Pollutant Loadings in the Upper Macatawa

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Nutrients				
Agricultural Runoff	Agricultural Land is 58.1% of the total land in this subbasin 58.1% of Total TP Load (8,196)=4762 lbs TP 58.1% of TKN load (44,884)=26,078 lbs TKN Based on MDEQ Pollutant Loading Model 2009	Loss of wetlands	There is an estimated 1,949 acres of wetland loss in the agricultural areas of the Upper Macatawa. It is estimated that it accounts for 25% of the total agricultural load.	100%
		Lack of riparian buffers	There is approximately 69.6 km of waterways in the agricutural areas of the Upper Macatawa, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that is accounts for 10% of the total agricultural load.	
		Lack of BMPs	There is 10,765 acres of agricultural land in this subbasin. It is estimated that 65% of that land is lacking BMPs (6997 acres). It is estimated that it accounts for 50% of the total agricultural load.	
		Improper Use or over application of Agricultural Fertilizers/Manure	There is 10,765 acres of agricultural land in this subbasin. It is estimated that 25% of that land has undergone improper fertilizer use (2,691acres). It is estimated that it accounts for 6% of the total agricultural load.	
		Livestock Access	FTCH documented eleven possible locations throughout the subbasin that may be impacted by grazing. It is assumed that 9% of the total agricultural nutrient load is from livestock access (2011 Geomorphology Study).	
Urban/Residential Sources	Urban land is 23.6% of the total land in this subbasin 23.6% of Total TP Load (8196)=1,934 lbs TP 23.6% of TKN load (44,884)=10,593 lbs TKN Based on MDEQ Pollutant Loading Model 2009	Wetland Loss	There is an estimated 172 acres of wetland loss in the urban areas of the Upper Macatawa. It is estimated that it accounts for 31% of the total urban load.	100%
		Improper use or overapplication of fertilizers	There is 4372 acres of urban land in this subbasin. It is estimated that 35% of that land has undergone improper fertilizer use (1530 acres). It is estimated that it accounts for 10% of the total urban load.	
		Lack of riparian buffers	There is approximately 5.3 km of waterways in the urban areas of the Upper Macatawa, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 8% of the total urban load.	
		Poor storm water mgt practices	There is 4372 acres of urban land in this subbasin. It is estimated that 60% of that land has poor storm water management (2623 acres). It is estimated that it accounts for 50% of the total urban load.	
		Car Washing	There is an unknown number of discharges from community car washing events. This is a low priority recommended for further study. It is assumed that 1% of the total urban nutrient load coming from this source.	
Untreated Sewage	LOW PRIORITY, UNKNOWN	Failing Septic Systems	Failing septic systems are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient load. The septic system risk analysis completed by the MACC estimates that there are 820 parcels at high risk for septic system maintenance issues or failure. It is estimated that it accounts for 90% of the total load which has not been quantified.	100%
		Illicit Connections	Illicit connections are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient load. More monitoring is required to quantify this further. It is estimated that it accounts for only 10% of the total load which has not been quantified.	

Pollutant Loadings in the Upper Macatawa

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Sediment				
Agricultural Runoff	Agricultural Land is 58.1% of the total land in this subbasin 58.1% of TSS load (2,686,070)=1,560,607 lbs TSS Based on MDEQ Pollutant Loading Model 2009	Loss of wetlands	There is an estimated 1,949 acres of wetland loss in the agricultural areas of the Upper Macatawa. It is estimated that it accounts for 25% of the total agricultural load.	100%
		Lack of riparian buffer	There is approximately 69.6 km of waterways in the agricutural areas of the Upper Macatawa, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that is accounts for 25% of the total agricultural load.	
		Lack of BMPs	There is 10,765 acres of agricultural land in this subbasin. It is estimated that 65% of that land is lacking BMPs (6997 acres). It is estimated that it accounts for 50% of the total agricultural load.	
Urban Stormwater	Urban land is 23.6% of the total land in this subbasin 23.6% of Total TSS Load (2,686,070)=633,913 lbs TSS Based on MDEQ Pollutant Loading Model 2009	Storm Drains/ Impervious Surfaces	There is 18,528 total acres in this subbasin and 7% is impervious (1,355 acres). It is estimated that it accounts for 45% of the total urban load.	100%
		Loss of wetlands	There is an estimated 172 acres of wetland loss in the urban areas of the Upper Macatawa. It is estimated that it accounts for 50% of the total urban load.	
		Construction Sites	Construction sites are of low priority because they are intermittent and scattered and regulated locally for soil erosion and sedimentation control. It is estimated that it only accounts for 5% of the total urban load.	
Streambanks	In stream sediment loading estimates from the 2011 Geomorphology Report are 435 tons annually.	Erosion (loss of vegation and logjams)	It is assumed that 92% of the total streambank sediment load is from streambank erosion and logjams (based on FTCH records from other subbasins).	100%
		Livestock Access	FTCH documented eleven possible locations throughout the subbasin that may be impacted by grazing. It is assumed that 4% of the total agricultural sediment load is from livestock access (2011 Geomorphology Study).	
Road Stream Crossings		Improper design, alignment or maintenance	There are 13 moderate risk RSXs and 2 high risk RSX in this subbasin according to the Bank Erosion Hazard Index (2009). It is assumed that 3% of the total streambank sediment load is from public road stream crossings.	
		Erosion at private crossings	There is an unknown number of eroding private crossings. This is a low priority recommended for further study. It is assumed that 1% of the total streambank sediment load is from erosion form private road crossings.	
Pollutant: Hydrology				
Agricultural Runoff	Hydrology impacts cannot be quantified as a traditional load. Hydrology impacts include changes in flows, timing of peak flows and duration of high flows.	Drain Tiling and Artifical Drainage	There is 10,765 acres of agricultural land in this subbasin. It is estimated that at least 40% of that land is drained (4306 acres). There is also 378,983 ft of stream in the subbasin (approximately 30% is considered county drain).	NA
		Wetland Loss	There is an estimated 1,949 acres of wetland loss in the agricultural areas of the Upper Macatawa.	NA
Urban/Residential Runoff		Impervious Surfaces and Storm Drains	There is 18,528 total acres in this subbasin and 7% is impervious (1,355 acres).	NA
		Wetland Loss	There is an estimated 172 acres of wetland loss in the urban areas of the Upper Macatawa.	NA
Road Stream Crossings		Improper design or maintenance (hydraulics)	There are a total number of 119 road stream crossings in the subbasin.There are 13 moderate risk RSXs and 2 high risk RSX in this subbasin according to the Bank Erosion Hazard Index (2009).	NA

Pollutant Loadings in the Upper Macatawa

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Temperature				
Urban/Residential Runoff	Temperature impacts cannot be quantified as a traditional load. Temperature impacts include any process that increases the temperature of surface water beyond the limits of the normal range suitable for a warm water fishery. Warm water fisheries in Michigan thrive up to 26 degrees Celsius (78.8 deg F) according to Wehrly et al. 1999. In addition, Part 4 rules indicate that summer temperatures cannot exceed 85 deg F in August.	Impervious Surfaces/Storm Drains	There is 18,528 total acres in this subbasin and 7% is impervious (1,355 acres).	NA
		Lack of riparian buffers	There is approximately5.3 km of waterways in the urban areas of the Upper Macatawa, categorized as having poor buffer (2011 Geomorphology Study).	NA
Agricultural Runoff		Lack of riparian buffers	There is approximately 69.6 km of waterways in the agricutural areas of the Upper Macatawa, categorized as having poor buffer (2011 Geomorphology Study).	NA
		Tiling and Artifical Drainage	There is 10,765 acres of agricultural land in this subbasin. It is estimated that at least 40% of that land is drained (4306 acres). There is also 378,983 ft of stream miles in the subbasin (approximately 30% is considered county drain).	NA
Pollutant: E. coli				
Agricultural Runoff	Impacts from *E.coli* bacteria cannot be quantified as a typical load. *E.coli* bacteria impacts a surface water body when measured levels exceed State water quality standards for total body contact (>130 *E.coli* per 100 milliliters) and/or partial body contact (>1000 *E.coli* per 100 milliliters). The following sources and causes are suspected. More monitoring needs to be completed to confirm each source.	Manure Applications	There is 10,765 acres of agricultural land in this subbasin that could be using manure for fertilizer.	NA
		Biofilms in drain tiles	There is 10,765 acres of agricultural land in this subbasin. It is estimated that at least 40% of that land is drained (4306 acres). There is potential for *E.coli* to grow inside tile drains.	NA
		Livestock Access	FTCH documented eleven possible locations throughout the subbasin that may be impacted by grazing.	NA
Urban/Residential Runoff		Biofilms in Storm Drains	There is 4,372 acres of urban land in this subbasin. There is 7% impervious surface. The Ottawa Co Road Commission may own enclosed storm drains in this subbasin. There is potential for *E.coli* to grow inside storm drains.	NA
		Improper Disposal Pet Waste	Disposal of pet waste in urban areas may be a problem. There is 4,372 acres of urban land in this subbasin. There is 7% impervious surface. The frequency of improper disposal is unknown.	NA
Untreated Sewage		Failing Septic Systems	Failing septic systems are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient.The septic system risk analysis completed by the MACC estimates that there are 820 parcels at high risk for septic system maintenance issues or failure.	NA
		Sewer Overflows	Sewer overflows and illicit connections are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total *E.coli* load. More monitoring is required to quantify this further.	NA
		Illicit Connections		NA

Pollutant Loadings in Peters Creek

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Nutrients				
Agricultural Runoff	Agricultural Land is 80.4% of the total land in this subbasin 80.4% of Total TP Load (3,440)=2,766 lbs TP 80.4% of TKN load (18,359)=14,761 lbs TKN Based on MDEQ Pollutant Loading Model 2009	Loss of wetlands	There were almost no historic wetlands located in the Peters Creek subbasin. Therefore, wetland loss is not a concern in the this subbasin.	100%
		Lack of riparian buffers	There is approximately 40.4 km of waterways in the agricutural areas of Peters Creek, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 25% of the total agricultural load.	
		Lack of BMPs	There is 7,314 acres of agricultural land in this subbasin. It is estimated that 65% of that land is lacking BMPs (4754 acres). It is estimated that it accounts for 60% of the total agricultural loads.	
		Improper Use or over application of Agricultural Fertilizers/Manure	There is 7,314 acres of agricultural land in this subbasin. It is estimated that 25% of that land subject to improper fertilizer use (1829 acres). It is estimated that it accounts for 12% of the total agricultural load.	
		Livestock Access	FTCH documented two possible locations throughout the subbasin that may be impacted by grazing. It is assumed that 3% of the total agricultural nutrient load is from livestock access (2011 Geomorphology Study).	
Urban/Residential Sources	Urban land is 5.4% of the total land in this subbasin 5.4% of Total TP Load (3,440)=186 lbs TP 5.4% of TKN load (18,359)=991 lbs TKN Based on MDEQ Pollutant Loading Model 2009	Wetland Loss	There were almost no historic wetlands located in the Peters Creek subbasin. Therefore, wetland loss is not a concern in the this subbasin	100%
		Improper use or overapplication of fertilizers	There is 491 acres of urban land in this subbasin. It is estimated that 25% of that land subject to improper fertilizer use (123 acres). It is estimated that it accounts for 15% of the total urban load.	
		Lack of riparian buffers	There is very little urban land in the watershed. There is approximately 40.4 km of waterways in Peters Creek, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 25% of the total urban load.	
		Poor storm water mgt practices	There is 491 acres of urban land in this subbasin. It is estimated that 60% of that land has poor storm water management (246 acres). It is estimated that it accounts for 59% of the total urban load.	
		Car Washing	There is an unknown number of discharges from community car washing events. This is a low priority recommended for further study. It is assumed that 1% of the total urban nutrient load coming from this source.	
Untreated Sewage	LOW PRIORITY, UNKNOWN	Failing Septic Systems	Failing septic systems are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient.The septic system risk analysis completed by the MACC estimates that there are 280 parcels at high risk for septic system maintenance issues or failure. It is estimated that it accounts for 90% of the total load which has not been quantified.	100%
		Illicit Connections	Illicit connections are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient load. More monitoring is required to quantify this further. It is estimated that it accounts for only 10% of the total load which has not been quantified.	

Pollutant Loadings in Peters Creek

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Sediment				
Agricultural Runoff	Agricultural Land is 80.4% of the total land in this subbasin 80.4% of Total TSS Load (1,280,554)=1,029,565 lbs TSS Based on MDEQ Pollutant Loading Model 2009	Loss of wetlands	There were almost no historic wetlands located in the Peters Creek subbasin. Therefore, wetland loss is not a concern in the this subbasin	100%
		Lack of riparian buffer	There is approximately 40.4 km of waterways in the agricutural areas of Peters Creek, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 25% of the total agricultural load.	
		Lack of BMPs	There is 7,314 acres of agricultural land in this subbasin. It is estimated that 65% of that land is lacking BMPs (4754 acres). It is estimated that it accounts for 75% of the total agricultural loads.	
Urban Stormwater	Urban land is 5.4% of the total land in this subbasin 5.4% of Total TSS Load (1,280,554)=69,150 lbs TSS Based on MDEQ Pollutant Loading Model 2009	Storm Drains/ Impervious Surfaces	There is 9,102 total acres in this subbasin and 1% is impervious (98 acres). It is estimated that it accounts for 80% of the urban load.	100%
		Loss of wetlands	There were almost no historic wetlands located in the Peters Creek subbasin. Therefore, wetland loss is not a concern in the this subbasin	
		Construction Sites	Construction sites are of low priority because they are intermittent and scattered and regulated locally for soil erosion and sedimentation control. It is estimated that it only accounts for 20% of the total urban load.	
Streambanks	In stream sediment loading estimates from the 2011 Geomorphology Report are 377 tons annually.	Erosion (loss of vegetion and logjams)	It is assumed that 95% of the total streambank sediment load is from streambank erosion and logjams (based on FTCH records for other parts of the watershed).	100%
		Livestock Access	FTCH documented two locations throughout the subbasin that may be impacted by grazing. It is assumed that 1% of the total streambank load is from livestock access	
Road Stream Crossings		Improper design, alignment or maintenance	There are 7 moderate risk RSXs and 1 high risk RSX in this subbasin according to the Bank Erosion Hazard Index (2009). It is assumed that 3% of the total streambank sediment load is from public road stream crossings.	
		Erosion at private crossings	There is an unknown number of eroding private crossings. This is a low priority recommended for further study. It is assumed that 1% of the total streambank sediment load is from erosion form private road crossings.	
Pollutant: Hydrology				
Agricultural Runoff	Hydrology impacts cannot be quantified as a traditional load. Hydrology impacts include changes in flows, timing of peak flows and duration of high flows.	Drain Tiling and Artifical Drainage	There is 7,314 acres of agricultural land in this subbasin. It is estimated that at least 50% of that land is drained (3651 acres). There is also 117,426 ft of stream in the subbasin (approximately 15% is considered county drain).	NA
		Wetland Loss	There were almost no historic wetlands located in the Peters Creek subbasin. Therefore, wetland loss is not a concern in the this subbasin	NA
Urban/Residential Runoff		Impervious Surfaces and Storm Drains	There is 9,102 total acres in this subbasin and 1% is impervious (98 acres).	NA
		Wetland Loss	There were almost no historic wetlands located in the Peters Creek subbasin. Therefore, wetland loss is not a concern in the this subbasin	NA
Road Stream Crossings		Improper design or maintenance (hydraulics)	There are a total number of 51 road stream crossings in the subbasin.There are 7 moderate risk RSXs and 1 high risk RSX in this subbasin according to the Bank Erosion Hazard Index (2009).	NA

Pollutant Loadings in Peters Creek

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Temperature				
Urban/Residential Runoff	Temperature impacts cannot be quantified as a traditional load. Temperature impacts include any process that increases the temperature of surface water beyond the limits of the normal range suitable for a warm water fishery. Warm water fisheries in Michigan thrive up to 26 degrees Celsius (78.8 deg F) according to Wehrly et al. 1999. In addition, Part 4 rules indicate that summer temperatures cannot exceed 85 deg F in August.	Impervious Surfaces/Storm Drains	There is 9,102 total acres in this subbasin and 1% is impervious (98 acres).	NA
		Lack of riparian buffers	There is very little urban land in the watershed. There is approximately 40.4 km of waterways in Peters Creek, categorized as having poor buffer (2011 Geomorphology Study).	NA
Agricultural Runoff		Lack of riparian buffers	There is approximately 40.4 km of waterways in the agricutural areas of Peters Creek, categorized as having poor buffer (2011 Geomorphology Study).	NA
		Tiling and Artifical Drainage	There is 7,314 acres of agricultural land in this subbasin. It is estimated that at least 50% of that land is drained (3651 acres). There is also 117,426 ft of stream miles in the subbasin (approximately 15% is considered county drain).	NA
Pollutant: E. coli				
Agricultural Runoff	Impacts from *E.coli* bacteria cannot be quantified as a typical load. *E.coli* bacteria impacts a surface water body when measured levels exceed State water quality standards for total body contact (>130 *E.coli* per 100 milliliters) and/or partial body contact (>1000 *E.coli* per 100 milliliters). The following sources and causes are suspected. More monitoring needs to be completed to confirm each source.	Manure Applications	There is 7,314 acres of agricultural land in this subbasin that could be using manure for fertilizer.	NA
		Biofilms in drain tiles	There is 7,314 acres of agricultural land in this subbasin. It is estimated that at least 50% of that land is drained (3651 acres).There is potential for *E.coli* to grow inside tile drains.	NA
		Livestock Access	FTCH documented two locations throughout the subbasin that may be impacted by grazing.	NA
Urban/Residential Runoff		Biofilms in Storm Drains	There is 491 acres of urban land in this subbasin. There is 2% impervious surface. The Allegan County Drain Commission may own enclosed storm drains in this subbasin. There is potential for *E.coli* to grow inside storm drains.	NA
		Improper Disposal Pet Waste	Disposal of pet waste in urban areas may be a problem. There is 491 acres of urban land in this subbasin. There is 2% impervious surface. The frequency of improper disposal is unknown.	NA
Untreated Sewage		Failing Septic Systems	Failing septic systems are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient.The septic system risk analysis completed by the MACC estimates that there are 280 parcels at high risk for septic system maintenance issues or failure.	NA
		Sewer Overflows	Sewer overflows and illicit connections are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total *E.coli* load. More monitoring is required to quantify this further.	NA
		Illicit Connections		NA

Pollutant Loadings in the South Branch of the Macatawa River

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Nutrients				
Agricultural Runoff	Agricultural Land is 74.9% of the total land in this subbasin 74.9% of Total TP Load (6,109)=4,576 lbs TP 74.9% of TKN load (33,271)=24,920 lbs TKN Based on MDEQ Pollutant Loading Model 2009	Loss of wetlands	There is an estimated 3,104 acres of wetland loss in the agricultural areas of the South Branch. It is estimated that it accounts for 25% of the total agricultural load.	100%
		Lack of riparian buffers	There is approximately 40.5 km of waterways in the agricutural areas of the South Branch, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 10% of the total agricultural load.	
		Lack of BMPs	There is 11,234 acres of agricultural land in this subbasin. It is estimated that 65% of that land is lacking BMPs (7302 acres). It is estimated that it accounts for 55% of the total agricultural load.	
		Improper Use or over application of Agricultural Fertilizers/Manure	There is 11,234 acres of agricultural land in this subbasin. It is estimated that 25% of that land subject to improper fertilizer use (2809 acres). It is estimated that it accounts for 9% of the total agricultural load.	
		Livestock Access	FTCH did not documented any possible locations throughout the subbasin that may be impacted by grazing. Almost all of the livestock operations are confined animal feeding operations. Based on local knowledge we knowof at least one horse farm in this area. It is assumed that 1% of the total agricultural nutrient load is from livestock access (2011 Geomorphology Study).	
Urban/Residential Sources	Urban land is 10.6% of the total land in this subbasin 10.6% of Total TP Load (6,109)=648 lbs TP 10.6% of TKN load (35,774)=3,792 lbs TKN Based on MDEQ Pollutant Loading Model 2009	Wetland Loss	There is very little urban land in the South Branch. There is an estimated 3,104 acres of total wetland loss. It is estimated that it accounts for 29% of the total urban load.	100%
		Improper use or overapplication of fertilizers	There is 1,583 acres of urban land in this subbasin. It is estimated that 50% of that land is subject to improper fertilizer use (792 acres). It is estimated that it accounts for 15% of the total urban load.	
		Lack of riparian buffers	There is very little urban land in the watershed. There is a total of 40.5 km of waterways South Branch, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 5% of the total urban load.	
		Poor storm water mgt practices	There is 1,583 acres of urban land in this subbasin. It is estimated that 60% of that land has poor storm water management (950 acres). It is estimated that it accounts for 50% of the total urban load.	
		Car Washing	There is an unknown number of discharges from community car washing events. This is a low priority recommended for further study. It is assumed that 1% of the total urban nutrient load coming from this source.	
Untreated Sewage	LOW PRIORITY, UNKNOWN	Failing Septic Systems	Failing septic systems are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient.The septic system risk analysis completed by the MACC estimates that there are 401 parcels at high risk for septic system maintenance issues or failure. It is estimated that it accounts for 90% of the total load which has not been quantified.	100%
		Illicit Connections	Illicit connections are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient load. More monitoring is required to quantify this further. It is estimated that it accounts for only 10% of the total load which has not been quantified.	

Pollutant Loadings in the South Branch of the Macatawa River

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Sediment				
Agricultural Runoff	Agricultural Land is 74.9% of the total land in this subbasin 74.9% of Total TSS Load (2,183,074)=4,576 lbs TSS Based on MDEQ Pollutant Loading Model 2009	Loss of wetlands	There is an estimated 3,104 acres of wetland loss in the agricultural areas of the South Branch. It is estimated that it accounts for 30% of the total agricultural load.	100%
		Lack of riparian buffer	There is approximately 40.5 km of waterways in the agricutural areas of the South Branch, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 10% of the total agricultural load.	
		Lack of BMPs	There is 11,234 acres of agricultural land in this subbasin. It is estimated that 65% of that land is lacking BMPs (7302 acres). It is estimated that it accounts for 60% of the total agricultural load.	
Urban Stormwater	Urban land is 10.6% of the total land in this subbasin 10.6% of Total TSS Load (2,183,074)=231,406 lbs TSS Based on MDEQ Pollutant Loading Model 2009	Storm Drains/ Impervious Surfaces	There is 14,993 total acres in this subbasin and 2% is impervious (356 acres). It is estimated that it accounts from 40% of the total urban load.	100%
		Loss of wetlands	There is very little urban land in the South Branch. There is an estimated 3,104 acres of total wetland loss. It is estimated that it accounts for 55% of the total urban load.	
		Construction Sites	Construction sites are of low priority because they are intermittent and scattered and regulated locally for soil erosion and sedimentation control. It is estimated that it only accounts for 5% of the total urban load.	
Streambanks	There is 87,000 feet of streambank erosion documented in Geomorphology Study (FTCH). FTCH calculates that it contributes 1,242 tons of sediment annually.	Erosion (loss of vegetion and logjams)	It is assumed that 95% of the total streambank sediment load is from streambank erosion and logjams (based on FTCH records).	100%
		Livestock Access	FTCH did not document any locations throughout the subbasin that may be impacted by grazing. Almost all of the livestock operations are confined animal feeding operations. Based on local knowledge we knowof at least one horse farm in this area. It is assumed that 1% of the total streambank load is from livestock access	
Road Stream Crossings		Improper design, alignment or maintenance	There are 14 moderate risk RSXs and 2 high risk RSX in this subbasin according to the Bank Erosion Hazard Index (2009). It is assumed that 3% of the total streambank sediment load is from public road stream crossings.	
		Erosion at private crossings	There is an unknown number of eroding private crossings. This is a low priority recommended for further study. It is assumed that 1% of the total streambank sediment load is from erosion form private road crossings.	
Pollutant: Hydrology				
Agricultural Runoff	Hydrology impacts cannot be quantified as a traditional load. Hydrology impacts include changes in flows, timing of peak flows and duration of high flows.	Drain Tiling and Artifical Drainage	There is 11,234 acres of agricultural land in this subbasin. It is estimated that at least 65% of that land is drained (7302 acres). There is also 91,481 ft of stream in the subbasin (approximately 80% is considered county drain).	NA
		Wetland Loss	There is an estimated 3,104 acres of wetland loss in the agricultural areas of the South Branch.	NA
Urban/Residential Runoff		Impervious Surfaces and Storm Drains	There is 14,993 total acres in this subbasin and 2% is impervious (356 acres).	NA
		Wetland Loss	There is very little urban land in the South Branch. There is an estimated 3,104 acres of total wetland loss.	NA
Road Stream Crossings		Improper design or maintenance (hydraulics)	There are a total number of 47 road stream crossings in the subbasin.There are 14 moderate risk RSXs and 2 high risk RSX in this subbasin according to the Bank Erosion Hazard Index (2009).	NA

Pollutant Loadings in the South Branch of the Macatawa River

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Temperature				
Urban/Residential Runoff	Temperature impacts cannot be quantified as a traditional load. Temperature impacts include any process that increases the temperature of surface water beyond the limits of the normal range suitable for a warm water fishery. Warm water fisheries in Michigan thrive up to 26 degrees Celsius (78.8 deg F) according to Wehrly et al. 1999. In addition, Part 4 rules indicate that summer temperatures cannot exceed 85 deg F in August.	Impervious Surfaces/Storm Drains	There is 14,993 total acres in this subbasin and 2% is impervious (356 acres).	NA
		Lack of riparian buffers	There is very little urban land in the watershed. There is a total of 40.5 km of waterways South Branch, categorized as having poor buffer (2011 Geomorphology Study).	NA
Agricultural Runoff		Lack of riparian buffers	There is approximately 40.5 km of waterways in the agricutural areas of the South Branch, categorized as having poor buffer (2011 Geomorphology Study).	NA
		Tiling and Artifical Drainage	There is 11,234 acres of agricultural land in this subbasin. It is estimated that at least 65% of that land is drained (7302 acres). There is also 91,481 ft of stream miles in the subbasin (approximately 80% is considered county drain).	NA
Pollutant: E. coli				
Agricultural Runoff	Impacts from *E.coli* bacteria cannot be quantified as a typical load. *E.coli* bacteria impacts a surface water body when measured levels exceed State water quality standards for total body contact (>130 *E.coli* per 100 milliliters) and/or partial body contact (>1000 *E.coli* per 100 milliliters). The following sources and causes are suspected. More monitoring needs to be completed to confirm each source.	Manure Applications	There is 11,234 acres of agricultural land in this subbasin that could be using manure for fertilizer.	NA
		Biofilms in drain tiles	There is 11,234 acres of agricultural land in this subbasin. It is estimated that at least 65% of that land is drained (7302 acres). There is potential for *E.coli* to grow inside tile drains.	NA
		Livestock Access	FTCH did not document any locations throughout the subbasin that may be impacted by grazing. Almost all of the livestock operations are confined animal feeding operations. Based on local knowledge we knowof at least one horse farm in this area.	NA
Urban/Residential Runoff		Biofilms in Storm Drains	There is 1,583 acres of urban land in this subbasin. There is 2% impervious surface. The Allegan County Drain Commission may own enclosed storm drains in this subbasin. There is potential for *E.coli* to grow inside storm drains.	NA
		Improper Disposal Pet Waste	Disposal of pet waste in urban areas may be a problem. There is 1,583 acres of urban land in this subbasin. There is 2% impervious surface. The frequency of improper disposal is unknown.	NA
Untreated Sewage		Failing Septic Systems	Failing septic systems are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient.The septic system risk analysis completed by the MACC estimates that there are 401 parcels at high risk for septic system maintenance issues or failure.	NA
		Sewer Overflows	Failing septic systems, sewer overflows and illicit connections are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total *E.coli* load. More monitoring is required to quantify this further.	NA
		Illicit Connections		NA

Pollutant Loadings in the North Branch of the Macatawa River

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Nutrients				
Agricultural Runoff	Agricultural Land is 44.8% of the total land in this subbasin 44.8% of Total TP Load (6,533)=2,297 lbs TP 44.8% of TKN load (35,774)=16,027 lbs TKN Based on MDEQ Pollutant Loading Model 2009	Loss of wetlands	There is an estimated 385 acres of wetland loss in the agricultural areas of the North Branch. It is estimated that it accounts for 15% of the total agricultural load.	100%
		Lack of riparian buffers	There is approximately 37.4 km of waterways in the agricutural areas of the North Branch, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 15% of the total agricultural load.	
		Lack of BMPs	There is 5,372 acres of agricultural land in this subbasin. It is estimated that 65% of that land is lacking BMPs (3492 acres). It is estimated that it accounts for 60% of the total agricultural load.	
		Improper Use or over application of Agricultural Fertilizers/Manure	There is 5,372 acres of agricultural land in this subbasin. It is estimated that 25% of that land subject to improper fertilizer use (1343 acres). It is estimated that it accounts for 5% of the total agricultural load.	
		Livestock Access	FTCH documented five possible locations throughout the subbasin that may be impacted by grazing. It is assumed that 5% of the total agricultural nutrient load is from livestock access (2011 Geomorphology Study).	
Urban/Residential Sources	Urban land is 32.2% of the total land in this subbasin 32.2% of Total TP Load (6,533)=2,104 lbs TP 32.2% of TKN load (35,774)=11,519 lbs TKN Based on MDEQ Pollutant Loading Model 2009	Wetland Loss	There is an estimated 1,113 acres of wetland loss in the urban areas of the North Branch. It is estimated that it accounts from 19% of the total urban load.	100%
		Improper use or overapplication of fertilizers	There is 3,859 acres of urban land in this subbasin. It is estimated that 50% of that land subject to improper fertilizer use (1930 acres). It is estimated that it accounts for 15% of the total urban load.	
		Lack of riparian buffers	There is approximately 12.6 km of waterways in the urban areas of the North Branch, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 15% of the total urban load.	
		Poor storm water mgt practices	There is 3,859 acres of urban land in this subbasin. It is estimated that 60% of that land has poor storm water management (2315 acres). It is estimated that it accounts for 50% of the total urban load.	
		Car Washing	There is an unknown number of discharges from community car washing events. This is a low priority recommended for further study. It is assumed that 1% of the total urban nutrient load coming from this source.	
Untreated Sewage	LOW PRIORITY, UNKNOWN	Failing Septic Systems	Failing septic systems are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient.The septic system risk analysis completed by the MACC estimates that there are 344 parcels at high risk for septic system maintenance issues or failure. It is estimated that it accounts for 90% of the total load which has not been quantified.	100%
		Illicit Connections	Illicit connections are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient load. More monitoring is required to quantify this further. It is estimated that it accounts for only 10% of the total load which has not been quantified.	

Pollutant Loadings in the North Branch of the Macatawa River

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Sediment				
Agricultural Runoff	Agricultural Land is 44.8% of the total land in this subbasin 44.8% of Total TSS Load (2,235,480)=1,001,495 lbs TSS Based on MDEQ Pollutant Loading Model 2009	Loss of wetlands	There is an estimated 385 acres of wetland loss in the agricultural areas of the North Branch. It is estimated that it accounts for 30% of the total agricultural load.	100%
		Lack of riparian buffer	There is approximately 37.4 km of waterways in the agricutural areas of the North Branch, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 10% of the total agricultural load.	
		Lack of BMPs	There is 5,372 acres of agricultural land in this subbasin. It is estimated that 65% of that land is lacking BMPs (3492 acres). It is estimated that it accounts for 60% of the total agricultural load.	
Urban Stormwater	Urban land is 32.2% of the total land in this subbasin 32.2% of Total TSS Load (2,235,480)=719,825 lbs TSS Based on MDEQ Pollutant Loading Model 2009	Storm Drains/ Impervious Surfaces	There is 11,989 total acres in this subbasin and 16% is impervious (1,908 acres). It is estimated that it accounts for 60% of the total urban load.	100%
		Loss of wetlands	There is an estimated 1,113 acres of wetland loss in the urban areas of the North Branch. It is estimated that it accounts from 30% of the total urban load.	
		Construction Sites	Construction sites are of low priority because they are intermittent and scattered and regulated locally for soil erosion and sedimentation control. It is estimated that it only accounts for 10% of the total urban load.	
Streambanks	There is 63,000 feet of streambank erosion documented in Geomorphology Study (FTCH). FTCH calculates that it contributes 1,235 tons of sediment	Erosion (loss of vegetion and logjams)	It is assumed that 95% of the total streambank sediment load is from streambank erosion and logjams (based on FTCH records).	100%
		Livestock Access	FTCH documented five locations throughout the subbasin that may be impacted by grazing. It is assumed that 2% of the total streambank load is from livestock access	
Road Stream Crossings		Improper design, alignment or maintenance	There are 2 moderate risk RSXs and 2 high risk RSX in this subbasin according to the Bank Erosion Hazard Index (2009). It is assumed that 2% of the total streambank sediment load is from public road stream crossings.	
		Erosion at private crossings	There is an unknown number of eroding private crossings. This is a low priority recommended for further study. It is assumed that 1% of the total streambank sediment load is from erosion form private road crossings.	
Pollutant: Hydrology				
Agricultural Runoff	Hydrology impacts cannot be quantified as a traditional load. Hydrology impacts include changes in flows, timing of peak flows and duration of high flows.	Drain Tiling and Artifical Drainage	There is 5,371 acres of agricultural land in this subbasin. It is estimated that at least 40% of that land is drained (2148 acres). There is also 214,616 ft of stream in the subbasin (approximately 75% is considered county drain).	NA
		Wetland Loss	There is an estimated 385 acres of wetland loss in the agricultural areas of the North Branch.	NA
Urban/Residential Runoff		Impervious Surfaces and Storm Drains	There is 11,989 total acres in this subbasin and 16% is impervious (1,908 acres).	NA
		Wetland Loss	There is an estimated 1,113 acres of wetland loss in the urban areas of the North Branch.	NA
Road Stream Crossings		Improper design or maintenance (hydraulics)	There are a total number of 83 road stream crossings in the subbasin.There are 2 moderate risk RSXs and 2 high risk RSX in this subbasin according to the Bank Erosion Hazard Index (2009).	NA

Pollutant Loadings in the North Branch of the Macatawa River

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Temperature				
Urban/Residential Runoff	Temperature impacts cannot be quantified as a traditional load. Temperature impacts include any process that increases the temperature of surface water beyond the limits of the normal range suitable for a warm water fishery. Warm water fisheries in Michigan thrive up to 26 degrees Celsius (78.8 deg F) according to Wehrly et al. 1999. In addition, Part 4 rules indicate that summer temperatures cannot exceed 85 deg F in August.	Impervious Surfaces/Storm Drains	There is 11,989 total acres in this subbasin and 16% is impervious (1,908 acres).	NA
		Lack of riparian buffers	There is approximately 12.6 km of waterways in the urban areas of the North Branch, categorized as having poor buffer (2011 Geomorphology Study).	NA
Agricultural Runoff		Lack of riparian buffers	There is approximately 37.4 km of waterways in the agricutural areas of the North Branch, categorized as having poor buffer (2011 Geomorphology Study).	NA
		Tiling and Artifical Drainage	There is 5,371 acres of agricultural land in this subbasin. It is estimated that at least 40% of that land is drained (2148 acres). There is also 214,616 ft of stream miles in the subbasin (approximately 75% is considered county drain).	NA
Pollutant: E. coli				
Agricultural Runoff	Impacts from *E.coli* bacteria cannot be quantified as a typical load. *E.coli* bacteria impacts a surface water body when measured levels exceed State water quality standards for total body contact (>130 *E.coli* per 100 milliliters) and/or partial body contact (>1000 *E.coli* per 100 milliliters). The following sources and causes are suspected. More monitoring needs to be completed to confirm each source.	Manure Applications	There is 5,371 acres of agricultural land in this subbasin that could be using manure for fertilizer.	NA
		Biofilms in drain tiles	There is 5,371 acres of agricultural land in this subbasin. It is estimated that at least 40% of that land is drained (2148 acres). There is potential for *E.coli* to grow inside tile drains.	NA
		Livestock Access	FTCH documented five locations throughout the subbasin that may be impacted by grazing.	NA
Urban/Residential Runoff		Biofilms in Storm Drains	There is 3,859 acres of urban land in this subbasin. There is 16% impervious surface. The City of Holland and the Allegan County Drain Commission may own enclosed storm drains in this subbasin. There is potential for *E.coli* to grow inside storm drains.	NA
		Improper Disposal Pet Waste	Disposal of pet waste in urban areas may be a problem. There is 3,859 acres of urban land in this subbasin. There is 16% impervious surface. The frequency of improper disposal is unknown.	NA
Untreated Sewage		Failing Septic Systems	Failing septic systems are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient.The septic system risk analysis completed by the MACC estimates that there are 344 parcels at high risk for septic system maintenance issues or failure.	NA
		Sewer Overflows	Sewer overflows and illicit connections are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total *E.coli* load. More monitoring is required to quantify this further.	NA
		Illicit Connections		NA

Pollutant Loadings in Noordeloos Creek

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Nutrients				
Agricultural Runoff	Agricultural Land is 50.2% of the total land in this subbasin 50.2% of Total TP Load (8245)=4139 lbs TP 50.2% of TKN load (48067)=24,129 lbs TKN Based on MDEQ Pollutant Loading Model 2009	Loss of wetlands	There is an estimated 2,933 acres of wetland loss in the agricultural areas of Noordeloos Creek. It is estimated that wetland loss accounts for 25% of the agricultural load.	100%
		Lack of riparian buffers	There is approximately 39.7 km of waterways in the agricutural areas of Noordeloos Creek, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 10% of the agricultural load.	
		Lack of BMPs	There is 8,529 acres of agricultural land in this subbasin. It is estimated that 65% of that land is lacking BMPs (5544 acres). It is estimated that it accounts for 55% of the total agricultural load.	
		Improper Use or over application of Agricultural Fertilizers/Manure	There is 8529 acres of agricultural land in this subbasin. It is estimated that 25% of that land has undergone improper fertilizer use (2,132 acres). It is estimated that it accounts for 9% of the agricultural load.	
		Livestock Access	FTCH documented only 2 locations throughout the subbasin that may be impacted by grazing. It is assumed that 1% of the total agricultural nutrient load is from livestock access (2011 Geomorphology Study).	
Urban/Residential Sources	Urban land is 33.7% of the total land in this subbasin 33.7% of Total TP Load (8245)=2,779 lbs TP 33.7% of TKN load (48067)=16,199 lbs TKN Based on MDEQ Pollutant Loading Model 2009	Wetland Loss	There is an estimated 383 acres of wetland loss in the urban areas of Noordeloos Creek. It is estimated that it accounts for 19% of the total urban load.	100%
		Improper use or overapplication of fertilizers	There is 5716 acres of urban land in this subbasin. It is estimated that 50% of that land has undergone improper fertilizer use (2858 acres). It is estimated that it accounts for 15% of the total urban load.	
		Lack of riparian buffers	There is approximately 19.8 km of waterways in the urban areas of Noordeloos Creek, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 15% of the total urban load.	
		Poor storm water mgt practices	There is 5716 acres of urban land in this subbasin. It is estimated that 60% of that land has poor storm water management (3430 acres). It is estimated that it accounts for 50% of the total urban load.	
		Car Washing	There is an unknown number of discharges from community car washing events. This is a low priority recommended for further study. It is assumed that 1% of the total urban nutrient load comes from this source.	
Untreated Sewage	LOW PRIORITY, UNKNOWN	Failing Septic Systems	Failing septic systems are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient load. The septic system risk analysis completed by the MACC estimates that there are 320 parcels at high risk for septic system maintenance issues or failure. It is estimated that it accounts for 90% of the total load which has not been quantified.	100%
		Illicit Connections	Illicit connections are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient load. More monitoring is required to quantify this further. It is estimated that it accounts for only 10% of the total load which has not been quantified.	

Pollutant Loadings in Noordeloos Creek

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Sediment				
Agricultural Runoff	Agricultural Land is 50.2% of the total land in this subbasin 50.2% of Total TSS Load (2,446,193)=1,227,989 lbs TSS Based on MDEQ Pollutant Loading Model 2009	Loss of wetlands	There is an estimated 2,933 acres of wetland loss in the agricultural areas of Noordeloos Creek. It is estimated that wetland loss accounts for 30% of the agricultural load.	100%
		Lack of riparian buffer	There is approximately 39.7 km of waterways in the agricutural areas of Noordeloos Creek, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 10% of the agricultural load.	
		Lack of BMPs	There is 8,529 acres of agricultural land in this subbasin. It is estimated that 65% of that land is lacking BMPs (5544 acres). It is estimated that it accounts for 60% of the total agricultural load.	
Urban Stormwater	Urban land is 33.7% of the total land in this subbasin 33.7% of Total TSS Load (2,446,193)=824,367 lbs TSS Based on MDEQ Pollutant Loading Model 2009	Storm Drains/ Impervious Surfaces	There is 17,006 total acres in this subbasin and 13% is impervious (2,265 acres). It is estimated that it accounts for 65% of the total urban load.	100%
		Loss of wetlands	There is an estimated 383 acres of wetland loss in the urban areas of Noordeloos Creek. It is estimated that it accounts for 30% of the total urban load.	
		Construction Sites	Construction sites are of low priority because they are intermittent and scattered and regulated locally for soil erosion and sedimentation control. It is estimated that it only accounts for 5% of the total urban load.	
Streambanks	There is 68,000 feet of streambank erosion documented in Geomorphology Study (FTCH). FTCH calculates that it contributes 951 tons of sediment annually.	Erosion (loss of vegetion and logjams)	It is assumed that 95% of the total streambank sediment load is from streambank erosion and logjams (based on FTCH records).	100%
		Livestock Access	FTCH documented only 2 locations throughout the subbasin that may be impacted by grazing. It is assumed that 1% of the total streambank load is from livestock access	
Road Stream Crossings		Improper design, alignment or maintenance	There are 3 moderate risk RSXs and 2 high risk RSX in this subbasin according to the Bank Erosion Hazard Index (2009). It is assumed that 3% of the total streambank sediment load is from public road stream crossings.	
		Erosion at private crossings	There is an unknown number of eroding private crossings. This is a low priority recommended for further study. It is assumed that 1% of the total streambank sediment load is from erosion form private road crossings.	
Pollutant: Hydrology				
Agricultural Runoff	Hydrology impacts cannot be quantified as a traditional load. Hydrology impacts include changes in flows, timing of peak flows and duration of high flows.	Drain Tiling and Artifical Drainage	There is 8529 acres of agricultural land in this subbasin. It is estimated that at least 40% of that land is drained (3412 acres). There is also 319,493 ft of waterway in the subbasin (approximately 70% is considered county drain).	NA
		Wetland Loss	There is an estimated 2,933 acres of wetland loss in the agricultural areas of Noordeloos Creek.	
Urban/Residential Runoff		Impervious Surfaces and Storm Drains	There is 17,006 total acres in this subbasin and 13% is impervious (2,265 acres).	NA
		Wetland Loss	There is an estimated 383 acres of wetland loss in the urban areas of Noordeloos Creek.	
Road Stream Crossings		Improper design or maintenance (hydraulics)	There are a total number of 86 road stream crossings in the subbasin.There are 3 moderate risk RSXs and 2 high risk RSX in this subbasin according to the Bank Erosion Hazard Index (2009).	NA

Pollutant Loadings in Noordeloos Creek

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Temperature				
Urban/Residential Runoff	Temperature impacts cannot be quantified as a traditional load. Temperature impacts include any process that increases the temperature of surface water beyond the limits of the normal range suitable for a warm water fishery. Warm water fisheries in Michigan thrive up to 26 degrees Celsius (78.8 deg F) according to Wehrly et al. 1999. In addition, Part 4 rules indicate that summer temperatures cannot exceed 85 deg F in August.	Impervious Surfaces/Storm Drains	There is 17,006 total acres in this subbasin and 13% is impervious (2,265 acres).	NA
		Lack of riparian buffers	There is approximately 19.8 km of waterways in the urban areas of Noordeloos Creek, categorized as having poor buffer (2011 Geomorphology Study).	NA
Agricultural Runoff		Lack of riparian buffers	There is approximately 39.7 km of waterways in the agricutural areas of Noordeloos Creek, categorized as having poor buffer (2011 Geomorphology Study).	NA
		Tiling and Artifical Drainage	There is 8529 acres of agricultural land in this subbasin. It is estimated that at least 40% of that land is drained (3412 acres). There is also 319,493 ft of waterway in the subbasin (approximately 70% is considered county drain).	NA
Pollutant: E. coli				
Agricultural Runoff	Impacts from *E.coli* bacteria cannot be quantified as a typical load. *E.coli* bacteria impacts a surface water body when measured levels exceed State water quality standards for total body contact (>130 *E.coli* per 100 milliliters) and/or partial body contact (>1000 *E.coli* per 100 milliliters). The following sources and causes are suspected. More monitoring needs to be completed to confirm each source.	Manure Applications	There is 8529 acres of agricultural land in this subbasin that could be using manure for fertilizer.	NA
		Biofilms in drain tiles	There is 8529 acres of agricultural land in this subbasin. It is estimated that at least 40% of that land is drained (3412 acres). There is potential for *E.coli* to grow inside tile drains.	NA
		Livestock Access	FTCH documented only 2 locations throughout the subbasin that may be impacted by grazing (2011 Geomorphology Report).	NA
Urban/Residential Runoff		Biofilms in Storm Drains	There is 5716 acres of urban land in this subbasin. There is 13% Impervious surface. The City of Zeeland and the Ottawa Co Road Commission own enclosed storm drain in this subbasin. There is potential for *E.coli* to grow inside storm drains.	NA
		Improper Disposal Pet Waste	Disposal of pet waste in urban areas may be a problem. There is 5716 acres of urban land in this subbasin. There is 13% impervious surface. The frequency of improper disposal is unknown.	NA
Untreated Sewage		Failing Septic Systems	Failing septic systems are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total load. The septic system risk analysis completed by the MACC estimates that there are 320 parcels at high risk for septic system maintenance issues or failure.	NA
		Sewer Overflows	Failing septic systems, sewer overflows and illicit connections are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total *E.coli* load. More monitoring is required to quantify this further.	NA
		Illicit Connections		NA

Pollutant Loadings in the Lower Macatawa

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Nutrients				
Agricultural Runoff	Agricultural Land is 23.4% of the total land in this subbasin 23.4% of Total TP Load (7,192)=1,683 lbs TP 23.4% of TKN load (41,696)=9,757 lbs TKN Based on MDEQ Pollutant Loading Model 2009	Loss of wetlands	There is an estimated 1,025 acres of wetland loss in the agricultural areas of the Lower Macatawa. It is estimated that it accounts for 25% of the total agricultural load.	100%
		Lack of riparian buffers	There is approximately 21.4 km of waterways in the agricutural areas of the Lower Macatawa, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 10% of the total agricultural load.	
		Lack of BMPs	There is 2,568 acres of agricultural land in this subbasin. It is estimated that 65% of that land is lacking BMPs (1669 acres). It is estimated that it accounts for 55% of the total agricultural load.	
		Improper Use or over application of Agricultural Fertilizers/Manure	There is 2,568 acres of agricultural land in this subbasin. It is estimated that 25% of that land is subject to improper fertilizer use (642 acres). It is estimated that it accounts for 9% of the total agricultural load.	
		Livestock Access	FTCH did not document any possible locations throughout the subbasin that may be impacted by grazing. It is assumed that less than 1% of the total agricultural nutrient load is from livestock access (2011 Geomorphology Study).	
Urban/Residential Sources	Urban land is 54.7% of the total land in this subbasin 54.7% of Total TP Load (7,192)=3,934 lbs TP 54.7% of TKN load (41,696)=22,808 lbs TKN Based on MDEQ Pollutant Loading Model 2009	Wetland Loss	There is an estimated 1,094 acres of wetland loss in the urban areas of the Lower Macatawa. It is estimated that is accounts for 19% of the total urban load.	100%
		Improper use or overapplication of fertilizers	There is 6,016 acres of urban land in this subbasin. It is estimated that 50% of that land subject to improper fertilizer use (3008acres). It is estimated that it accounts for 15% of the total urban load.	
		Lack of riparian buffers	There is approximately 22.7 km of waterways in the urban areas of the Lower Macatawa, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 15% of the total urban load.	
		Poor storm water mgt practices	There is 6,016 acres of urban land in this subbasin. It is estimated that 60% of that land has poor storm water management (3610acres). It is estimated that it accounts for 50% of the total urban load.	
		Car Washing	There is an unknown number of discharges from community car washing events. This is a low priority recommended for further study. It is assumed that 1% of the total urban nutrient load coming from this source.	
Untreated Sewage	LOW PRIORITY, UNKNOWN	Failing Septic Systems	Failing septic systems are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient.The septic system risk analysis completed by the MACC estimates that there are 138 parcels at high risk for septic system maintenance issues or failure. It is estimated that it accounts for 90% of the total load which has not been quantified.	100%
		Illicit Connections	Illicit connections are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient load. More monitoring is required to quantify this further. It is estimated that it accounts for only 10% of the total load which has not been quantified.	

Pollutant Loadings in the Lower Macatawa

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Sediment				
Agricultural Runoff	Agricultural Land is 13% of the total land in this subbasin 13% of Total TSS Load (3,854,809)=501,125 lbs TSS Based on MDEQ Pollutant Loading Model 2009	Loss of wetlands	There is an estimated 1,025 acres of wetland loss in the agricultural areas of the Lower Macatawa. It is estimated that it accounts for 30% of the total agricultural load.	100%
		Lack of riparian buffer	There is approximately 21.4 km of waterways in the agricutural areas of the Lower Macatawa, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 10% of the total agricultural load.	
		Lack of BMPs	There is 2,568 acres of agricultural land in this subbasin. It is estimated that 65% of that land is lacking BMPs (1669 acres). It is estimated that it accounts for 60% of the total agricultural load.	
Urban Stormwater	Urban land is 57% of the total land in this subbasin 57% of Total TSS Load (3,854,809)=219,341 lbs TSS Based on MDEQ Pollutant Loading Model 2009	Storm Drains/ Impervious Surfaces	There is 6,016 total acres in this subbasin and 28% is impervious (3,130 acres). It is estimated that it accounts for 60% of the total urban load.	100%
		Loss of wetlands	There is an estimated 1,094 acres of wetland loss in the urban areas of the Lower Macatawa. It is estimated that is accounts for 30% of the total urban load.	
		Construction Sites	Construction sites are of low priority because they are intermittent and scattered and regulated locally for soil erosion and sedimentation control. It is estimated that it only accounts for 10% of the total urban load.	
Streambanks	In stream sediment loading estimates from the 2011 Geomorphology Report are 249 tons annually.	Erosion (loss of vegetion and logjams)	It is assumed that 90% of the total streambank sediment load is from streambank erosion and logjams (based on FTCH records for other parts of the watershed).	100%
		Livestock Access	FTCH did not document any locations throughout the subbasin that may be impacted by grazing. It is assumed that none of the total streambank load is from livestock access.	
Road Stream Crossings		Improper design, alignment or maintenance	There was 1 moderate risk RSX and 1 high risk RSX in this subbasin according to the Bank Erosion Hazard Index (2009). However, this subbasin has many RSXs (109) and many of them were not surveyed. It is assumed that 9% of the total streambank sediment load is from public road stream crossings.	
		Erosion at private crossings	There is an unknown number of eroding private crossings. This is a low priority recommended for further study. It is assumed that 1% of the total streambank sediment load is from erosion form private road crossings.	
Pollutant: Hydrology				
Agricultural Runoff	Hydrology impacts cannot be quantified as a traditional load. Hydrology impacts include changes in flows, timing of peak flows and duration of high flows.	Drain Tiling and Artifical Drainage	There is 2,568 acres of agricultural land in this subbasin. It is estimated that at least 20% of that land is drained (514 acres). There is also 186,510 ft of stream in the subbasin (approximately 90% is considered county drain).	NA
		Wetland Loss	There is an estimated 1,025 acres of wetland loss in the agricultural areas of the Lower Macatawa.	NA
Urban/Residential Runoff		Impervious Surfaces and Storm Drains	There is 6,016 total acres in this subbasin and 28% is impervious (3,130 acres).	NA
		Wetland Loss	There is an estimated 1,094 acres of wetland loss in the urban areas of the Lower Macatawa.	NA
Road Stream Crossings		Improper design or maintenance (hydraulics)	There are a total number of 109 road stream crossings in the subbasin. There was 1 moderate risk RSX and 1 high risk RSX in this subbasin according to the Bank Erosion Hazard Index (2009).	NA

Pollutant Loadings in the Lower Macatawa

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Temperature				
Urban/Residential Runoff	Temperature impacts cannot be quantified as a traditional load. Temperature impacts include any process that increases the temperature of surface water beyond the limits of the normal range suitable for a warm water fishery. Warm water fisheries in Michigan thrive up to 26 degrees Celsius (78.8 deg F) according to Wehrly et al. 1999. In addition, Part 4 rules indicate that summer temperatures cannot exceed 85 deg F in August.	Impervious Surfaces/Storm Drains	There is 6,016 total acres in this subbasin and 28% is impervious (3,130 acres).	NA
		Lack of riparian buffers	There is approximately 22.7 km of waterways in the urban areas of the Lower Macatawa, categorized as having poor buffer (2011 Geomorphology Study).	NA
Agricultural Runoff		Lack of riparian buffers	There is approximately 21.4 km of waterways in the agricutural areas of the Lower Macatawa, categorized as having poor buffer (2011 Geomorphology Study).	NA
		Tiling and Artifical Drainage	There is 2,568 acres of agricultural land in this subbasin. It is estimated that at least 20% of that land is drained (514 acres). There is also 186,510 ft of stream in the subbasin (approximately 90% is considered county drain).	NA
Pollutant: E. coli				
Agricultural Runoff	Impacts from *E.coli* bacteria cannot be quantified as a typical load. *E.coli* bacteria impacts a surface water body when measured levels exceed State water quality standards for total body contact (>130 *E.coli* per 100 milliliters) and/or partial body contact (>1000 *E.coli* per 100 milliliters). The following sources and causes are suspected. More monitoring needs to be completed to confirm each source.	Manure Applications	There is 2,568 acres of agricultural land in this subbasin that could be using manure for fertilizer.	NA
		Biofilms in drain tiles	There is 2,568 acres of agricultural land in this subbasin. It is estimated that at least 20% of that land is drained (514 acres). There is potential for E.coli to grow inside tile drains.	NA
		Livestock Access	FTCH did not document any possible locations throughout the subbasin that may be impacted by grazing. It is assumed that less than none of the total agricultural load is from livestock access (2011 Geomorphology Study).	NA
Urban/Residential Runoff		Biofilms in Storm Drains	There is 6,016 total acres in this subbasin and 28% is impervious (3,130 acres). The City of Holland, Ottawa County Road Commission and Ottawa Co Drain Commission may own enclosed storm drains in this subbasin. There is potential for *E.coli* to grow inside storm drains.	NA
		Improper Disposal Pet Waste	Disposal of pet waste in urban areas may be a problem. There is 6,016 acres of urban land in this subbasin. There is 28% impervious surface. The frequency of improper disposal is unknown.	NA
Untreated Sewage		Failing Septic Systems	Failing septic systems are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient.The septic system risk analysis completed by the MACC estimates that there are 138 parcels at high risk for septic system maintenance issues or failure.	NA
		Sewer Overflows	Sewer overflows and illicit connections are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total *E.coli* load. More monitoring is required to quantify this further.	NA
		Illicit Connections		NA

Pollutant Loadings in Pine Creek

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Nutrients				
Agricultural Runoff	Agricultural Land is 30.3% of the total land in this subbasin 30.3% of Total TP Load (4185)=1,268 lbs TP 30.3% of TKN load (25,416)=7,701 lbs TKN Based on MDEQ Pollutant Loading Model 2009	Loss of wetlands	There is an estimated 1,807 acres of wetland loss in the agricultural areas of Pine Creek. It is estimated that it accounts for 25% of the total agricultural load.	100%
		Lack of riparian buffers	There is approximately 20.7 km of waterways in the agricutural areas of Pine Creek, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 10% of the total agricultural load.	
		Lack of BMPs	There is 3,378 acres of agricultural land in this subbasin. It is estimated that 65% of that land is lacking BMPs (2196 acres). It is estimated that it accounts for 55% of the total agricultural load.	
		Improper Use or over application of Agricultural Fertilizers/Manure	There is 3,378 acres of agricultural land in this subbasin. It is estimated that 25% of that land subject to improper fertilizer use (845 acres). It is estimated that it accounts for 9% of the total agricultural load.	
		Livestock Access	FTCH documented one possible location throughout the subbasin that may be impacted by grazing. It is assumed that less than 1% of the total agricultural nutrient load is from livestock access (2011 Geomorphology Study)	
Urban/Residential Sources	Urban land is 45.7% of the total land in this subbasin 45.7% of Total TP Load (4,185)=1,913 lbs TP 45.7% of TKN load (25,416)=11,615 lbs TKN Based on MDEQ Pollutant Loading Model 2009	Wetland Loss	There is an estimated 866 acres of wetland loss in the urban areas of Pine Creek. It is estimated that it accounts for 10% of the total urban load.	100%
		Improper use or overapplication of fertilizers	There is 5088 acres of urban land in this subbasin. It is estimated that 50% of that land subject to improper fertilizer use (2544 acres). It is estimated that it accounts for 29% of the total urban load.	
		Lack of riparian buffers	There is approximately 8.2 km of waterways in the urban areas of Pine Creek, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 10% of the total urban load.	
		Poor storm water mgt practices	There is 5088 acres of urban land in this subbasin. It is estimated that 60% of that land has poor storm water management (3053 acres). It is estimated that it accounts for 50% of the total urban load.	
		Car Washing	There is an unknown number of discharges from community car washing events. This is a low priority recommended for further study. It is assumed that 1% of the total urban nutrient load coming from this source.	
Untreated Sewage	LOW PRIORITY, UNKNOWN	Failing Septic Systems	Failing septic systems are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient.The septic system risk analysis completed by the MACC estimates that there are 5 parcels at high risk for septic system maintenance issues or failure. It is estimated that it accounts for 90% of the total load which has not been quantified.	100
		Illicit Connections	Illicit connectiona are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient load. More monitoring is required to quantify this further. It is estimated that it accounts for only 10% of the total load which has not been quantified.	

Pollutant Loadings in Pine Creek

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Sediment				
Agricultural Runoff	Agricultural Land is 30.3% of the total land in this subbasin 30.3% of Total TSS Load (990,697)=300,181 lbs TSS Based on MDEQ Pollutant Loading Model 2009	Loss of wetlands	There is an estimated 1,807 acres of wetland loss in the agricultural areas of Pine Creek. It is estimated that it accounts for 30% of the total agricultural load.	100%
		Lack of riparian buffer	There is approximately 20.7 km of waterways in the agricutural areas of Pine Creek, categorized as having poor buffer (2011 Geomorphology Study). It is estimated that it accounts for 10% of the total agricultural load.	
		Lack of BMPs	There is 3,378 acres of agricultural land in this subbasin. It is estimated that 65% of that land is lacking BMPs (2196 acres). It is estimated that it accounts for 60% of the total agricultural load.	
Urban Stormwater	Urban land is 45.7% of the total land in this subbasin 45.7% of Total TSS Load (990,697)=452,749 lbs TSS Based on MDEQ Pollutant Loading Model 2009	Storm Drains/ Impervious Surfaces	There is 11,136 total acres in this subbasin and 14% is impervious (1,527 acres). It is estimated that it accounts for 60% of the total urban load.	100%
		Loss of wetlands	There is an estimated 866 acres of wetland loss in the urban areas of Pine Creek. It is estimated that it accounts for 30% of the total urban load.	
		Construction Sites	Construction sites are of low priority because they are intermittent and scattered and regulated locally for soil erosion and sedimentation control. It is estimated that it only accounts for 10% of the total urban load.	
Streambanks	In stream sediment loading estimates from the 2011 Geomorphology Report are 66 tons annually.	Erosion (loss of vegetion and logjams)	It is assumed that 95% of the total streambank sediment load is from streambank erosion and logjams (based on FTCH records for other parts of the watershed).	100%
		Livestock Access	FTCH documented one location throughout the subbasin that may be impacted by grazing. It is assumed that 1% of the total streambank load is from livestock access.	
Road Stream Crossings		Improper design, alignment or maintenance	There are 3 moderate risk RSXs and no high risk RSX in this subbasin according to the Bank Erosion Hazard Index (2009). It is assumed that 3% of the total streambank sediment load is from public road stream crossings.	
		Erosion at private crossings	There is an unknown number of eroding private crossings. This is a low priority recommended for further study. It is assumed that 1% of the total streambank sediment load is from erosion form private road crossings.	
Pollutant: Hydrology				
Agricultural Runoff	Hydrology impacts cannot be quantified as a traditional load. Hydrology impacts include changes in flows, timing of peak flows and duration of high flows.	Drain Tiling and Artifical Drainage	There is 3,378 acres of agricultural land in this subbasin. It is estimated that at least 25% of that land is drained (845 acres). There is also 130,459 ft of stream in the subbasin (approximately 98% is considered county drain).	NA
		Wetland Loss	There is an estimated 1,807 acres of wetland loss in the agricultural areas of Pine Creek.	NA
Urban/Residential Runoff		Impervious Surfaces and Storm Drains	There is 11,136 total acres in this subbasin and 14% is impervious (1,527 acres).	NA
		Wetland Loss	There is an estimated 866 acres of wetland loss in the urban areas of Pine Creek.	NA
Road Stream Crossings		Improper design or maintenance (hydraulics)	There are a total number of 68 road stream crossings in the subbasin.There are 3 moderate risk RSXs and no high risk RSX in this subbasin according to the Bank Erosion Hazard Index (2009).	NA

Pollutant Loadings in Pine Creek

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Temperature				
Urban/Residential Runoff	Temperature impacts cannot be quantified as a traditional load. Temperature impacts include any process that increases the temperature of surface water beyond the limits of the normal range suitable for a warm water fishery. Warm water fisheries in Michigan thrive up to 26 degrees Celsius (78.8 deg F) according to Wehrly et al. 1999. In addition, Part 4 rules indicate that summer temperatures cannot exceed 85 deg F in August.	Impervious Surfaces/Storm Drains	There is 11,136 total acres in this subbasin and 14% is impervious (1,527 acres).	NA
		Lack of riparian buffers	There is approximately 8.2 km of waterways in the urban areas of Pine Creek, categorized as having poor buffer (2011 Geomorphology Study).	NA
Agricultural Runoff		Lack of riparian buffers	There is approximately 20.7 km of waterways in the agricutural areas of Pine Creek, categorized as having poor buffer (2011 Geomorphology Study).	NA
		Tiling and Artifical Drainage	There is 3,378 acres of agricultural land in this subbasin. It is estimated that at least 25% of that land is drained (845 acres). There is also 130,459 ft of stream miles in the subbasin (approximately 98% is considered county drain).	NA
Pollutant: E. coli				
Agricultural Runoff	Impacts from *E.coli* bacteria cannot be quantified as a typical load. *E.coli* bacteria impacts a surface water body when measured levels exceed State water quality standards for total body contact (>130 *E.coli* per 100 milliliters) and/or partial body contact (>1000 *E.coli* per 100 milliliters). The following sources and causes are suspected. More monitoring needs to be completed to confirm each source.	Manure Applications	There is 3,378 acres of agricultural land in this subbasin that could be using manure for fertilizer.	NA
		Biofilms in drain tiles	There is 3,378 acres of agricultural land in this subbasin. It is estimated that at least 25% of that land is drained (845 acres). There is potential for *E.coli* to grow inside tile drains.	NA
		Livestock Access	FTCH documented one location throughout the subbasin that may be impacted by grazing.	NA
Urban/Residential Runoff		Biofilms in Storm Drains	There is 5,088 acres of urban land in this subbasin. There is 14% impervious surface. The Ottawa County Road Commission and the Ottawa Co Drain Commission may own enclosed storm drains in this subbasin. There is potential for *E.coli* to grow inside storm drains.	NA
		Improper Disposal Pet Waste	Disposal of pet waste in urban areas may be a problem. There is 5,088 acres of urban land in this subbasin. There is 14 % impervious surface. The frequency of improper disposal is unknown.	NA
Untreated Sewage		Failing Septic Systems	Failing septic systems are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient.The septic system risk analysis completed by the MACC estimates that there are 5 parcels at high risk for septic system maintenance issues or failure.	NA
		Sewer Overflows	Sewer overflows and illicit connections are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total *E.coli* load. More monitoring is required to quantify this further.	NA
		Illicit Connections		NA

Pollutant Loadings in the Lake Macatawa Direct Drainage Tributaries

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Nutrients				
Agricultural Runoff	Agricultural Land is 6.4% of the total land in this subbasin 6.4% of Total TP Load (7,920)=507 lbs TP 6.4% of TKN load (49,020)=3,137 lbs TKN Based on MDEQ Pollutant Loading Model 2009	Loss of wetlands	There is an estimated 1,749 acres of total wetland loss in Lake Macatawa Direct Drainage subbasin. It is assumed that most of it occurs in the urban areas. It is estimated that it accounts for 10% of the total agricultural load.	100%
		Lack of riparian buffers	There is approximately 14.8 km of waterways in the Lake Macatawa Direct Drainage subbasin with poor buffers (2011 Geomorphology Study). This subbasin is predominantly urban so the assumption is that most of the poor buffers occur in urban areas. It is estimated that it accounts for 10% of the total agricultural load.	
		Lack of BMPs	There is 1,020 acres of agricultural land in this subbasin. It is estimated that 65% of that land is lacking BMPs (663 acres). It is estimated that it accounts for 65% of the total agricultural load.	
		Improper Use or over application of Agricultural Fertilizers/Manure	There is 1,020 acres of agricultural land in this subbasin. It is estimated that 25% of that land subject to improper fertilizer use (255 acres). It is estimated that it accounts for 9% of the total agricultural load.	
		Livestock Access	FTCH documented one, rather large possible location throughout the subbasin that may be impacted by grazing. It is assumed that less than 6% of the total agricultural nutrient load is from livestock access (2011 Geomorphology Study).	
Urban/Residential Sources	Urban land is 58.3% of the total land in this subbasin 58.3% of Total TP Load (7,920)=4,617 lbs TP 58.3% of TKN load (49,020)=28,579 lbs TKN Based on MDEQ Pollutant Loading Model 2009	Wetland Loss	There is an estimated 1,149 acres of wetland loss in the urban areas of the Lower Macatawa. It is estimated that it accounts for 14% of the total urban load.	100%
		Improper use or overapplication of fertilizers	There is 9,302 acres of urban land in this subbasin. It is estimated that 50% of that land subject to improper fertilizer use (4651acres). It is estimated that it accounts for 15% of the total urban load.	
		Lack of riparian buffers	There is approximately 14.8 km of waterways in the Lake Macatawa Direct Drainage subbasin with poor buffers (2011 Geomorphology Study). This subbasin is predominantly urban so the assumption is that most of the poor buffers occur in urban areas. It is estimated that it accounts for 15% of the total urban load.	
		Poor storm water mgt practices	There is 9,302 acres of urban land in this subbasin. It is estimated that 60% of that land has poor storm water management (5581acres). It is estimated that it accounts for 50% of the total urban load.	
		Marinas/Boating	There are four known marinas on Lake Macatawa. It is estimated that it may account for 5% of the total urban load.	
		Car Washing	There is an unknown number of discharges from community car washing events. This is a low priority recommended for further study. It is assumed that 1% of the total urban nutrient load coming from this source.	
Untreated Sewage	LOW PRIORITY, UNKNOWN	Failing Septic Systems	Failing septic systems are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient.The septic system risk analysis completed by the MACC estimates that there are 112 parcels at high risk for septic system maintenance issues or failure. It is estimated that it accounts for 90% of the total load which has not been quantified.	100%
		Illicit Connections	Illicit connections are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient load. More monitoring is required to quantify this further. It is estimated that it accounts for only 10% of the total load which has not been quantified.	

Pollutant Loadings in the Lake Macatawa Direct Drainage Tributaries

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Sediment				
Agricultural Runoff	Agricultural Land is 6.4% of the total land in this subbasin 6.4% of Total TSS Load (1,659,901)=106,234 lbs TSS Based on MDEQ Pollutant Loading Model 2009	Loss of wetlands	There is an estimated 1,749 acres of total wetland loss in Lake Macatawa Direct Drainage subbasin. It is assumed that most of it occurs in the urban areas. It is estimated that it accounts for 20% of the total agricultural load.	100%
		Lack of riparian buffer	There is approximately 14.8 km of waterways in the Lake Macatawa Direct Drainage subbasin with poor buffers (2011 Geomorphology Study). This subbasin is predominantly urban so the assumption is that most of the poor buffers occur in urban areas. It is estimated that it accounts for 15% of the total agricultural load.	
		Lack of BMPs	There is 1,020 acres of agricultural land in this subbasin. It is estimated that 65% of that land is lacking BMPs (663 acres). It is estimated that it accounts for 65% of the total agricultural load.	
Urban Stormwater	Urban land is 58.3% of the total land in this subbasin 58.3% of Total TSS Load (1,659,901)=967,723 lbs TSS Based on MDEQ Pollutant Loading Model 2009	Storm Drains/ Impervious Surfaces	There is 15,967 total acres in this subbasin and 20% is impervious (3,193 acres). It is estimated that it accounts for 60% of the total urban load.	100%
		Loss of wetlands	There is an estimated 1,749 acres of wetland loss in the urban areas of the Lower Macatawa. It is estimated that it accounts for 30% of the total urban load.	
		Construction Sites	Construction sites are of low priority because they are intermittent and scattered and regulated locally for soil erosion and sedimentation control. It is estimated that it only accounts for 10% of the total urban load.	
Streambanks	In stream sediment loading estimates from the 2011 Geomorphology Report are 1,016 tons annually.	Erosion (loss of vegetion and logjams)	It is assumed that 90% of the total streambank sediment load is from streambank erosion and logjams (based on FTCH records for other parts of the watershed).	100%
		Livestock Access	FTCH documented one, rather large location throughout the subbasin that may be impacted by grazing. It is assumed that 3% of the total streambank load is from livestock access.	
Road Stream Crossings		Improper design, alignment or maintenance	There was 1 moderate risk RSX and 1 high risk RSX in this subbasin according to the Bank Erosion Hazard Index (2009). However, this subbasin has many RSXs (59) and many of them were not surveyed. It is assumed that 6% of the total streambank sediment load is from public road stream crossings.	
		Erosion at private crossings	There is an unknown number of eroding private crossings. This is a low priority recommended for further study. It is assumed that 1% of the total streambank sediment load is from erosion form private road crossings.	
Pollutant: Hydrology				
Agricultural Runoff	Hydrology impacts cannot be quantified as a traditional load. Hydrology impacts include changes in flows, timing of peak flows and duration of high flows.	Drain Tiling and Artifical Drainage	There is 1,021 acres of agricultural land in this subbasin. It is estimated that at least 20% of that land is drained (204 acres). There is also 277,894 ft of stream in the subbasin (approximately 90% is considered county drain).	NA
		Wetland Loss	There is an estimated 1,749 acres of total wetland loss in Lake Macatawa Direct Drainage subbasin. It is estimated that all of it occurs in the urban areas.	NA
Urban/Residential Runoff		Impervious Surfaces and Storm Drains	There is 15,967 total acres in this subbasin and 20% is impervious (3,193 acres).	NA
		Wetland Loss	There is an estimated 1,749 acres of wetland loss in the urban areas of the Lower Macatawa.	NA
Road Stream Crossings		Improper design or maintenance (hydraulics)	There are a total number of 59 road stream crossings in the subbasin. There is 1 moderate risk RSX and 1 high risk RSX in this subbasin according to the Bank Erosion Hazard Index (2009).	NA

Pollutant Loadings in the Lake Macatawa Direct Drainage Tributaries

Source	Load From Source	Cause	Quantification	Totals
Pollutant: Temperature				
Urban/Residential Runoff	Temperature impacts cannot be quantified as a traditional load. Temperature impacts include any process that increases the temperature of surface water beyond the limits of the normal range suitable for a warm water fishery. Warm water fisheries in Michigan thrive up to 26 degrees Celsius (78.8 deg F) according to Wehrly et al. 1999. In addition, Part 4 rules indicate that summer temperatures cannot exceed 85 deg F in August.	Impervious Surfaces/Storm Drains	There is 15,967 total acres in this subbasin and 20% is impervious (3,193 acres).	NA
		Lack of riparian buffers	There is approximately 14.8 km of waterways in the Lake Macatawa Direct Drainage subbasin with poor buffers (2011 Geomorphology Study). This subbsain is predominantly urban so the assumption is that all of the poor buffers occur in urban areas.	NA
Agricultural Runoff		Lack of riparian buffers	There is approximately 14.8 km of waterways in the Lake Macatawa Direct Drainage subbasin with poor buffers (2011 Geomorphology Study). This subbsain is predominantly urban so the assumption is that none of the poor buffers occur in agricultural areas.	NA
		Tiling and Artifical Drainage	There is 1,021 acres of agricultural land in this subbasin. It is estimated that at least 20% of that land is drained (204 acres). There is also 277,894 ft of stream miles in the subbasin (approximately 90% is considered county drain).	NA
Pollutant: E. coli				
Agricultural Runoff	Impacts from *E.coli* bacteria cannot be quantified as a typical load. *E.coli* bacteria impacts a surface water body when measured levels exceed State water quality standards for total body contact (>130 *E.coli* per 100 milliliters) and/or partial body contact (>1000 *E.coli* per 100 milliliters). The following sources and causes are suspected. More monitoring needs to be completed to confirm each source.	Manure Applications	There is 1,021 acres of agricultural land in this subbasin that could be using manure for fertilizer.	NA
		Biofilms in drain tiles	There is 1,021 acres of agricultural land in this subbasin. It is estimated that at least 20% of that land is drained (204 acres). There is potential for *E.coli* to grow inside tile drains.	NA
		Livestock Access	FTCH documented one, rather large possible location throughout the subbasin that may be impacted by grazing. It is assumed that less than 3% of the total agricultural load is from livestock access (2011 Geomorphology Study).	NA
Urban/Residential Runoff		Biofilms in Storm Drains	There is 9,301 acres of urban land in this subbasin. There is 20% impervious surface. The City of Holland, Ottawa County Road Commission, Allegan County Road, Ottawa Co Drain Commission and Allegan Co Drain Commission may own enclosed storm drains in this subbasin. There is potential for *E.coli* to grow inside storm drains.	NA
		Improper Disposal Pet Waste	Disposal of pet waste in urban areas may be a problem. There is 9,301 acres of urban land in this subbasin. There is 20% impervious surface. The frequency of improper disposal is unknown.	NA
Untreated Sewage		Failing Septic Systems	Failing septic systems are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total nutrient.The septic system risk analysis completed by the MACC estimates that there are 112 parcels at high risk for septic system maintenance issues or failure.	NA
		Sewer Overflows	Sewer overflows and illicit connections are categorized as a concern of low priority (small amounts, scattered, infrequent) and are assumed to be only a small fraction of the total *E.coli* load. More monitoring is required to quantify this further.	NA
		Illicit Connections		NA