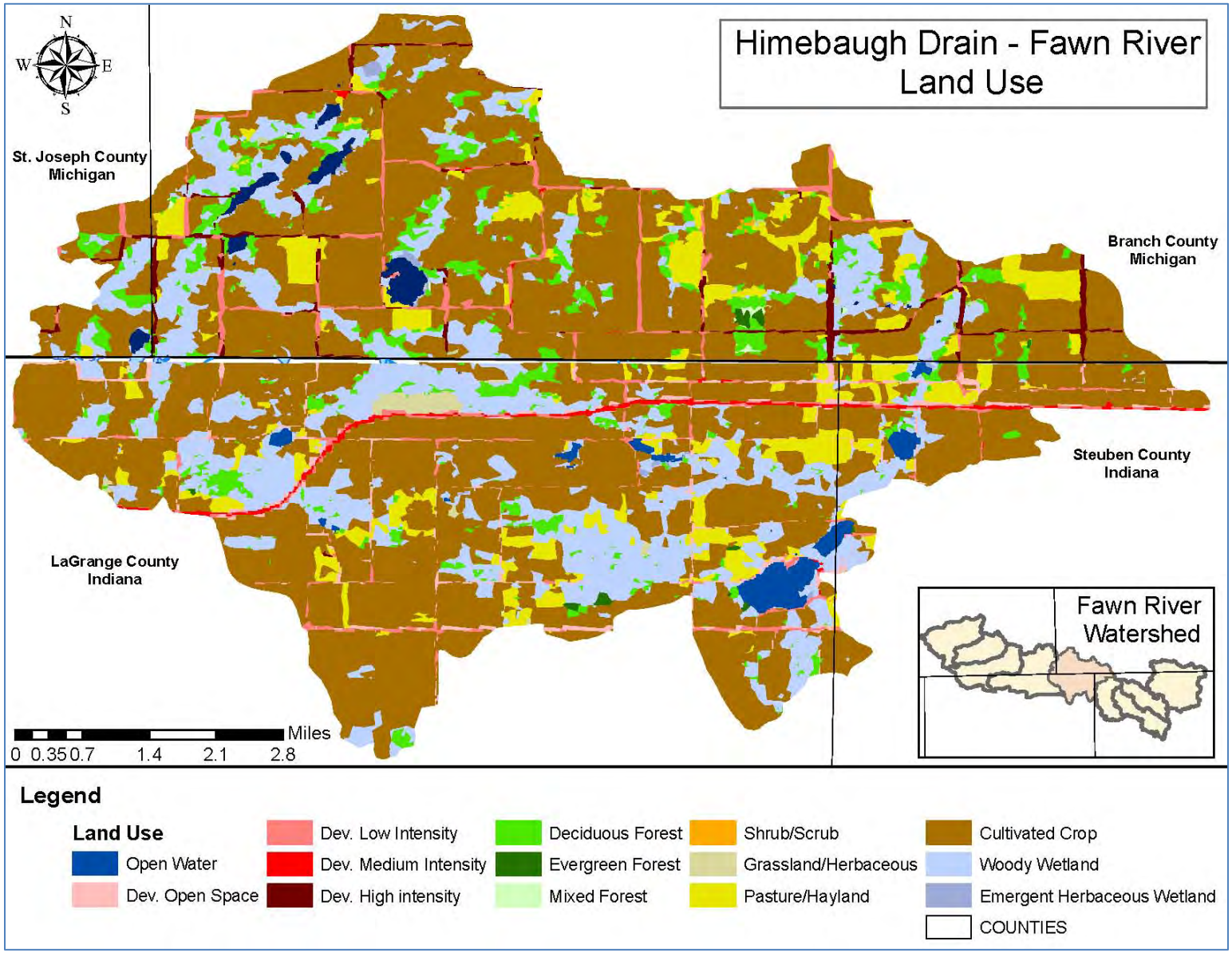
3.4.5 Himebaugh Drain – Fawn River Sub-watershed Land Use

The primary influence on water quality in the Himebaugh Drain Sub-watershed is agriculture as over 67% of the drainage area is in row crops or pasture and hayland. Unsewered homes in the rural areas of this sub-watershed also have a major influence on the water quality within the Himebaugh Drain sub-watershed. Of significance in this sub-watershed is that over 17% of the sub-watershed is covered by wetlands. This will be discussed in more detail later in this Section. Nearly 7% of the this sub-watershed is developed, most of which is from major roads, including Interstate 80 which is a four lane partial toll road that connects the west and east coasts, as there are no populated areas located within the drainage. Table 3.4.11 shows the percentage of the Himebaugh Drain Sub-watershed that is in each land use and Figure 3.35 is a map showing the delineation of land use in the sub-watershed. All landuse data presented was obtained from the National Land Cover Data from the USGS and analyzed in ArcGIS.

Table 3.4.11: Land Use in the Himebaugh Drain Sub-watershed

NLCD Land Use Designation	Acres	%
Open Water	471.99	1.71%
Developed Open Space	866.52	3.14%
Developed Low Intensity	739.08	2.68%
Developed Medium Insensity	168.56	0.61%
Developed High Intensity	1.74	0.01%
Barren Land	15.38	0.06%
Deciduous Forest	1629.07	5.91%
Evergreen Forest	50.46	0.18%
Shrub/Scrub	11.68	0.04%
Mixed Forest	27.49	0.10%
Grassland Herbaceous	173.26	0.63%
Pasture Hayland	1977.96	7.17%
Row Crops	16727.24	60.64%
Woody Wetland	4665.82	16.91%
Emergent Herbaceous Wetlands	59.54	0.22%
Total	27,585.79	100.00%

Figure 3.35: Himebaugh Drain Sub-watershed Land Use Designations



The windshield survey conducted as part of this project in May, 2014 revealed some common concerns scattered throughout the Himebaugh Drain sub-watershed including agriculture land that lacks a riparian buffer along open water, sea walls constructed along the lakes in the watershed, and lush green lawns adjacent to open water, indicating fertilizer use in areas that lack adequate riparian and shoreline buffers. However, there were several locations where more specific issues were observed. There were 11 sites where there was zero riparian buffer present adjacent to agriculture fields, and slight erosion of the streambank was observed at each of the 11 locations. The total length of the streambank needing a riparian buffer in the agriculture community (verified through a desktop survey) is 24,534 linear feet. One site was noted as having severe erosion, where the banks were sloughing into the stream due to a lack of riparian buffer adjacent to row crop fields. The total length of streambank needing stabilized is 628 linear feet. There were also two residential properties adjacent to a stream where there was no riparian buffer with lush green turf grass leading directly up to the streambank. The total length of those residential areas in need of a riparian buffer is 513 linear feet. One location was noted where livestock had direct access to open water which contributes to erosion along the streambanks that become denuded of vegetation from the livestock, and to nutrients and E. coli due to the livestock depositing waste directly into the stream. Finally, one bridge was noted as a fish barrier in the Fawn River where five culverts were placed under the road for the river to pass, though the culvert was not conducive to the passage of fish. Table 3.4.12 lists the observations made during the survey, and the approximate length of the problem. Figure 3.36 shows the location of each of the issues discovered during the windshield survey, as well as the populated lakes where seawalls and excessive fertilizer application may be used.

Table 3.4.12: Windshield Observations in the Himebaugh Drain Sub-watershed

Windshield Survey Observation	Potential Contaminant	Number or Length
Severe Streambank Erosion - Ag.	Sediment and Nutrients	628 linear ft
Lack of Riparian Buffer - Ag	Sediment and Nutrients	24,534 linear ft
Lack of Riparian Buffer - Residential	Sediment, Nutrients, and *E. coli*	513 linear ft
Livestock Access to Open Water	Sediment, Nutrients, and *E. coli*	1
Fish Barrier	Decline in Fish Species	1

Another potential problem related to residential homes in the Himebaugh Drain sub-watershed is the areas that are not currently serviced by a centralized sewer system. These homes most likely utilize an on-site waste disposal system that has the potential to leak or fail if not properly maintained. As is illustrated in Figure 3.37, over 96% of the sub-watershed's soils are designated as being very limited or somewhat limited for septic system placement and there are no areas of the sub-watershed that is serviced by a centralized sewer system, including the four populated lakes in the sub-watershed.

Figure 3.36: Windshield Observations in the Himebaugh Drain Sub-watershed

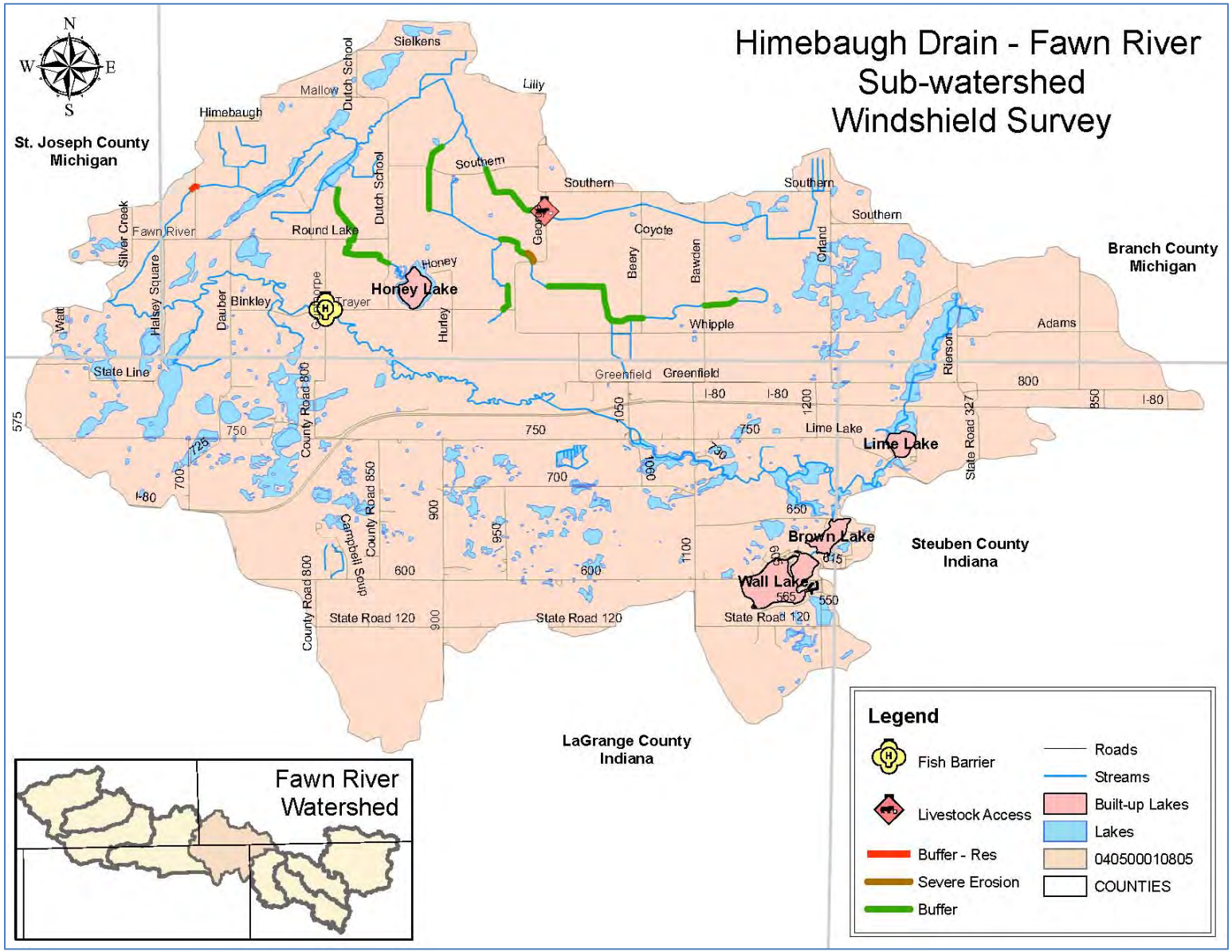
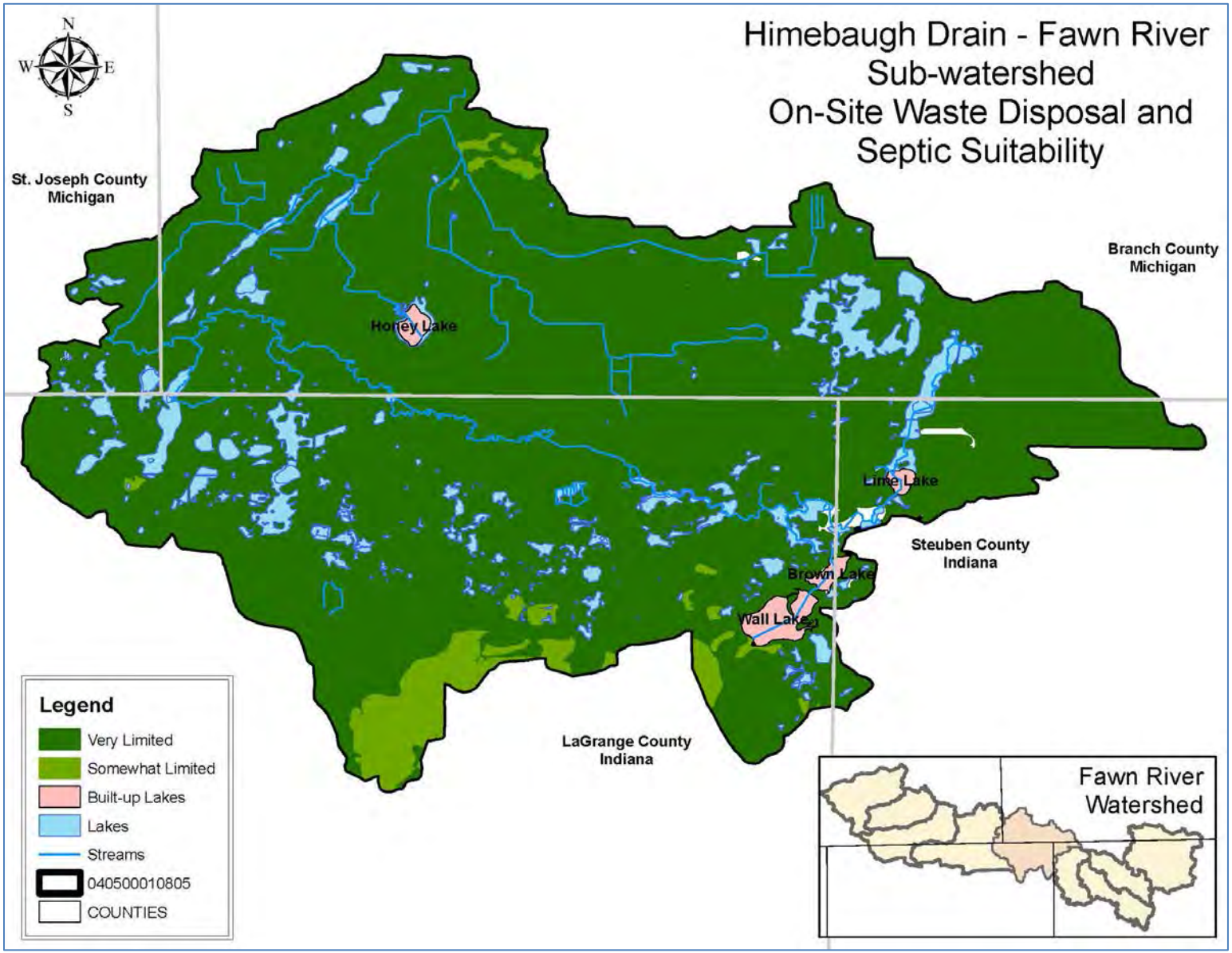


Figure 3.37: Septic Suitability in the Himebaugh Drain Sub-watershed



As stated above, most of the land in the Himebaugh Drain sub-watershed is used for agriculture; either cultivated crops or pasture and hayland. Approximately 17% of the land in the sub-watershed is designated as highly or potentially highly erodible by the respective county's NRCS. This percentage is not as significant as it is in other sub-watersheds. However, there is still potential for sediment, carrying nutrients attached to the soil particles, from HEL that is being conventionally tilled, or farmed directly up to the streambank to deposit in open water. Special precautions must be taken on farmland in this sub-watershed that is designated as HEL or PHEL to prevent soil erosion, and sedimentation and nutrification of open water. Figure 3.38 shows the location of HEL and PHEL in the watershed, overlaid on the agriculture land to paint a picture of where there is a risk of soil erosion.

The Himebaugh Drain sub-watershed has a significant amount of land cover designated as wetland: over 17%. According to the 2005 wetland inventory conducted by MDEQ and partners, the Himebaugh Drain sub-watershed currently has 3600.78 acres of wetland from the 5939.65 acres of wetland present in pre-settlement times. This is nearly a 39% decline in the wetlands since settlement of the area. The loss in wetlands translates to a huge loss in the ability of the wetlands to absorb pollutants prior to them being released into open water and in prime habitat for fauna that relies on wetlands for survival. According to data collected in 2005, there has been a water quality functional use loss of 42% and a habitat functional use loss of 44% in the HImebaugh Drain sub-watershed; much greater of a loss than the previous sub-watershed. Figure 3.39 shows the wetland delineation for the historic and current wetlands in the Himebaugh Drain sub-watershed.

Figure 3.38: Highly and Potentially Highly Erodible Land in Himebaugh Drain Sub-watershed

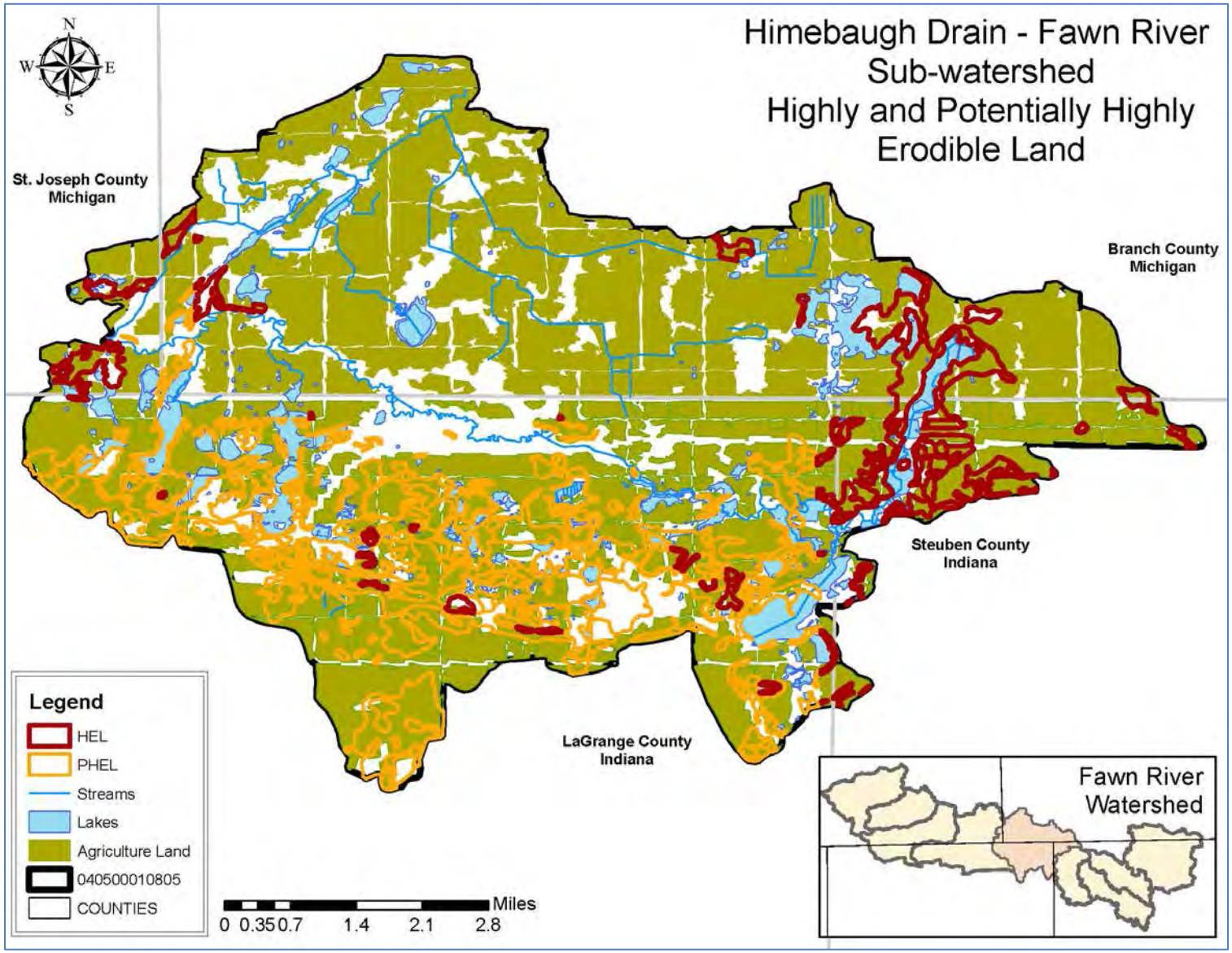
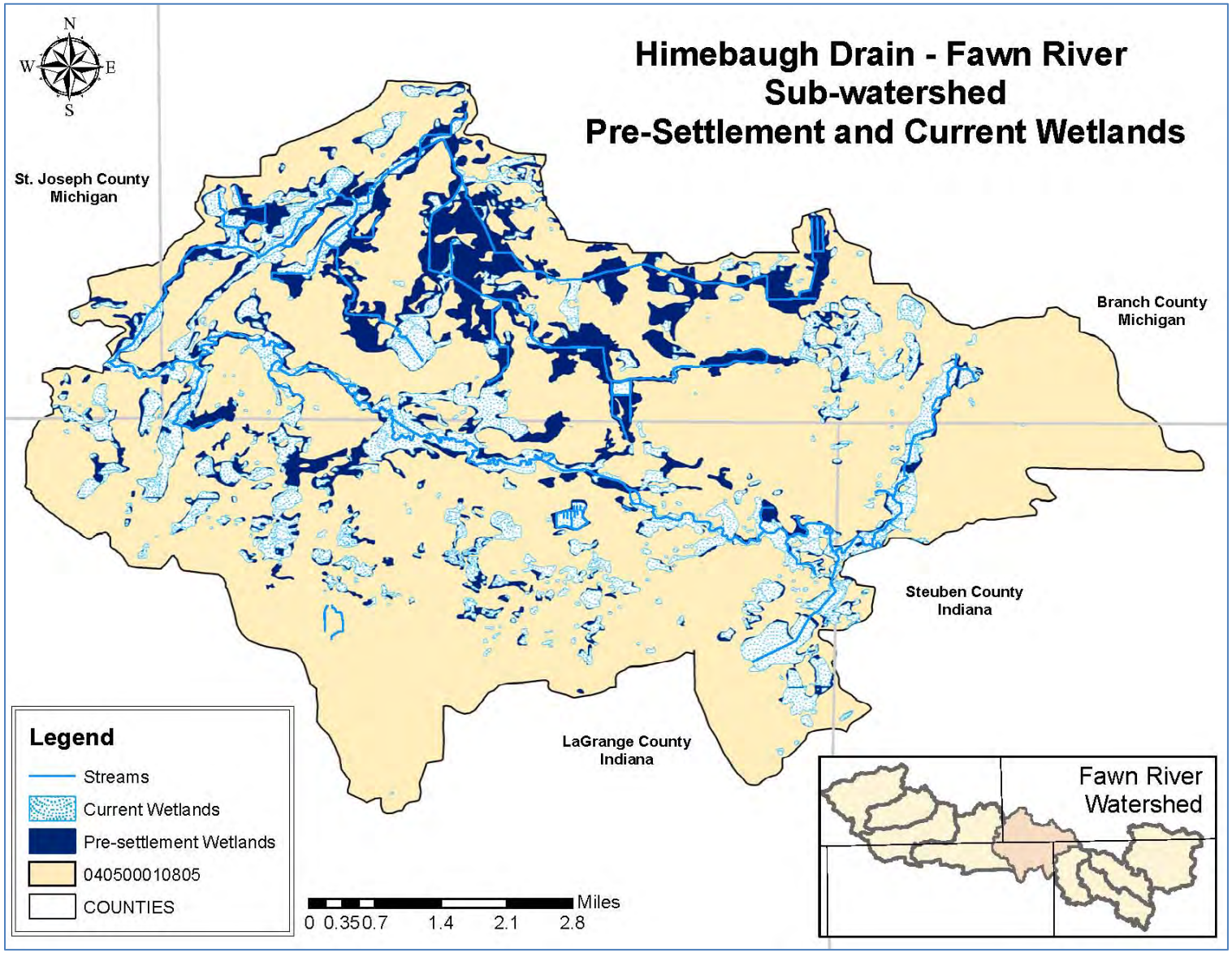


Figure 3.39: Wetlands in Himebaugh Drain Sub-watershed



A final threat to water quality found during the inventory of Himebaugh Drain sub-watershed is potential point sources of pollution. There are not any NPDES permitted facilities located within this sub-watershed. However, there are two USTs located within the Himebaugh Drain sub-watershed. While USTs do not pose an immediate threat to water resources, they do run the risk of leaking if not properly inspected and maintained. Of the two USTs located within this sub-watershed one of them is considered to be a LUST by IDEM and it is considered to be a medium priority for remediation. Table 3.4.13 lists the information about the LUST located in the Himebaugh Drain sub-watershed.

Table 3.4.13: Leaking Underground Storage Tank in the Himebaugh Drain Sub-waterhsed

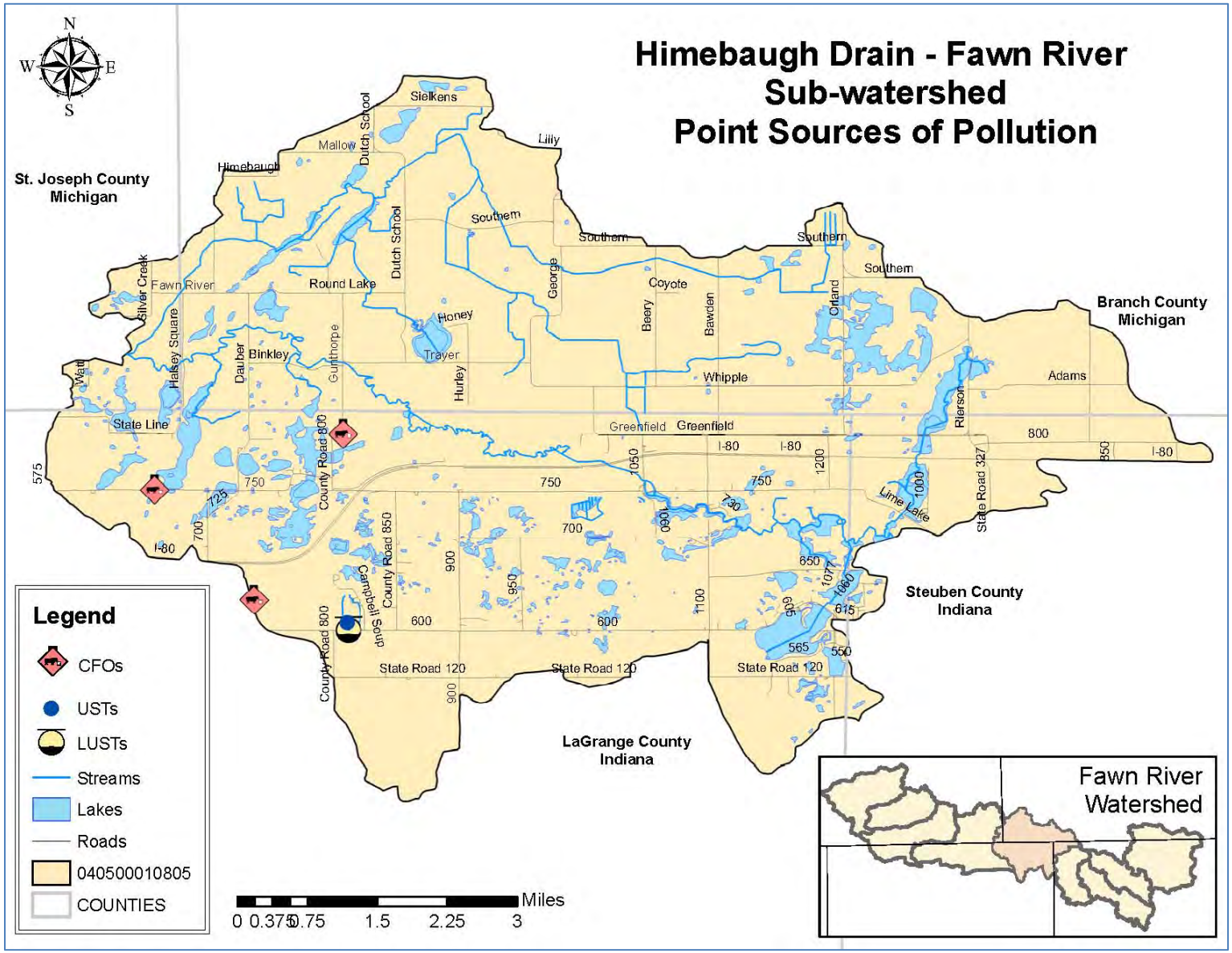
UST FACILITY ID	INCIDENT NUMBER	NAME	PRIORITY DESC	TANK STATUS DESCRIPTION	AFFECTED AREA NAME
16869	199004525	Campbell's Mushroom's, Inc.	Medium	Active	Soil
	199004525		Medium	Active	Groundwater

Three confined feeding operations can be found in the Himebaugh Drain Sub-watershed; all in LaGrange County, IN and all are swine operations. CFOs present a potential problem due to the volume of manure produced at the facility. If the manure holding facility is not large enough, or is not properly maintained, there is the potential for manure to discharge from the holding facility and potentially contaminate surface and/or groundwater. They also pose a threat if the manure is being land applied as fertilizer and soil tests to determine the proper amount of manure needed for plant uptake are not performed; manure may be applied to the land in excess. Two of the CFOs are relatively close to a wetland area. Michael Fanning Farms is located approximately 300 feet from a wetland that is connected to a tributary of the Fawn River and Contract Pork is located approximately 600 feet from a stand-alone wetland. Table 3.4.14 lists the three CFOs located within the Himebaugh Drain sub-watershed and Figure 3.40 shows the location of the potential point sources of pollution in the sub-watershed.

Table 3.4.14: Confined Feeding Operations in the Himebaugh Drain Sub-watershed

Operation Name	County	Sub-watershed	Program	Animal Type	Animal #
Laurent D Jennings	Lagrange	Himebaugh Drain	CFO	Swine/Beef Cattle	2300/25
Contract Pork	Lagrange	Himebaugh Drain	CFO	Swine	6000
Michael Fanning Farms	Lagrange	Himebaugh Drain	CFO	Swine	1430

Figure 3.40: Point Sources of Pollution in Himebaugh Drain Sub-watershed



Water quality data collected in the Himebaugh Drain sub-watershed indicates a significant pollution issue with phosphorus and nitrates, and to a lesser degree *E. coli*. An analysis of all the samples collected in the Himebaugh Drain sub-watershed shows that nitrates exceeded the target level in 74% of the samples, phosphorus in 57% of the samples, and *E. coli* exceeded the state standard in 13% of the samples collected. The high nutrients and *E. coli* levels may be due to leaking septic systems as only 4% of the land is designated suitable for septic placement and none of the residents in this sub-watershed have access to a centralized sewer system at this time. The high nutrients and *E. coli* levels may also be due to runoff of fertilizer from turf lawns around the built-up lakes, and agriculture fields that do not utilize conservation tillage, nutrient management, or riparian buffers. The windshield survey revealed that there is over 24,000 linear feet of streambank with no riparian buffer in place. There was also one site where livestock were seen in the stream during the windshield survey. The livestock at that site pose a significant risk to water quality by contributing sediment, bacteria, and nutrients directly to the stream. Finally, the destruction of wetlands that can efficiently filter pollutants from water may also be contributing to the high nutrient levels as the Himebaugh Drain sub-watershed has a wetland functional use loss for water quality benefits of 42%.

The biological data collected by the MDEQ at this site indicates that the habitat is moderately impaired, which may be due to the wetland functional use loss for habitat of 44%, and also the lack of riparian buffer used in the Himebaugh Drain sub-watershed.

Specific water quality problems that can be tied to the windshield survey are that the FRP's site 23 collects water that flows through Wall and Brown Lakes, both of which are built-up and the residents utilize on-site waste disposal. Site 23 samples exceeded the target level for nitrates and phosphorus in 100% of the samples. The FRP's site 28 exceeded the target level for phosphorus in 100% of the samples, nitrates exceeded the target level in 75% of the samples, and *E. coli* exceeded the state standard in 42% of the samples. This may be a results of the sites observed during the windshield survey, upstream of site 28 that lacked a riparian buffer, as well as the site where livestock have direct access to open water, also upstream of Site 28.

A variety of best management practices and management measures that could benefit the water quality in the Himebaugh sub-watershed are available. Some of those practices include conservation tillage, cover crops, riparian and shoreline buffer installation adjacent to residential and agriculture land, nutrient management, wetland restoration, septic system education and livestock exclusion from open water.

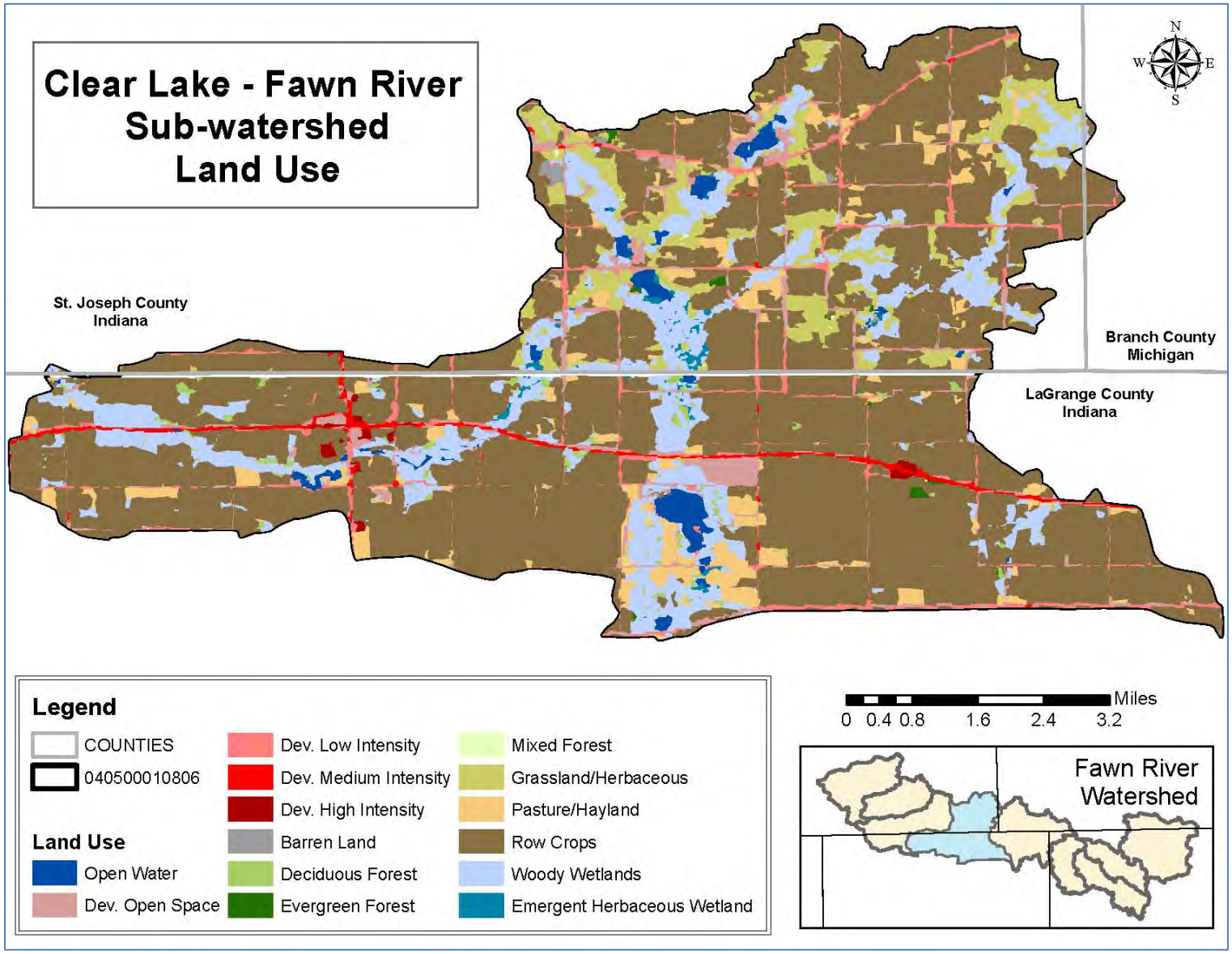
3.4.6 Clear Lake – Fawn River Sub-watershed Land Use

The primary influence on water quality in the Clear Lake Sub-watershed is agriculture as over 70% of the drainage area is in row crops or pasture and hayland. Unsewered homes in the rural areas of this sub-watershed also have a major influence on the water quality within the Clear Lake sub-watershed. There are no large populated areas located within the Clear Lake sub-watershed, however over 8% of the watershed is considered to be developed mainly because I-80 runs through this watershed, as well as the US-12 which is a major road, though less traveled than I-80. There are also three built-up lakes located in the Clear Lake sub-watershed, including Cedar Lake (the largest of the three), Williams Lake and Sweet Lake; none of which are connected to a centralized sewer system. Table 3.4.15 shows the percentage of the Clear Lake Sub-watershed that is in each land use and Figure 3.41 is a map showing the delineation of land use in the sub-watershed. All landuse data presented was obtained from the National Land Cover Data from the USGS and analyzed in ArcGIS.

Table 3.4.15: Land Use in the Clear Lake Sub-watershed

NLCD Land Use Designation	Acres	%
Open Water	413.74	1.28%
Developed Open Space	1204.93	3.73%
Developed Low Intensity	1110.84	3.44%
Developed Medium Insensity	315.58	0.98%
Developed High Intensity	79.11	0.24%
Barren Land	59.59	0.18%
Deciduous Forest	2018.14	6.25%
Evergreen Forest	55.96	0.17%
Shrub/Scrub	17.22	0.05%
Mixed Forest	21.19	0.07%
Grassland Herbaceous	78.62	0.24%
Pasture Hayland	1449.01	4.48%
Row Crops	21840.32	67.60%
Woody Wetland	3473.87	10.75%
Emergent Herbaceous Wetlands	171.31	0.53%
Total	32,309.43	100.00%

Figure 3.41: Clear Lake – Fawn River Sub-watershed Land Use Designations



The windshield survey conducted as part of this project in May, 2014 revealed some common concerns scattered throughout the Clear Lake sub-watershed including agriculture land that lacks a riparian buffer along open water, sea walls constructed along the lakes in the watershed, and lush green lawns adjacent to open water, indicating fertilizer use in areas that lack adequate riparian and shoreline buffers. However, there were three locations where more specific issues were observed. There was one site where there was zero riparian buffer present adjacent to a residential property, and slight erosion of the streambank was observed at the site as well. The total length of the streambank needing a riparian buffer in the (verified through a desktop survey) is 743 linear feet. Two sites were identified as possibly having pasture runoff. One site on CR 250 has livestock in a pasture that frequently floods allowing for animal waste to wash into the adjacent stream during the floodwater recession back into the stream banks. The other location is on CR 600 near Duff Lake where cattle are in pasture directly adjacent to tributaries to Duff Lake. It appears the livestock are fenced out of the stream, however there is a high potential that animal waste will run directly into the stream due to the pasture's proximity to the stream and the lack of riparian buffer. Table 3.4.16 lists the observations made during the survey, and the approximate length of the problem. Figure 3.42 shows the location of each of the issues discovered during the windshield survey, as well as the populated lakes where seawalls and excessive fertilizer application may be used.

Table 3.4.16: Windshield Survey Observations in the Clear Lake – Fawn River Sub-watershed

Windshield Survey Observation	Potential Contaminant	Number or Length
Pasture Runoff	*E. coli*, Sediment and Nutrients	2
Lack of Riparian Buffer - Res	Sediment and Nutrients	743 linear ft

Another potential problem related to residential homes in the Clear Lake sub-watershed is the areas that are not currently serviced by a centralized sewer system. These homes most likely utilize an on-site waste disposal system that has the potential to leak or fail if not properly maintained. As is illustrated in Figure 3.43, over 93% of the sub-watershed's soils are designated as being very limited for septic system placement and there are no areas of the sub-watershed that is serviced by a centralized sewer system, including the three populated lakes in the sub-watershed.

Figure 3.42: Windshield Survey Observations in the Clear Lake Sub-watershed

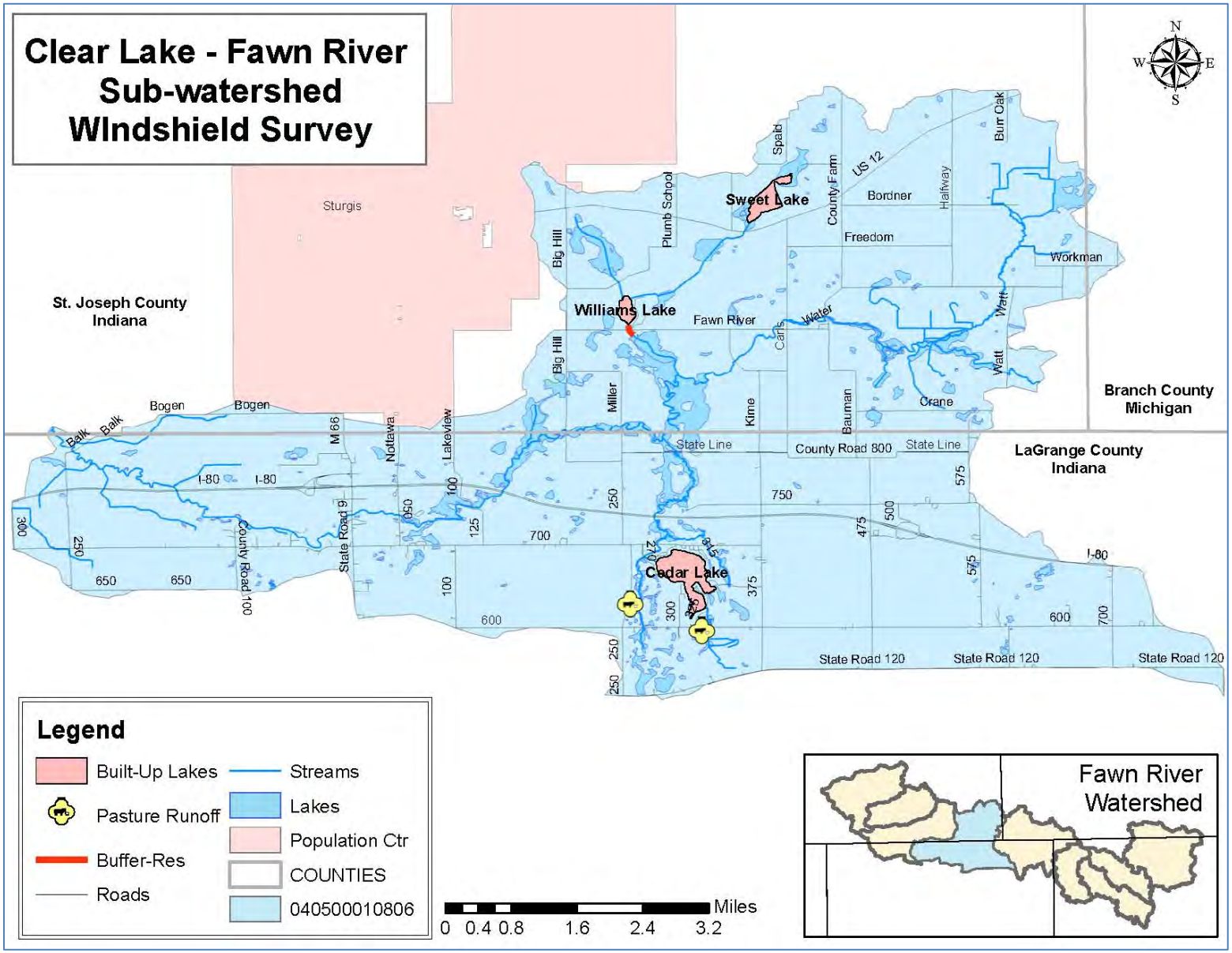
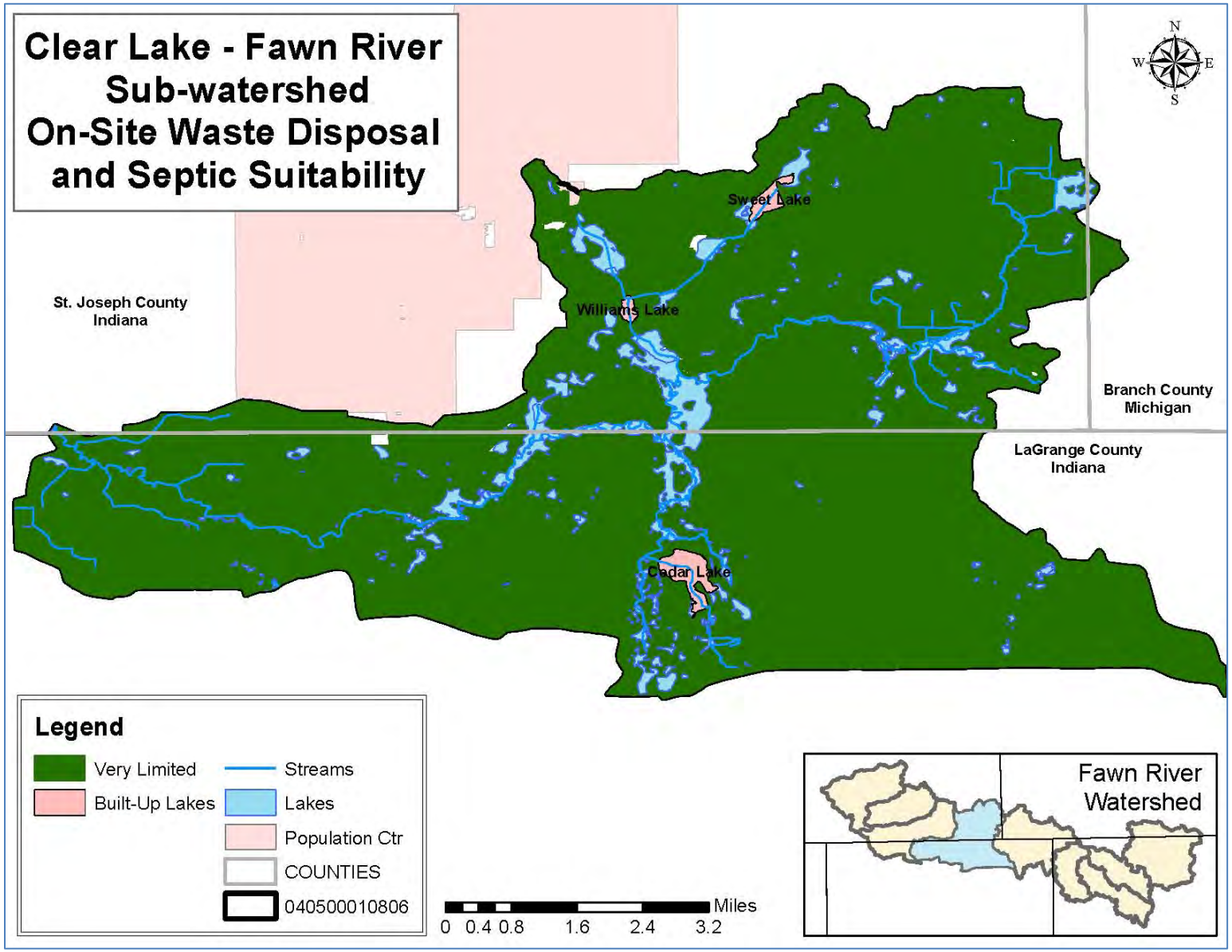


Figure 3.43: Septic Suitability in the Clear Lake Sub-watershed



As stated above, most of the land in the Clear Lake sub-watershed is used for agriculture; either cultivated crops or pasture and hayland. Approximately 16% of the land in the sub-watershed is designated as highly or potentially highly erodible by the respective county's NRCS. This percentage is not as significant as it is in other sub-watersheds. However, there is still potential for sediment, carrying nutrients attached to the soil particles, from HEL that is being conventionally tilled, or farmed directly up to the streambank to deposit in open water. Special precautions must be taken on farmland in this sub-watershed that is designated as HEL or PHEL to prevent soil erosion, and sedimentation and nutrification of open water. Figure 3.44 shows the location of HEL and PHEL in the watershed, overlaid on the agriculture land to paint a picture of where there is a risk of soil erosion.

The Clear Lake sub-watershed has approximately 11% of land cover designated as wetland. According to the 2005 wetland inventory conducted by MDEQ and partners, the Clear Lake sub-watershed currently has 3,080.12 acres of wetland from the 5840.12 acres of wetland present in pre-settlement times. This is over a 47% decline in the wetlands since settlement of the area. The loss in wetlands translates to a huge loss in the ability of the wetlands to absorb pollutants prior to them being released into open water and in prime habitat for fauna that relies on wetlands for survival. According to data collected in 2005, there has been a water quality functional use loss of 47% and a habitat functional use loss of 53% in the Clear Lake sub-watershed; much greater of a loss than the previous sub-watersheds. Since only 11% of the watershed is classified as wetland, it is important to protect the existing wetlands, to prevent further loss in the ability of the land cover to absorb pollutants and provide habitat to important flora and fauna. Figure 3.45 shows the wetland delineation for the historic and current wetlands in the Clear Lake sub-watershed.

Figure 3.44: Highly and Potentially Highly Erodible Land in the Clear Lake Sub-watershed

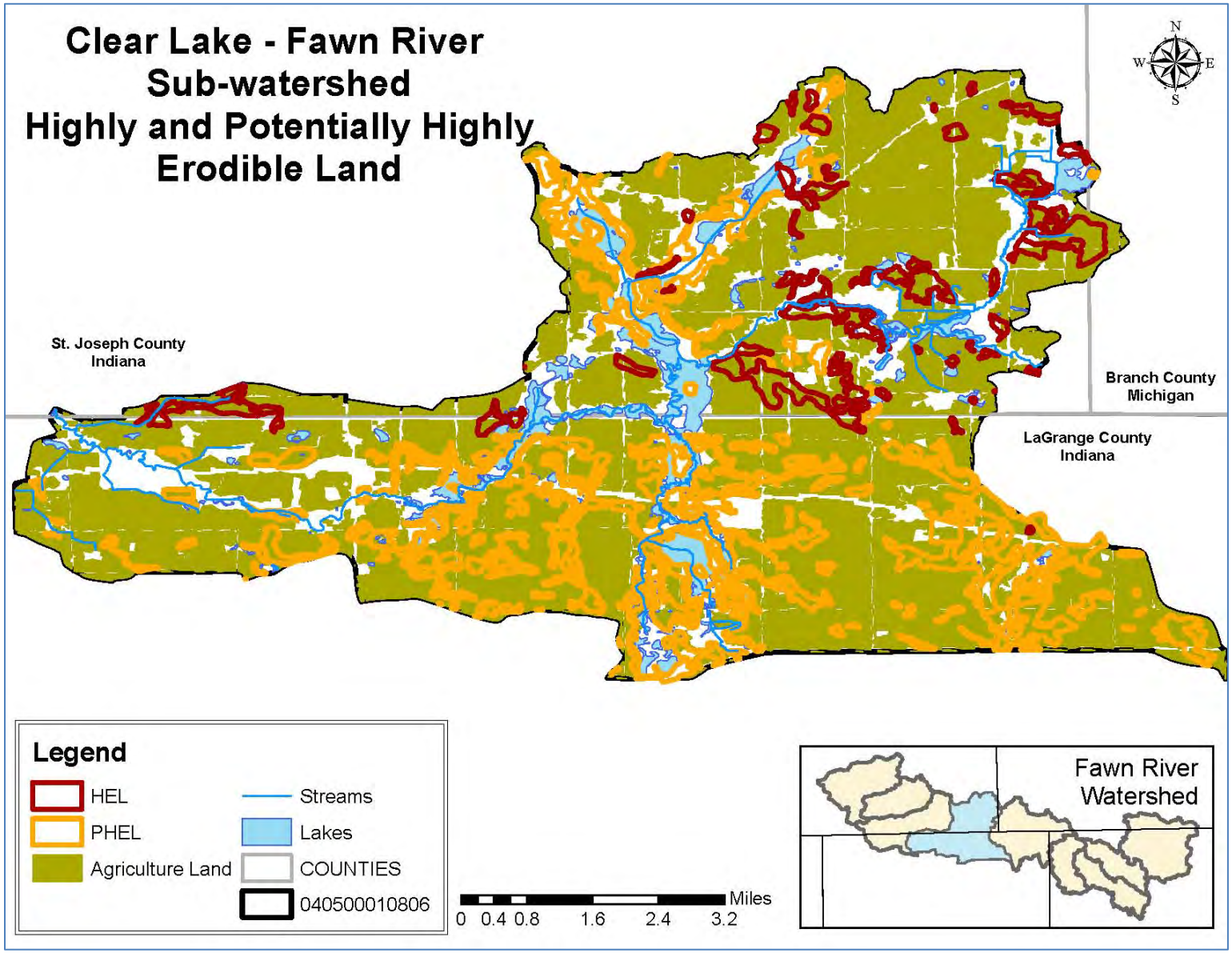
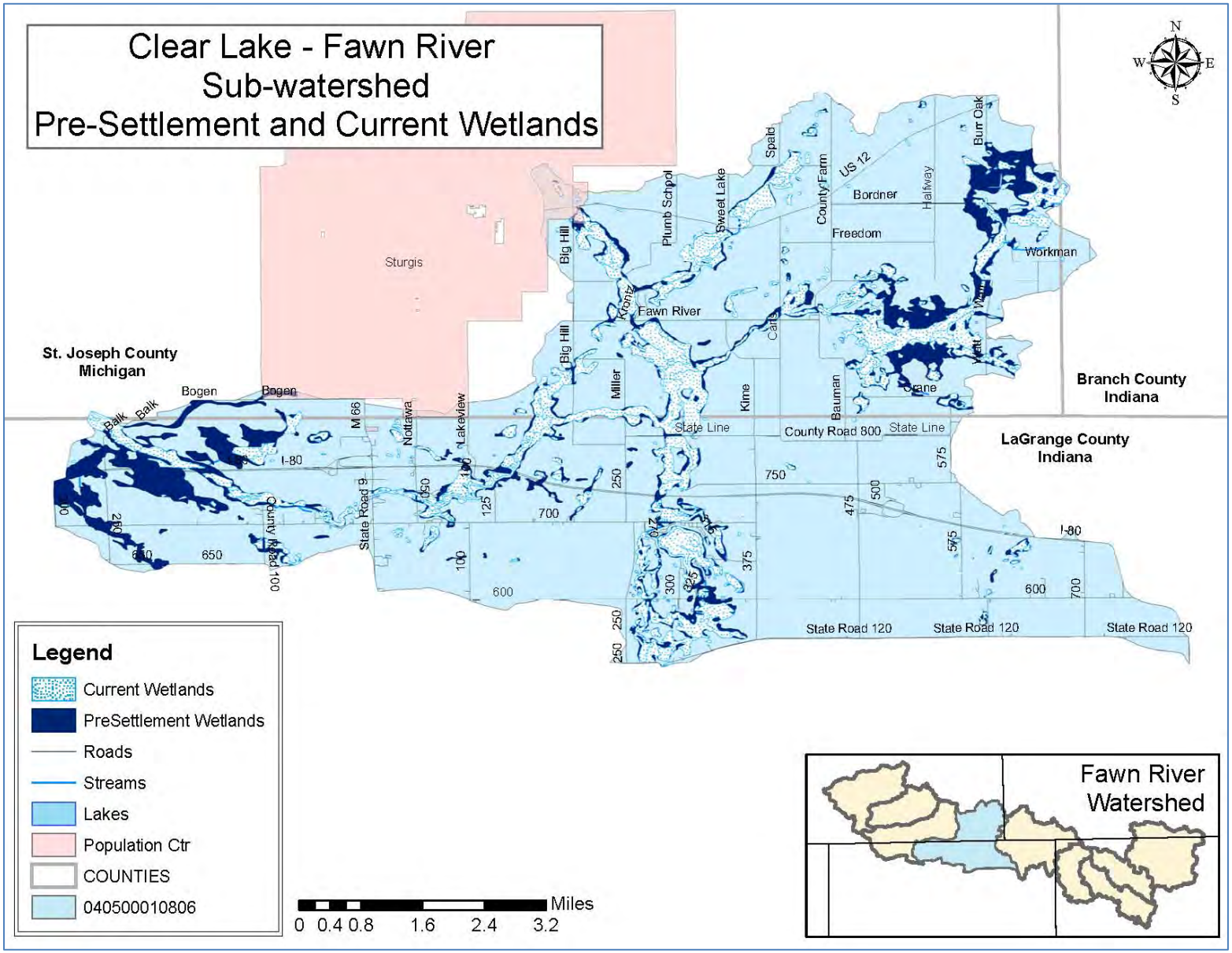


Figure 3.45: Current and Pre-Settlement Wetlands in the Clear Lake Sub-watershed



A final threat to water quality found during the inventory of Clear Lake sub-watershed is potential point sources of pollution. There are two NPDES permitted facilities located within this sub-watershed, however one of the facilities drains into the Pigeon River Watershed and is highlighted in yellow in Table 3.4.17 below. There are four USTs located within the Clear Lake sub-watershed. While USTs do not pose an immediate threat to water resources, they do run the risk of leaking if not properly inspected and maintained. Of the three USTs located within this sub-watershed three of them are considered to be a LUST by IDEM and while the one located in Michigan does not have its priority level listed, those located in Indiana are all considered to be a high priority for remediation. Table 3.4.18 lists the information about the LUSTs located in the Clear Lake sub-watershed.

Table 3.4.17: NPDES Permitted Facilities in the Clear Lake Sub-watershed

Permit Name	Permit #	Receiving Water Body Name	Qrts in Non-compliance (3 yrs)	Qtrs in Significant Non-compliance (3 yrs)	Pollutant Causing Non-compliance	Pollutant with Significant violations	Enforcement Actions (I=informal; F=formal) (5 yrs)
Sturgis-Big Hill Rd LF	MI0047716	Moe Drain	0	0	N/A	N/A	N/A
Travel Plaza - Ernie Pyle	IN0050300	Pigeon River via Unnamed Trib	2	0	non-RNCV		0

Table 3.4.18: Leaking Underground Storage Tanks in the Clear Lake Sub-watershed

UST FACILITY ID	INCIDENT NUMBER	NAME	PRIORITY DESC	TANK STATUS DESCRIPTION	AFFECTED AREA NAME
3837	200204502	Amoco Ss 30969 / Travel Plaza 7 South	High	Active	Groundwater
	200204502		High	Active	Free Product
	200204502		High	Active	Soil
	200204502		High	Active	MTBE
3836	199912534	BP-Ernie Pyle/Travel Plaza 7 North	High	Active	Soil
	199912534		High	Active	MTBE
	199912534		High	Active	Groundwater
	199912534		High	Active	Free Product
	200411509		N/A	Deactivated (no release confirmed)	Unknown
000-08736	C-1152-98	J & M Service Center	Unknown	Unknown	Unknown

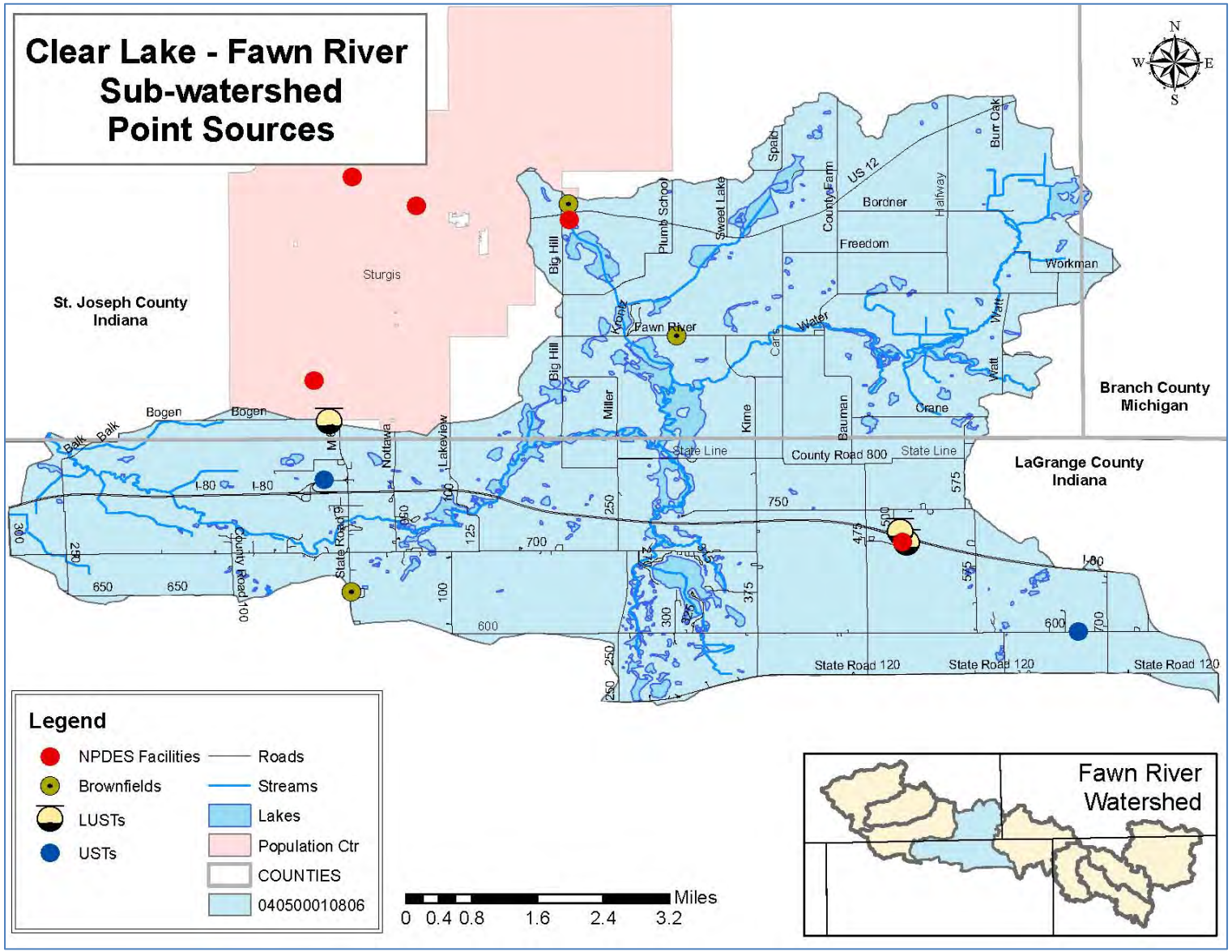
There are three sites in the Clear lake sub-watershed that are potential Brownfield sites and should be examined closer to determine if the sites are contaminated. Since these sites are listed as potential brownfields, they are eligible for funding to do further studies on the properties to determine the correct remediation work that needs to be completed to make the sites useful for other purposes while remediating any potential contamination from the site. Table 3.4.19 lists the three Brownfield sites located within the Clear Lake sub-watershed.

Figure 3.46 shows the location of all the potential point sources of pollution in the Clear lake sub-watershed.

Table 3.4.19: Brownfield Eligible Sites in the Clear Lake Sub-watershed

Name	Address	City	County
Fawn River Road Drums	30390 Fawn River Rd	Sturgis	St. Joseph
Sturgis City of LF (WWTP)	Big Hill Road 70250 S. Treatment Plant Rd	Sturgis	St. Joseph
Multiplex Incorporated	6505 N SR 9	Howe	LaGrange

Figure 3.46: Potential Point Sources of Pollution in the Clear Lake Sub-watershed



Water quality data collected in the Clear Lake sub-watershed indicates a significant pollution issue with phosphorus and nitrates, and to a lesser degree *E. coli*. An analysis of all the samples collected in the sub-watershed shows that nitrates exceeded the target level in 49% of the samples, phosphorus in 54% of the samples, and *E. coli* exceeded the state standard in 19% of the samples collected. The high nutrients and *E. coli* levels may be due to leaking septic systems as only 7% of the land is designated suitable for septic placement and none of the residents in this sub-watershed have access to a centralized sewer system at this time. The high nutrients and *E. coli* levels may also be due to runoff of fertilizer from turf lawns around the built-up lake (Cedar Lake), and agriculture fields that do not utilize conservation tillage, nutrient management, or riparian buffers.

The windshield survey revealed that there is over 740 linear feet of streambank with no riparian buffer in place adjacent to residential properties, though a small riparian buffer was noted throughout the sub-watershed adjacent to agriculture land as well. It should also be noted that St. Joseph County has the highest use of irrigation for crop fields in the entire state of Michigan. The reliance on irrigation in the county was observed during the windshield survey where over half of the crop fields had irrigation equipment in the field. Irrigating crop fields without an irrigation management plan in place may pose a threat to water quality due to over use or improper timing of the irrigation. There were also two sites where livestock pose a threat due to the proximity of their pastures to open water sources. The livestock pose a significant risk to water quality by contributing sediment, bacteria, and nutrients directly to the stream through storm flow or when the pasture becomes flooded and the flood water recedes. Finally, the destruction of wetlands that can efficiently filter pollutants from water may also be contributing to the high nutrient levels as the Clear Lake sub-watershed has a wetland functional use loss for water quality benefits of 47%, and 53% for habitat.

Specific water quality problems that can be tied to the land use survey are that the pasture runoff issues are a significant problem as FRPs sites 37 and 38 both had 100% of the samples that were tested for phosphorus exceed the target level. Site 38 is directly adjacent to one of the pastures and that site's samples exceeded targets for nitrate in 92% of the samples and *E. coli* in 17% of the samples. Many of the sample sites in the Clear Lake sub-watershed had higher exceedances for *E. coli* than in other sub-watersheds that were examined, specifically FRP's sites 32, 39, and 41 where each exceeded the state standard for *E. coli* in 40% of the samples. This may be due to the number of homes utilizing on-site waste management systems that are improperly placed or leaking, the heavy use of irrigation on land that has had manure fertilizer application, livestock operation runoff, or improper manure application.

A variety of best management practices and management measures that could benefit the water quality in the Clear Lake sub-watershed are available. Some of those practices include conservation tillage, riparian and shoreline buffer installation adjacent to residential and agriculture land, nutrient management, wetland restoration, septic system education pasture management, and irrigation management.

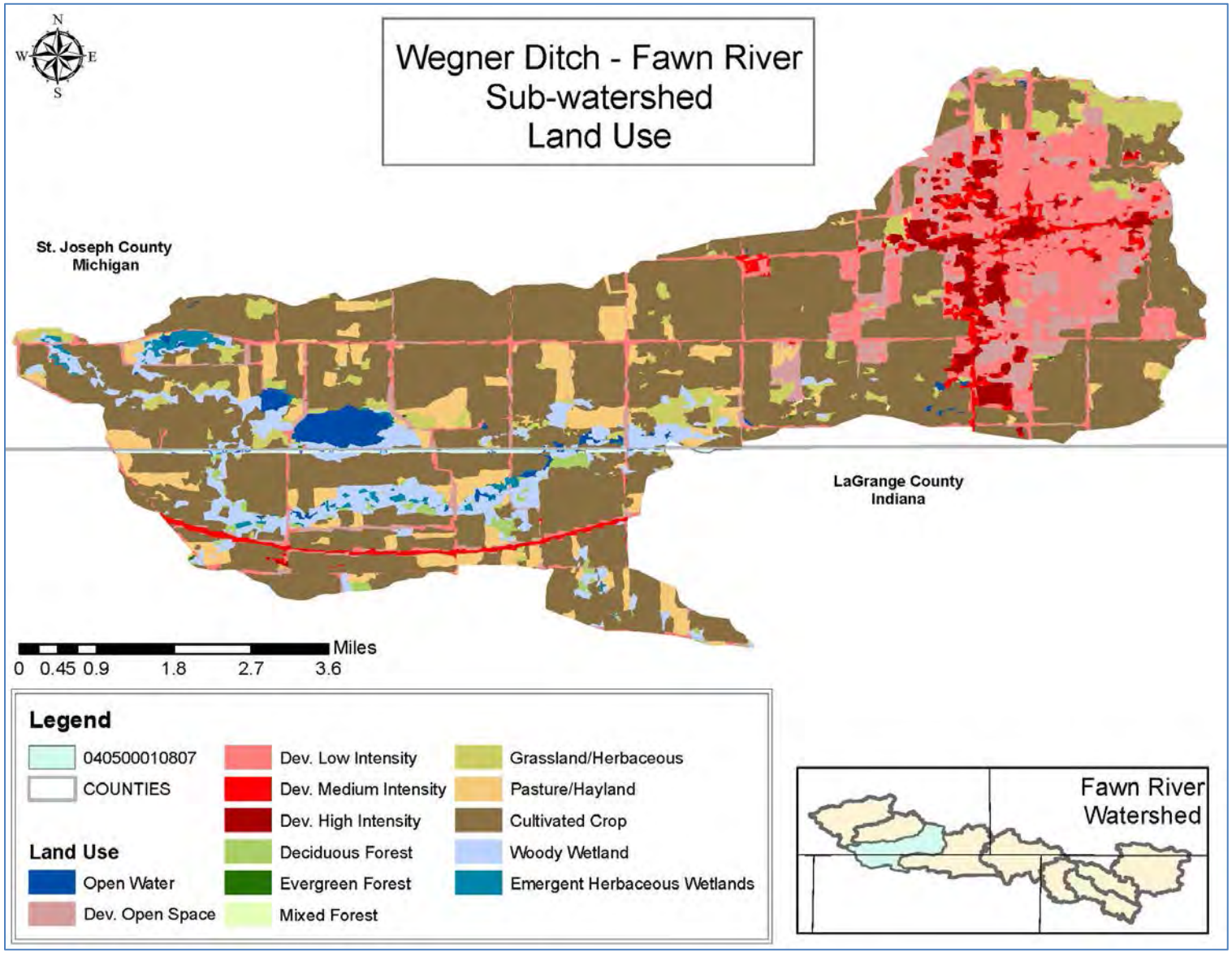
3.4.7 Wegner Ditch Sub-watershed Land Use

The primary influence on water quality in the Wegner Ditch Sub-watershed is agriculture as over 67% of the drainage area is in row crops or pasture and hayland. However, urban areas also have a significant influence on this sub-watershed as over 20% of the drainage area is considered to be developed, mostly as a result of the majority of the city of Sturgis being located within the sub-watershed boundaries, as well as the built-up Aldrich Lake. Unsewered homes in the rural areas of this sub-watershed have a major influence on the water quality within the Wegner Ditch sub-watershed as does the unsewered community of Aldrich Lake. Table 3.4.15 shows the percentage of the Clear Lake Sub-watershed that is in each land use and Figure 3.47 is a map showing the delineation of land use in the sub-watershed. All landuse data presented was obtained from the National Land Cover Data from the USGS and analyzed in ArcGIS.

Table 3.4.20: Land Use in the Wegner Ditch Sub-watershed

NLCD Land Use Designation	Acres	%
Open Water	281.37	1.13%
Developed Open Space	1588.84	6.39%
Developed Low Intensity	2340.95	9.42%
Developed Medium Insensity	612.48	2.46%
Developed High Intensity	451.97	1.82%
Barren Land	32.93	0.13%
Deciduous Forest	1236.37	4.98%
Evergreen Forest	10.84	0.04%
Shrub/Scrub	3.35	0.01%
Mixed Forest	6.64	0.03%
Grassland Herbaceous	62.63	0.25%
Pasture Hayland	1536.06	6.18%
Row Crops	15192.42	61.14%
Woody Wetland	1319.49	5.31%
Emergent Herbaceous Wetlands	171.07	0.69%
Total	24,847.41	100.00

Figure 3.47: Wegner Ditch Sub-watershed Land Use Designations



The windshield survey conducted as part of this project in May, 2014 revealed some common concerns scattered throughout the Wegner Ditch sub-watershed including agriculture land that lacks a riparian buffer along open water, sea walls constructed along the lakes in the watershed, and lush green lawns adjacent to open water, indicating fertilizer use in areas that lack adequate riparian and shoreline buffers. However, there were four locations where more specific issues were observed. There were three sites where there was zero riparian buffer present adjacent to agricultural land, and slight erosion of the streambank was observed at the sites as well. Two of the streams that lacked a buffer were also directly adjacent to I-80 so erosion may be more intense at those streams due to the runoff from the highway. The total length of the slightly eroded streambank needing a riparian buffer in the (verified through a desktop survey) is 3,177 linear feet. There were also two natural streams which run through the same agriculture field that have been tiled and no longer function as a natural stream. The tiled streams would benefit from daylighting as they are connected to a tributary of the Fawn River. The total length of the two streams that have been tiled is 10,977 linear feet. Table 3.4.21 lists the observations made during the survey, and the approximate length of the problem. Figure 3.48 shows the location of each of the issues discovered during the windshield survey, as well as the populated lake (Aldrich Lake) where seawalls and excessive fertilizer application may be used.

Table 3.4.21: Windshield Survey Observations in the Wegner Ditch Sub-watershed

Windshield Survey Observation	Potential Contaminant	Number or Length
Tiled Natural Stream in Row Crop Fields	Sediment and Nutrients	10,977 linear ft
Lack of Riparian Buffer - Ag.	Sediment and Nutrients	3,177 linear ft

Another potential problem related to residential homes in the Wegner Ditch sub-watershed is the areas that are not currently serviced by a centralized sewer system. These homes most likely utilize an on-site waste disposal system that has the potential to leak or fail if not properly maintained. As is illustrated in Figure 3.49, over 77% of the sub-watershed's soils are designated as being very limited for septic system placement. The City of Sturgis is serviced by a centralized sewer system, however the populated Aldrich Lake is not currently serviced and the residents most likely utilize on-site waste disposal systems

Figure 3.48: Windshield Survey Observations in the Wegner Ditch Sub-watershed

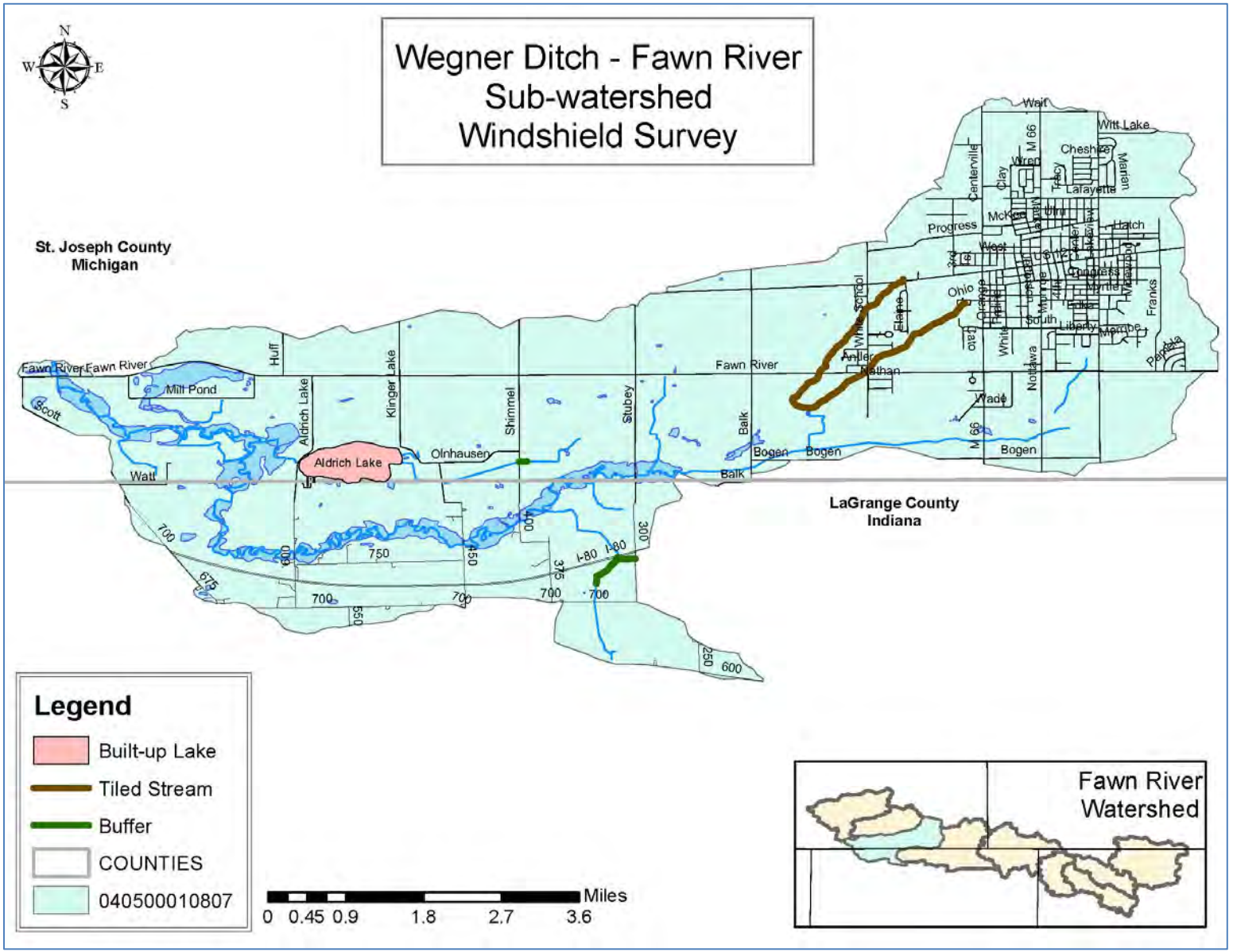
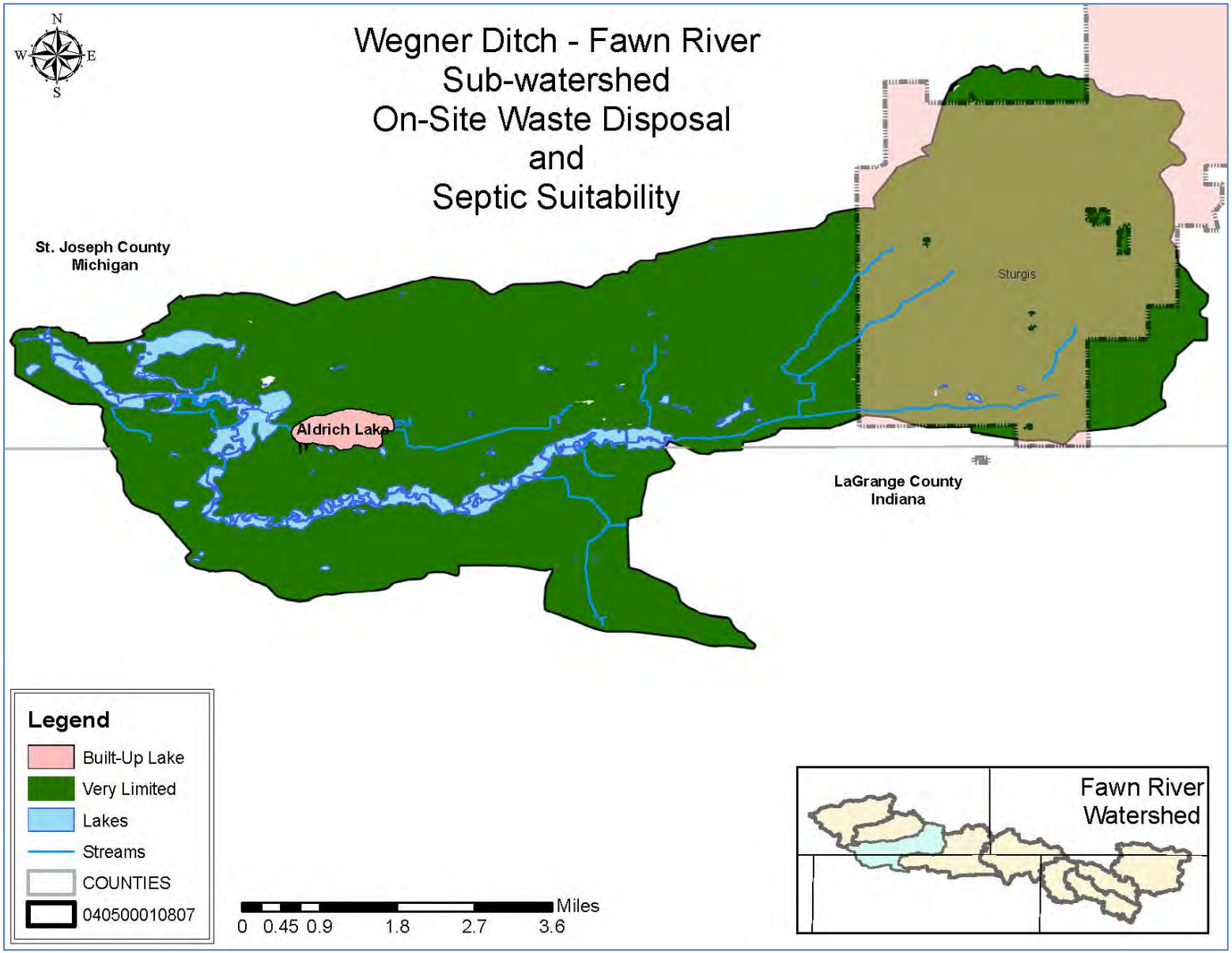


Figure 3.49: Septic Suitability in the Wegner Ditch Sub-watershed



As stated above, most of the land in the Wegner Ditch sub-watershed is used for agriculture; either cultivated crops or pasture and hayland. Approximately 12% of the land in the sub-watershed is designated as highly or potentially highly erodible by the respective county's NRCS. This percentage is not as significant as it is in other sub-watersheds. However, there is still potential for sediment, carrying nutrients attached to the soil particles, from HEL that is being conventionally tilled, or farmed directly up to the streambank to deposit in open water. Special precautions must be taken on farmland in this sub-watershed that is designated as HEL or PHEL to prevent soil erosion, and sedimentation and nutrification of open water. Figure 3.50 shows the location of HEL and PHEL in the watershed, overlaid on the agriculture land to paint a picture of where there is a risk of soil erosion.

The Wegner Ditch sub-watershed has approximately 6% of land cover designated as wetland. According to the 2005 wetland inventory conducted by MDEQ and partners, the Wegner Ditch sub-watershed currently has 1,876.82 acres of wetland from the 3,158.6 acres of wetland present in pre-settlement times. This is over a 40% decline in the wetlands since settlement of the area. The loss in wetlands translates to a huge loss in the ability of the wetlands to absorb pollutants prior to them being released into open water and in prime habitat for fauna that relies on wetlands for survival. According to data collected in 2005, there has been a water quality functional use loss of 43% and a habitat functional use loss of 47% in the Wegner Ditch sub-watershed. Since only 6% of the watershed is currently classified as wetland, it is important to protect the existing wetlands, to prevent further loss in the ability of the land cover to absorb pollutants and provide habitat to important flora and fauna. Figure 3.51 shows the wetland delineation for the historic and current wetlands in the Wegner Ditch sub-watershed.

Figure 3.50: Highly and Potentially Highly Erodible Land in Wegner Ditch Sub-watershed

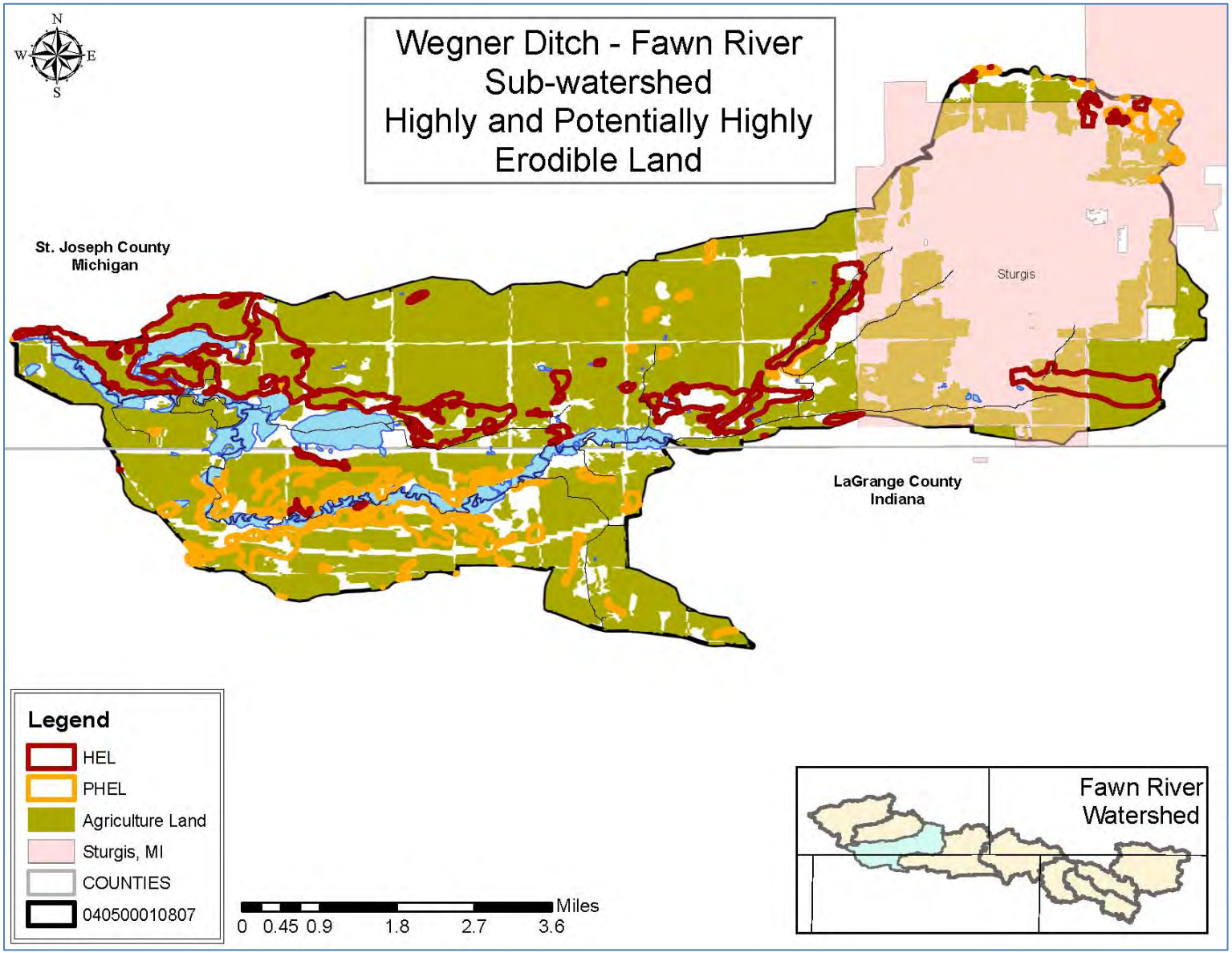
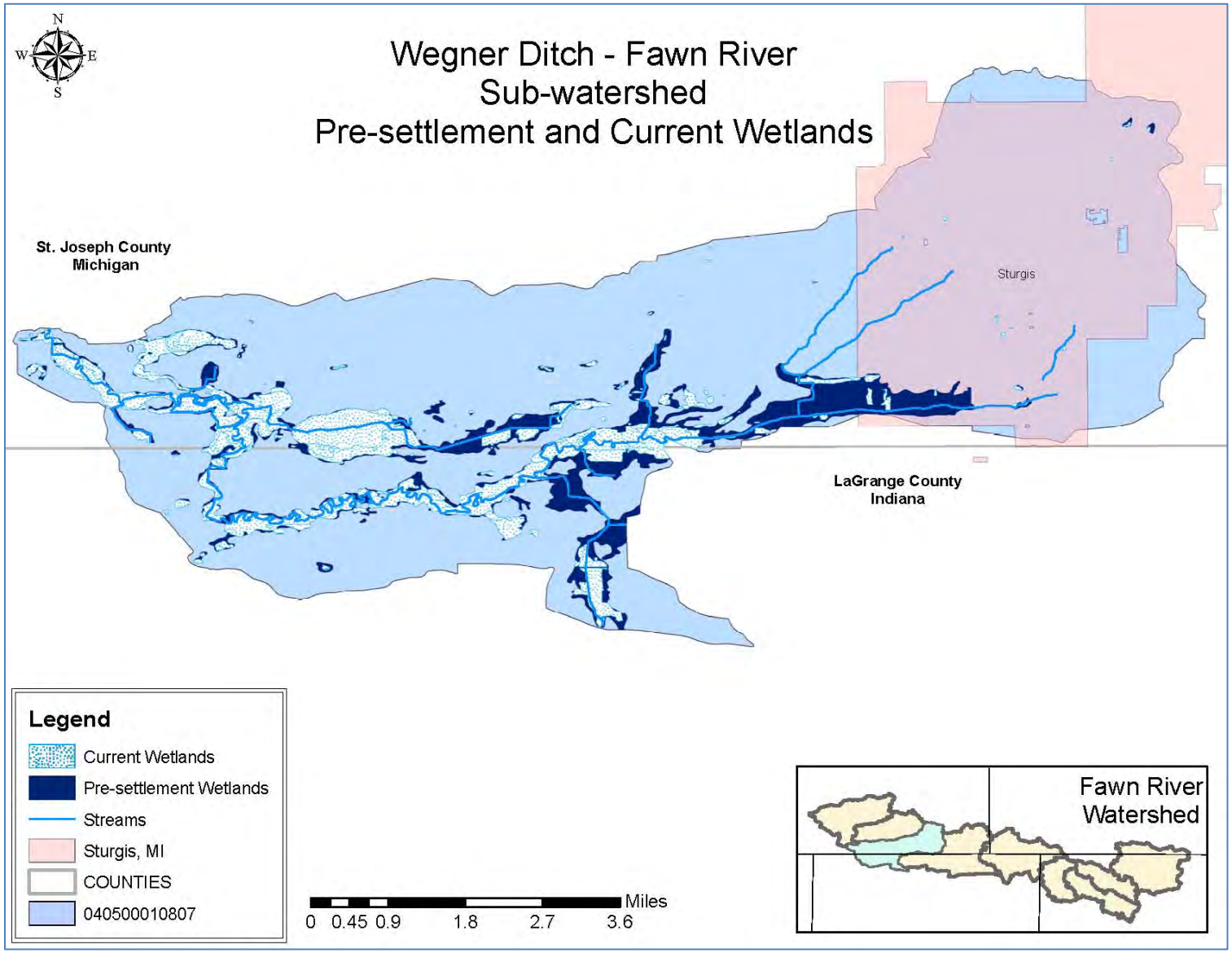


Figure 3.51: Current and Pre-Settlement Wetlands in the Wegner Ditch Sub-watershed



A final threat to water quality found during the inventory of Wegner Ditch sub-watershed is potential point sources of pollution. There are four NPDES permitted facilities located within this sub-watershed; three of which have been in non-compliance within the past 3 years, but none of them have been in significant con-compliance. Table 3.4.22 below lists the four NPDES permitted facilities.

Table 3.4.22: NPDES Permitted Facilities in the Wegner Ditch Sub-watershed

Permit Name	Permit #	Receiving Water Body Name	Qrts in Non-compliance (3 yrs)	Qtrs in Significant Non-compliance (3 yrs)	Pollutant Causing Non-compliance	Pollutant with Significant violations	Enforcement Actions (I=informal; F=formal) (5 yrs)
City of Sturgis WWTP	MI0020451	Fawn River	1	0	non-RNCV/C	N/A	0
Abbott Nutrition	MI0025313	Nye Drain	1 (RCRA) 0 (CWA)	0	Sulfuryl Flouride	N/A	I - 1
Sturgis Well Field - SF	MI0053465	Fawn River via Nye Drain	0	0	N/A	N/A	N/A
MI Milk Producers Assoc.	MI0001414	St. Joseph River	1	0	pH	N/A	0

non-RNCV = facility has effluent, compliance schedule, permit schedule, or single-event violations in the current quarter, however, is not considered to be in violation (https://echo.epa.gov/dfr_data_dictionary#compbyqtr); C = not considered in violation based on a manual review of data by State or EPA region.

There are 48 USTs located within the Wegner Ditch sub-watershed. While USTs do not pose an immediate threat to water resources, they do run the risk of leaking if not properly inspected and maintained. Of the 48 USTs located within this sub-watershed seven of them are considered to be a LUST by IDEM and/or MDEQ. MDEQ does not prioritize the LUSTs as does IDEM, therefore only the one LUST located in Indiana is prioritized; it is considered to be a medium or low priority for remediation. Table 3.4.23 lists the information about the LUSTs located in the Clear Lake sub-watershed.

Table 3.4.23: Leaking Under Ground Storage Tanks in the Wegner Ditch Sub-watershed

UST FACILITY ID	INCIDENT NUMBER	NAME	PRIORITY DESC	TANK STATUS DESCRIPTION	AFFECTED AREA NAME
3834	199105255	Lagrange Maintenance	Medium	NFA-Unconditional Closure	Soil
	199105255		Medium	NFA-Unconditional Closure	Groundwater
	199902544		Low	NFA-Unconditional Closure	Soil
000-13190	C-1285-98	Sturgis Iron and Metal Co. Inc./ Omni Source	Unknown	Unknown	Unknown
000-11932	C-0530-94	Consumers Concrete Corp.	Unknown	Unknown	Unknown
000-05286	C-0129-90	Sturgis Diesel Plant	Unknown	Unknown	Unknown
000-09958	C-0306-92	Annette's Shell	Unknown	Unknown	Unknown
000-16812	C-0069-94	Sturgis Hospital	Unknown	Unknown	Unknown
000-10085	C-0108-11	Admiral Petroleum #68	Unknown	Unknown	Unknown

One confined feeding operations can be found in the Wegner Ditch Sub-watershed. The CFO houses 240,000 broiler chickens, which is 210,000 more than is required to designate the farm as a CFO. CFOs present a potential problem due to the volume of manure produced at the facility. If the manure holding facility is not large enough, or properly maintained there is the potential for manure to discharge from the holding facility and potentially contaminate surface and/or groundwater. They also pose a threat if the manure is being land applied as fertilizer and soil tests to determine the proper amount of manure needed for plant uptake is not performed; manure may be applied to the land in excess. The CFO in Wegner Ditch is approximately 2,400 feet, (approximately ½ mile) from the Fawn River. Table 3.4.24 lists the CFO located within the Wegner Ditch sub-watershed.

Table 3.4.24: Confined Feeding Operations in the Wegner Ditch Sub-watershed

Operation Name	County	Sub-watershed	Program	Animal Type	Animal #
N & M Incorporated Fawn River Farm	Lagrange	Wegner Ditch	CFO	Broilers	240,000

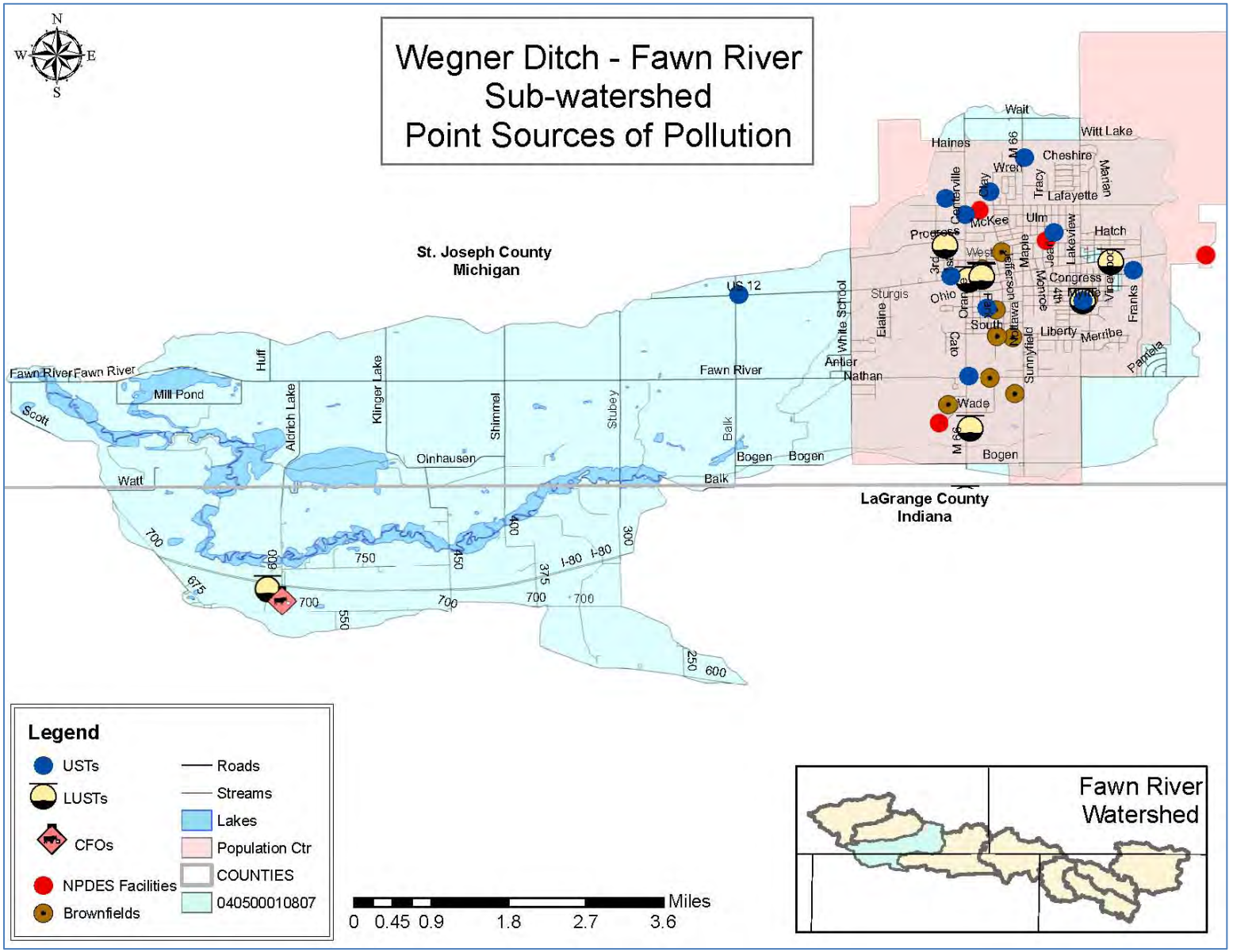
There are eight sites in the Wegner Ditch sub-watershed that are potential Brownfield sites and should be examined closer to determine if the sites are contaminated. Since these sites are listed as potential brownfields, they are eligible for funding to do further studies on the properties to determine the correct remediation work that needs to be completed to make the sites useful for other purposes, while remediating any potential contamination from the site. Table 3.4.25 lists the Brownfield sites located within the Wegner Ditch sub-watershed.

Figure 3.52 shows the location of all the potential point sources of pollution in the Wegner Ditch sub-watershed.

Table 3.4.25: Brownfield Eligible Sites in the Wegner Ditch Sub-watershed

Site #	Name	Address	City	County
75000120	Grumman Olson Industrial	1801 South Nottawa St (Plant 5)	Sturgis	St. Joseph
75000127	Grumman Olson Industrial, Inc - West	1861 S Centerville Rd. (Plants 1-4)	Sturgis	St. Joseph
00009958	Maruti Namah Inc	704 W Chicago Rd	Sturgis	St. Joseph
75000112	Paramount/ Berridge	303/401 St. Joseph Street	Sturgis	St. Joseph
75000036	Sturgis Hospital (Fuel Oil)	916 Myrtle Ave	Sturgis	St. Joseph
75000016	Sturgis Municipal Wells	309 N. Prospect	Sturgis	St. Joseph
75000119	SW Sturgis TCE	210 West South St	Sturgis	St. Joseph
75000109	Fawn River and Nattawa	Fawn River Rd/ Nattawa Rd	Sturgis	St. Joseph
75000067	Oak International	1160 White Street	Sturgis	St. Joseph
75000116	MGP - Sturgis - MGU	308 Florence St	Sturgis	St. Joseph

Figure 3.52: Potential Point Sources of Pollution in the Wegner Ditch Sub-watershed



Water quality data collected in the Wegner Ditch sub-watershed indicates a significant pollution issue with phosphorus, nitrates, and *E. coli*. TDS also appears to be an issue directly downstream of Sturgis. An analysis of all the samples collected in the sub-watershed shows that nitrates exceeded the target level in 86% of the samples, phosphorus in 37% of the samples, *E. coli* exceeded the state standard in 26% of the samples collected, and TDS exceeded the state standard in 13% of the samples. All exceedances for TDS were at FRP sites 40 and 42, the two samples sites directly downstream of Sturgis, indicating that urban stormwater runoff is the contributing factor causing the high TDS readings.

The high nutrients and *E. coli* levels found in Wegner Ditch may be due to leaking septic systems as only 23% of the land is designated suitable for septic placement and none of the residents in this sub-watershed, outside of those in Sturgis, have access to a centralized sewer system at this time. The high nutrients and *E. coli* levels may also be due to runoff of fertilizer from turf lawns around the built-up lake (Aldrich Lake) and Sturgis, and agriculture fields that do not utilize conservation tillage or cover, nutrient management, or riparian buffers.

It is notable that the samples from the Wegner Ditch sub-watershed measured so high for the nutrients and E. coli due to the fact that all samples (except Site 42) were collected directly from the Fawn River where more water and higher flow would typically dilute the samples.

As mentioned in the above Section, St. Joseph County has the highest use of irrigation for crop fields in the entire state of Michigan. Again, the reliance on irrigation in the county was observed during the windshield survey where nearly half of the crop fields had irrigation equipment in the field.

It appears that agriculture land and urban land both cause significant water quality impairment in the Wegner Ditch sub-watershed, and it would benefit from best management practices that focus on both land uses. The functional use loss of wetlands also appears to have a great impact on water quality in the Wegner Ditch sub-watershed; therefore, wetland restoration would be beneficial to the overall health of the sub-watershed.

A variety of best management practices and management measures that could benefit the water quality in the Wegner Ditch sub-watershed are available. Some of those practices include conservation tillage, cover crops, riparian and shoreline buffer installation adjacent to residential and agriculture land, nutrient management, wetland restoration, septic system education, irrigation management, and stormwater management measures.

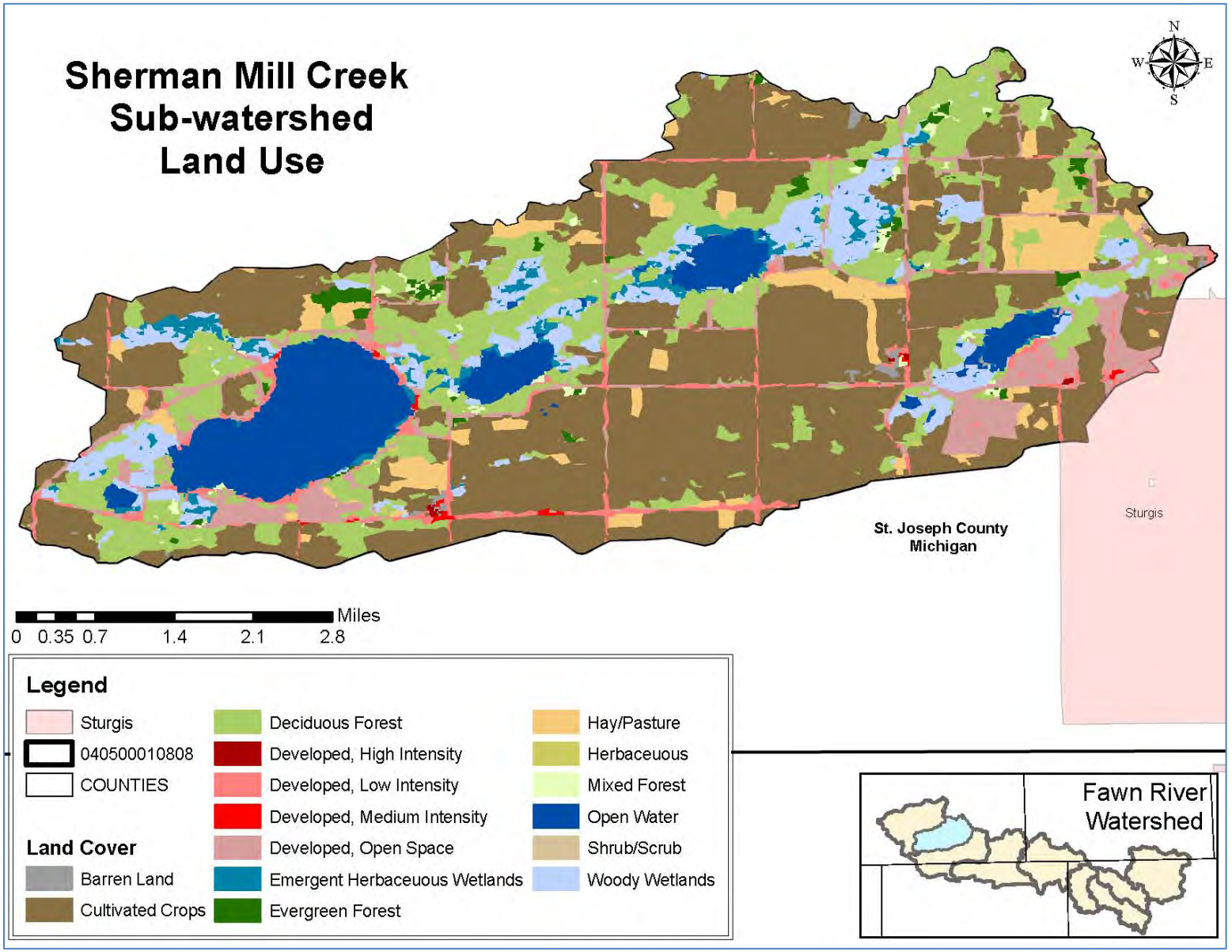
3.4.8 Sherman Mill Creek Sub-watershed Land Use

The primary influences on water quality in the Sherman Mill Creek Sub-watershed are agriculture as nearly 60% of the drainage area is in row crops or pasture and hayland, unsewered homes, and the lake communities. Slightly over 8% of the Sherman Mill Creek sub-watershed is developed from the northwest corner of Sturgis and Klinger Lake, mostly, which also impacts water quality in this sub-watershed. Table 3.4.26 shows the percentage of the Sherman Mill Creek sub-watershed that is in each land use and Figure 3.53 is a map showing the delineation of land use in the sub-watershed. All landuse data presented was obtained from the National Land Cover Data from the USGS and analyzed in ArcGIS.

Table 3.4.26: Land Use in the Sherman Mill Creek Sub-watershed

NLCD Land Use Designation	Acres	%
Open Water	1247.66	6.44%
Developed Open Space	1051.58	5.42%
Developed Low Intensity	545.52	2.81%
Developed Medium Insensity	24.15	0.12%
Developed High Intensity	7.57	0.04%
Barren Land	62.33	0.32%
Deciduous Forest	2639.47	13.61%
Evergreen Forest	159.66	0.82%
Shrub/Scrub	10.04	0.05%
Mixed Forest	118.66	0.61%
Grassland Herbaceous	62.25	0.32%
Pasture Hayland	924.78	4.77%
Row Crops	10,500.87	54.17%
Woody Wetland	987.6	5.09%
Emergent Herbaceous Wetlands	1044.35	5.39%
Total	19,386.49	100.00%

Figure 3.53: Land Use Designations in the Sherman Mill Creek Sub-watershed



The windshield survey conducted as part of this project in May, 2014 revealed that Sherman Mill Creek has few problems associated with inadequate riparian buffers, though it could benefit from cover crops and increased conservation tillage usage. A small and sparsely populated area of Sturgis is located in Sherman Mill Creek sub-watershed, though Klinger Lake is completely developed, and three smaller lakes are partially developed, indicating that future development may be a possibility. Lush green lawns on lake residences were observed during the windshield survey, indicating fertilizer use in areas that lack adequate riparian and shoreline buffers. There was one natural stream, a tributary to Klinger Lake, that has been tiled and no longer functions as a natural stream. The tiled stream would benefit from daylighting. The total length of the stream that has been tiled is approximately 21,637 linear feet. Figure 3.54 shows the location of each of the issues discovered during the windshield survey, as well as the populated lakes in the sub-watershed where seawalls and excessive fertilizer application may be used.

Another potential problem related to residential homes in the Sherman Mill Creek sub-watershed is the areas that are not currently serviced by a centralized sewer system. The city of Sturgis and Klinger Lake are the only areas in the sub-watershed that are currently serviced by a sewer system. All other homes most likely utilize an on-site waste disposal system that has the potential to leak or fail if not properly maintained. As is illustrated in Figure 3.55, over 62% of the sub-watershed's soils are designated as being very limited for septic system placement. Minnewaukan Lake is very close to the City of Sturgis, however the St. Joseph County Health Department expressed that Klinger Lake is the only built-up lake that is currently serviced by a sewage treatment plant, therefore, it can be assumed that Minnewauken Lake, Tamarack Lake, and Thompson Lake residents all utilize on-site waste disposal systems.

Figure 3.54: Windshield Survey Observations in the Sherman Mill Creek Sub-watershed

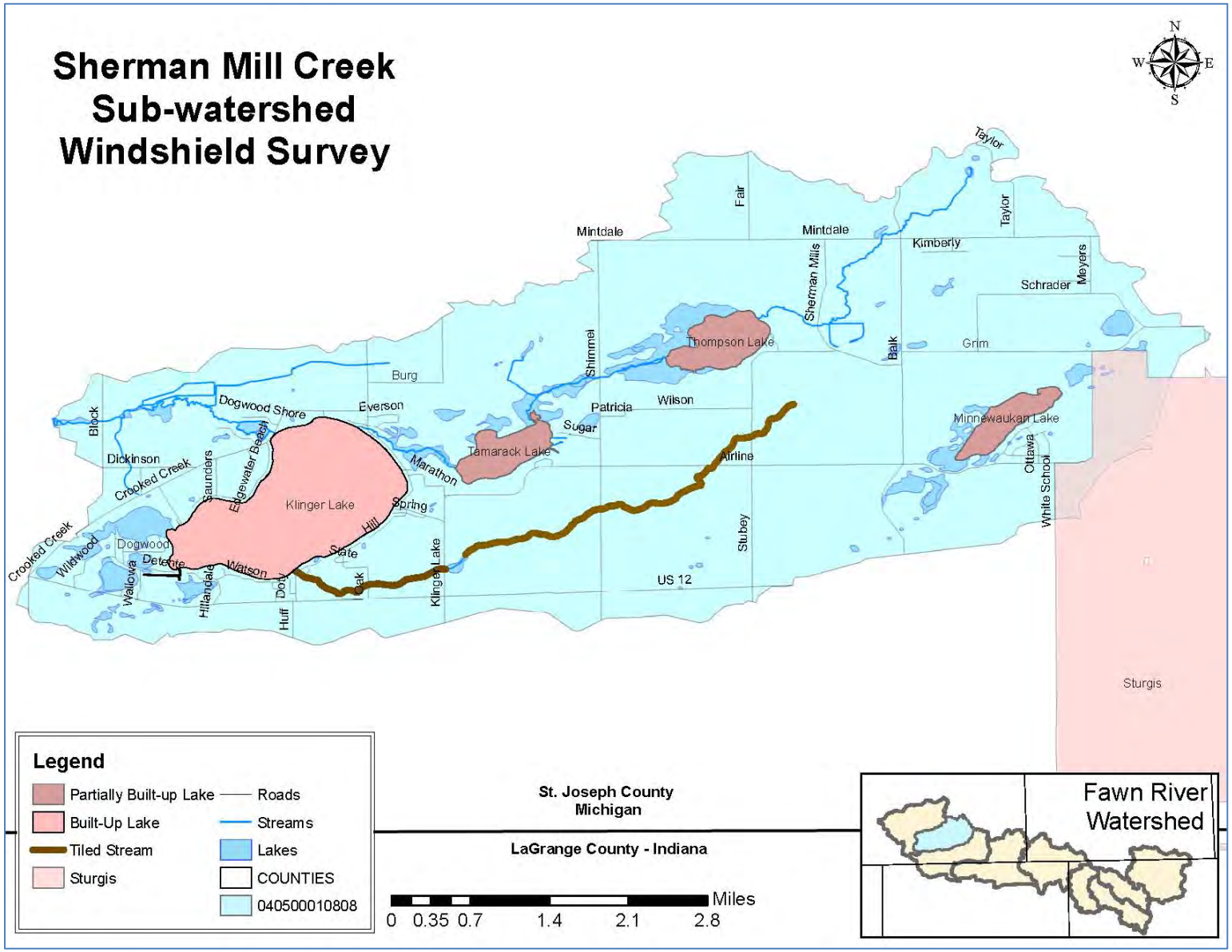
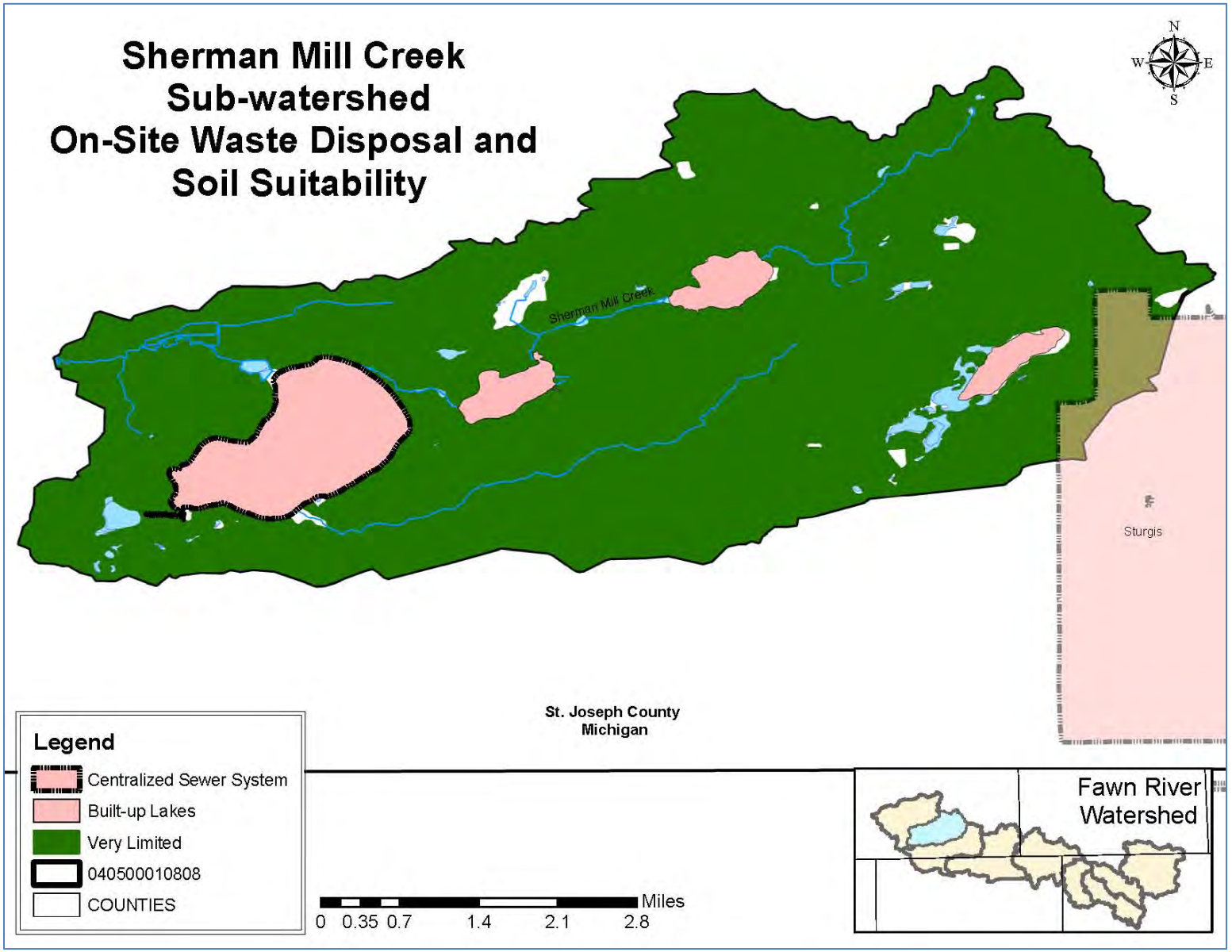


Figure 3.55: Septic Suitability in the Sherman Mill Creek Sub-watershed



As stated above, most of the land in the Sherman Mill Creek sub-watershed is used for agriculture; either cultivated crops or pasture and hayland. Approximately 18% of the land in the sub-watershed is designated as highly or potentially highly erodible by the St. Joseph County's NRCS. This percentage is not as high as it is in other sub-watersheds, though it is significant in the Sherman Mill Creek sub-watershed since just less than 60% of the drainage area is designated as agriculture land and the majority of the HEL and PHEL falls within the agriculture land. There is potential for sediment, carrying nutrients attached to the soil particles, from HEL and PHEL that is being conventionally tilled, or farmed directly up to the streambank to deposit in open water. Special precautions must be taken on farmland in this sub-watershed that is designated as HEL or PHEL to prevent soil erosion, and sedimentation and nutrification of open water. Figure 3.56 shows the location of HEL and PHEL in the watershed, overlaid on the agriculture land to paint a picture of where there is a risk of soil erosion.

The Sherman Mill Creek sub-watershed has approximately 10.5% of land cover designated as wetland. According to the 2005 wetland inventory conducted by MDEQ and partners, the Sherman Mill Creek sub-watershed currently has 2,472.85 acres of wetland from the 4,039.74 acres of wetland present in pre-settlement times. This is nearly a 39% decline in the wetlands since settlement of the area. The loss in wetlands translates to a huge loss in the ability of the wetlands to absorb pollutants prior to them being released into open water and, especially, in prime habitat for fauna that relies on wetlands for survival. According to data collected in 2005, there has been a water quality functional use loss of 47% and a habitat functional use loss of 61% in the Sherman Mill Creek sub-watershed. Since only 10% of the watershed is currently classified as wetland, it is important to protect the existing wetlands, to prevent further loss in the ability of the land cover to absorb pollutants and provide habitat to important flora and fauna. Figure 3.57 shows the wetland delineation for the historic and current wetlands in the Sherman Mill Creek sub-watershed.

Figure 3.56: Highly and Potentially Highly Erodible Land in Sherman Mill Creek Sub-watershed

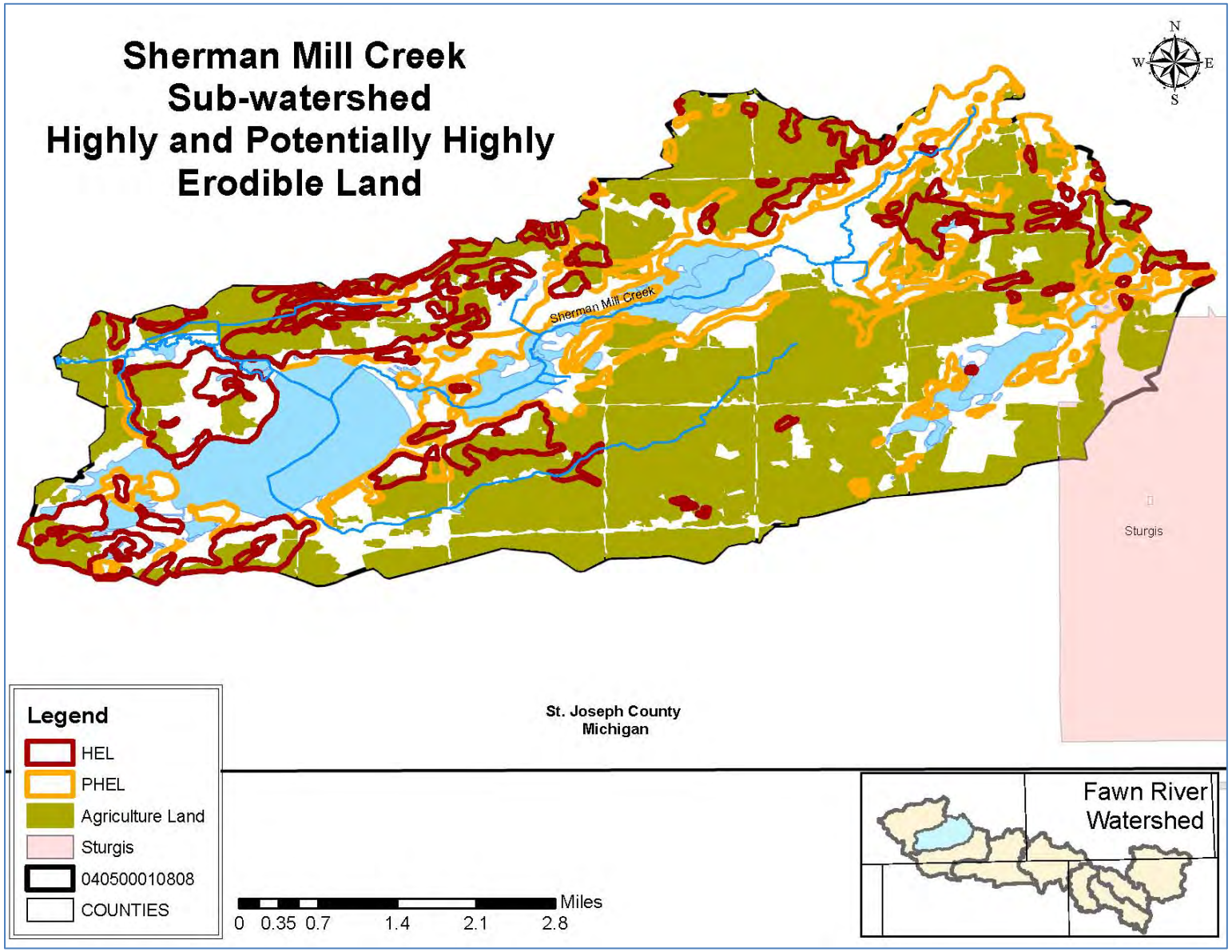
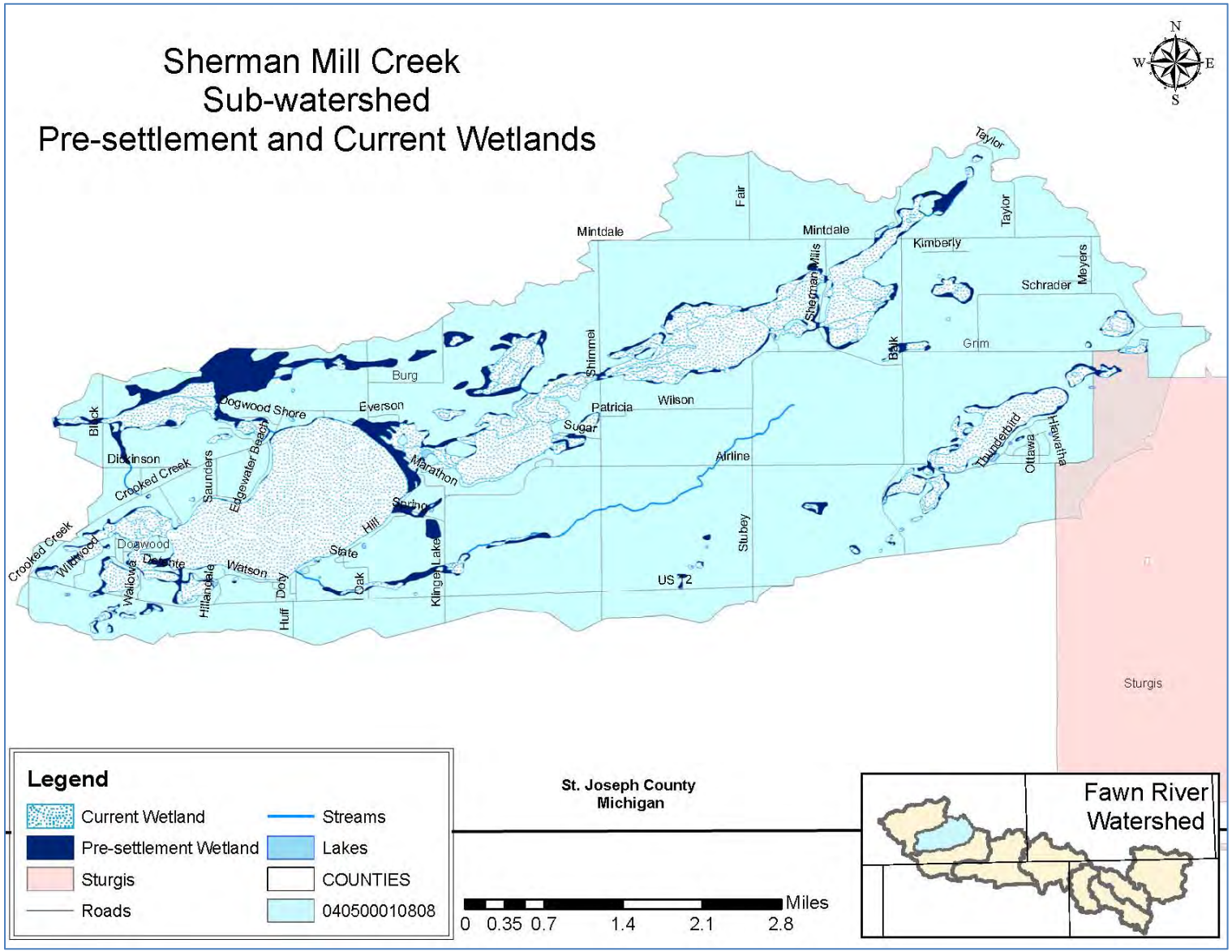


Figure 3.57: Wetlands in the Sherman Mill Creek Sub-watershed



A final threat to water quality found during the inventory of Sherman Mill Creek sub-watershed is potential point sources of pollution. There are not any NPDES permitted facilities located within this sub-watershed. However, there are two USTs both of which are leaking and therefore considered to be LUSTs. MDEQ does not prioritize the LUSTs as does IDEM, therefore the same information provided in previous Sections is not available for the Sherman Mill Creek sub-watershed. Table 3.4.27 lists the LUSTs located within the Sherman Mill Creek sub-watershed.

Table 3.4.27: Leaking Underground Storage Tanks in the Sherman Mill Creek Sub-watershed

UST FACILITY ID	INCIDENT NUMBER	NAME	PRIORITY DESC	TANK STATUS DESCRIPTION	AFFECTED AREA NAME
000-33437	C-0074-97	Klinger Lake Marina	Unknown	Unknown	Unknown
000-17765	C-2709-91	Bart's Bait Shop	Unknown	Unknown	Unknown

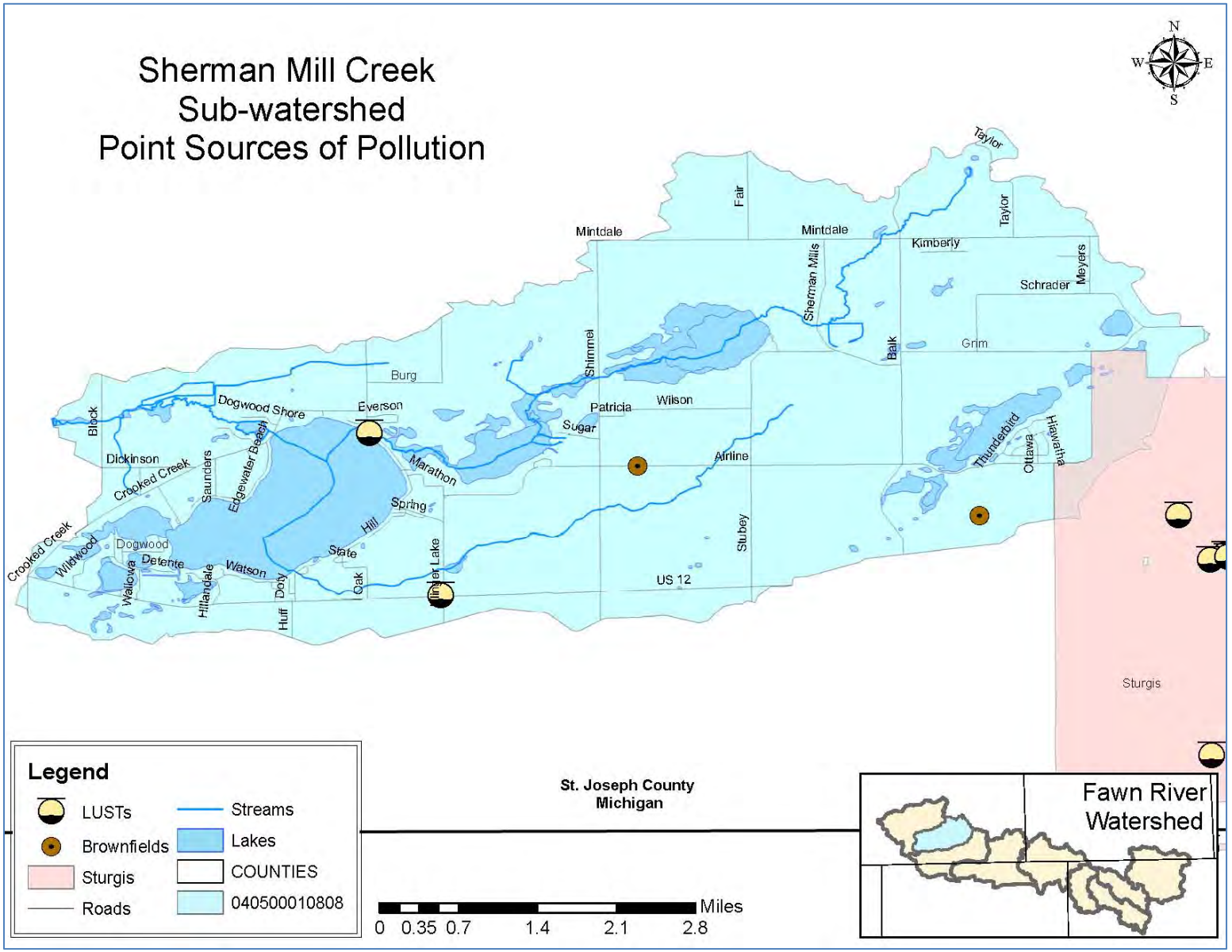
There are two sites in the Sherman Mill Creek sub-watershed that are potential Brownfield sites and should be examined closer to determine if the sites are contaminated. Since these sites are listed as potential brownfields, they are eligible for funding to do further studies on the properties to determine the correct remediation work that needs to be completed to make the sites useful for other purposes, while remediating any potential contamination from the site. Table 3.4.28 lists the Brownfield sites located within the Sherman Mill Creek sub-watershed.

Figure 3.58 shows the location of all the potential point sources of pollution in the Sherman Mill Creek sub-watershed.

Table 3.4.28 Brownfields Located in the Sherman Mill Creek Sub-watershed

Site #	Name	Address	City	County
75000130	Abbott Laboratories Ross Products Div.	White School Rd	Sturgis	St. Joseph
75000113	Carl Eaton Farm/Sturgis	23240 Airline Rd	Sturgis	St. Joseph

Figure 3.58: Potential Point Sources of Pollution in the Sherman Mill Creek Sub-watershed



Water quality data collected in the Sherman Mill Creek sub-watershed indicates a significant pollution issue with phosphorus, nitrates, and *E. coli*. An analysis of all the samples collected in the sub-watershed shows that nitrates exceeded the target level in 67% of the samples, phosphorus in 89% of the samples, *E. coli* exceeded the state standard in 17% of the samples collected, specifically *E. coli* was high at FRP sites 47 which is at the outlet from Thompson Lake, an unsewered community, and at FRP site 46, which is at Klinger Lake inlet from a tributary that has been mostly tiled and converted to farm land. Nitrates and phosphorus were high at every sample site though the highest readings were at FRP site 46, on the tributary that has been mostly tiled allowing for nutrients to have a direct conduit to open water.

The high nutrients and *E. coli* levels found in Sherman Mill Creek may be due to factors beyond those listed above. They may be a result of leaking septic systems as only 23% of the land is designated suitable for septic placement and none of the residents in this sub-watershed, outside of those in Sturgis and Klinger Lake, have access to a centralized sewer system at this time. This is evident from the high E. coli and nutrient levels at FRP site 47, which is at an outlet to Thompson Lake, an unsewered community. The high nutrients and *E. coli* levels may also be due to runoff of fertilizer from turf lawns around the built-up lakes and Sturgis, and agriculture fields that do not utilize conservation tillage or cover, nutrient management, or riparian buffers.

It should be noted that FRP Site 49, at Klinger Lake outlet, had no samples exceed the state standard for E. coli, though did exceed for nutrients, and phosphorus exceeded the target in 50% of the samples, again reinforcing the assumption that the high nutrients may be from fertilizer on turf grass. Phosphorus released from disturbed bottom sediment has been shown to be the source of high nutrient readings in other lakes in the region, and may be the source of the high nutrient levels in Klinger Lake as well. This phenomenon of “legacy phosphorus” found in benthic sediment is often exacerbated by the use of seawalls which are common practice on built-up lakes throughout the project area.

As mentioned in the above Section, St. Joseph County has the highest use of irrigation for crop fields in the entire state of Michigan. Again, the reliance on irrigation in the county was observed during the windshield survey where nearly half of the crop fields had irrigation equipment in the field.

Finally, the destruction of wetlands that can efficiently filter pollutants from water may also be contributing to the high nutrient levels as the Sherman Mill Creek sub-watershed has a wetland functional use loss for water quality benefits of 47%, and the highest functional use loss for habitat at 61%, therefore wetland preservation and restoration should be a high priority in the Sherman Mill Creek sub-watershed.

It appears that agriculture land and urban/residential land both cause significant water quality impairment in the Sherman Mill Creek sub-watershed, and it would benefit from best management practices that focus on both land uses.

A variety of best management practices and management measures that could benefit the water quality in the Sherman Mill Creek sub-watershed are available. Some of those practices include conservation tillage, cover crops, riparian and shoreline buffer installation adjacent to residential and agriculture land, nutrient management, wetland restoration, septic system education, irrigation management, and stormwater management measures.

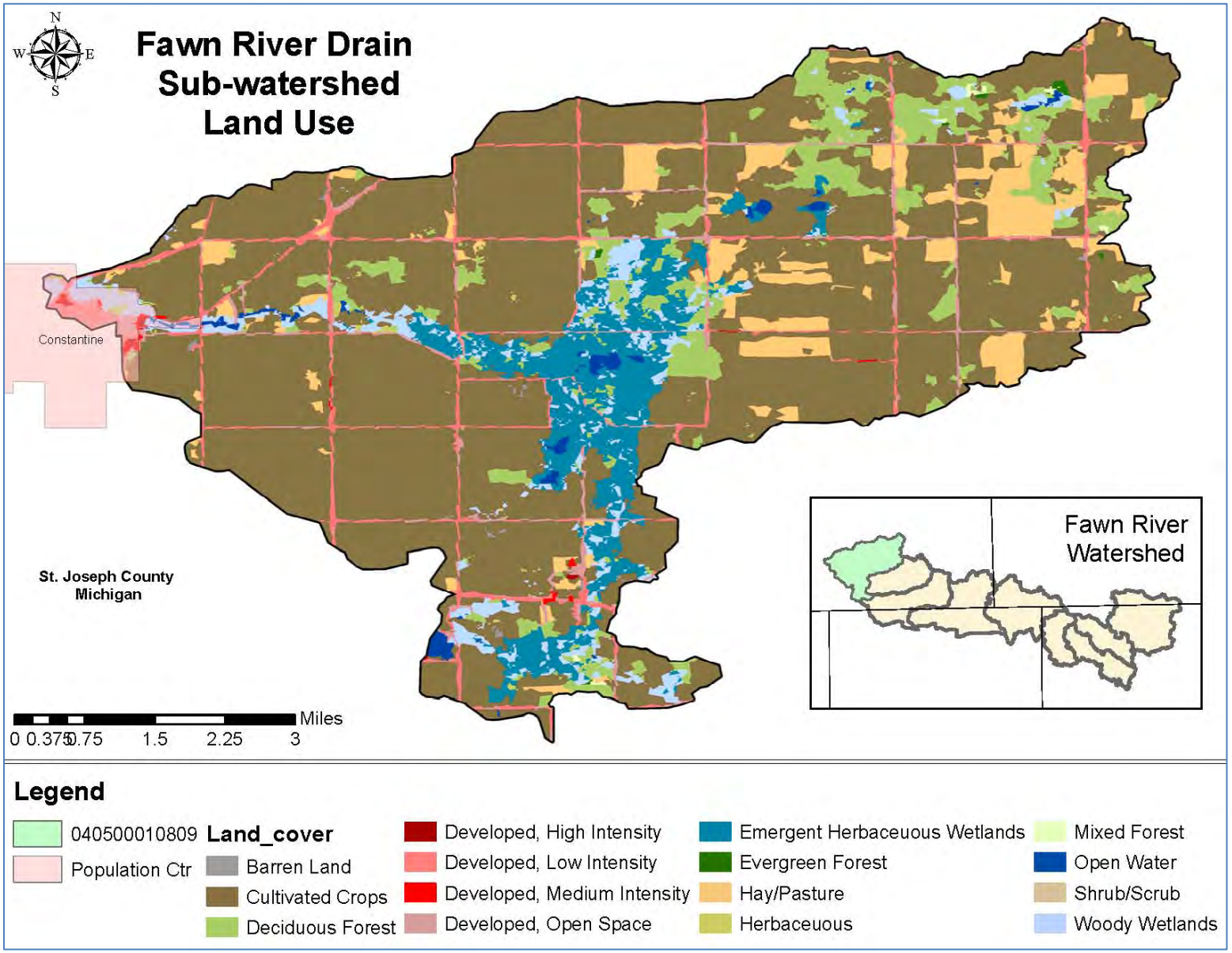
3.4.9 Fawn River Drain Sub-watershed Land Use

The primary influences on water quality in the Fawn River Drain Sub-watershed are agriculture as nearly 74% of the drainage area is in row crops or pasture and hayland and unsewered homes. Slightly under 6% of the Fawn River Drain sub-watershed is developed; primarily from the rural roads and the east side of the Village of Constantine, MI, which is located within the Fawn River Drain sub-watershed. Table 3.4.29 shows the percentage of the Fawn River Drain Sub-watershed that is in each land use and Figure 3.59 is a map showing the delineation of land use in the sub-watershed. All landuse data presented was obtained from the National Land Cover Data from the USGS and analyzed in ArcGIS.

Table 3.4.29: Land Use in the Fawn River Drain Sub-watershed

NLCD Land Use Designation	Acres	%
Open Water	167.88	0.73%
Developed Open Space	544.53	2.36%
Developed Low Intensity	742.7	3.22%
Developed Medium Insensity	37.08	0.16%
Developed High Intensity	11.71	0.05%
Barren Land	28.53	0.12%
Deciduous Forest	1939.2	8.42%
Evergreen Forest	21.78	0.09%
Shrub/Scrub	7.68	0.03%
Mixed Forest	23.27	0.10%
Grassland Herbaceous	52.27	0.23%
Pasture Hayland	1609.98	6.99%
Row Crops	15397.27	66.85%
Woody Wetland	978.84	4.25%
Emergent Herbaceous Wetlands	1472.41	6.39%
Total	23,035.13	100.00%

Figure 3.59: Land Use Designations in the Fawn River Drain Sub-watershed



The windshield survey conducted as part of this project in May, 2014 revealed that the Fawn River Drain has more areas than other sub-watershed where agriculture fields have an inadequate riparian buffer resulting in streambank erosion. Observations made during the windshield survey, and verified through a desk top survey, reveal that approximately 10,086 linear feet of open water is in need of a larger riparian buffer to protect water quality. The Fawn River Drain also has several natural streams that have been tiled and converted to farm land, approximately 14,182 linear feet. The Village of Constantine is partially located in the Fawn River Drain. Constantine is at the confluence of the Fawn River and the St. Joseph River; therefore, it is important to manage polluted stormwater in Constantine. Unlike the other sub-watersheds, there are not any populated lakes located in the Fawn River Drain. It was also noted during the windshield survey, that the Fawn River Drain has far more channelized ditches and streams than any of the other sub-watersheds within the Fawn River watershed. Table 3.4.30 shows the observations made during the windshield survey, and the approximate length of the problem (verified through a desktop survey of aerial photography). Figure 3.60 shows the location of each of the issues discovered during the windshield survey.

Table 3.4.30: Windshield Survey Observations for the Fawn River Drain Sub-watershed

Windshield Survey Observation	Potential Contaminant	Number or Length
Lack of Riparian Buffer - Ag	Sediment and Nutrients	10,086 linear ft
Tiled Natural Stream	Sediment, Nutrients, and *E. coli*	14,182 linear ft

Another potential problem related to residential homes in the fawn River Drain sub-watershed is the areas that are not currently serviced by a centralized sewer system. The Village of Constantine is the only area in the sub-watershed that is currently serviced by a sewer system. All other homes most likely utilize an on-site waste disposal system that has the potential to leak or fail if not properly maintained. As is illustrated in Figure 3.61, approximately 90% of the sub-watershed's soils are designated as being very limited for septic system placement.

Figure 3.60: Windshield Survey Observations in the Fawn River Drain Sub-watershed

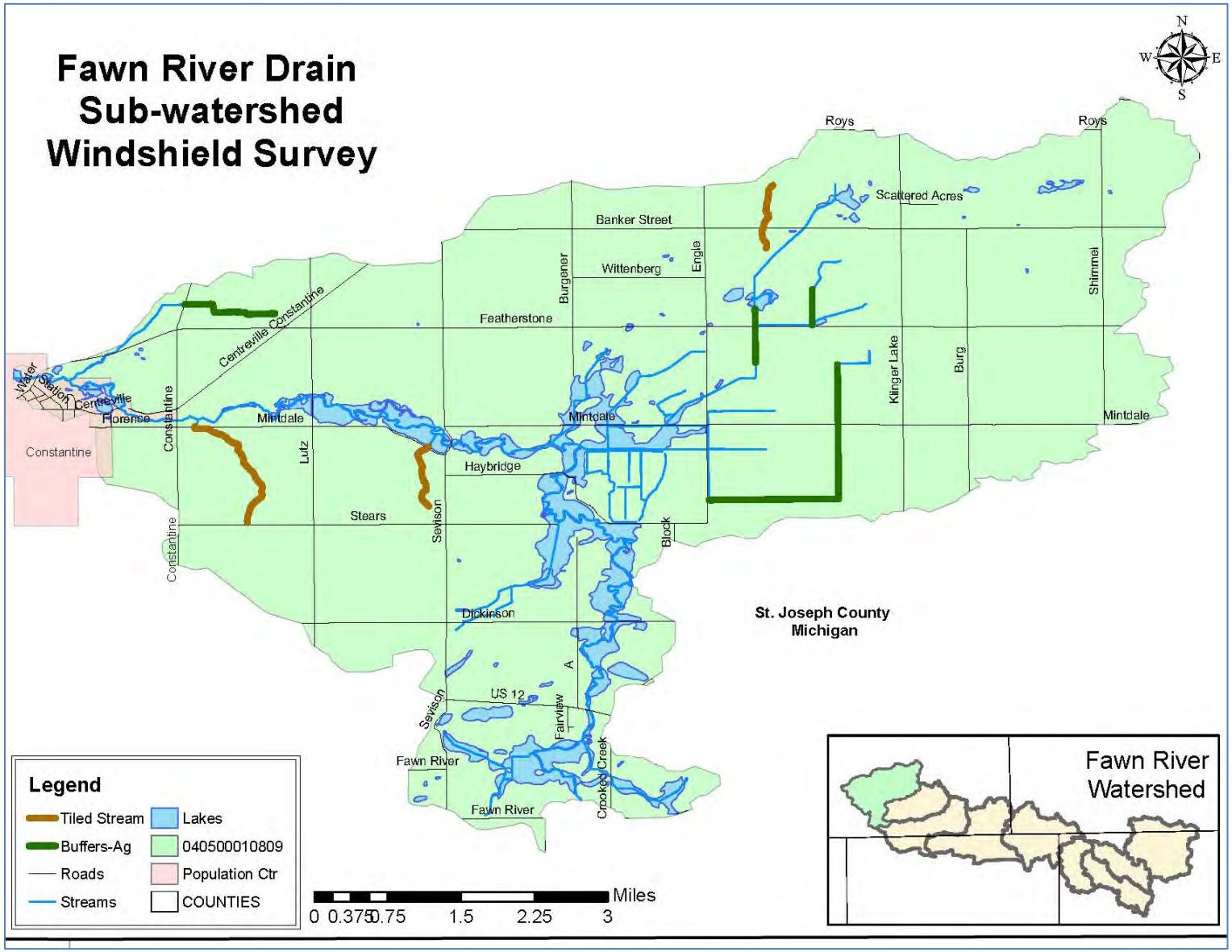
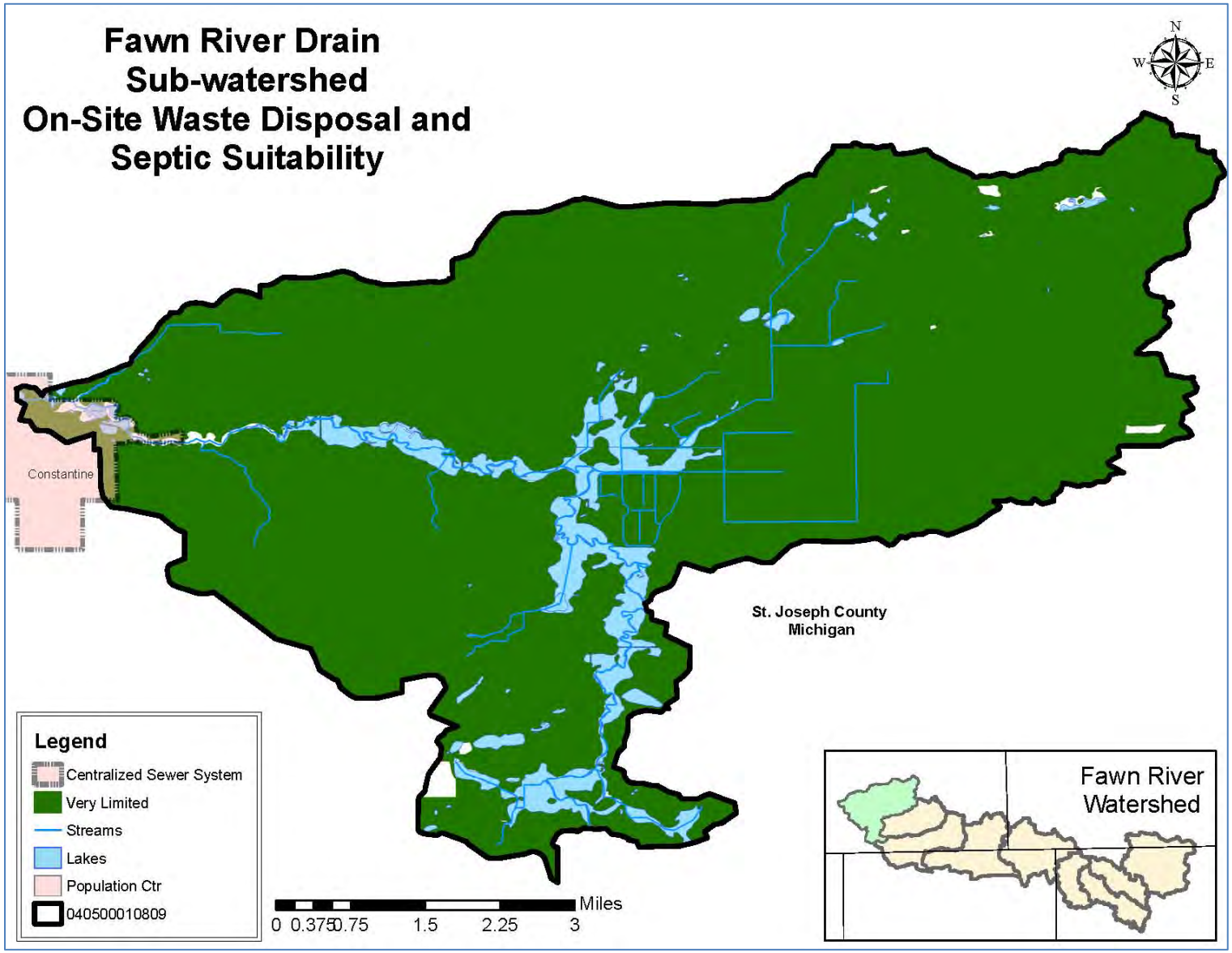


Figure 3.61: Septic Suitability in the Fawn River Drain Sub-watershed



As stated above, most of the land in the Fawn River Drain sub-watershed is used for agriculture; either cultivated crops or pasture and hayland. Approximately 15% of the land in the sub-watershed is designated as highly or potentially highly erodible by the St. Joseph County's NRCS. This percentage is not as high as it is in other sub-watersheds, though it is significant in the Fawn River Drain sub-watershed since most of the HEL and PHEL is agriculture land. There is potential for sediment, carrying nutrients attached to the soil particles, from HEL and PHEL that is being conventionally tilled, or farmed directly up to the streambank to deposit in open water. Special precautions must be taken on farmland in this sub-watershed that is designated as HEL or PHEL to prevent soil erosion, and sedimentation and nutrification of open water. Figure 3.62 shows the location of HEL and PHEL in the watershed, overlaid on the agriculture land to paint a picture of where there is a risk of soil erosion.

The Fawn River Drain sub-watershed has approximately 11% of land cover designated as wetland. According to the 2005 wetland inventory conducted by MDEQ and partners, the Fawn River Drain sub-watershed currently has 1,949.98 acres of wetland from the 4,567.92 acres of wetland present in pre-settlement times. This is over a 57% decline in the wetlands since settlement of the area; much more than in any other sub-watershed in the Fawn River watershed. The loss in wetlands translates to a huge loss in the ability of the wetlands to absorb pollutants prior to them being released into open water and, especially, in prime habitat for fauna that relies on wetlands for survival. According to data collected in 2005, there has been a water quality functional use loss of nearly 60% and a habitat functional use loss ofnearly 73% in the Fawn River Drain sub-watershed. Since only 10% of the watershed is currently classified as wetland, it is very important to protect the existing wetlands, to prevent further loss in the ability of the land cover to absorb pollutants and provide habitat to important flora and fauna. Figure 3.63 shows the wetland delineation for the historic and current wetlands in the Fawn River Drain sub-watershed.

Figure 3.62: Highly and Potentially Highly Erodible Land in Fawn River Drain Sub-watershed

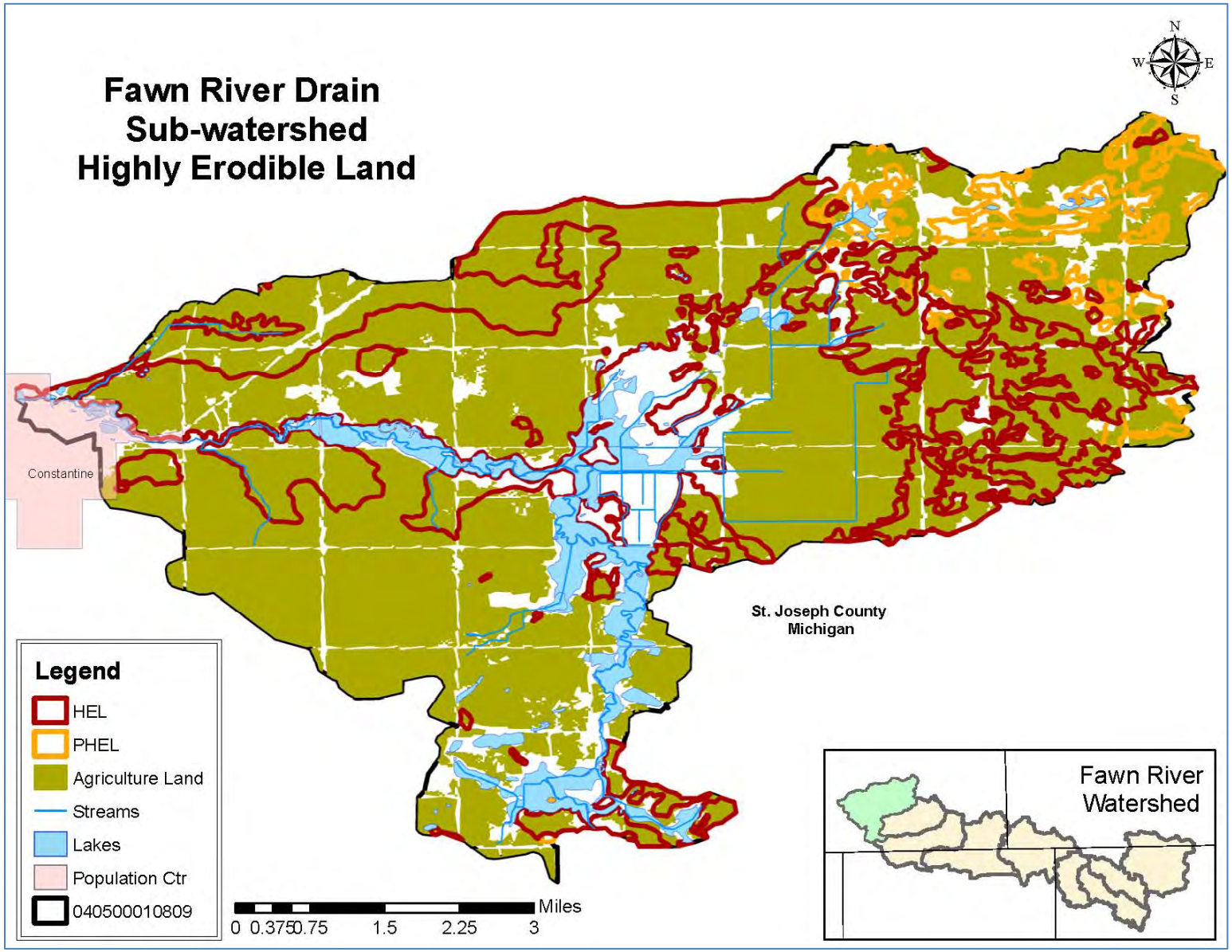
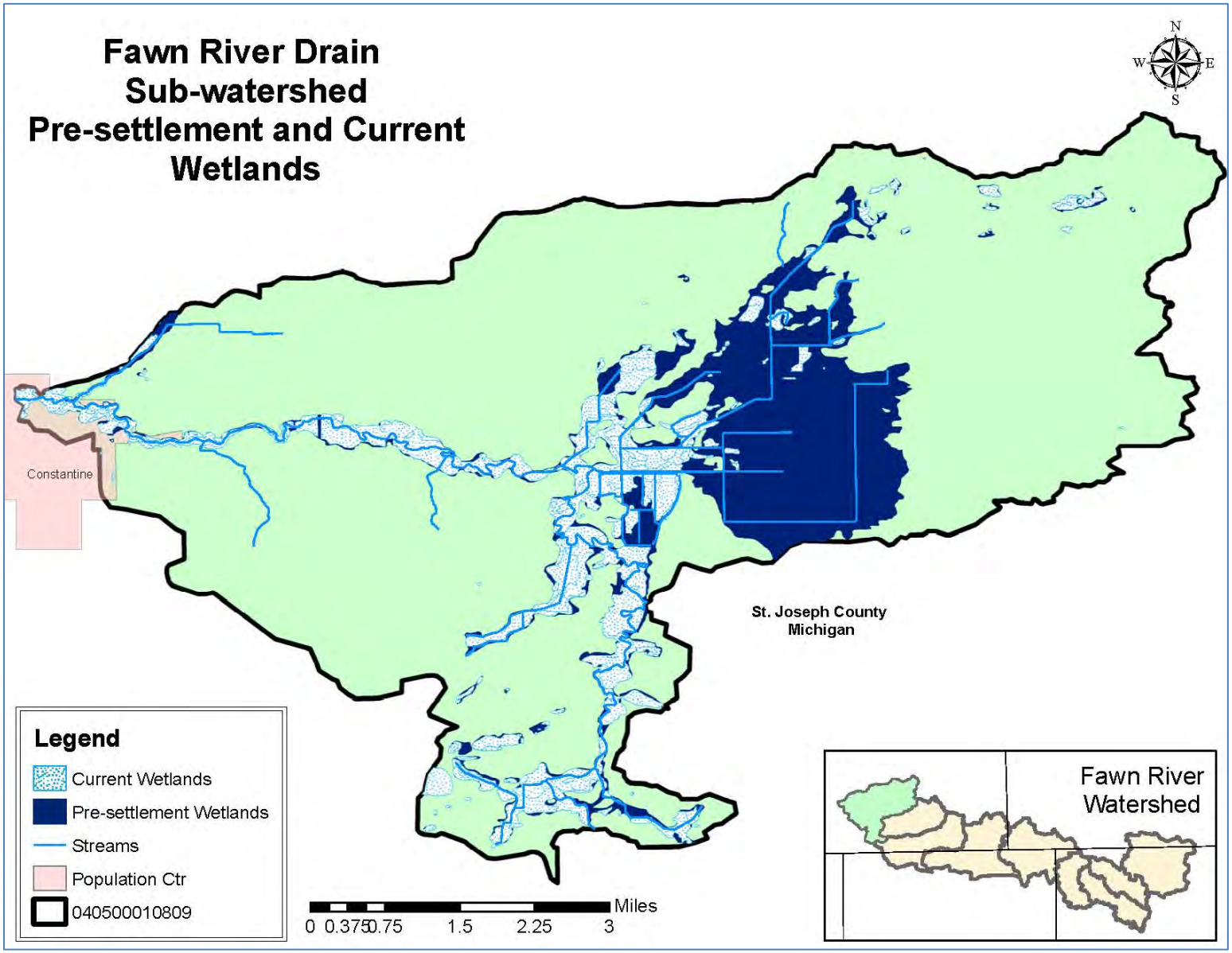


Figure 3.63: Wetlands in the Fawn River Drain Sub-watershed



A final threat to water quality found during the inventory of Fawn River Drain sub-watershed is potential point sources of pollution. There is one NPDES permitted facility located in Constantine within the Fawn River Drain sub-watershed. It was in violation of its permit once within the past three years for pH levels. Table 3.4.31 lists the information about the NPDES permitted facility in the Fawn River Drain sub-watershed.

Table 3.4.31: NPDES Permitted Facility in the Fawn River Drain Sub-watershed

Permit Name	Permit #	Receiving Water Body Name	Qrts in Non-compliance (3 yrs)	Qtrs in Significant Non-compliance (3 yrs)	Pollutant Causing Non-compliance	Pollutant with Significant violations	Enforcement Actions (I=informal; F=formal) (5 yrs)
MI Milk Producers Assoc.	MI0001414	St. Joseph River	1	0	pH	N/A	0

There is one UST located within the Fawn River Drain sub-watershed. The UST is leaking and is therefore considered to be a LUST by the MDEQ. MDEQ does not prioritize the LUSTs as does IDEM, therefore the same information provided in previous Sections is not available for the Fawn River Drain sub-watershed. Table 3.4.32 lists the information available regarding the LUST located within the Fawn River Drain sub-watershed.

Table 3.4.32: Leaking Underground Storage Tanks in the Fawn River Drain Sub-watershed

UST FACILITY ID	INCIDENT NUMBER	NAME	PRIORITY DESC	TANK STATUS DESCRIPTION	AFFECTED AREA NAME
000-10086	C-0159-12	Jit Food and Gas Inc/Shell Speedy Mart	Unknown	Unknown	Unknown

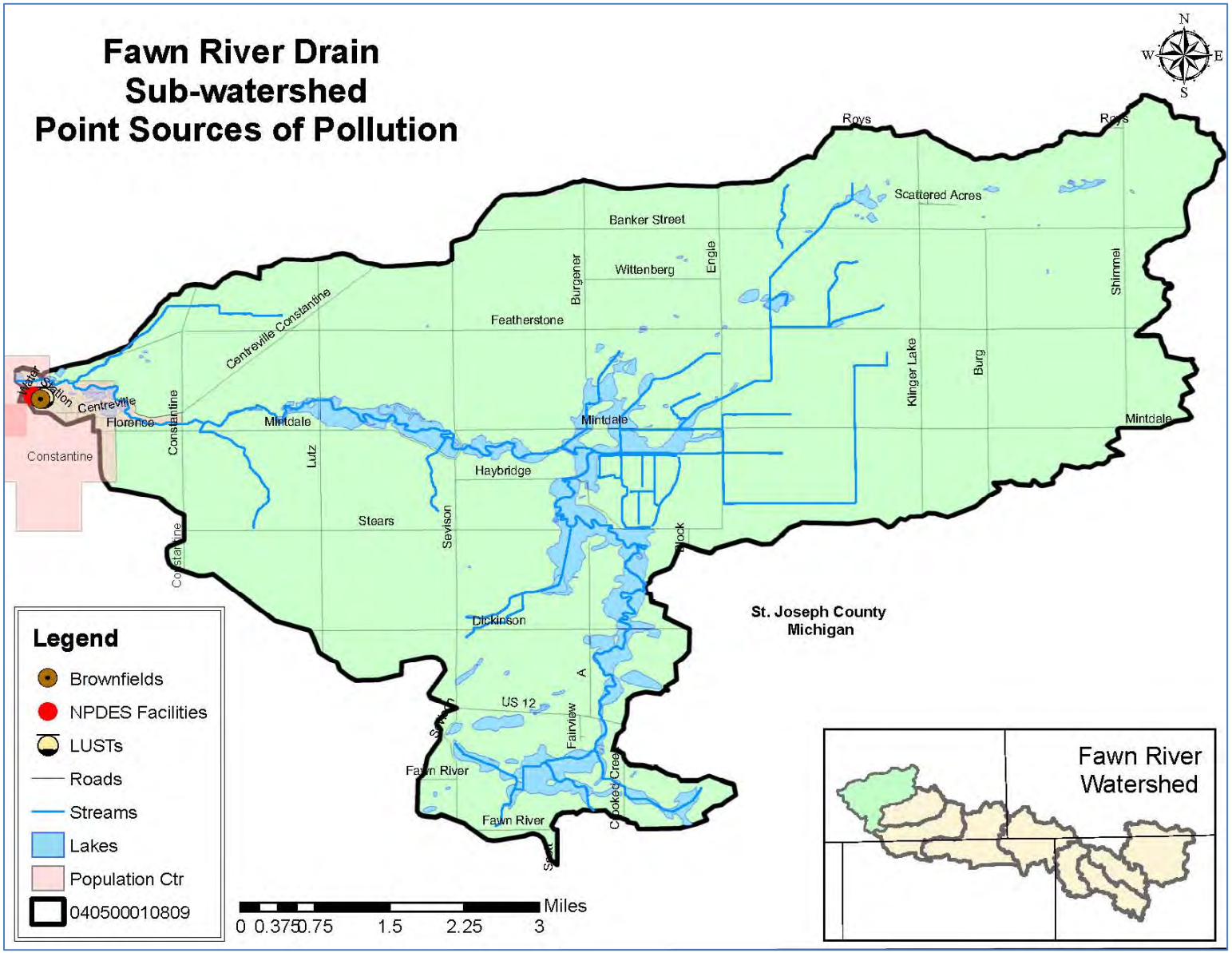
There is one site in the Fawn River drain sub-watershed that is a potential Brownfield site and should be examined closer to determine if the sites are contaminated. Since the site is listed as a potential brownfield, it is eligible for funding to do further studies on the property to determine the correct remediation work that needs to be completed to make the site useful for other purposes, while remediating any potential contamination from the site. Table 3.4.33 lists the Brownfield site located within the Fawn River Drain sub-watershed.

Figure 3.64 shows the location of all the potential point sources of pollution in the Fawn River Drain sub-watershed.

Table 3.4.33 Brownfields Located in the Fawn River Drain Sub-watershed

Site #	Name	Address	City	County
75000027	Constantine Residential Wells	Centerville/Dept/ White Pigeon Rd	Constantine	St. Joseph

Figure 3.64: Potential Point Sources of Pollution in the Fawn River Drain Sub-watershed



Water quality data collected in the Fawn River Drain sub-watershed indicates a significant pollution issue with phosphorus and nitrates, and to a lesser degree *E. coli* and sediment. An analysis of all the samples collected in the sub-watershed shows that nitrates exceeded the target level in 71% of the samples, phosphorus in 39% of the samples, *E. coli* exceeded the state standard in 17% of the samples collected, and TSS and turbidity both exceeded the target level in 4% of the samples.

Looking at specific water quality sampling sites; FRP Site 50 measured high for all parameters which may be partially due to Aldrich Lake which is directly upstream of this site, as well as extensive agriculture and septic system usage on land that is not suitable for either practice as a significant amount of HEL is present upstream from FRP Site 50, and only 10% of the land in the sub-watershed is suited for on-site waste disposal systems. FRP Site 52 is located downstream of the channelized streams in the drainage, which is where the majority of the 10,089 linear feet of riparian buffer is needed. Site 52 is also directly downstream of where the majority of the wetland loss is. The loss in wetlands limited the ability of the land to absorb pollutants prior to them entering the streams by nearly 59%. The remaining sample sites are all located on the Fawn River, and all exceeded targets for *E. coli*, phosphorus and nitrates. It can be assumed that the tiled streams, which provide a direct means of transporting pollutants to open water, lack of adequate riparian buffers, septic system leachate, the devastating loss in wetlands, and extensively farmed land contribute to the high pollutant levels at FRP Sites 51, 53, and 54.

As mentioned in the above Section, St. Joseph County has the highest use of irrigation for crop fields in the entire state of Michigan. Again, the reliance on irrigation in the county was observed during the windshield survey where nearly half of the crop fields had irrigation equipment in the field.

A variety of best management practices and management measures that could benefit the water quality in the Fawn River Drain sub-watershed are available. Some of those practices include conservation tillage, cover crops, riparian buffer installation adjacent to, nutrient management, wetland restoration, septic system education, irrigation management, and stormwater management measures.

3.5 Watershed Inventory Summary

To better understand the water quality problems in the Fawn River Watershed and what influences may be contributing to those problems, a map was developed outlining the water quality issues in each sub-watershed, as well as showing the results of the land use inventory, specifically those sites that were identified during the windshield survey, where inadequate macroinvertebrate and/or habitat data was found as well as other points of interest that may be contributing to the degradation of water quality (Figure 3.65). As can be seen in the map below, *E. coli,* Nitrates, and Phosphorus levels were elevated in every sub-watershed and TSS and turbidity were elevated slightly in scattered sub-watersheds. It can also be seen in Figure 3.65 that biological data was poor at sample sites downstream of populated areas, as well as at sites located on streams or ditches that have been modified, or where livestock issues were noted during the windshield survey.

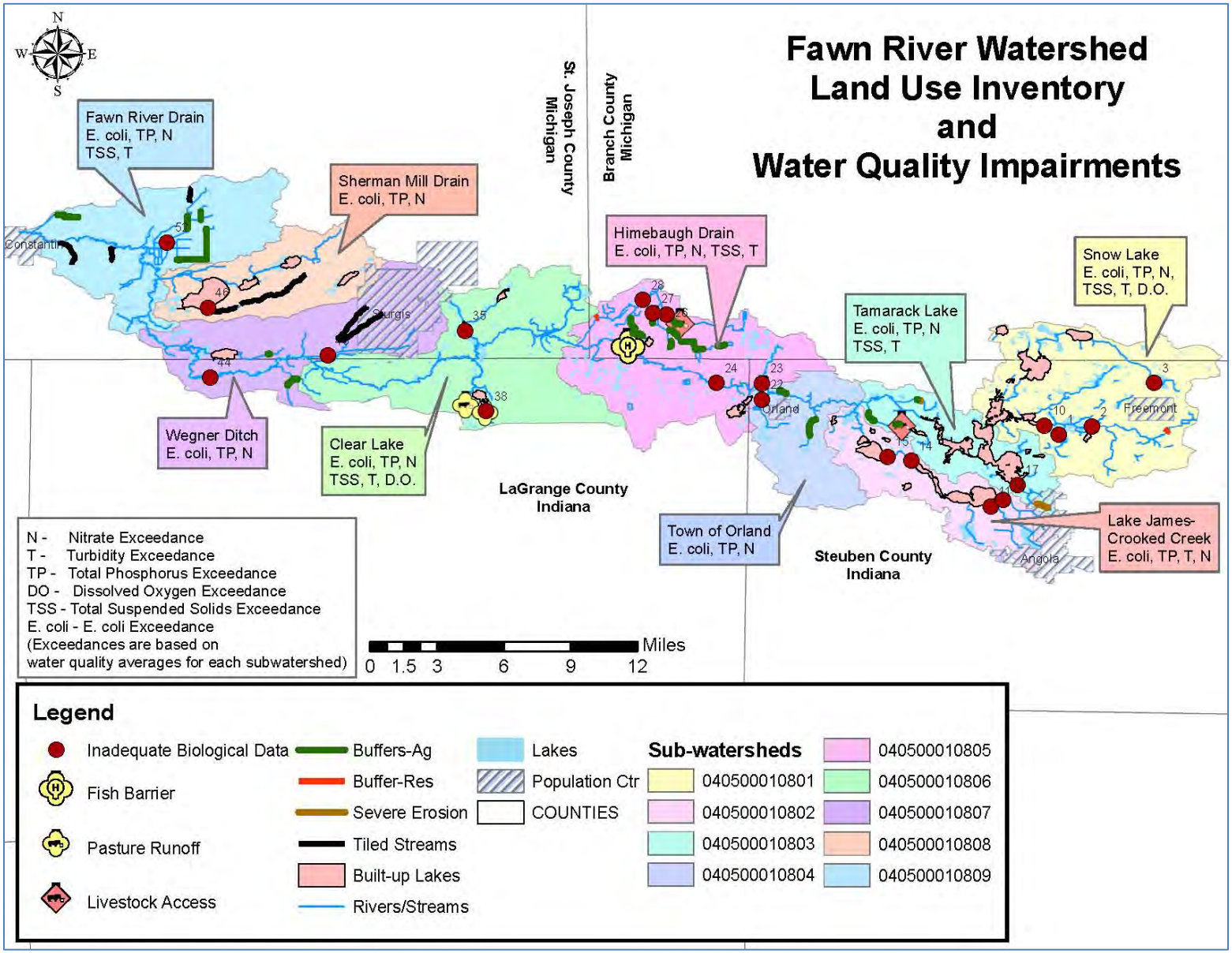
After examining water quality and land uses throughout the Fawn River watershed it can be determined that the problems and concerns contributing to water quality impairments within the watershed vary from sub-watershed to sub-watershed. As stated above, sub-watersheds with a populated area located within the boundaries show a higher concentration of *E. coli*, and TDS, than is typically found in the more rural sub-watersheds. Conversely, the more rural sub-watersheds typically show higher concentrations of phosphorus and nitrates (with the exception of Wegner Ditch where the nitrates exceeded the target in 86% of the samples). This indicates that each sub-watershed will need to be addressed individually to address the varying sources of water impairment across the Fawn River Watershed.

Land uses throughout the watershed are primarily row crops, and pasture fields. The soils within the project area are ideal for row crops as they are nutrient rich soils; however there is a significant amount of farm land that is still being conventionally tilled on HEL and/or PHEL. Most crop fields within the watershed do not have winter cover crops planted, are farmed directly up to the streambank which lack an adequate riparian buffer to prevent soil erosion and absorb polluted runoff. Since so much of the watershed is rural, it can be assumed that on-site sewage treatment is prevalent throughout the watershed. Though, there are 14 built-up lakes within the Fawn River Watershed that are not connected to a centralized sewer system and may be leaking directly into the lake. This poses a threat to water quality as over 91% of the soils in the watershed are classified as not suitable for septic placement.

The windshield survey revealed several possible contributors to the degradation of water quality in the Fawn River watershed including mowed residential lawns that have little to no riparian and/or shoreline buffer. Often times, stormwater runoff from urban areas can carry bacteria from pet waste and excess fertilizer and pesticides, as well as road salt, oil and grease and other pollutants. These urban issues transcend to the lake communities as well. However, lake residents can exacerbate the problems by installing hard surface seawalls which can increase erosion, as well as not provide the vegetation necessary to decrease the velocity of storm flow carrying nutrients, bacteria and other pollutants, prior to it discharging into the lake. Some more direct sources of pollution identified during the windshield and desktop survey are; two sites where livestock have direct access to open water and two sites with pasture runoff,

49,027 linear feet of riparian buffer needed where slight erosion is beginning to occur as well, 4,465 feet of streambank with severe erosion, 56,210.26 feet of stream that has been tiled and would benefit from being daylighted, a culvert under a bridge providing a barrier for fish migration, nearly 15,373 acres of wetland lost since pre-settlement times, and extensive irrigation use, especially in St. Joseph County. Each of these sites and observations made during the windshield survey provide a direct means for pollution to enter surface water and can be remediated with the implementation of BMPs.

Figure 3.65: Land Use and Water Quality Summary of the Fawn River Watershed



3.6 Analysis of Stakeholder Concerns

Stakeholders in the Fawn River Watershed expressed concerns regarding water quality and land uses during the public meeting held in 2013 and additional concerns were raised after performing the watershed inventory. These concerns are outlined in Table 3.6.1, as well as whether or not the concerns are supported by the collected data, quantifiable, outside the scope of this project, and whether or not the steering committee would like to focus on the concerns. The evidence found during the watershed inventory was presented to the steering committee at a meeting in August 2014. The steering committee expressed that focus should be placed on all the concerns outlined in the table, as each concern poses a threat to water quality.

Table 3.6.1: Analysis of Stakeholder Concerns

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Livestock access to open water	Yes	All sub-watersheds had sample sites that exceeded the target for E. coli, TP, and nitrates. Two sites were noted during the windshield survey where livestock have access to open water. More may be present in the watershed as the survey took place from the road only. (Himebaugh Drain and Tamarack Lake)	Yes	No	Yes
Stormwater runoff from livestock operations	Yes	All sub-watersheds had sample sites that exceeded the target for E. coli, TP, and nitrates. Four sites (including the two livestock access sites) were noted during the windshield survey where livestock operations had a direct influence on water quality through stormwater runoff from pastures and/or barnyards. (Clear Lake, Himebaugh Drain and Tamarack Lake) There are also four CFOs with the potential to have manure runoff. (Himebaugh Drain and Wegner Ditch)	Yes	No	Yes
Increase in impervious surfaces	Yes	While specifics were not able to be obtained to determine the increase in imperviousness within the Fawn River, stakeholder observations have concluded that there is an increase in impervious surface, especially around the lakes. Observations made during the windshield survey verify stakeholder claims, as many new homes were being erected around the lakes. Also, the Fawn River Crossing on SR 9, south of Sturgis is relatively new, and includes an industrial park, as well as truck stop and other businesses. Sub-watersheds with populated areas had increased TDS readings compared to less urbanized sub-watershed (Snow Lake, Lake James, and Wegner Ditch)	Yes	No	Yes

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Fertilizer used on urban lawns	Yes	All sub-watersheds had sample sites that exceeded the target for TP, and nitrates. Specific information regarding fertilizer use on urban lawns is unobtainable at this time, however, the lakes are surrounded by lush green turf grasses, and many residential properties also have lush turf grass lawns which indicate the use of fertilizer. Also, many homes were observed to have the flags in their lawns advertising a commercial fertilizer service, many of which routinely apply fertilizer six times annually without soil samples to determine the correct application amount for each individual lawn.	Yes	No	Yes
Lakes in the area becoming more developed	Yes	While specifics were not able to be obtained to determine the increase in imperviousness within the Fawn River, stakeholder observations have concluded that there is an increase in impervious surface, especially around the lakes. Observations made during the windshield survey verify stakeholder claims, as many new homes were being erected around the lakes.	Yes	No	Yes
Septic system discharge	Yes	All sub-watersheds had sample sites that exceeded the target for E. coli, TP, and nitrates. Nearly 85% of the soils are classified by the NRCS as being very limited for septic usage and nearly 7% are classified as somewhat limited for septic usage. US EPA estimates that 25% of households utilize on-site waste disposal systems with up to 5% of those failing. The National Environmental Service Center estimates up to 30% of all systems are failing.	Yes	No	Yes
Lack of no-till and cover crop practices	Yes	All sub-watersheds except Town of Orland, Wegner Ditch, and Sherman Mill Creek has water quality results for turbidity and TSS that were greater than the target level. Estimates for MI counties could not be obtained but only 2% of all crops in Steuben County and 19% of all crops in LaGrange County use cover crops. 31% of corn in Steuben and LaGrange counties are in no-till and 68% and 63% of beans in Steuben and LaGrange counties, respectively, are in no-till.	Yes	No	Yes

Concerns	Supported by Data?	Evidence	Able to Quantify?	Outside Scope?	Group Wants to Focus On?
Wetland Conservation	Yes	According to the NWI, approximately 16% of the watershed is considered to be wetland. The Friends of the St. Joseph River Association - Wetland Partnership estimates nearly a 53% decrease in wetlands since presettlement time. Comparing pre-settlement wetland data to 2005 data, the Fawn River watershed has lost approximately 11,000 acres of wetlands within that time. Four species that rely on wetlands for habitat are on the federal endangered species list. Functional use loss data shows that a WQ filtering functional use loss of between 21% in Snow Lake sub-watershed and 59% in the Fawn River Drain sub-watershed and a habitat functional use loss of between 21% in Tamarack Lake sub-watershed and 73% in the Fawn River Drain sub-watershed.	Yes	No	Yes
Stream Bank Erosion	Yes	All sub-watersheds had sample sites that exceeded the target levels for TSS and turbidity, except for Town of Orland, Wegner Ditch, and Sherman Mill Creek. The windshield and desktop surveys revealed a lack of riparian buffer which also exhibited slight erosion, including 2,176 linear feet in residential areas, and 49,027 linear feet in agriculture areas. 4,465 linear feet of moderate to severe bank erosion was also observed during the windshield survey.	Yes	No	Yes
Tiled Streams in Ag fields and un-buffered tile inlets	Yes	All sub-watersheds had sample sites that exceeded nitrate, TP, and E. coli targets and all sub-watersheds, except Town of Orland, Wegner Ditch, and Sherman Mill Creek, had sample sites that exceeded the targets for TSS, and turbidity. County surveyors in Steuben and LaGrange County manage 233,270.4 feet of tiled drains, and the windshield and desktop surveys revealed 46,796 feet of stream that has been tiled as it is no longer visible on the surface and the National Hydrologic Dataset has the streams marked as being present. An inventory of tile inlets has not been performed in the Fawn River watershed, however many un-buffered inlets were observed during the windshield survey.	Yes	No	Yes