, & III	3 surveys and results	Record the number of surveys returned and how awareness and education of watershed stakeholders have changed over time.
Watershed Libraries	3 sites at public libraries & 1 online library	Record the number of people using the watershed information at the public libraries and specific information they are looking at.
Enhancement of MRWA Website		Record the number of hits on the website before and after enhancement.
Muskegon River Watershed Assembly Recognition Program	6 plaques/yr x 5 yrs	Record the organizations/individuals who are recognized and the type of activity they accomplished.
MRWA Information Sheets	2 information sheets (10,000 copies, 2-3 color, 8.5x11)	Conduct a before and after survey to see if watershed stakeholders read the information sheets and retained any of the information.
EnviroScape	EnviroScape	Record number of events where Envrioscape presented.

TABLE 58. RECOMMENDED MANAGERIAL AND INFORMATION/EDUCATION PRACTICES FOR THE ENTIRE MUSKEGON RIVER WATERSHED WITH EVALUATION TECHNIQUES TO MONITOR SUCCESS OF IMPLEMENTATION EFFORTS (CONT.)

Managerial and I/E Practices	Quantity	Evaluation Measures
General Public/Stakeholders (cont.)		
Magnets, other Giveaways and Saleable Items	10,000 magnets, 1000 tote bags, 1000 calendars	Record the number of giveaways given out and the events where they were available.
Muskegon River Traveling Display	Graphics	Record the number of places that display is exhibited.
Develop a Set of Fun Facts	---	Conduct a before and after survey to see if watershed stakeholders read the information sheets and retained any of the information.
Muskegon River Media	5 Signs/ Billboards, Newspaper:1 insert/yr x 2 papers x 5 yrs -10,000 color copies, Video: 1 30-minute watershed video, Radio: Series of radio spots	Conduct a survey to see how many watershed stakeholders have heard or seen the Muskegon River media products and include questions regarding information presented to see if they have gained knowledge from these media outlets.
Agricultural Producers/Stakeholders		
Cost-share promotional mailer	1 mailer 11x6 5,000 color copies	Conduct a before and after survey to see if watershed stakeholders read the information sheets and retained any of the information.
Articles in Specialty Publications	A minimum of 5 articles/yr	Record number of newspapers that the information is going to; create a "map" to determine gaps in the watershed where people aren't receiving information on the watershed and find out their media outlets; record number of new stakeholder outreach tools that are used.
Partnerships with Agricultural Service Providers	---	Record number of current partnerships with agricultural service producers; determine gaps in the watershed where partnerships are needed; record number of new partnerships created.
Show Participation	Estimate 3 shows/yr	Record number of people that visit the booth at the shows and the types of material that is being viewed and picked up; use this information to provide focus to the types of information that you present and bring to future shows.
Coffee Talk	9 groups (1 each county) x 1mtg/yr x 5 yrs = 45 mtgs	Record number of participants in "coffee talks"; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future meetings.
Nutrient Management Field Day	Formation of group to discuss ag issues. 4 field days	Record number of participants in nutrient management field days; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future field days.
Michigan Lake and Stream Associations with MSU;USDA-NRCS Programs and Trainings	4 programs/ trainings 4 follow-up tours	Record number of participants involved in trainings and tours; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future trainings and tours.

TABLE 58. RECOMMENDED MANAGERIAL AND INFORMATION/EDUCATION PRACTICES FOR THE ENTIRE MUSKEGON RIVER WATERSHED WITH EVALUATION TECHNIQUES TO MONITOR SUCCESS OF IMPLEMENTATION EFFORTS (CONT.)

Managerial and I/E Practices	Quantity	Evaluation Measures
Agricultural Producers/Stakeholders (cont.)		
Demonstration Farms for Education	5 demo. days	Record number of people visiting demonstration farms; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future demonstration days.
Conservation Easements	1 informational meeting/year	Record number of people attending information meeting; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future informational meetings.
Riparian/Stakeholders		
Support Volunteer Monitoring Efforts and Involvement	---	Research other possible monitoring groups in watershed; contact these groups and coordinate monitoring efforts with those of MRWA; advertise efforts in the MRWA newsletter.
Support the Establishment of Local Stewardship Teams	---	Research other possible stewardship teams within watershed; contact these groups and coordinate stewardship efforts with those of MRWA; advertise the groups efforts in the MRWA newsletter.
Print Muskegon River Watershed Information in Newsletters	Articles written for other newslt.	Record number of newspapers that the information is going to; create a "map" to determine gaps in the watershed where people aren't receiving information on the watershed and find out their media outlets; record number of new stakeholder outreach tools that are used.
Develop a MRW Riparian Landowner's Guide	Currently in production by AWRI	Record number of landowner's guides printed; document where the guide's are being mailed to; create a "map" to determine gaps in the watershed where this information should be sent.
Coordinate Residential Shoreline & Streamside Buffers and BMP Training	4 landscape-based trainings/yr (in Spring)	Record number of people attending trainings; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future trainings.
Information Kiosk	10 kiosks throughout watershed	Record number of people that visit the kiosk and the types of material that is being viewed and picked up; use this information to provide focus to the types of information that is presented at the kiosk.
Homeowners Advertising Campaign	Variety of media outputs	Target a specific area for advertising campaign; conduct a survey before media outputs available to determine awareness of homeowners on water quality issues; record number of media outputs printed and the types; document where the information is being mailed to and the events where the information was handed out; conduct a post survey to see if awareness of homeowners in target area has increased.
Presentations/ Workshops/ Training for Riparian Homeowners	8 riparian homeowner trainings/yr (4 in Fall & 4 in Spring)	Record number of people attending trainings; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future trainings.
Storm Drain Stenciling Program	Stenciling in 6 urban centers over 5 yrs.	Before and after photographs; document the number of sites stenciled; before and after surveys of drain stencil program to determine knowledge gained.

TABLE 58. RECOMMENDED MANAGERIAL AND INFORMATION/EDUCATION PRACTICES FOR THE ENTIRE MUSKEGON RIVER WATERSHED WITH EVALUATION TECHNIQUES TO MONITOR SUCCESS OF IMPLEMENTATION EFFORTS (CONT.)

Managerial and I/E Practices	Quantity	Evaluation Measures
Riparian/Stakeholders (cont.)		
Septic System Maintenance Program	---	Target a specific area for maintenance program; conduct a survey to determine awareness of homeowners on septic system maintenance; record number of media outputs printed and the types; document where the information is being mailed to and the events where the information was handed out; conduct a post survey to see if awareness has increased.
Conservation Easements	1 informational meeting/year	Record number of people attending information meeting; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future informational meetings.
Recreational Users of the Watershed/Stakeholders		
Watershed Information Signage	Signage at various access points (20 signs over 5 yrs)	Target a specific area to establish watershed signage; conduct a survey to determine awareness of recreational users on water quality issues before establishment of signs; conduct a post survey to see if awareness of recreational users in target area has increased.
Implement Conservation Practices	---	Record number of people implementing conservation practices and in what area; create a "map" to determine areas in the watershed where conservation practices should be implemented; recruit other individuals to adopt these practices.
Provide a Series of Educational Workshops	2 workshops/yr	Record number of people attending workshops; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future workshops.
Increase Access to Conservation Products & Plant Materials	2 Vendor Fairs/yr	Record number of people that attend the vendor fairs and the types of products/plant materials they are interested in; use this information to provide focus to the types of vendors that participate in future fairs.
Muskegon River Greenways and Walking Trails	Signage and Maps along Trail ways	Target a specific area to establish signage; conduct a survey to determine awareness of recreational users before establishment of signs; conduct a post survey to see if awareness of recreational users in target area has increased.
Partnering with Recreational Businesses & Tourism Outlets	---	Record number of current partnerships with recreational businesses and tourism outlets; determine gaps in the watershed where partnerships are needed; record number of new partnerships created.
Integrate Information with Existing Publications	---	Record number of publications that the information is going to; create a "map" to determine gaps in the watershed where people aren't receiving information on the watershed and find out their media outlets; record number of new stakeholder outreach tools that are used.
Local Government Officials/Stakeholders		
Local Government Recognition Campaign	---	List current activities that local governments in the watershed are doing to protect water quality; recognize municipalities that are promoting water quality efforts in their area; provide materials and trainings for local governments that may not be promoting water quality efforts.

TABLE 58. RECOMMENDED MANAGERIAL AND INFORMATION/EDUCATION PRACTICES FOR THE ENTIRE MUSKEGON RIVER WATERSHED WITH EVALUATION TECHNIQUES TO MONITOR SUCCESS OF IMPLEMENTATION EFFORTS (CONT.)

Managerial and I/E Practices	Quantity	Evaluation Measures
Local Government Officials/Stakeholders (cont.)		
Demonstration Site Tours	3 tours/yr	Record number of people attending tours; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future tours.
GIS Development Activities	---	Research current local governments that have GIS capability; organize a packet of information which provides resources for local governments that do not have this ability.
Storm Water Policy and Management	MRWA official stormwater policy	Research current storm water policy and management for each local government; provide information to those that do not follow MRWA official stormwater policy; record number of municipalities that have "adopted" the MRWA stormwater policy.
Ecological Services and Economic Benefits	2 information dissemination based meetings	Record number of people attending meetings; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future meetings.
Promote the Establishment of Funds at Community Foundations for Municipalities	---	Research current funds at community foundations for municipalities; conduct "working" meetings with foundations and local municipalities to establish these funds; record number of municipalities that have these funds available after these efforts.
Stewardship Month Activities/Participation/Sponsorship	---	Record number of stewardship month activities that local municipalities involved in every year; record the number of participants; identify areas where there is a lot of participation and expand on this area to develop new programs for the following years.
Critical "Sensitive" Areas Maps	---	Talk with local municipalities on the types of maps that they might need to help address water quality issues; create critical areas maps; survey the participating municipalities afterwards to see how useful the maps are and if they are used in site plan reviews and in planning decisions.
Workshops/Presentations for Local Boards and Planning commissions	5 workshops/yr	Record number of people attending workshops; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future workshops.
Promote Distribution of Watershed Information through Municipal Zoning and Building Offices	---	Record number of municipal zoning and buildings office where information was made available; record numbers of brochures, flyers, etc. set out and determine amount of information taken.
Partner with Michigan Township Associations	---	Establish a partnership with Michigan Township Association; establish MRWA link on MTA website; record number of projects where MTA is one of the partners.
Master Plan and Zoning Ordinance Review	1 community/yr	Record number of participating municipalities; provide pre and post surveys to participants to see what they learned and if it was useful; determine the number of municipalities that adopted revised language provided by this review.

TABLE 58. RECOMMENDED MANAGERIAL AND INFORMATION/EDUCATION PRACTICES FOR THE ENTIRE MUSKEGON RIVER WATERSHED WITH EVALUATION TECHNIQUES TO MONITOR SUCCESS OF IMPLEMENTATION EFFORTS (CONT.)

Managerial and I/E Practices	Quantity	Evaluation Measures
Commercial Businesses and Industries/Stakeholders		
Watershed Stewardship Opportunities	---	Include commercial businesses and industries on MRWA newsletter to make them aware of watershed stewardship opportunities; record the number of watershed stewardship events where commercial businesses and industries are partners.
Articles in Specialty Publications	Articles written for publications	Record number of publications that the information is going to; create a "map" to determine gaps in the watershed where people aren't receiving information on the watershed and find out their media outlets; record number of new stakeholder outreach tools that are used.
Event Participation	Participation in 1 Show/ yr	Record number of people that visit the booth at the shows and the types of material that is being viewed and picked up; use this information to provide focus to the types of information that you present and bring to future shows.
Training Programs Directed at the Construction Business	4 trainings and/or site tours each year	Record number of people attending trainings; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future trainings.
Partnerships with Area Builders	---	Record number of current partnerships with area builders; determine gaps in the watershed where partnerships are needed; record number of new partnerships created.
Partnerships with Community Leaders	---	Record number of current community leaders; determine gaps in the watershed where partnerships are needed; record number of new partnerships created.
Communications Industry Partnerships	---	Record number of current industry; determine gaps in the watershed where partnerships are needed; record number of new partnerships created.
K-12 Educators, Students, & Community Education/Stakeholders		
Educator Workshops	---	Record number of people attending workshops; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future workshops; collect information from educators on how the information they learned will be applied in the classroom.
Michigan Envirothon	---	Research current envirothon subjects on water quality issues and determine historical number of student teams annually; work with existing educators to create a water quality subject and record number of student teams annually.
The Watershed Classroom	Water quality activities each year	Record the numbers of schools participating in event; work with the educators to create pre- and post tests on students to see how information provided as part of the watershed classroom has increased their awareness; also survey the educator to get feedback on the process for future water quality activities.
Watershed Lessons	Quarterly Advisory Committee Meetings	Record the numbers of schools participating in event; work with the educators to create pre- and post tests on students to see how information provided as part of the watershed lessons has increased their awareness; also survey the educator to get feedback on the process for future watershed lessons.

TABLE 58. RECOMMENDED MANAGERIAL AND INFORMATION/EDUCATION PRACTICES FOR THE ENTIRE MUSKEGON RIVER WATERSHED WITH EVALUATION TECHNIQUES TO MONITOR SUCCESS OF IMPLEMENTATION EFFORTS (CONT.)

Managerial and I/E Practices	Quantity	Evaluation Measures
K-12 Educators, Students, & Community Education/Stakeholders (cont.)		
Student Involvement	1 Summit/yr	Record number of students involved in summit; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future summits.
Muskegon River Science Festival	Annual Science Festival	Record number of participants in science festival; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future festivals.
Science/ Wetland Curriculum	---	Record the numbers of schools participating in event; work with the educators to create pre- and post tests on students to see how information provided as part of the science/wetland curriculum has increased their awareness; also survey the educator to get feedback on the process for future curriculum.
Conservation District Water Quality Action Teams (WAT)	---	Record the numbers of schools participating in event; work with the educators to create pre- and post tests on students to see how information provided as part of the WAT efforts has increased their awareness; also survey the educator to get feedback on the process for future WAT efforts.
Enviroscape Training	5 Enviroscape training sessions with volunteers	Record number of people attending training; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future trainings.
Community College Watershed Courses	---	Record the numbers of community colleges participating in event; work with the educators to create pre- and post tests on students to see how information provided as part of the watershed courses has increased their awareness; also survey the educator to get feedback on the process for future courses.
Muskegon River Watershed Camps	---	Record number of people attending watershed camps; provide pre and post surveys to participants to see what they learned and if it was useful; use the survey information to update format of future events and sessions at watershed camps.

14.8 COLLABORATION WITH OTHER SUBWATERSHED EFFORTS

The Muskegon River Watershed is one of the largest in Michigan, over 2,700 square miles, larger than the state of Delaware. The size of the Muskegon River Watershed made it necessary to develop and test new approaches and techniques to gather and disseminate information about problems and potential solutions for nonpoint source pollution. Within the two-year development phase of the watershed management plan, water quality impairments and threats were identified and implementation efforts to improve these areas were researched. However, not all of the current problems and potential problems could be identified and addressed within this framework.

To understand such a large system, additional 319 research efforts and non 319 efforts have been done at the subwatershed level. In the Muskegon River Watershed Project Evaluation developed by Dr. Paul Mavima and Ms. Jennifer DeHann in 2002, they recommended "localized studies of the different parts of the watershed should continue until a full analysis of the whole watershed has been completed". These studies will accurately identify the pollutants, effects, sources, and causes affecting different parts of the watershed, and will help to craft watershed management initiatives meeting the needs of each specific section of the watershed.

Although work is being done on a smaller subwatershed level, the overall mission is *"…to preserve, protect, and enhance the natural, historic, and cultural resources of the Muskegon River Watershed through educational and scientific initiatives, while supporting positive economic development, agricultural, and quality of life initiatives of organizations working in the river watershed"*. This goal is the mission of the Muskegon River Watershed Assembly (MRWA) which has become an effective long-time steward of the Muskegon River Watershed. In addition to collaborating on the development and implementation phases of the watershed management plan, the MRWA also works with several partners and stakeholder groups to coordinate, facilitate, partner and/or leverage financial support for other initiatives and project efforts at a subwatershed level. Other key (subwatershed) projects or initiatives (past / present / pending) within the Muskegon River watershed include:

1. Bear Creek & Bear Lake (Muskegon County) 319 Watershed Management Plan (March 2004); and subsequent Transition / Implementation 1 Project (2004-2007)
2. Brooks Creek (Fremont, Newaygo County) 319 Watershed Project (1991-1995); 1 year planning phase and 3 year implementation phase
3. Higgins Lake 319 Watershed Management Plan (Sept. 2002); and subsequent implementation efforts including biological control of Eurasian Watermilfoil (2004-2006)
4. Muskegon Lake 2002 Remedial Action Plan (RAP) Update - companion to the 1994 RAP Update and the 1987 RAP for the Muskegon Lake Area of Concern (AOC)
5. Muskegon Lake Watershed (319) Implementation Project (was pending for 2006-2008, but did not receive funding); update the phase II Muskegon Lake Watershed Mgt. Plan to 319 standards; update the 2002 RAP for Muskegon Lake; develop hydrologic / pollutant load model for Ruddiman Creek, Ryerson Creek and Division St. Outfall areas; design / construct 3 raingarden demonstration sites

6. Muskegon River (CMI) Education Project (2005-2007); focus on 1 critical subwatershed (Brooks Creek / Fremont, Newaygo County) to develop social profile & information / education targeted at local decision-makers & revise local ordinances in 2 townships
7. Muskegon River Water Monitoring (MiCorps) Program (2005-2007); recruit and train volunteers and provide equipment to conduct water monitoring and assessment of stream habitats during spring / fall annually throughout watershed; MRWA has allocated additional funds to continue monitoring program through 2009, emphasizing a subwatershed approach

In addition to the projects above, there have been a number of research efforts funded outside of the scope of Section 319 funds that have provided vital information to the status of the Muskegon River Watershed. Some of these projects are listed below:

1. A Collaborative Approach to Understanding the Dynamics of the Muskegon Watershed: A Comprehensive Model, Risk Assessment and Tools for Use in Management (Mega Model); funded by the Great Lakes Fisheries Trust; researchers from UM/SNRE, MSU, GVSU, MDNR, and a number of regional stakeholders organizations are collaborating to develop a model framework for risk assessment and ecosystem management in the Muskegon River Watershed.
2. Developing Sustainable Futures for the Muskegon River Watershed: A Decentralized Approach; funded by the Wege Foundation and the Fremont Area Community Foundation; the goal of the project was to develop a geographical information system (GIS) outreach tool, which was presented through an integrated information and education program.
3. Development and Use of Indices of Biotic Integrity (IBI) in Great Lake Coastal Wetlands; funded by MDEQ, USEPA, USGS, TNC, GLFT, USFWS; researchers developed and tested indices of biotic integrity for use in Great Lakes Coastal Wetlands (including the wetlands in the Muskegon River Watershed).
4. Ecological Assessment Project; funded by the Great Lakes Fisheries Trust; primary goal of the project is to develop and apply new methods for assessing the ecological integrity of aquatic ecosystems.
5. Muskegon Lake Long-Term Monitoring; funded by an endowment from the Community Foundation for Muskegon County; one of the major goals of the project is to observe short-term and long-term changes in the ecological health of Muskegon Lake.
6. Muskegon River Project; add-on to the Muskegon River Initiative, an existing Great Lakes Fisheries Trust project; the goal of the project is to measure algae and plant biomass, productivity, and species composition in the lower Muskegon Estuary system to be used in the Mega Model Project.
7. Non-Point Source Pollution Project; funding by U.S. Department of Education; the project is aimed at better understanding the impact of NPS pollution on lower trophic levels by conducting an experimental investigation that stimulates NPS-contributing events.
8. Integrated Economic and Environmental Analysis Model Project; funded by the Great Lakes Protection Fund; researchers from MSU developed and tested an on line

modeling tool that can document the economic and environmental costs associated with a development project.

MRWA committees also play a role in fostering, promoting and coordinating subwatershed efforts through collaboration. Specifically, a focus of the MRWA Education Committee is to continually identify key stakeholders and leaders at the subwatershed level and incorporate them into the MRWA as active stewards and collaborators. The MRWA Resource Committee consists of vested individuals from local, regional, state and federal resource agencies, organizations and institutions that provide technical advice and help develop and prioritize projects on a subwatershed scale. Both of these committees provide a venue for collaborative participation and information exchange regarding on-going and future project ideas / initiatives at the local level.

The MRWA also provides fiduciary / administrative services to partners as a means to engage and oversee collaborative subwatershed project initiatives. In this capacity, the MRWA strives to leverage additional dollars where possible for subwatershed projects to enhance project results and build partnerships.

Through the Muskegon River Watershed Research Partnership, academic researchers recognize that the MRWA plays a vital role in helping researchers connect with local constituents. Researchers often need local connections to fulfill research objectives and disseminate research findings among subwatershed stakeholder groups. This collaborative interaction also provides MRWA project partners access to the latest scientific information allowing them to better address subwatershed issues.

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