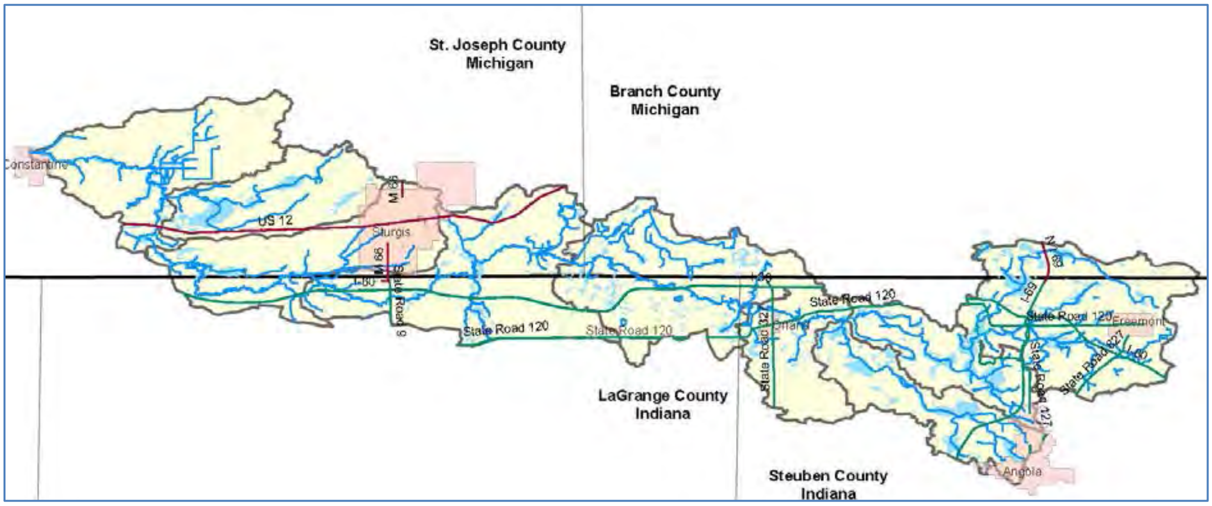
Fawn River Watershed Management Plan

HUC 0405000108

April, 2015



Prepared in Cooperation With:
LaGrange County Soil and Water Conservation District
910 S. Detroit Street
LaGrange, IN 46761
260-463-3471 ext. 3
www.lagrangeswcd.org

Prepared By:

SNRT, Inc
Natural Resource Associates

Principle Author: Kyle Quandt
5000 E 100 S
LaGrange, IN 46761

This project has been funded wholly or in part by the United State Environmental Protection Agency under assistance agreement C600E72012 to the Indiana Department of Environmental Management. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Table of Contents

Table of Contents ii

Table of Figures v

Table of Tables viii

List of Acronyms xiv

1.0 Introduction 1

2.0 Physical Description of the Watershed 5

2.1 Watershed Location 5

2.2 Geology, Topography, and Soils 9

2.2.1 Geology 9

2.2.2 Topography 11

2.2.3 Soils 11

2.3 Climate 18

2.4 Hydrology 19

2.4.1 Lakes 19

2.4.2 Legal Drains 22

2.4.3 Wetlands 24

2.4.4 Floodplains and Levees 27

2.4.5 Dams 29

2.4.6 Drinking Water and Ground Water Resources 32

2.5 Land Use 34

2.5.1 Tillage Transect Data 37

2.5.2 Septic System Usage 38

2.5.3 Confined Feeding Operations 40

2.5.4: Windshield Survey 42

2.5.5 National Pollution Discharge Elimination System 42

2.5.6 Brownfields 45

2.5.10 Underground Storage Tanks 45

2.5.11: Parks 47

2.6 Previous Watershed Planning Efforts 52

2.6.1 City and County Management Plans 52

2.6.2 Watershed Management Plans 57

2.6.3 Lake Management Plans 57

2.6.4 Other Studies 62
2.6.5 Wellhead Protection Plans 63
2.6.6 Municipal Separate Storm Sewer System 64
2.7 Endangered Species 67
2.11 Invasive Species 71
2.12 Summary of Watershed Inventory 79
3.0 Watershed Inventory by Sub-watershed 83
3.1 Water Quality Data 83
3.1.1 Water Quality Parameters 83
3.1.2 Water Quality Targets 86
3.2 Water Quality Sampling Efforts 87
3.2.1 IDEM and MI DEQ Integrated Reports 89
3.2.2 Fish Consumption Advisory (FCA) 100
3.2.3 Steuben County Lakes Council 102
3.2.4 LaGrange County Soil and Water Conservation District 102
3.3 Water Quality Data per Sub-watershed 102
3.3.1 Snow Lake Sub-watershed Water Quality Analysis 103
3.3.2 Lake James – Crooked Creek Sub-watershed Water Quality Analysis 115
3.3.3 Tamarack Lake Sub-watershed Water Quality Analysis 123
3.3.4 Town of Orland – Fawn River Sub-watershed Water Quality Analysis 131
3.3.5 Himebaugh Drain Sub-watershed Water Quality Analysis 137
3.3.6 Clear Lake – Fawn River Sub-watershed Water Quality Analysis 143
3.3.7 Wegner Ditch – Fawn River Sub-watershed Water Quality Analysis 153
3.3.8 Sherman Mill Creek Sub-watershed Water Quality Analysis 159
3.3.9 Fawn River Drain Sub-watershed Water Quality Analysis 163
3.3.10 Summary of Water Quality Data in the Fawn River Watershed 170
3.4 Land Use per Sub-watershed 172
3.4.1 Snow Lake Sub-watershed Land Use 173
3.4.2 Lake James – Crooked Creek Sub-watershed Land Use 186
3.4.3 Tamarack Lake Sub-watershed Land Use 197
3.4.4 Town of Orland – Fawn River Sub-watershed Land Use 209
3.4.5 Himebaugh Drain – Fawn River Sub-watershed Land Use 220
3.4.6 Clear Lake – Fawn River Sub-watershed Land Use 231

3.4.7 Wegner Ditch Sub-watershed Land Use ... 243
3.4.8 Sherman Mill Creek Sub-watershed Land Use ... 256
3.4.9 Fawn River Drain Sub-watershed Land Use ... 267
3.5 Watershed Inventory Summary ... 278
3.6 Analysis of Stakeholder Concerns ... 281
4.0 Pollution Sources and Loads ... 285
4.1 Potential Causes of Water Quality Problems ... 285
4.2 Potential Sources Resulting in Water Quality Impairment ... 288
4.3 Pollution Loads and Necessary Load Reductions ... 292
5.0 Critical Areas ... 297
5.1 Critical Areas to Focus Implementation Efforts. ... 297
5.1.1 Pollutant Based Critical Areas ... 297
5.1.2 Wetland Based Critical Areas ... 301
6.0 Goals, Management Measures, and Objectives ... 303
6.1 Goal Statements and Progress Indicators ... 303
6.1.1 Reduce Nitrogen Loading ... 303
6.1.2 Reduce Total Phosphorus Loading ... 304
6.1.3 Reduce *E. coli* Loading ... 305
6.1.4 Increase Wetland Acreage throughout the Watershed ... 306
6.1.4 Reduce the Number of Faulty Septic Systems ... 306
6.2 Management Practices to Address Critical Areas and Accomplish Goals ... 308
6.3 Action Register to Accomplish Goals ... 314
6.3.1 General Action Register for Implement ... 315
6.3.2 Action Registers to Implement Cost-share Program in Each Sub-watershed ... 321
7.0 Potential Annual Load Reductions after Implementation ... 327
8.0 Future Activities ... 328
References ... 330
Appendix A ... 333

Table of Figures

Figure 2.1: Fawn River Watershed Percentage of Area per County 6
Figure 2.3: Fawn River Watershed 8
Figure 2.4: Quarternary Geology of the Fawn River Watershed 10
Figure 2.5: Highly and Potentially Highly Erodible Soil 13
Figure 2.6: Hydric Soils 15
Figure 2.7: Soil Septic Suitability in the Fawn River Watershed 17
Figure 2.8: Average Monthly Temperatures within Fawn River Watershed 18
Figure 2.9: Average Monthly Precipitation within the Fawn River Watershed 18
Figure 2.10: Rivers and Streams in the Fawn River Watershed 20
Figure 2.11: Lakes in the Fawn River Watershed 21
Figure 2.12: Legal Drains in the Fawn River Watershed 23
Figure 2.13: Current Wetlands in the Fawn River Watershed 26
Figure 2.14: Floodplains Located within the Fawn River Watershed 28
Figure 2.15: Dams Located in the Fawn River Watershed 31
Figure 2.16: Unconsolidated Aquifer System within the Fawn River Watershed 33
Figure 2.17: Land Use/ Land Cover in Fawn River Watershed 36
Figure 2.18: Communities Served by a Centralized Sewer System 39
Figure 2.19: Confined Feeding Operations in the Fawn River Watershed 41
Figure 2.20: Potential Point Sources of Pollution in the Fawn River Watershed 46
Figure 2.21: Parks and Nature Preserves in the Fawn River Watershed 51
Figure 2.22: Existing and Planned Waste Water Treatment Services in St. Joseph County 54
Figure 2.23: Historic and Existing Studies in the Fawn River Watershed 66
Figure 3.1: Water Quality Sample Sites in the Fawn River Watershed 88
Figure 3.2: State Listed Impaired Waters in the Fawn River 99
Figure 3.3: Snow Lake Water Quality Sample Sites 104
Table 3.11: Steuben County Lakes Council Sampling at Walter’s Lake Drain 107
Figure 3.4: Water Quality Sample Sites in the Lake James – Crooked Creek Sub-watershed 117
Figure 3.5: Water Quality Sample Site in Tamarack Lake Sub-watershed 124
Figure 3.6: Water Quality Sample Sites in Town of Orland – Fawn River Sub-watershed 132
Figure 3.7: Water Quality Sample Sites in the Himebaugh Drain Sub-watershed 138
Figure 3.8: Water Quality Sample Sites in the Clear Lake – Fawn River Sub-watershed 144
Figure 3.9: Water Quality Sample Sites in the Wegner Ditch Sub-watershed 154

Figure 3.10: Water Quality Sample Sites in the Sherman Mill Creek Sub-watershed............... 160
Figure 3.11: Water Quality Sample Sites in the Fawn River Drain Sub-watershed................... 165
Figure 3.12: Snow Lake Sub-watershed Land Use Delineations.. 174
Figure 3.13: Windshield Survey Observations for Snow Lake Sub-watershed.......................... 176
Figure 3.14: Septic Suitability in Snow Lake Sub-watershed 177
Figure 3.15: Highly Erodible Land in Agricultural Areas in the Snow Lake Sub-watershed........ 178
Figure 3.16: Current and Pre-settlement Wetlands in the Snow Lake Sub-watershed 179
Figure 3.17: Potential Point Sources of Pollution in the Snow Lake Sub-watershed 184
Figure 3.18: Lake James – Crooked Creek Sub-watershed Land Use Designations................... 187
Figure 3.19: Windshield Survey Observations in Lake James –Crooked Creek Sub-watershed. 189
Figure 3.20: Septic Suitability in Lake James –Crooked Creek Sub-watershed 190
Figure 3.21: Highly Erodible Land in Lake James–Crooked Creek Sub-watershed.................... 192
Figure 3.22: Wetlands in Lake James-Crooked Creek Sub-watershed 193
Figure 3.23: Potential Point Sources of Pollution (Lake James–Crooked Lake Sub-watershed) 195
Figure 3.24: Tamarack Lake Sub-watershed Land Use Designations 198
Figure 3.25: Windshield Observations in the Tamarack Lake Sub-watershed 200
Figure 3.25: Septic Suitability in the Tamarack Lake Sub-watershed....................................... 201
Figure 3.26: Highly Erodible Land in the Tamarack Lake Sub-watershed 203
Figure 3.27: Current and Pre-settlement Wetlands in the Tamarack Lake Sub-watershed 204
Figure 3.28: Potential Point Sources of Pollution in the Tamarack Lake Sub-watershed 207
Figure 3.29: Town of Orland – Fawn River Sub-watershed Land Use Designations.................. 210
Figure 3.30: Windshield Survey Observations in Town of Orland–Fawn River Sub-watershed. 212
Figure 3.31: Septic Suitability in Town of Orland – Fawn River Sub-watershed 213
Figure 3.32: Highly Erodible Land in Town of Orland – Fawn River Sub-watershed................. 215
Figure 3.33: Wetlands in the Town of Orland – Fawn River Sub-watershed 216
Figure 3.34: Potential Point Sources of Pollution in the Tamarack Lake Sub-watershed 218
Figure 3.35: Himebaugh Drain Sub-watershed Land Use Designations................................... 221
Figure 3.36: Windshield Observations in the Himebaugh Drain Sub-watershed...................... 223
Figure 3.37: Septic Suitability in the Himebaugh Drain Sub-watershed................................... 224
Figure 3.38: Highly and Potentially Highly Erodible Land in Himebaugh Drain Sub-watershed 226
Figure 3.39: Wetlands in Himebaugh Drain Sub-watershed 227
Figure 3.40: Point Sources of Pollution in Himebaugh Drain Sub-watershed........................... 229
Figure 3.41: Clear Lake – Fawn River Sub-watershed Land Use Designations 232

Figure 3.42: Windshield Survey Observations in the Clear Lake Sub-watershed....................... 234
Figure 3.43: Septic Suitability in the Clear Lake Sub-watershed 235
Figure 3.44: Highly and Potentially Highly Erodible Land in the Clear Lake Sub-watershed...... 237
Figure 3.45: Current and Pre-Settlement Wetlands in the Clear Lake Sub-watershed............. 238
Figure 3.46: Potential Point Sources of Pollution in the Clear Lake Sub-watershed................. 241
Figure 3.47: Wegner Ditch Sub-watershed Land Use Designations 244
Figure 3.48: Windshield Survey Observations in the Wegner Ditch Sub-watershed................ 246
Figure 3.49: Septic Suitability in the Wegner Ditch Sub-watershed... 247
Figure 3.50: Highly and Potentially Highly Erodible Land in Wegner Ditch Sub-watershed 249
Figure 3.51: Current and Pre-Settlement Wetlands in the Wegner Ditch Sub-watershed........ 250
Figure 3.52: Potential Point Sources of Pollution in the Wegner Ditch Sub-watershed............ 254
Figure 3.53: Land Use Designations in the Sherman Mill Creek Sub-watershed 257
Figure 3.54: Windshield Survey Observations in the Sherman Mill Creek Sub-watershed 259
Figure 3.55: Septic Suitability in the Sherman Mill Creek Sub-watershed 260
Figure 3.56: Highly and Potentially Highly Erodible Land in Sherman Mill Creek Sub-watershed 262
Figure 3.57: Wetlands in the Sherman Mill Creek Sub-watershed... 263
Figure 3.58: Potential Point Sources of Pollution in the Sherman Mill Creek Sub-watershed... 265
Figure 3.59: Land Use Designations in the Fawn River Drain Sub-watershed........................... 268
Figure 3.60: Windshield Survey Observations in the Fawn River Drain Sub-watershed............ 270
Figure 3.61: Septic Suitability in the Fawn River Drain Sub-watershed 271
Figure 3.62: Highly and Potentially Highly Erodible Land in Fawn River Drain Sub-watershed. 273
Figure 3.63: Wetlands in the Fawn River Drain Sub-watershed.. 274
Figure 3.64: Potential Point Sources of Pollution in the Fawn River Drain Sub-watershed....... 276
Figure 3.65: Land Use and Water Quality Summary of the Fawn River Watershed 280
Figure 4.1: Fawn River Project Sample Sites with E.coli Exceedances 296
Figure 5.1: Implementation Priority for Pollutant Based Critical Areas 300
Figure 5.3: Critical Areas for Wetland Restoration... 302

Table of Tables

Table 1.1: Steuben and Branch County Steering Committee Members 3
Table 1.2: LaGrange and St. Joseph County Steering Committee Members..... 3
Table 2.1: General Soil Associations 11
Table 2.2: Stream Miles in the Fawn River Watershed 19
Table 2.3: Legal Drains by County in the Fawn River Watershed..... 22
Table 2.4: Wetland Classification within the Fawn River Watershed 24
Table 2.5: Dams Located in the Fawn River Watershed..... 29
Table 2.6: Water Withdrawals in Indiana and Michigan (2005)..... 32
Table 2.7: Land Use/Land Cover in Fawn River Watershed..... 35
Table 2.8: Tillage Transect Data for Michigan Counties in 1993 37
Table 2.9: Tillage Transect and Cover Crop Data for Indiana Counties in 2013 37
Table 2.10: Confined Feeding Operations in the Fawn River Watershed 40
Table 2.11: NPDES Permitted Facilities in the Fawn River Watershed..... 43
Table 2.12: Parks and Nature Preserves in the Fawn River Watershed 47
Table 2.13: Wellhead Protection Plans in the Fawn River Watershed..... 64
Table 2.14: Federally Listed Endangered Species..... 68
Table 2.15: Invasive Species in the St. Joseph-Lake Michigan Watershed..... 72
Table 2.16: List of Invasive Plant Species per County..... 76
Table 2.16: Stakeholder Concerns and Relevant Evidence for Concern 81
Table 3.1: Water Quality Targets..... 87
Table 3.2: IDEM Consolidated List of Waters in the Fawn River Watershed 90
Table 3.3: MI DEQ Consolidated List of Waters in the Fawn River Watershed..... 97
Table 3.4: Fish Consumption Advisory in the Fawn River Watershed..... 100
Table 3.5: Water Quality Analysis for all Sample Sites in the Snow Lake Sub-watershed 103
Table 3.6: Steuben County Lakes Council Sampling at the Crane Marsh Outlet..... 105
Table 3.7: Fawn River Project Sampling at the Crane Marsh Outlet 105
Table 3.8: Steuben County Lakes Council Sampling at Deller Ditch 106
Table 3.9: Steuben County Lakes Council Sampling at Follet Creek..... 106
Table 3.10: Fawn River Project Sampling at Follett Creek..... 107
Table 3.12: Fawn River Project Sampling at Walter's Lake Drain..... 108
Table 3.13: Steuben County Lakes Council Sampling in Follett Creek (Big Otter Lake Outlet) .. 108
Table 3.14: Steuben County Lakes Council Sampling in Follett Creek (Snow Lake Inlet)..... 109

Table 3.15: Fawn River Project Sampling in Follett Creek (Snow Lake Inlet) 109
Table 3.16: Steuben County Lakes Council Sampling at the Lake George Outlet 110
Table 3.17: Fawn River Project Sampling at the Lake George Outlet....................................... 110
Table 3.18: Steuben County Lakes Council Sampling -Crooked Creek; Site 33 111
Table 3.19: Steuben County Lakes Council Sampling -Tributary to Snow Lake......................... 111
Table 3.20: Steuben County Lakes Council Sampling at Walter’s Lake Drain 112
Table 3.21: Fawn River Project Sampling at Seven Sister’s Lake Outlet................................... 112
Table 3.22: Fawn River Project Sampling in the Little Fawn River: Site 3 113
Table 3.23: Fawn River Project Sampling in the Little Fawn River; Site 4 114
Table 3.24: Fawn River Project Sampling in Little Fawn River; Site 5....................................... 114
Table 3.25: Fawn River Project Sampling in a Tributary to Lake James; Site 7 115
Table 3.26: Analysis of all Sample Sites in the Lake James-Crooked Creek Sub-watershed 116
Table 3.27: Steuben County Lakes Council Sampling at Croxton Ditch (Site 37) 118
Table 3.28: Fawn River Project Sampling at Croxton Ditch (Site 17).. 118
Table 3.29: IDEM Sampling at Lake James in Pokagon State Park (Site 1) 119
Table 3.30: Steuben County Lakes Council Sampling -Snow Lake to Lake James Inlet (Site 45) 119
Table 3.31: Steuben County Lakes Council Sampling -Crooked Creek (Lake James Outlet Site 46) 120
Table 3.32: Fawn River Project Sampling in Crooked Creek- Lake James Outlet (Site 18)......... 120
Table 3.33: Steuben County Lakes Council Sampling -Crooked Creek (Jimmerson Lake outlet Site 38) 121
Table 3.34: Fawn River Project Sampling -Crooked Creek (Jimmerson Lake Outlet Site 19)..... 121
Table 3.35: IDEM Sampling in Crooked Creek (Site 2)... 122
Table 3.36: Fawn River Project Sampling in Crooked Creek (Site 20) 122
Table 3.37: Analysis of all Sample Sites in the Tamarack Lake Sub-watershed......................... 123
Table 3.38: Steuben County Lakes Council Sampling at Carpenter Ditch (Site 34)................... 125
Table 3.39: Steuben County Lakes Council Sampling at Carpenter Ditch (Site 35)................... 125
Table 3.40: Fawn River Project Sampling at Carpenter Ditch (Site 11) 126
Table 3.41: Steuben County Lakes Council Sampling at Palfreyman Ditch (Site 36)................. 126
Table 3.42: Fawn River Project Sampling at Palfreyman Ditch (Site 12) 127
Table 3.43: Fawn River Project Sampling at an Unnamed tributary to Crooked Lake (Site 13). 127
Table 3.44: Steuben County Lakes Council Sampling - Third Basin of Crooked Lake (Site 63)... 128

Table 3.45: Steuben County Lakes Council Sampling -Concorde Creek (Crooked Lake Outlet Site 39) 128
Table 3.46: Fawn River Project Sampling - Concorde Creek (Crooked Lake Outlet Site 14) 129
Table 3.47: Steuben County Lakes Council Sampling -Concorde Creek (Lake Gage Inlet Site 40) 129
Table 3.48: Fawn River Project Sampling - Concorde Creek (Lake Gage Inlet Site 15) 130
Table 3.49: Steuben County Lakes Council Sampling -Concorde Creek (Lime Lake Outlet Site 41) 130
Table 3.50: Fawn River Project Sampling - Concorde Creek (Lime Lake Outlet Site 16)............ 131
Table 3.51: Analysis of all Sample Sites in the Town of Orland Sub-watershed 131
Table 3.52: Fawn River Project Sampling in Crooked Creek (Site 21) 133
Table 3.53: IDEM Sampling in Crooked Creek (Site 3) 133
Table 3.54: IDEM Sampling in Orland Ditch (Site 4) 134
Table 3.55: IDEM Sampling in Orland Ditch at Lake Outlet (Site 5)... 134
Table 3.56: IDEM Sampling in Orland Ditch (Site 6) 135
Table 3.57: IDEM Sampling in Orland Ditch (Site 7) 135
Table 3.58: IDEM Sampling in Orland Ditch (Site 8) 136
Table 3.59: Fawn River Project Sampling in Orland Ditch (Site 22)... 136
Table 3.60: Analysis of all Sample Sites in the HImebaugh Drain Sub-watershed 137
Table 3.61: Fawn River Project Sampling - Unnamed Tributary to the Fawn River (Site 23)..... 139
Table 3.62: Fawn River Project Sampling - Fawn River (Site 24) 139
Table 3.63: Fawn River Project Sampling - Unnamed Tributary to Himebaugh Drain (Site 26). 140
Table 3.64: Fawn River Project Sampling - Unnamed Tributary to Himebaugh Drain (Site 27). 140
Table 3.65: Fawn River Project Sampling - Himebaugh Drain (Site 28)..................................... 141
Table 3.66: Fawn River Project Sampling - Fawn River (Site 29) 141
Table 3.67: Fawn River Project Sampling - Himebaugh Drain (Site 30)..................................... 142
Table 3.68: MI DEQ Sampling - Himebaugh Drain (Site 6).. 142
Table 3.69: Fawn River Project Sampling -Fawn River (Site 31) 143
Table 3.70: Analysis of all Sample Sites - Clear Lake Sub-watershed 143
Table 3.71: MI DEQ Sampling in the Fawn River (Site 5) 145
Table 3.72: Fawn River Project Sampling -Unnamed Tributary to Fawn River (Site 32)............ 146
Table 3.73: Fawn River Project Sampling in the Fawn River (Site 33) 146
Table 3.74: Fawn River Project Sampling in the Fawn River (Site 34) 147

Table 3.75: Fawn River Project Sampling -Unnamed Tributary to Fawn River (Site 35) 148
Table 3.76: IDEM Sampling in Meteer Lake (Site 9) 148
Table 3.77: Fawn River Project Sampling -Inlet to Cedar Lake (Site 38)................................... 149
Table 3.78: IDEM Sampling in Cedar Lake in 2000 (Site 10) 149
Table 3.79: Fawn River Project Sampling at Cedar Lake Outlet (Site 37) 150
Table 3.80: Fawn River Project Sampling in Fawn River (Site 36) 151
Table 3.81: Fawn River Project Sampling in the Fawn River (Site 39) 151
Table 3.82: MI DEQ Sampling in the Fawn River (Site 3) 152
Table 3.83: Fawn River Project Sampling in the Fawn River (Site 41) 152
Table 3.84: Analysis of FRP Sample Sites in Wegner Ditch Sub-watershed 153
Table 3.85: Fawn River Project Sampling in Nye Drain (Site 40) 155
Table 3.86: MI DEQ Sampling in Nye Drain in 2000 (Site 4) 155
Table 3.87: Fawn River Project Sampling in the Fawn River (Site 42) 156
Table 3.88: MI DEQ Sampling in the Fawn River (Site 2) 156
Table 3.89: Fawn River Project Sampling in Fawn River (Site 43) 157
Table 3.90: Fawn River Project Sampling in the Fawn River (Site 44) 158
Table 3.91: IDEM Sampling in the Fawn River (Site 11)... 158
Table 3.92: Fawn River Project Sampling in the Fawn River (Site 45) 159
Table 3.93: Analysis of FRP Sample Sites in the Sherman Mill Creek Sub-watershed............... 159
Table 3.94: Fawn River Project Sampling in Tributary to Sherman Mill Creek (Site 46) 161
Table 3.95: Fawn River Project Sampling -Sherman Mill Creek (Thompson Lake Outlet Site 47) 162
Tale 3.96: Fawn River Project Sampling -Sherman Mill Creek (Klinger Lake Inlet Site 48)......... 162
Table 3.97: Fawn River Project Sampling - Sherman Mill Creek (Klinger Lake Outlet Site 49).. 163
Table 3.98: Analysis of FRP Samples in the Fawn River Drain Sub-watershed.......................... 164
Table 3.99: Fawn River Project Sampling in the Fawn River (Site 50) 166
Table 3.100: Fawn River Project Sampling in the Fawn River Drain (Site 52) 167
Table 3.101: Fawn River Project Sampling in the Fawn River (Site 51) 168
Table 3.102: MI DEQ Sampling in the Fawn River (Site 1) 168
Table 3.103: Fawn River Project Sampling in the Fawn River (Site 53) 169
Table 3.104: Fawn River Project Sampling in Fawn River (Site 54) 169
Table 3.105: Summary of Water Quality Data per Parameter and Percent Exceedance per Sub-watershed 171

Table 3.4.1: Snow Lake Land Use Designations 173
Table 3.4.2: NPDES Permitted Facilities in the Snow Lake Sub-watershed 180
Table 3.4.3: Leaking Underground Storage Tanks in the Snow Lake Sub-watershed 181
Table 3.4.4: Land Use in the Lake James – Crooked Creek Sub-watershed 186
Table 3.4.5: Windshield Survey Observations in Lake James–Crooked Creek Sub-watershed 188
Table 3.4.6: NPDES Permitted Facilities in Lake James–Crooked Creek Sub-watershed 194
Table 3.4.7: Land Use in the Tamarack Lake Sub-watershed 197
Table 3.4.8: Leaking Underground Storage Tanks in Tamarack Lake Sub-watershed 205
Table 3.4.9: Land Use in Town of Orland–Fawn River Sub-watershed 209
Table 3.4.10: Leaking Underground Storage Tanks in Town of Orland–Fawn River Sub-watershed 217
Table 3.4.11: Land Use in the Himebaugh Drain Sub-watershed 220
Table 3.4.12: Windshield Observations in the Himebaugh Drain Sub-watershed 222
Table 3.4.13: Leaking Underground Storage Tank in the Himebaugh Drain Sub-waterhsed 228
Table 3.4.14: Confined Feeding Operations in the Himebaugh Drain Sub-watershed 228
Table 3.4.15: Land Use in the Clear Lake Sub-watershed 231
Table 3.4.16: Windshield Survey Observations in the Clear Lake – Fawn River Sub-watershed 233
Table 3.4.17: NPDES Permitted Facilities in the Clear Lake Sub-watershed 239
Table 3.4.18: Leaking Underground Storage Tanks in the Clear Lake Sub-watershed 239
Table 3.4.19: Brownfield Eligible Sites in the Clear Lake Sub-watershed 240
Table 3.4.20: Land Use in the Wegner Ditch Sub-watershed 243
Table 3.4.21: Windshield Survey Observations in the Wegner Ditch Sub-watershed 245
Table 3.4.22: NPDES Permitted Facilities in the Wegner Ditch Sub-watershed 251
Table 3.4.23: Leaking Under Ground Storage Tanks in the Wegner Ditch Sub-watershed 252
Table 3.4.24: Confined Feeding Operations in the Wegner Ditch Sub-watershed 252
Table 3.4.25: Brownfield Eligible Sites in the Wegner Ditch Sub-watershed 253
Table 3.4.26: Land Use in the Sherman Mill Creek Sub-watershed 256
Table 3.4.27: Leaking Underground Storage Tanks in the Sherman Mill Creek Sub-watershed 264
Table 3.4.28 Brownfields Located in the Sherman Mill Creek Sub-watershed 264
Table 3.4.29: Land Use in the Fawn River Drain Sub-watershed 267
Table 3.4.30: Windshield Survey Observations for the Fawn River Drain Sub-watershed 269
Table 3.4.31: NPDES Permitted Facility in the Fawn River Drain Sub-watershed 275
Table 3.4.32: Leaking Underground Storage Tanks in the Fawn River Drain Sub-watershed 275

Table 3.4.33 Brownfields Located in the Fawn River Drain Sub-watershed 275
Table 3.6.1: Analysis of Stakeholder Concerns 282
Table 4.1.1: Connection between Stakeholder Concerns, Problems, and Potential Causes 285
Table 4.2.1: Problems, Causes, and Sources.. 288
Table 4.3.1: Target Concentration for Parameters of Concern 293
Table 4.3.2: Nitrate Pollution Load Reductions Needed to Meet Target Loads......................... 293
Table 4.3.3: Phosphorus Pollution Load Reductions Needed to Meet Target Loads 294
Table 4.3.4: Total Dissolved Solids Pollution Load Reductions Needed to Meet Target Loads . 294
Table 4.3.5: Total Suspended Solids Pollution Load Reductions Needed to Meet Target Loads295
Table 3.4.6: E. coli and Turbidity Concentrations and Percent Exceedance per Sub-watershed 295
Table 5.1: Implementation Prioritization for Nutrient Load Based Critical Areas...................... 298
Table 5.2: Implementation Prioritization for E. coli Based Critical Areas.................................. 299
Table 5.3: Implementation Prioritization for Wetland Restoration Critical Areas 301
Table 6.1: Management measures to Address Critical Areas and Project Goals 309
Table 6.1: General Action Register for Personnel and Funding... 315
Table 6.2: General Action Register for Education and Outreach 316
Table 6.3: General Action Register for Partnerships 318
Table 6.4: General Action Register for Tracking Indicators 319
Table 6.5: General Action Register for Cost-Share Program 320
Table 6.6: Implementation Action Register for Urban and Lake Residents 321
Table 6.7: Implementation Action Register for Agriculture Producers 324
Table 6.8: Implementation Action Register for Wetland Restoration....................................... 326
Table 7.1: Estimated Load Reductions after Implementation... 327

List of Acronyms

AFOs	Animal feeding operations
AU	Assessment Unit
BMPs	Best Management Practices
CAFF	Confined Animal Feeding Facility
CAFOs	Concentrated Animal Feeding Operations
CFOs	Confined Feeding Operations
cfu	Colony-Forming Unit
CSO	Combined Sewer Overflow
CWA	Clean Water Act
DMR	Discharge Monitoring Report
DNR	Department of Natural Resources
DO	Dissolved oxygen
DRP	Dissolved Reactive Phosphorus
FRP	Fawn River Project
FCAs	Fish Consumption Advisory
HEL	Highly Erodible Land
HUC	Hydrologic Unit Codes
IDEM	Indiana Department of Environmental Management
IN	Indiana
INDOT	Indiana Department of Transportation
IR	Integrated Report
LTCP	Long Term Control Plan
LUSTs	Leaky underground storage tanks
MCL	Maximum Contaminant Level
MCM	Minimum Control Measures
MDEQ	Michigan Department of Environmental Quality
mg/L	Milligram per Liter
MGD	Million gallons per day
mIBI	Macroinvertebrate Index of Biotic Integrity
MS4	Municipal Separate Storm Sewer System
NFA	No Further Action
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resource Conservation Service
NPS	Nonpoint source pollution
NTUs	Nephelometric Turbidity Units
NWI	National Wetland Inventory
PCBs	Polychlorinated biphenyls
PHEL	Potentially Highly Erodible Land
ppb	Parts Per Billion

QAPP RC&D	Quality Assurance Project Plan Resource Conservation and Development
SWCD	Soil and Water Conservation District
SCLC	Steuben County Lakes Council
SWQMP	Storm Water Quality Management Plan
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
TP	Total Phosphorus
UDO	Unified Development Ordinance
US EPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey
USTs	Underground storage tanks
WHPP	Wellhead Protection Plan
WMP	Watershed Management Plan
WWTP	Waste Water Treatment Plant

1.0 Introduction

The LaGrange County Soil and Water Conservation District (SWCD) has been working with landowners and producers in LaGrange County to provide education on water quality issues and sustainable farming for the past 17 years. The relationship that has been formed between the SWCD and the farmers in the community has afforded the SWCD the ability to write comprehensive watershed management plans (WMP) for the Little Elkhart River, the Little Elkhart River Addendum, and Pigeon River and begin implementation of those WMPs with full support and help from the community. Monthly water testing in the Little Elkhart River system has shown improvements in water quality indicating that the SWCD's and local farmer's efforts to implement best management practices and improve water quality have made a difference in the watershed. It is anticipated as BMP implementation continues in the Pigeon River system, similar NPS pollution reductions will be achieved.

The success seen in previous watershed projects led the SWCD to look at surrounding watersheds to see if they could expand their efforts to include the Fawn River system. Steuben County SWCD had similar interests in this watershed resulting in a close partnership with the LaGrange County SWCD.

Agriculture is the major land usage for the entire drainage. Seed corn production is a major component along the drainage from western Steuben County, Indiana until it empties into the St. Joseph River. Other food production such as green beans, beets, and potatoes also play a significant role along the corridor. An important aspect in this type of agricultural landscape is the use of traditional practices which includes fall plowing that exposes fields to wind and sheet erosion. Evidence suggests traditional tillage practices may be having an influence on water quality in the watershed due to parts of the drainage being listed on the IDEM 303(d) list for impaired biotic communities. Big Otter Lake Inlet, Follette Creek, Walters Lake Inlet, Marsh Lake Outlet, and Green Lake Outlet are listed for impaired biotic communities in the draft 2012 Integrated Report.

Livestock operations are a growing commodity within the watershed. The Amish community is rather small along the Fawn River when compared to the Little Elkhart and Pigeon River drainages, but this community continues to grow resulting in an expansion of livestock based agriculture. Livestock related issues have been documented and are validated in water testing results with Crooked Creek, located in the Fawn River-Orland sub-watershed being listed as an impaired water body for *E.coli*.

Urban influences likely have an impact on the water quality throughout the watershed. Angola (p=8612) in Steuben County, is an Municipal Separate Storm Sewer System (MS4) city that currently affects Tamarack Lake (040500010802) and Lakes James-Crooked Creek (040500010803) sub-watersheds. It is anticipated that as the city grows north, the sub-watershed of Snow Lake (040500010801) will be included in the city's drainage area. Other urban influences include Fremont (p=2138), Howe (p=807), and Orland (p=434) in Indiana, and the majority of Sturgis, Michigan (p=10,994). The town of Constantine, Michigan (p=2076) primarily influences the St. Joseph River directly, but may contribute to the Fawn River along the northern edge of the watershed, in residential areas. In addition, the majority of lake systems within the river drainage have dense residential areas along the shorelines. These residential lake areas likely have an effect on the lake systems through use of lawn fertilizers, the increased use of seawalls rather than natural shorelines, and on lakes without centralized sewers, septic systems may be a significant problem.

After taking the above findings into consideration, both SWCDs met with several local organizations and agencies to present the above information and to collaborate on a project to write a WMP for the Fawn River watershed to develop an implementation plan to delist the impaired waterways from the IDEM 303(d) list outlined in the IDEM Integrated Report which is submitted to the US Environmental Protection Agency (EPA) every two years. A collaborative effort between the LaGrange County and Steuben County SWCDs, Branch County and St. Joseph County Conservation Districts, The Nature Conservancy, Pheasants Forever, LaGrange and Steuben County Lakes Councils, Indiana Department of Natural Resources (IN DNR), Friends of the St. Joe, the St. Joseph River Basin Commission, and many other organizations led to an application for funding to be submitted to IDEM through the CWA§319 grant program in September, 2011. The application was passed to the CWA§205(j) grant program and was approved for funding. The Fawn River Watershed project began in January, 2013.

Due to the high level of interest in all four counties it was decided to divide the area between east (Steuben and Branch Counties) and west (LaGrange and St. Joseph Counties). Steering Committees were developed for both locations which will allow a greater amount of participation in the planning process and not overwhelm meetings. This design gives every participant ample opportunity to voice their opinions. In April of 2013, steering committee meetings were held in Steuben and LaGrange Counties to kick off the project and begin listing stakeholder concerns for the Fawn River. The steering committee members were also charged with collecting additional concerns from their organizations and other concerned stakeholders. Tables 1.1 and 1.2 are lists of the two steering committee members and Table 1.3 lists current stakeholder concerns, as well as their relevance to this project.

Table 1.1: Steuben and Branch County Steering Committee Members

Name	Affiliation	Stakeholder Group
Kayleen Hart	Steuben County SWCD	Government/Conservation
Tom Green	Steuben County SWCD Supervisor	Government/ Coservation
Brian Musser	Natural Resource Conservation Service	Government/Conservation
Bill Schmidt	Steuben County Lakes Council	Lake Residents/Conservation
Eric Henion	Angola/Trine University MS4	Government/Stormwater
Anne Abernathy	Fremont Library and Fremont Parks	Government
Linda Hagerman	Lake George Conservancy	Lake Residents/Conservation
Renate Brenneke	Lake George Conservancy	Lake Residents/Conservation
Chris Snyder	Town of Fremont	Municipal Government
Beth Warner	The Nature Conservancy	Non-profit/Environment
Kathy Worst	Branch County Conservation District	Government/Conservation
Larry Gilbert	Steuben County Surveyor	Local Government
Neil Ledet	Indiana Department of Natural Resources	Environment

Table 1.2: LaGrange and St. Joseph County Steering Committee Members

Name	Affiliation	Stakeholder Group
Monroe Raber	Producer	Landowner
Neil Ledet	Indiana Department of Natural Resources	Environment
Jen Miller	St. Joseph County Conservation District	Government/Conservation
Leslie Raymer	LaGrange County Lakes Council	Lake Resident/Conservation
Rex Pranger	LaGrange County Surveyor	Government
Karen Mackowiak	St. Joseph River Basin Commission	Indiana State Government
Kevin Shide	LaGrange - Natural Resource Conservation Svc.	Government
Gary Heller	LaGrange County Commissioner	Government

Table 1.3: Stakeholder Concerns

Concerns	Relevance	Potential Problem
Livestock access to open water	It has been noted that livestock often have regular access to open water for drinking or to move between adjacent pastures	*E. coli* contamination, excess nutrients, erosion, sediment
Stormwater runoff from livestock operations	Stormwater will pick up pollutants from barnyards and pastures and carry them to open water if it is not properly contained or diverted from ditches, streams, rivers, and ponds	*E. coli* contamination, excess nutrients, and sediment
Increase in impervious surfaces	As the urban areas in the watershed expand, so does the impervious surfaces which increases stormwater runoff which can carry pollutants to open water	Oil and grease, Excess sediment, nutrients
Fertilizer used on urban lawns	As the urban centers and lakes in watershed expand so do the number of homes. Many homeowners are unaware of how to follow guidelines for lawn fertilizers and may over-apply fertilizer which has the potential to run over the land and into waterways	Excess nutrients and impaired biotic communities
Lakes in the area becoming more developed	Over fertilization of lawns around lakes in the area has been noted in the past. Also, as more homes are added the natural shoreline is often degraded, removed, or replaced with a seawall which may increase the chance for nutrients to reach open water and sediment from shoreline erosion.	Excess sediment, nutrients, impaired biotic communities, *E. coli*
Septic system discharge	Septic systems, if not properly maintained, can leak effluent into ground water or leach into surface waters. Many small lakes have concentrated residential areas still using septic systems.	Excess nutrients, sediment, *E. coli*
Lack of no-till and cover crop practices	Seed corn and other food crop field preparation does not include no-till or cover crop practices. In addition fall plowing that leave fields unprotected from erosion is a common practice throughout the drainage.	*E. coli* contamination, excess nutrients and sediments

Concerns	Relevance	Potential Problem
Wetland Conservation	Northeast Indiana has lost many of its historic wetlands which play a vital role in the ecosystem as they absorb floodwaters and pollution	Flooding, lack of wildlife and aquatic habitat, and impaired biotic communities
Stream Bank Erosion	An increase in surface runoff and stream channel modification can increase the potential for stream bank erosion	Sedimentation, turbidity, impaired biotic community
Sedimentation	Sedimentation of the surface water, especially within the Lake system is a concern expressed by stakeholders most anywhere surrounded by agricultural land. This concern has increased with the reduction of conservation tillage practices in the area over the past several years.	Sedimentation, turbidity, impaired biotic community

2.0 Physical Description of the Watershed

This Section will describe the Fawn River watershed in detail to provide a general understanding of the physical attributes of the area that led to its current landuse.

2.1 Watershed Location

A watershed is an area with defined boundaries such that all land and waterways drain into a particular point. Watersheds are given "addresses" called Hydrologic Unit Codes (HUC) that identify where they are located within the United States and into which point they drain. The largest HUC is two digits and defines a particular region. The more digits to a HUC the more specific the drainage area is. The Fawn River drainage is a 10 digit HUC (0405000108) located within the greater St. Joseph River – Lake Michigan watershed, an 8 digit HUC (04050001), shown in Figure 2. The Fawn River watershed is divided into nine, 12 digit HUCs; Snow Lake (040500010801), Tamarack Lake (040500010802), Lake James-Crooked Creek (040500010803), Town of Orland-Fawn River (040500010804), Himebaugh Drain–Fawn River (040500010805), Clear Lake-Fawn River (040500010806), Wegner Ditch-Fawn River (040500010807), Sherman Mill Creek (040500010808), and Fawn River Drain-Fawn River (040500010809). Each of the sub-watersheds will be discussed in detail in Section 3 of the WMP.

The Fawn River watershed, located in Steuben and LaGrange County, Indiana, and Branch and St. Joseph County, Michigan encompasses 165,361 acres of land including over 70 lakes. The Fawn River drainage begins in Steuben County, Indiana at Fish Lake north of the town of Fremont and flows northwest for a short distance before entering Branch County, Michigan where it encompasses several large lake systems. The drainage then turns south reentering Steuben County, Indiana where it encompasses many large and small lake systems north and northwest of the city of Angola. This portion of the river system involves the bulk of the county's largest lakes that are a significant economic base for the region. From this point the river flows west by northwest and enters LaGrange County, Indiana in the northeast corner and continues for a short distance before reentering Branch County, Michigan. The river flows west by northwest and enters St. Joseph County, Michigan southeast of the town of Sturgis where it turns southwest reentering LaGrange County, Indiana north of the town of Howe. This portion of the river encompasses many large and small lake systems in both Michigan Counties. The river flows west from Howe paralleling Interstate 80/90 to the northwest corner of LaGrange County, Indiana before turning north flowing into St. Joseph County, Michigan. The river drainage continues north encompassing several large and small lake systems before turning west where it empties into the St. Joseph River-Lake Michigan north of the town of Constantine, Michigan. The percent of the Fawn River watershed located within each of the four counties is depicted in Figure 2.1 and the Fawn River watershed is depicted in Figure 2.3.

Figure 2.1: Fawn River Watershed Percentage of Area per County

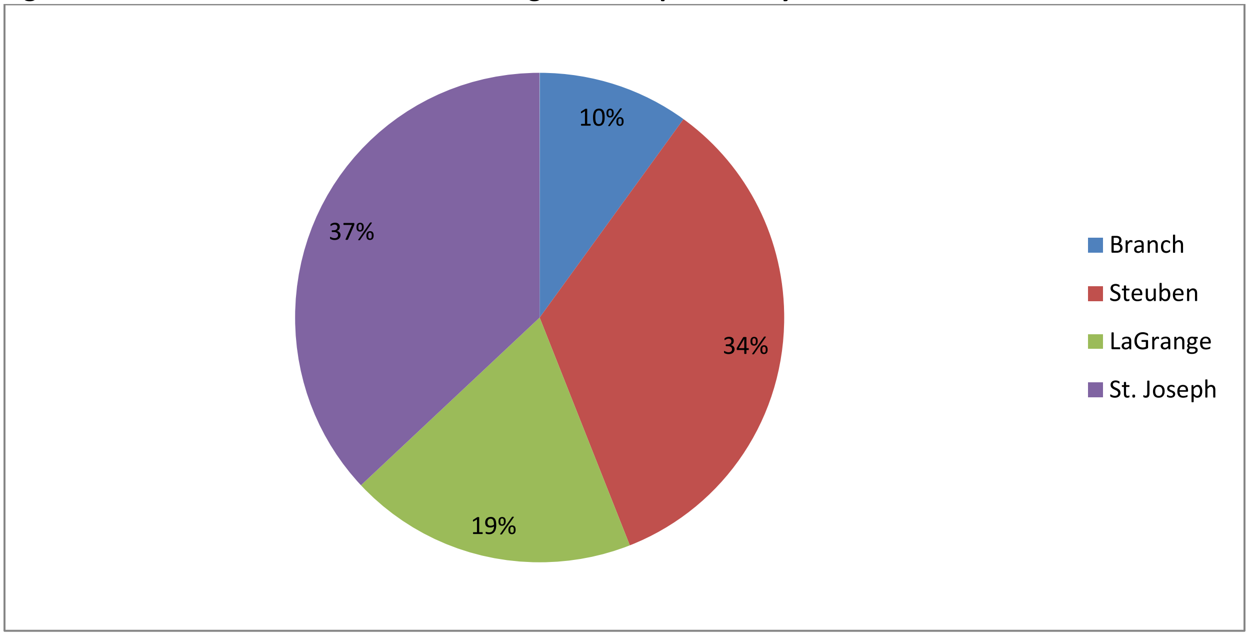


Figure 2.2: Fawn River Watershed Location

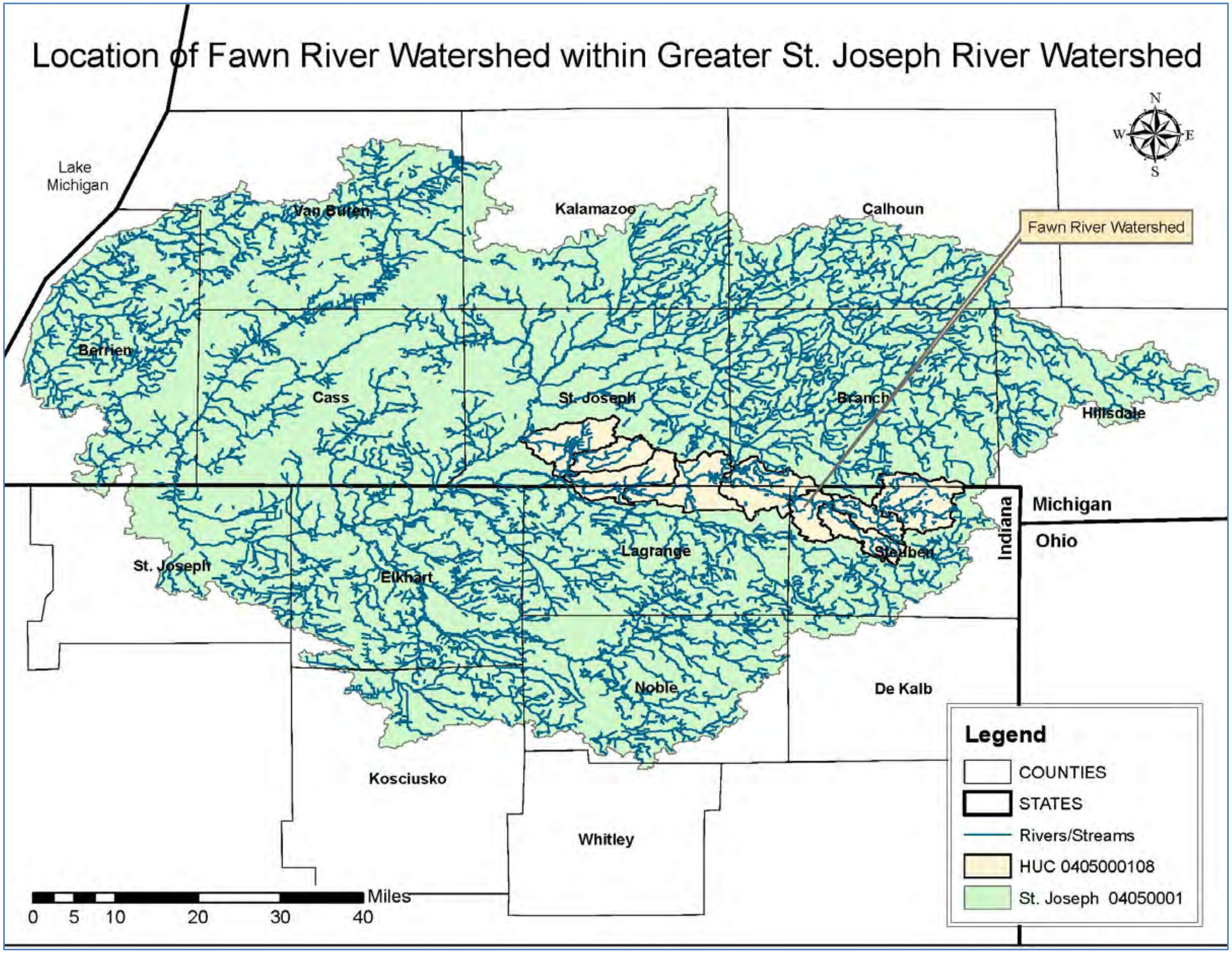
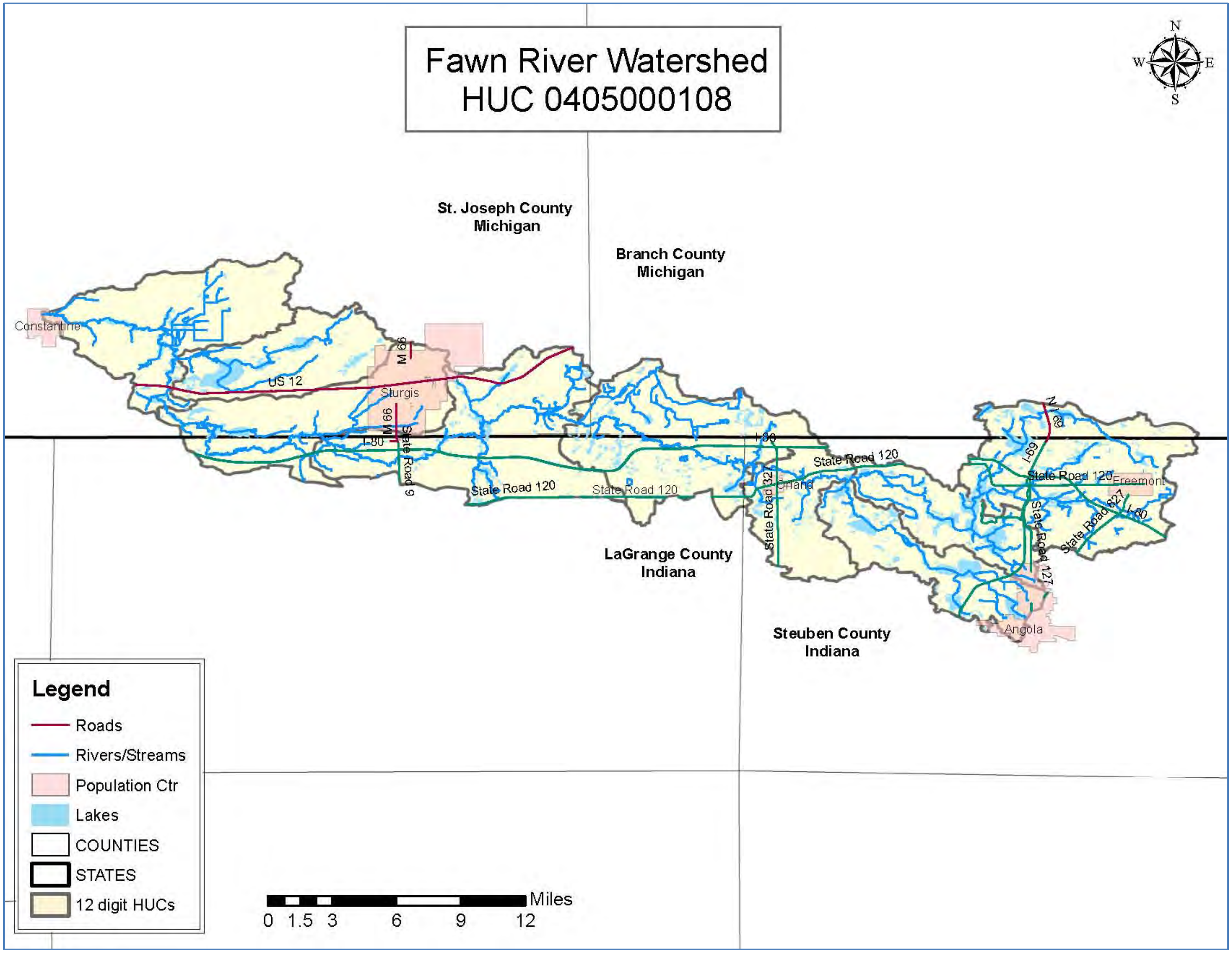


Figure 2.3: Fawn River Watershed



2.2 Geology, Topography, and Soils

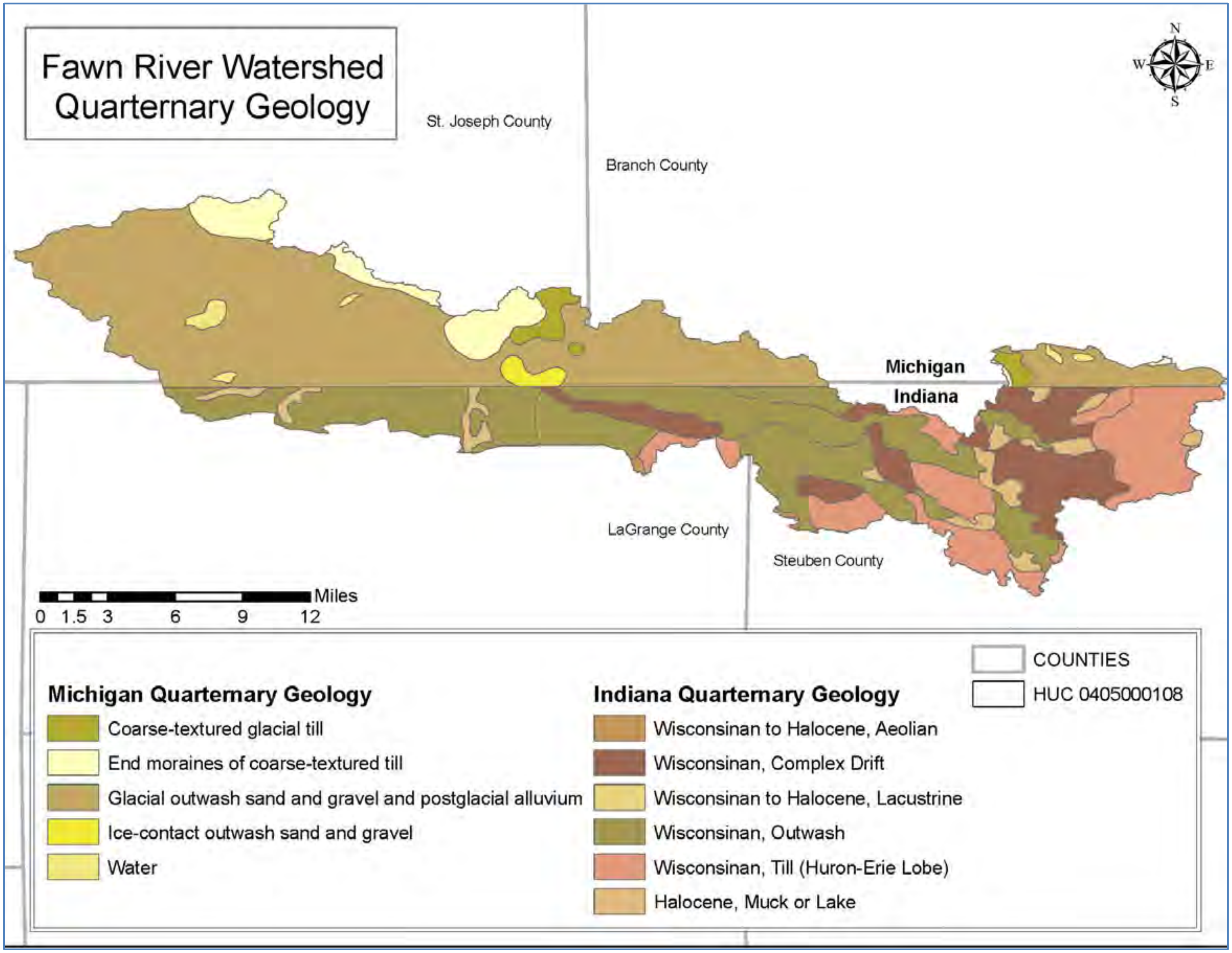
This Section describes the landscape of the area including the formation of the soils and topography present today, which makes the area a prime location for agriculture and the recreational destination it is.

2.2.1 Geology

The landscape of northern Indiana and southern Michigan is directly influenced by the last great glaciation which occurred over 10,000 years ago; the Lake Michigan Lobe of the Wisconsinan glaciation. The glaciers significantly changed the landscape of the project area, filling and damming rivers which created the present day Great Lakes. Prior to the glaciers sweeping over the land, the entire project area's landscape was comprised of rolling hills separated by broad valleys that were dominated by oak-hickory forests, and swamp and marsh lowlands. All of Indiana had the same characteristic rolling hills present in southern Indiana, as the limits of the Wisconsinan glaciation follows the line connecting Terre Haute, Edinburgh, and Richmond, Indiana. As the glaciers advanced and retreated, the massive structures flattened the land surface and wiped out whole forests. As the glaciers melted they formed the many kettle lakes that give northern Indiana and southern Michigan the nickname of "Lake Country". The melting glaciers also deposited rock, dirt and sand that they had picked up while traveling across the landscape. In the project area of northern Indiana and southern Michigan, where the glaciers melted relatively rapidly, glacial till ridges, called moraines, were left. However, the landscape is still much more level than pre-Wisconsinan times but presents a low hilly and rolling landscape.

The bedrock of the project area was deposited during the Mississippian Age, some 300 million years ago. The rocks deposited during the Mississippian Age are called the Borden Group and in the Fawn River watershed, consist primarily of shale and limestone in Indiana, and shale in Michigan. The type of bedrock present within the project area accounts for the ground water wells that supply drinking water to the population centers in the watershed including Sturgis, MI and Fremont and Angola, IN, as well as, the many wells that supply drinking water to the rural communities throughout the project area. The unconsolidated deposits, above the bedrock, are typically between 200 and 350 feet thick throughout the St. Joseph River – Lake Michigan watershed, however there are areas in extreme northeastern Steuben County with a thickness nearing 900 feet in thickness. The project area is covered in glaciofluvial material over the deeper clay deposits. The glaciofluvial material consists of mostly sand and gravel or loamy till and range in thickness from 5 to 25 feet in thickness. Figure 2.4 presents a map showing the geologic characteristics of the watershed.

Figure 2.4: Quarternary Geology of the Fawn River Watershed



2.2.2 Topography

The Fawn River watershed is located within the general physiographic province of the Central Lowlands, which can be broken down further to include the Southern Lower Peninsula Hills and Plains and Three River Lowlands physiographic regions in Michigan (Michigan State University), and the St. Joseph Drainageways and Warsaw Moraines and Drainageways in Indiana (IN DNR). The topography of the watershed is not drastically different from one end to the other with elevations ranging from 1070 feet above sea level at the headwaters to 800 feet above sea level where the Fawn outlets to the St. Joseph River. However, the landscape presents with low, rolling hills throughout the watershed with some flat plains between topographic peaks.

2.2.3 Soils

The project area is comprised of 15 general soil associations. Table 2.1 is a list of the soil associations present in the project area and a description of each association. Soil association descriptions were obtained from the Steuben, LaGrange, Branch, and St. Joseph county United States Department of Agriculture (USDA) soil surveys. The soil associations found throughout much of the Fawn River watershed are exceptionally productive soils, when properly drained and managed, which accounts for the heavy agriculture production present within the watershed. It should also be noted, that several of the soils associations in the watershed are ideal for wetlands, though many wetlands have been drained and converted to agriculture land.

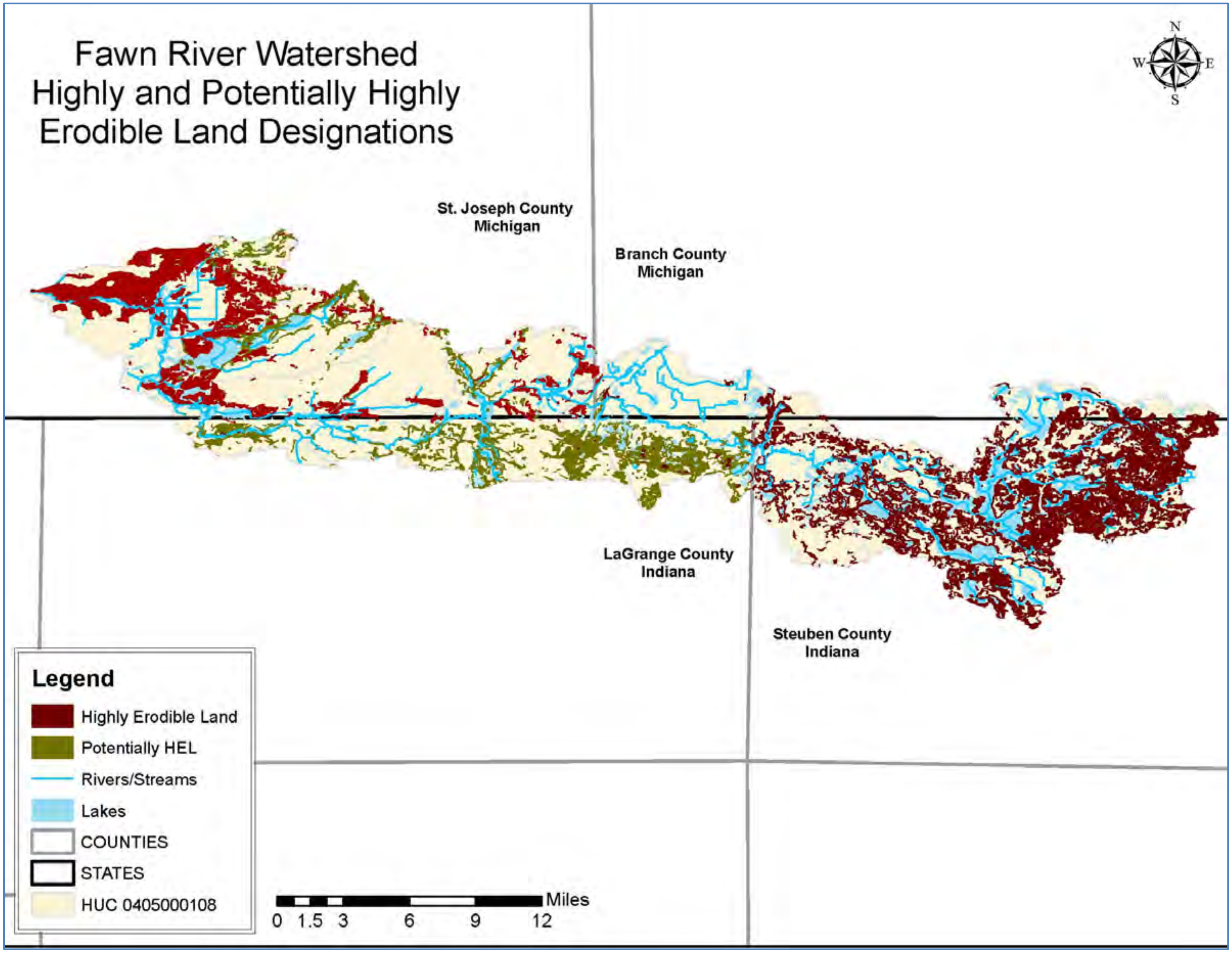
Table 2.1: General Soil Associations

County	Soil Association	Association Description
Steuben	Kosciusko-Ormas-Boyer	Nearly level to strongly sloping, well drained, loamy and sandy soils that are moderately deep or deep over sand and gravel; on outwash plains and moraines
	Riddles-Miami-Brookston	Deep, nearly level to moderately steep, well drained and very poorly drained, loamy soils on till plains
	Glynwood-Morely-Blount	Deep, nearly level to moderately steep, well drained to somewhat poorly drained, silty soils on till plains and moraines
	Houghton-Rensselaer-Milford	Deep, nearly level, very poorly drained, mucky, loamy, and silty soils in depressions on outwash plains and lake plains
LaGrange	Wawasee-Hillsdale-Conover	Nearly level to strongly sloping, well drained and somewhat poorly drained, moderately coarse textured and medium textured soils on till plains and moraines
	Boyer-Oshtemo	Nearly level to moderately steep, well drained, coarse textured soils on outwash plains, valley trains, moraines, and kames
	Shipshe-Parr	Nearly level to moderately sloping, well drained, moderately coarse textured and medium textured soils on outwash plains and till plains
	Houghton-Adrian	Nearly level, very poorly drained muck soils in depressional areas on outwash plains, till plains, and moraines

County	Soil Association	Association Description
Branch	Fox-Oshtemo-Ormas	Nearly level to moderately steep, well drained, loamy and sandy soils on outwash plains and moraines
	Fox-Houghton-Edwards	Nearly level to moderately sloping, well drained, loamy soils on outwash plains and moraines and level, very poorly drained, mucky soils in swamps, depressions, and drainageways
	Locke-Barry-Hillsdale	Level to moderately sloping, somewhat poorly drained, poorly drained, and well drained, loamy soils on till plains and moraines
St. Joseph	Adrian-Granby	Nearly level, very poorly drained and poorly drained mucky and loamy soils; in bogs and depressions and on outwash plains and lake plains
	Oshtemo-Spinks	Nearly level to gently rolling, well drained loamy and sandy soils; on outwash plains and moraines
	Hillsdale-Elmdale	Nearly level to gently rolling, well drained and moderately well drained loamy soils; on till plains and moraines
	Elston	Nearly level, well drained loamy soils; on outwash plains

The Fawn River steering committee and stakeholders expressed concern about soil erosion and sedimentation of streams, rivers, and lakes. The erosion issues present in the watershed may be due to unsustainable farming practices on land that is considered to be highly or potentially highly erodible. The Natural Resource Conservation Service (NRCS) maintains a database of highly erodible (HEL), potentially highly erodible land (PHEL), and hydric soils for each county. The soils that have been determined to be highly erodible are so designated by dividing their average rate of erosion by the soil loss tolerance, which is the maximum amount of soil loss that can occur before a long term reduction in productivity will be seen. Soils are determined potentially highly erodible based on the slope and length of the slope. The presence of HEL and PHEL in farmland can contribute significantly to nonpoint source pollution (NPS) by increasing the amount of sediment carrying other pollutants such as, nutrients and pesticides, to open water. Slightly over 26% of the soils present within the Fawn River watershed are considered to be HEL (20.17%) or PHEL (6.05%). Figure 2.5 is a map of the project area showing the location of HEL and PHEL in the watershed.

Figure 2.5: Highly and Potentially Highly Erodible Soil

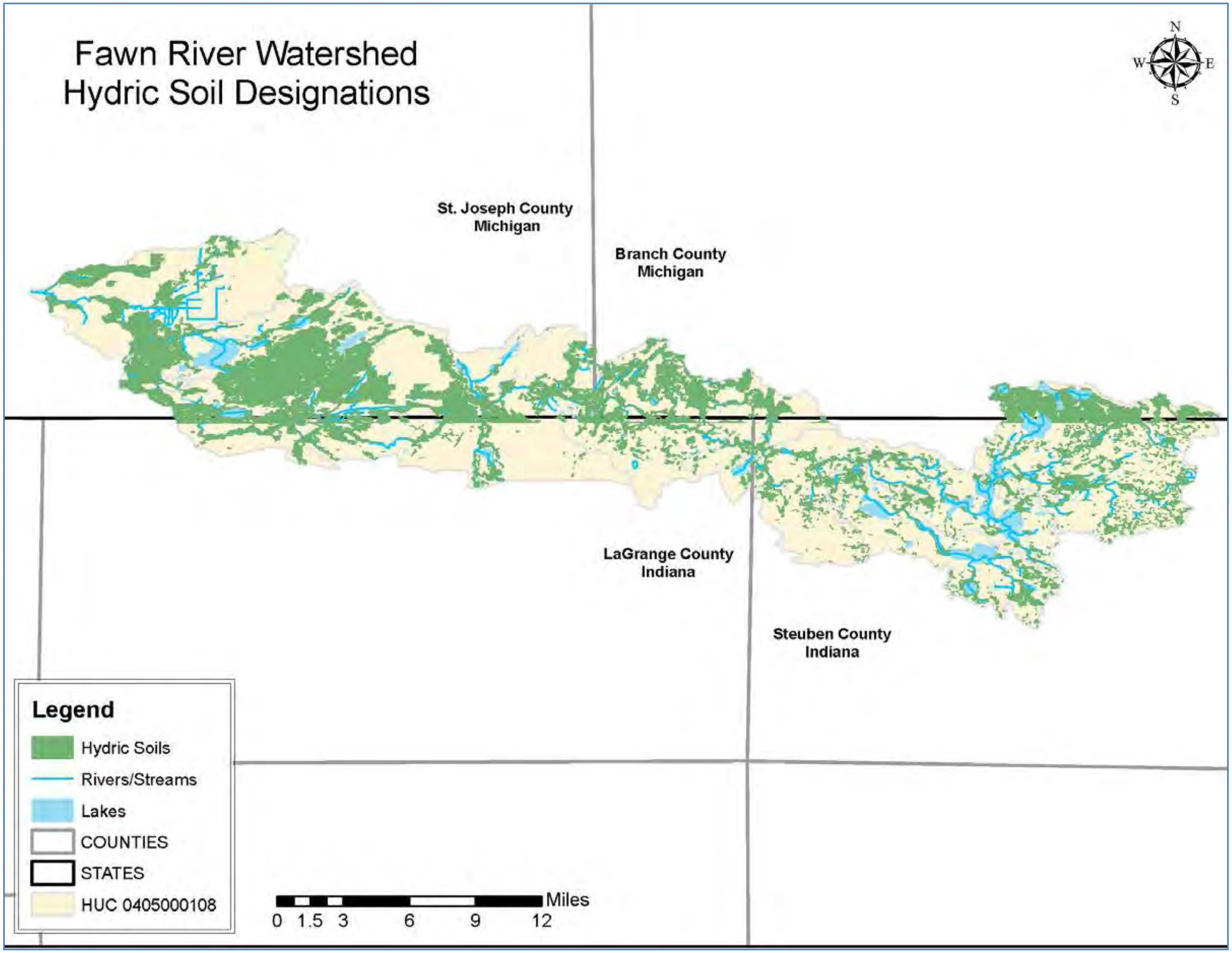


Hydric soils are present where wetlands are, or were. Several soils present within the project area are classified by the local NRCS as hydric as can be seen in Figure 2.6. The NRCS is in the process of standardizing soil classifications throughout the country; however Indiana and Michigan currently classify their soils differently. MI classifies all their major soil types as either hydric or not hydric while IN classifies their soils as hydric based on the dominant soil type and its associations. Hydric soils can pose threats to surface water when farmed due to excessive runoff of fertilizers, pesticides, and manure. Farmland located on hydric soils often requires the installation of field tiles to keep the fields from flooding or ponding. Field tiles can provide a direct conduit for water polluted with fertilizer, land applied manure, and sediment to reach surface waters. Hydric soils are also not suitable soils for septic usage as they do not allow for proper filtration of the septic leachate and may result in surface and/or groundwater contamination. Soils that are considered hydric are so classified for several reasons. The following explanation of hydric soils was taken from the NRCS, Field Office Technical Guide.

1) All Histols except for Folistels, and Histosols except for Folists.
2) Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that.
    a) Are somewhat poorly drained and have a water table at the surface (0.0 feet) during the growing season, or
    b) Are poorly drained or very poorly drained and have either:
        i) Water table at the surface (0.0 feet) during the growing season if textures are coarse sand, sand, or fine sand in all layers within a depth of 20 inches, or
        ii) Water table at a depth of 0.5 feet or less during the growing season if permeability is equal to or greater than 6.0 in/hr in all layers within a depth of 20 inches, or
        iii) Water table at a depth of 1.0 foot or less during the growing season if permeability is less than 6.0 in/hr in any layer within a depth of 20 inches.
    c) Soils that are frequently ponded for long/very long duration at the growing season.
    d) Soils that are frequesntly flooded for long/very long duration at the growing season.

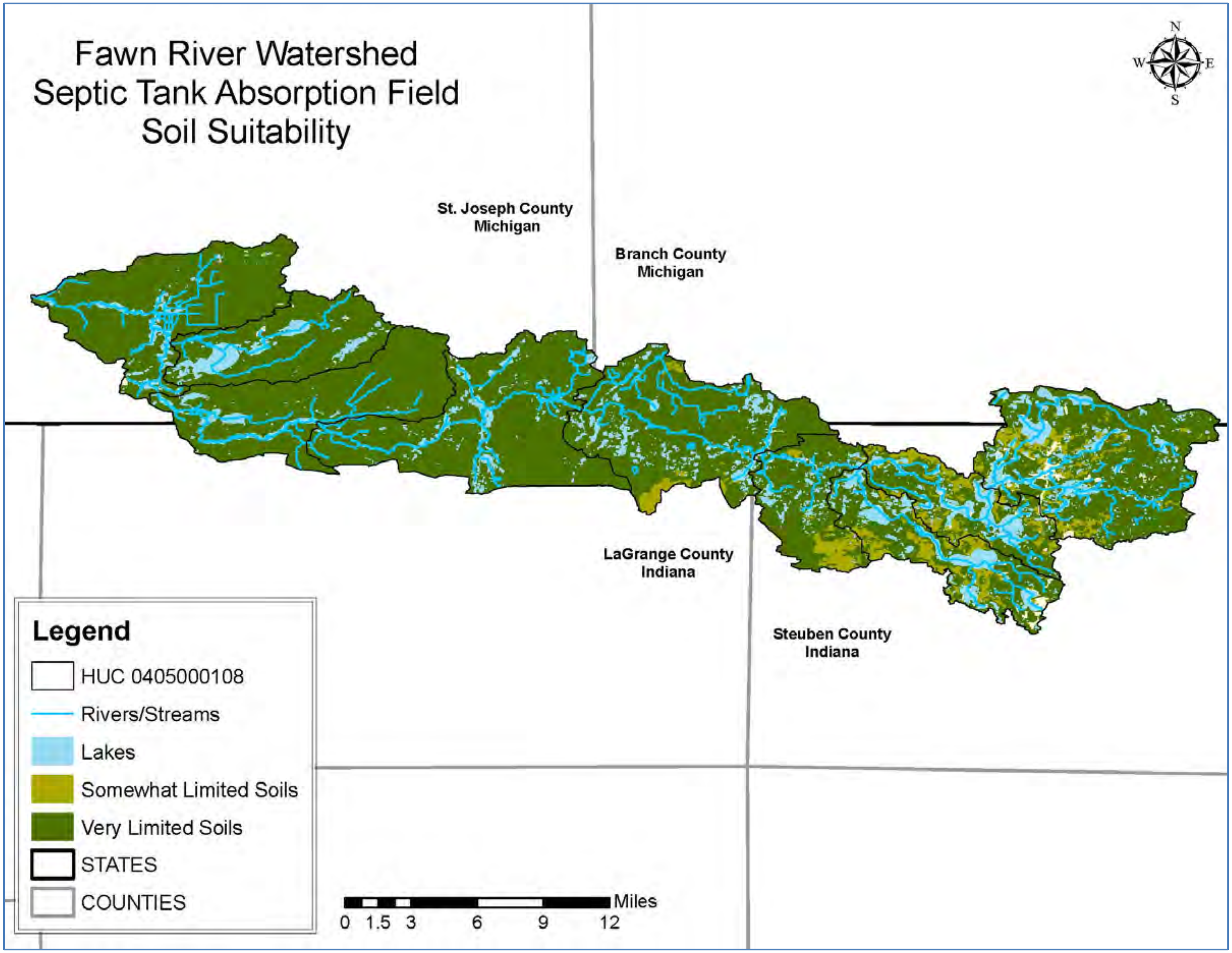
Hydric soils, while posing a significant problem when farmed, also are quite beneficial as they are prime locations to create or restore wetlands, which is a concern for the Fawn River steering committee and stakeholders. The Fawn River watershed is located where the many historic swamps once existed which were drained and converted to prime farmland in the late 19^{th} century which may account for the presence of hydric soils as over 27.46% of the soil in the watershed is classified as hydric. Wetlands are great resources as they supply many ecological benefits and could help prevent polluted runoff from reaching open water.

Figure 2.6: Hydric Soils



Soil type is important to consider when installing an onsite sewage disposal system as traditional septic tanks utilize the soil to absorb effluent discharged from the tank into absorption fields. Septic tank absorption fields are subsurface systems of French drains that distribute septic liquid waste evenly throughout the designated area and into the natural soil. Soil properties and landscape features that affect the ability of the soil to properly absorb and filter the effluent should be considered when designing a septic system. Most of the rural population within the Fawn River project area uses septic systems to process their wastewater, as do several lake populations in the area. All incorporated population centers utilize a centralized sewer system to handle household effluent. The Fawn River steering committee expressed concern regarding failing on-site waste disposal systems and since the majority of the watershed is rural and using on-site waste disposal, it is important to note that most of the soils (84.67%) located within the project area are rated as "very limited" for septic usage according to the NRCS. The NRCS has classified 6.8% of the soils as "somewhat limited" for the installation of an on-site sewage processing. Somewhat limited means that modifications can be made to either the site of septic installation or to the system itself to overcome any potential problems. A designation of "Very limited" means that modifications to the septic system site, or septic system itself, are either impractical or impossible. However, since less than 9% of the project area can safely handle a septic system (Figure 2.7), the ideal situation would be to not install any septic systems and revert to an above ground mound system, a constructed wetland to process wastewater, hook up to a centralized sewer system, or utilize another innovative means to safely process wastewater.

Figure 2.7: Soil Septic Suitability in the Fawn River Watershed



2.3 Climate

The climate in the project area is considered temperate with warm summers and cold winters. The warmest month of the year is July with an average high of 83°F and average low of 61°F. The coldest month of the year is January with an average high of 30°F and low of 16°F. There is an average of 38.5 inches of precipitation each year. Figure 2.8 graphically illustrates the average temperature range per month and Figure 2.9 illustrates the average precipitation per month within the project area.

Figure 2.8: Average Monthly Temperatures within Fawn River Watershed

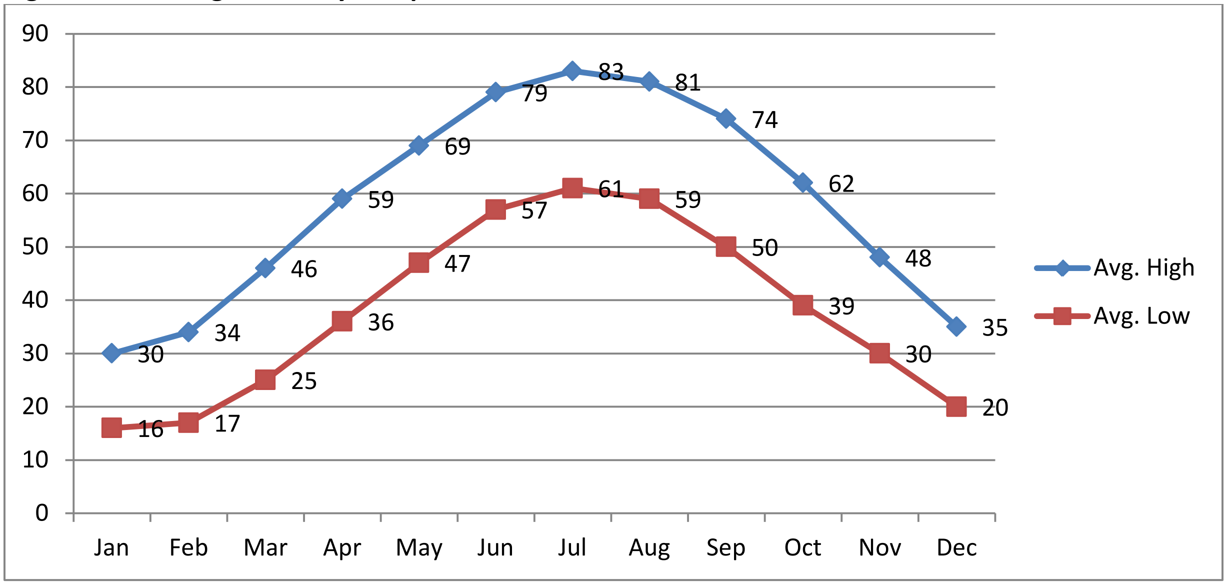
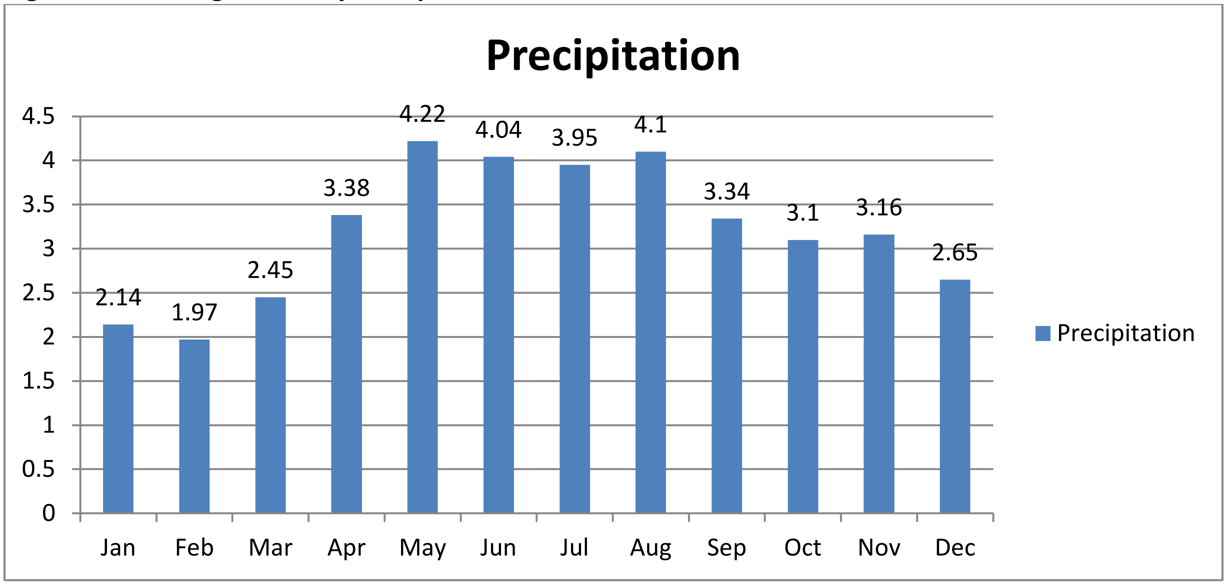


Figure 2.9: Average Monthly Precipitation within the Fawn River Watershed



2.4 Hydrology

There are 299.53 miles of streams, rivers, ditches, and canals located within the Fawn River Watershed according to the National Hydrography Dataset (NHD) which is released by the US Geological Survey (USGS). The Fawn River itself begins on the north edge of the town of Orland at the Indiana Department of Natural Resources (INDNR) Fawn River Fish Hatchery where Crooked Creek feeds into the hatchery and the Fawn exits the hatchery. The Fawn River measures 55.44 miles total between the hatchery and its confluence with the St. Joseph River – Lake Michigan. The Fawn River is listed by the Division of Recreation of the INDNR as "Outstanding" due to it being identified by the state natural heritage program, or similar program, as having outstanding ecological importance and because it is a state designated canoe route. Michigan does not have the Fawn River listed for any significance. Table 2.2 and Figure 2.10 represent the various types of flowing water in the Fawn River Watershed and a description of those various types is listed below.

- Stream/River – A body of flowing water.
- Artificial Path – A feature that represents flow through a two-dimensional feature, such as a lake or a double-banked stream.
- Connector Path – Establishes a known, but non-specific connection between two non-adjacent network segments that each has flow.
- Canal/Ditch – An artificial open waterway constructed to transport water, to irrigate or drain land, to connect two or more bodies of water, or to serve as a waterway for watercraft.

Table 2.2: Stream Miles in the Fawn River Watershed

Stream/River	Artificial Path	Connector Path	Canal/Ditch	Unit
143.36	113.45	0.04	42.68	Miles
230.71	182.57	0.07	68.69	Kilometers
			Total = 299.53	Miles

It should be noted that since the flowing water types are determined through aerial photography, that they may not be classified correctly. As will be discussed in Section 2.4.2, there are more maintained ditches located within the Fawn River watershed than is described in the NHD.

2.4.1 Lakes

There are over 2000 lakes located within the Fawn River Watershed, with 70 of those lakes having given names, most of which are also populated and are, or are becoming built-up. The sizes of the lakes vary from as small as less than a quarter of an acre to as large as 1,842 acres (the Lake James chain). The high number of lakes account for 16,792.54 acres (6,795.7 hectares) of surface area within the watershed. Figure 2.11 shows the location of the lakes within the Fawn River Watershed.

Figure 2.10: Rivers and Streams in the Fawn River Watershed

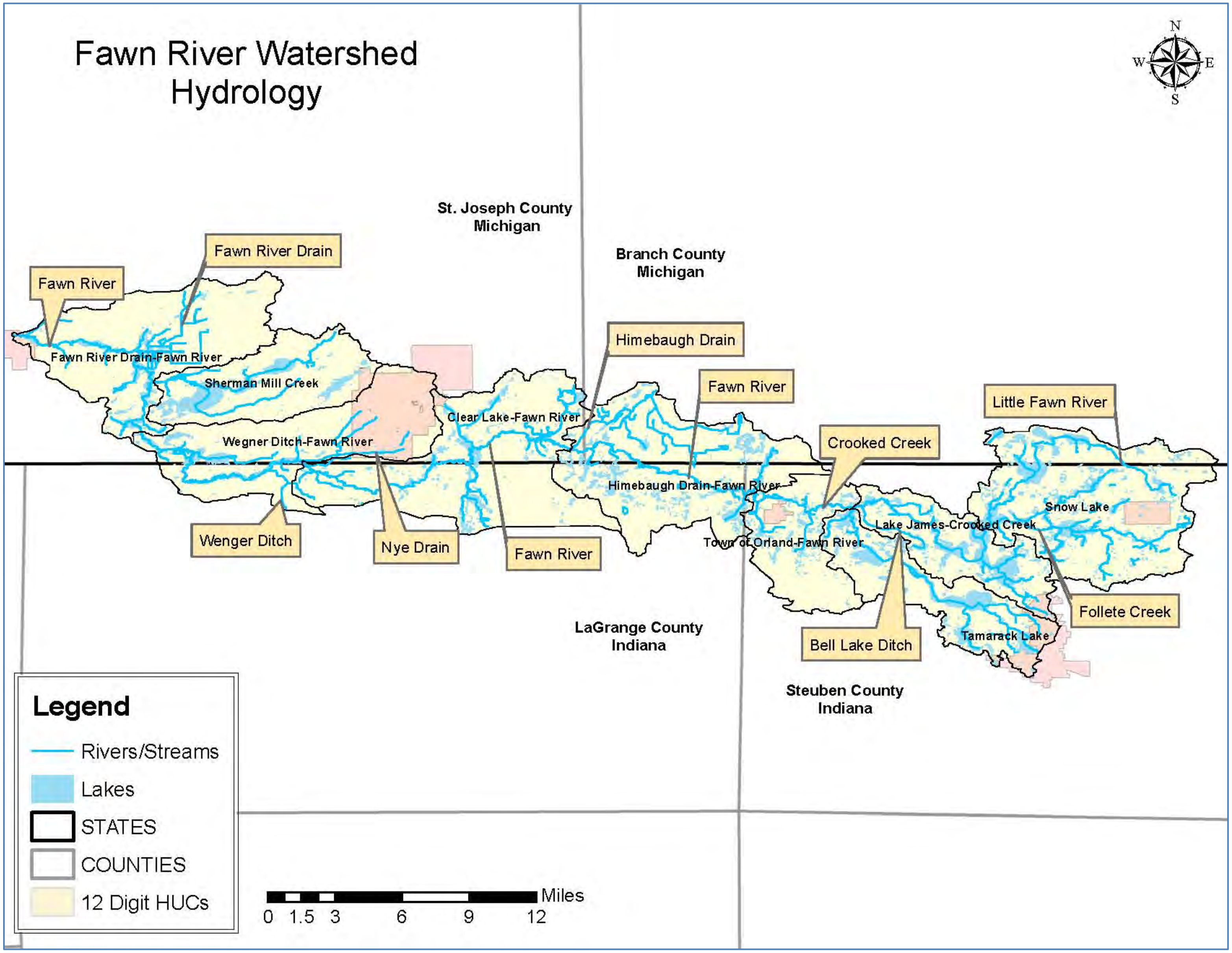
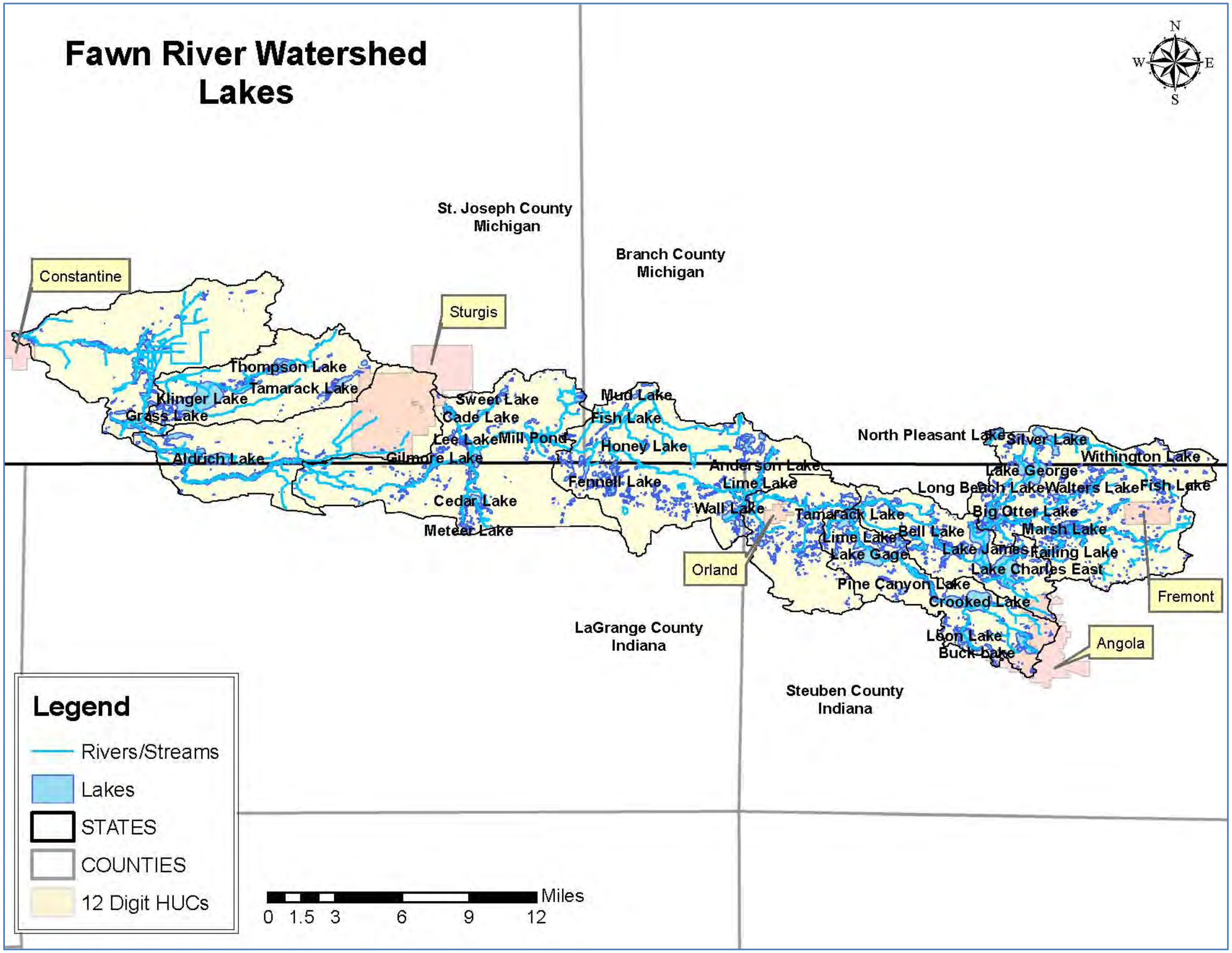


Figure 2.11: Lakes in the Fawn River Watershed



The lakes located in the Fawn River Watershed, specifically Steuben and LaGrange counties, are a major attraction to northeastern Indiana, bringing tourists in from around the tri-state area. Many residents of Fort Wayne, the second largest city in Indiana, have summer homes "at the lake" in northeast Indiana and it is estimated that the population of Angola nearly doubles during the warmer recreational months. Nearly all lakes of substantial size in the Fawn River Watershed are built-up now, and homes and businesses continue to be built in the area. Some struggles of this continues growth include the fact that the Regional Sewer Districts are struggling to ensure all new homes and facilities are hooked up to the centralized sewer system and the shorelines of the lakes are being turned into hardscapes which disrupts the natural aquatic ecosystem.

2.4.2 Legal Drains

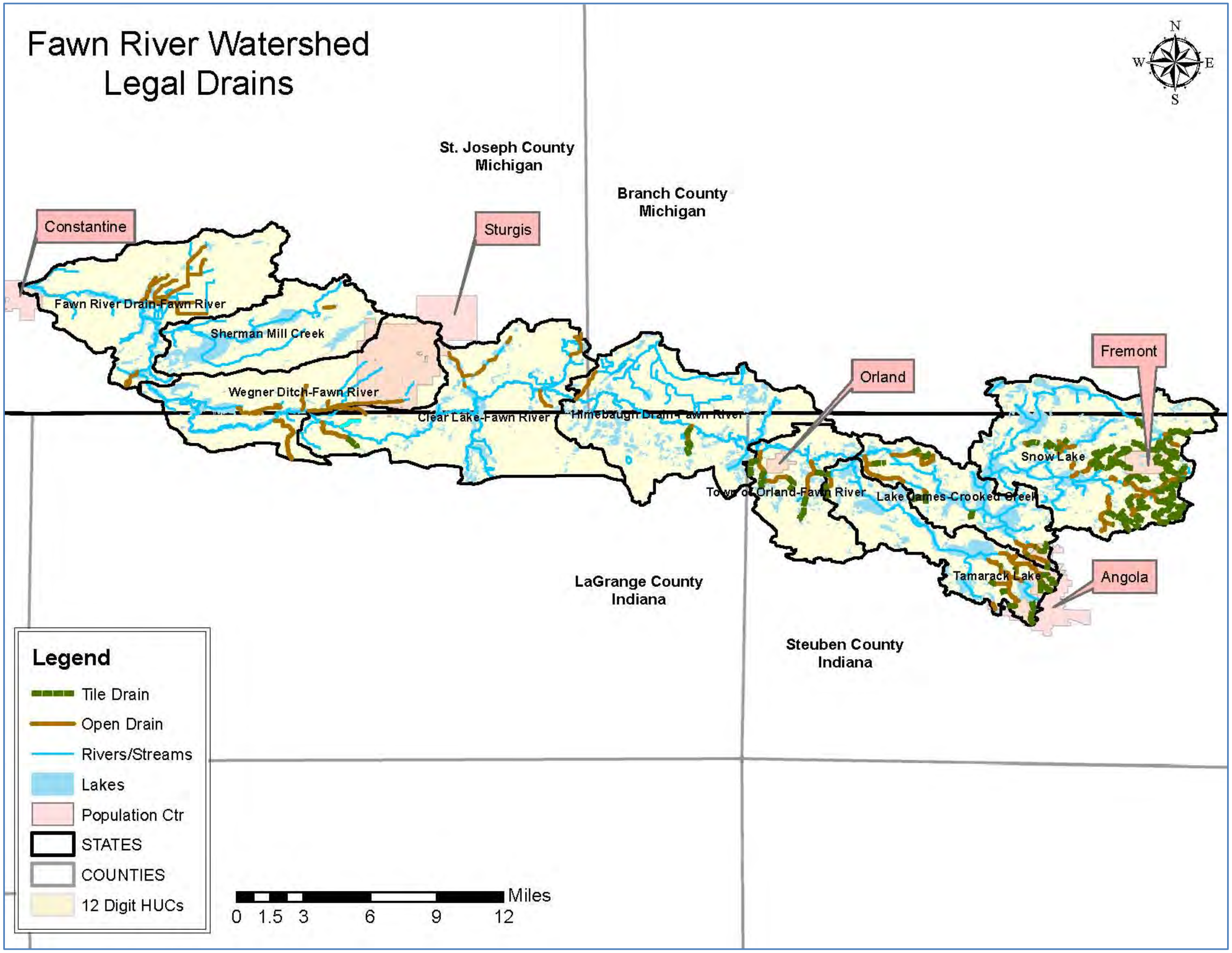
The natural streams, as well as legal drains, within the project area are used as a means to carry excess water from the land so that it may be used for agriculture, commerce, industry, and many other uses. However, due to flooding or ponding issues, many of the tributaries have been channelized to increase the velocity of water flowing downstream and decrease the risk of ponding and flooding. As can be seen in the Figure 2.10, above, many tributaries, specifically those located in St. Joseph County, have been channelized and straightened to aid in the draining of those heavily farmed areas.

Local drainage boards and County Surveyors are charged with maintaining many of the streams and ditches so that they may continue to function properly for their designed use. These maintained waterways are often referred to as legal drains. There are approximately 61.86 miles of legal surface drains and 44.18 miles of legal tile drains maintained by the county government within the Fawn River Watershed. St. Joseph County does not maintain records on any tile drains throughout the entire county, though they do assist with maintenance of tile drains, and Branch County does not have any regulated drains located within the project area. LaGrange County does not presently have the legal drains digitized, so paper maps were provided by the LaGrange County Surveyor Office and the drains were digitized by SNRT, Inc from the paper maps. Therefore, the total miles of legal drains located within LaGrange County may not be accurate. Table 2.3 provides a breakdown of legal drain miles within the project area for each county and Figure 2.12 shows the location of the legal drains.

Table 2.3: Legal Drains by County in the Fawn River Watershed

County	Steuben	LaGrange	St. Joseph	Branch	Total
Miles Open Drain	28.72	4.76	28.38	0	61.86
Miles Tiled Drain	42.33	1.85	0	0	44.18

Figure 2.12: Legal Drains in the Fawn River Watershed



2.4.3 Wetlands

Wetlands play an integral role in our lives. Wetlands are important habitat to many species of plants and animals, some of which are on the endangered species list. They provide recreational areas for wildlife and bird watching, fishing, and many other recreational past-times. Wetlands also help to lessen the impact of flooding and act as pollution sinks to absorb many pollutants prior to being released to open water. However, there are few wetlands still present in the Fawn River watershed compared to pre-settlement time. It was estimated by Friends of the St. Joseph River Association – Wetland Partnership, that the Fawn River Watershed has lost 39% of the wetlands present before settlement of the area. There are currently 26,798.56 acres of wetlands in the Fawn River watershed according to the National Wetland Inventory (NWI) which is based on 1979 data. The wetland land cover according to the NWI accounts for approximately 16% of the watershed area. The loss of wetlands has increased flooding and drought damage, as well as initiated the major decline in fish, bird, and wildlife species in the watershed.

There are several types of wetlands each providing different degrees of eco-services. The approximate area containing each type of wetland is outlined in Table 2.4 and described below.

- Freshwater Emergent Wetland – Palustrine; Herbaceous marsh, fen, swale, and wet meadow.
- Freshwater Forested/Shrub Wetland – Palustrine; Forested swamp or wetland shrub bog
- Freshwater Pond – Palustrine unconsolidated bottom or aquatic bed; pond
- Lake – Lacustrine wetland and deepwater; Lake or reservoir basin
- Riverine – Riverine wetland and deepwater; River or stream channel

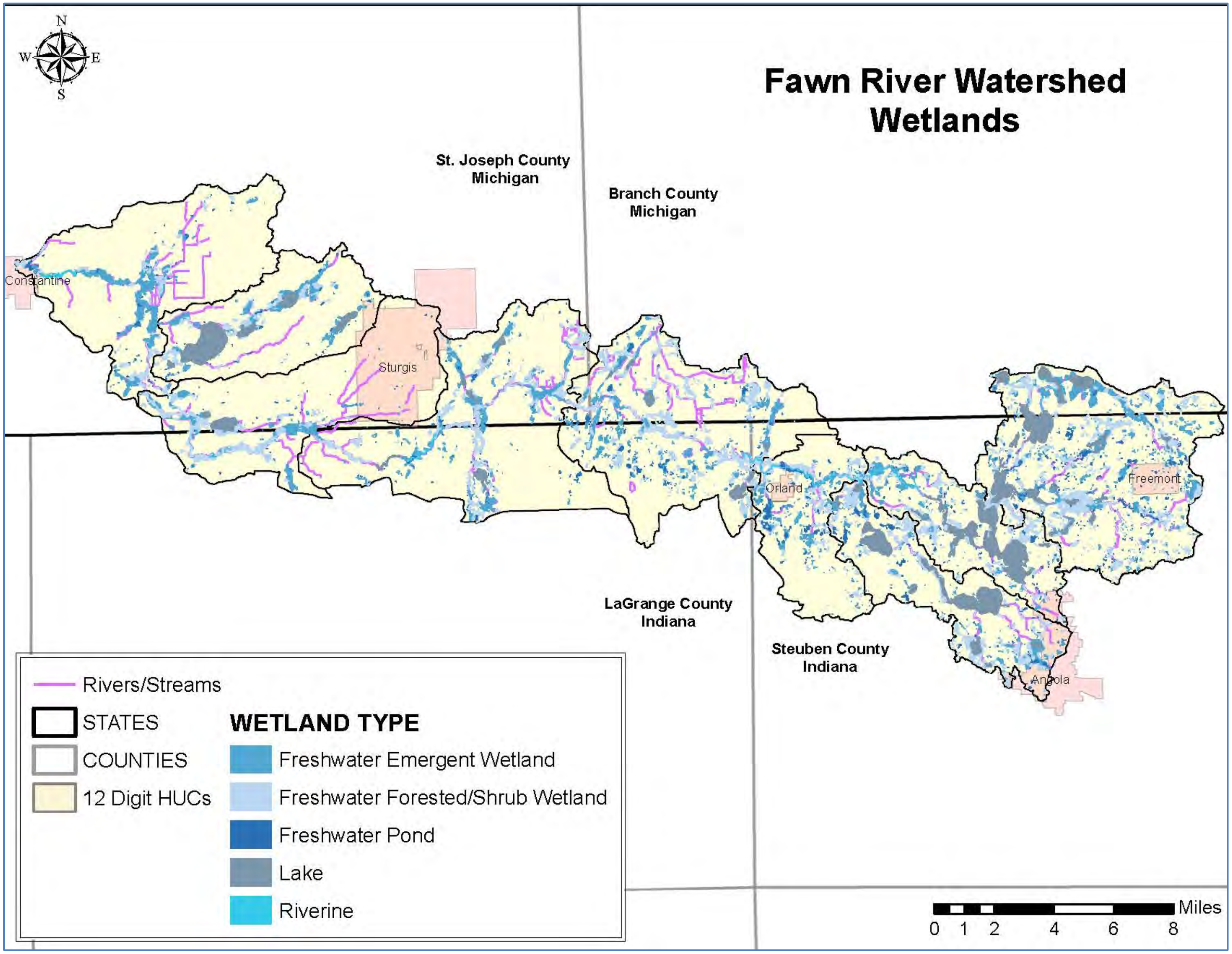
Table 2.4: Wetland Classification within the Fawn River Watershed

Wetland Type	Emergent	Forested/Shrub	Pond	Lake	Riverine
Acres	7487.75	9868.48	1440.34	7742.24	259.75
					Total = 26,798.56

It should be noted that an update to the 1979 NWI has been completed though it has not been made available to the public at this time. Matt Meersman of the Friends of the St. Joseph River Association was a part of a project involving the Michigan Department of Environmental Quality (MDEQ) that looked at the functional use of each wetland present in 2005, as well as that of pre-settlement wetlands to evaluate the functional use loss of wetlands in the entire St. Joseph River – Lake Michigan Watershed. That data has been supplied to this project by Matt Meersman. According to the wetland functional use study, the Fawn River watershed has lost 40% of its floodwater functional use, 36% of shoreline stabilization functional use, and a combined water quality functional use loss of 36% and habitat loss of 44%. It was also estimated that the Fawn River watershed has lost 61% of the ability to retain pathogens. These results suggest that the 39% loss in overall wetlands has had a greater impact on the quality of various aspects of the watershed. The wetland inventory conducted in 2005 shows approximately 616 acres of wetland has been lost between 1979 and 2005 (currently estimated at 26,182.4 acres) and nearly 11,000 acres of wetland has been lost since pre-settlement times. The publicly available, National Wetland Inventory, data was used for the analysis of acres per wetland type here to keep consistent with other published data, studies, and reports. However, the wetland functional use study, conducted by the Friends of the St. Joseph River Association – Wetland Partnership, will be used to evaluate wetland loss at the Sub-watershed level in Section 3.

Figure 2.13 shows where the wetlands within the Fawn River watershed have been delineated by the US Fish and Wildlife Service's, NWI. The wetlands in Figure 2.12 were not verified by a ground survey so should not be considered definitive wetland boundaries but rather estimates only.

Figure 2.13: Current Wetlands in the Fawn River Watershed



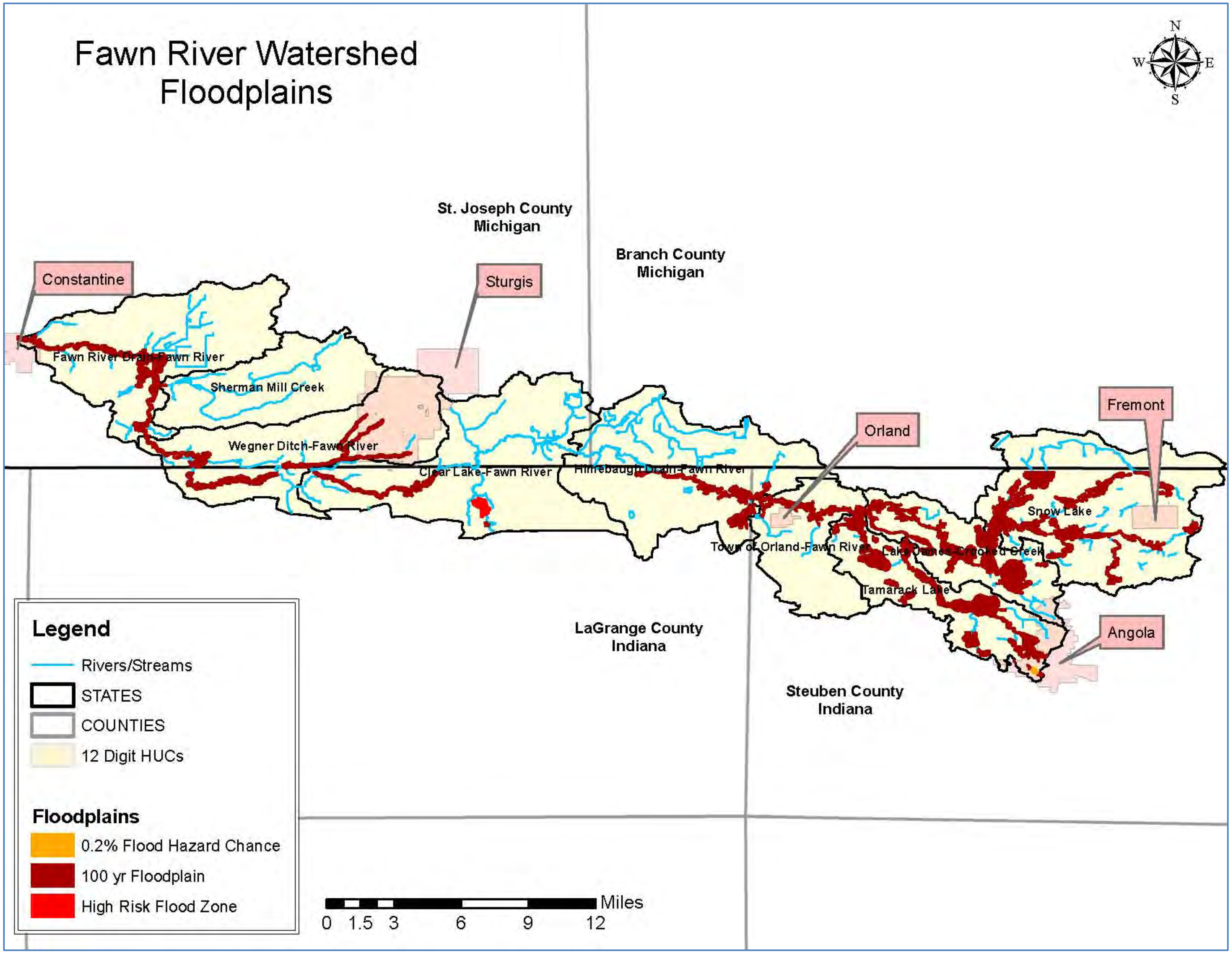
2.4.4 Floodplains and Levees

The Fawn River is not known to flood regularly largely because the river is fed by glacial lakes and is interconnected with a large aquifer system. However, flooding in general can be linked to economic hardship, water impairment, and the destruction of key wildlife habitat. There are three historic gage stations located within the Fawn River watershed, though none of them have been in use since the mid-1980s, the flood stage was set at 10 feet.

Floodplains are important to protect for environmental and economic reasons, as mentioned above. As was explained in Section 2.4.2, many open waterways in the Fawn River Watershed are under regular maintenance by the regulating offices in each county and as waterways are straightened and dredged, nature fights the banks to restore the natural sinuosity of the waterway and reestablish the streambank shelves to allow for floodwater to settle. Flooding can also be exacerbated by an increase in impervious surfaces such as those in and around Angola and Fremont, IN, and Sturgis, MI, as well as the many built-up lakes in the watershed. It should be noted that portions of Angola and Sturgis are located within the 100 year floodplain and are at risk of property and environmental damage from flooding according to the Federal Emergency Management Agency (FEMA). Imperviousness adds to the amount of water within the river, as well as the velocity and erosive power of the river. Indiana has made available floodplain maps to the public. Indiana agencies have designated Crooked Creek and much of the Fawn River, as well as most lake communities to be within a 100 year flood plain (approximately 9,505 acres) which means there is a 1% annual chance of the area becoming flooded. Indiana agencies have also deemed Cedar Lake, located in the Clear Lake – Fawn River sub-watershed, to be at high risk of flooding (approximately 149 acres) as well as approximately 13 acres located in Angola to be at a 0.2% risk of flooding. Michigan has only just begun to digitize their floodplain maps; therefore the entire watershed is not represented by flood risk maps in MI. The only portions of the watershed available for MI are located in St. Joseph County. A map showing the designated flood plains in the Fawn River is shown in Figure 2.14. Please note that GIS files are not available for MI and the flood risk areas on the map were digitized based on hard maps, and is an approximation only.

Due to the potential of flood damage to residences and businesses located within the floodplain, many areas will install levees as an urban flood protection measure. There are no levees located in the Fawn River watershed.

Figure 2.14: Floodplains Located within the Fawn River Watershed



2.4.5 Dams

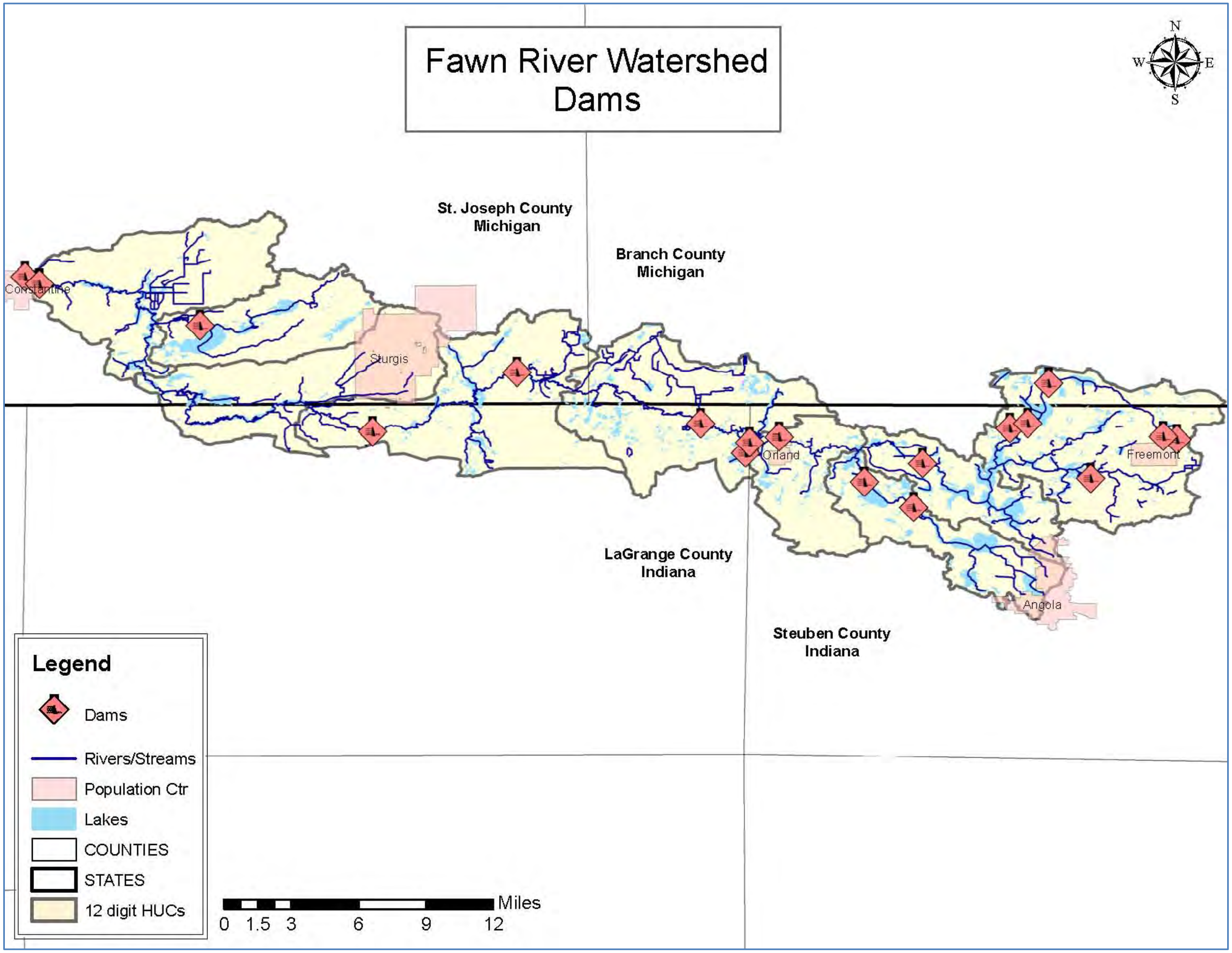
There are eleven dams located within the Fawn River Watershed. Five dams are located in St. Joseph County Michigan, and the remaining six dams are located in Steuben and LaGrange County, IN. Those dams are listed in Table 2.5, below. While dams can be beneficial to communities to supply recreational opportunities, drinking water reservoirs, hydroelectric power, and help control flood waters, they can also be detrimental to the natural hydrology and aquatic ecosystem. Some of the dangers of dams include blocking fish migration (discussed further in Section 2.6), slowing the natural flow of a river, altering the water temperature, decreasing oxygen levels, and causing silt, debris, and nutrients to collect in the waters behind the dam. Also, dams have an expected life span of about 50 years at which point their intended purpose may become compromised. A map of the dams and levees located within the project area can be seen in Figure 2.15.

Table 2.5: Dams Located in the Fawn River Watershed

Dam Name	Yr Completed	River Name	Pond Name	Pond Area	Sub-watershed
Fawn River Mill Dam	1830	Fawn River	Mill Pond	29.0	Fawn River Drain
Fawn River Power Company	1830	Fawn River	N/A	100.0	Clear Lake
Klinger Lake Level Control Structure	1969	Sherman Mill Creek	Klinger Lake	830.0	Sherman Mill Creek
Silver Lake Level Control Structure	N/A	Crooked Creek	Silver Lake	206.0	Snow Lake
Upper Constantine Dam	1948	Fawn River	N/A	90.0	Fawn River Drain
Minifenokee Lake Dam	1960	Unnamed Tributary	Lake Minfenokee	33.9	Snow Lake
Jimmerson Lake Dam	1945	Crooked Creek	Jimmerson Lake	305.3	Lake James
Fawn River Fishery Dam	N/A	Crooked Creek/ Fawn River	N/A	1.5	Town of Orland
Greenfield Mills Dam	1835	Fawn River	N/A	27.4	Himebaugh Drain
Long Beach Lake Dam	N/A	Little Fawn River	Long Beach Lake	16.6	Snow Lake
Lake George Dam	1927	Little Fawn River	Lake George	542.6	Snow Lake
Swaggers Plug Control Structure	N/A	Little Fawn River	Swaggers Lake	4.7	Snow Lake
Fish Lake Control Structure	N/A	Little Fawn River	Fish Lake	42	Snow Lake
Crooked Lake Control Structure	N/A	Carpenter Drain	Crooked Lake	785.3	Tamarack Lake
Lake Gage Control Structure	N/A	Carpenter Drain	Lake Gage	323.5	Tamarack Lake

Dam Name	Yr Completed	River Name	Pond Name	Pond Area	Sub-watershed
Mud Lake Control Structure	N/A	Unnamed Tributary	Mud Lake	37.6	Himebaugh Drain
Wall Lake Control Structure	N/A	Unnamed Tributary	Wall Lake	134.9	Himebaugh Drain
Star Mill Dam	1929	Fawn River	N/A	0	Clear Lake

Figure 2.15: Dams Located in the Fawn River Watershed



2.4.6 Drinking Water and Ground Water Resources

The Fawn River Watershed is located over three unconsolidated aquifer systems; the Howe Outwash Subsystem, Howe Outwash System, and Kendalville System. An unconsolidated aquifer means that the groundwater present within the Fawn River watershed is readily available for uptake and use to drinking and irrigation; however, it also means that the groundwater is more susceptible to contamination than consolidated aquifers. The thickness of the substrate over the aquifers varies from only 30 feet in depth at the southern edge of the Clear Lake sub-watershed, to 145 feet in depth throughout the majority of the rest of the watershed.

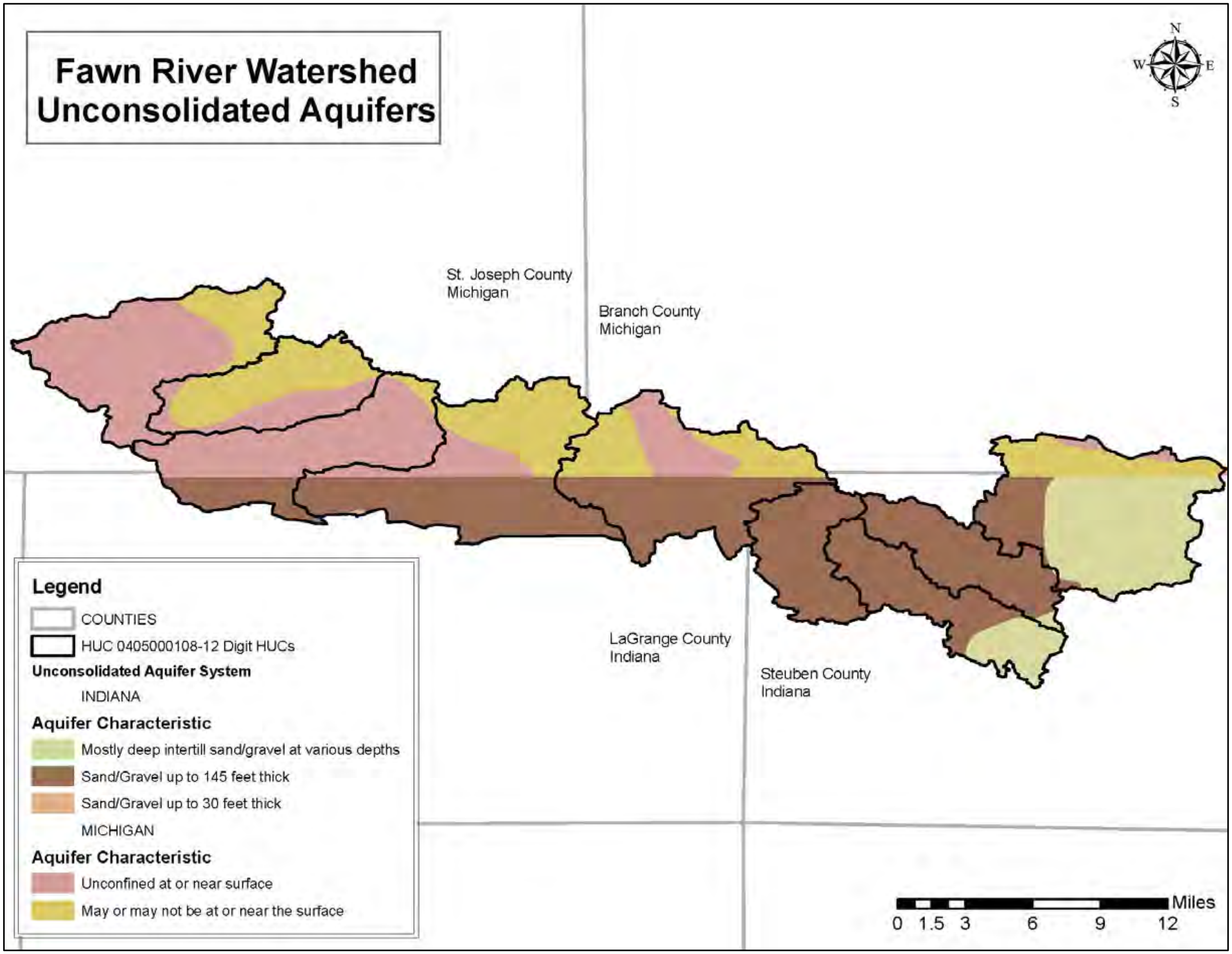
All residents in the watershed acquire their drinking water through wells. The incorporated areas of Fremont, Angola, Orland, Sturgis and Constantine supply drinking water to their residents through groundwater wells from one of the various aquifer systems located in the watershed and have some sort of protection plan in place to protect the groundwater from contamination, which will be discussed in Section 2.8. The other residents in the watershed have private water wells in which they obtain their drinking and irrigation water. The county health departments are responsible for the safety of the groundwater for private water wells and test the water before a new well can be installed. The wells are typically deemed inadequate for drinking if they test positive for the presence of fecal coliforms.

A survey of water withdrawals completed by the USGS in 2005 showed that Indiana and Michigan withdrew approximately 616 million gallons of water a day from ground water resources. Table 2.6 shows the total water withdrawals for Indiana and Michigan according to the 2005 USGS study. Figure 2.16 shows the aquifer system within the Fawn River watershed.

Table 2.6: Water Withdrawals in Indiana and Michigan (2005)

State	% of Population	Ground-water (Mgal/day)	Surface water (Mgal/day)	Total (Mgal/day)
Indiana	74	356	320	676
Michigan	71	260	883	1140
Total (Mgal/day)		616	1203	1816

Figure 2.16: Unconsolidated Aquifer System within the Fawn River Watershed



2.5 Land Use

Land use in the project area greatly influences the quality of the water resources. Land in agricultural production has the potential to erode, especially if over worked or if it is conventionally tilled annually. Thus soil particles carrying high levels of nutrients and pesticides have the potential to reach open water sources and effect aquatic plants and animals and cause the water to become non-potable. Livestock operations often can lead to high levels of bacteria in open water from manure storage areas that are not properly maintained or from livestock having direct access to open water sources. These two activities can also lead to high levels of sedimentation and nutrients in surface water. Industrial areas and urban centers can pose a threat to water quality due to the increased imperviousness of the landscape and industrial waste outfalls. For the reasons listed above, it is very important to investigate land use activities in the project area so as to determine the best method of remediating the pollution coming from the various land uses in the project area. Below is a general description of land uses in the project area. Section 3 of this WMP will provide an in depth look at the land use in the watershed by breaking it down to HUC 12 sub-watersheds.

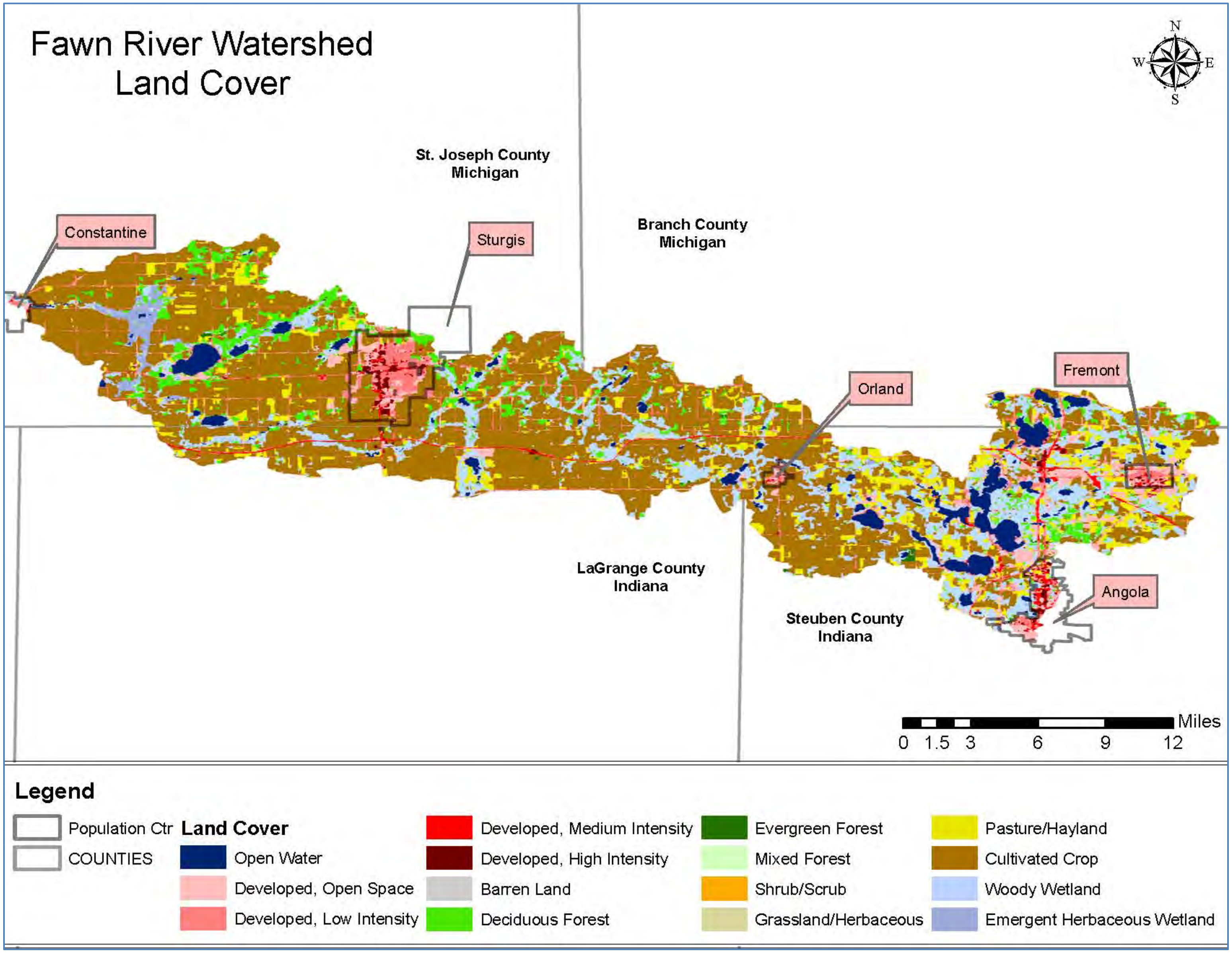
The predominant land use in the watershed is agriculture, specifically cultivated crops, as can be seen in Figure 2.17. It is important to note however, that wetlands take up nearly 16% of the land cover in the Fawn River watershed. There are few urban settings including Fremont, IN (Pop.=2,135), Orland, IN (Pop.=432), Sturgis, MI (Pop.=10,884), and part of Angola, IN (Pop.=8,591) and Constantine, MI (Pop.=2,057). Table 2.7 below shows the number of acres of land in each type of land use per state.

It should be noted here that while irrigation is used for row crops throughout the project area, it is predominately used in St. Joseph County. Jennifer Miller, Administrator for the St. Joseph County Soil and Water Conservation District, explained that St. Joseph County uses the most irrigation for agriculture between all the counties in the state of Michigan. The St. Joseph County Master Plan states that 44% of all crop land in the county is irrigated which accounts for 23% of all irrigated land in Michigan. Irrigation use must be monitored to ensure the aquifer system can support the amount of irrigation taking place, and that the use of irrigation does not promote soil and fertilizer runoff from fields to open water.

Table 2.7: Land Use/Land Cover in Fawn River Watershed

NLCD Land Use Designation	Acres	%
Open Water	9405.65	4.76%
Developed Open Space	11265.96	5.70%
Developed Low Intensity	8639.33	4.37%
Developed Medium Insensity	2436.08	1.23%
Developed High Intensity	1097.74	0.56%
Barren Land	241.39	0.12%
Deciduous Forest	13048.83	6.61%
Evergreen Forest	549.27	0.28%
Shrub/Scrub	68.62	0.03%
Mixed Forest	223.64	0.11%
Grassland Herbaceous	845.62	0.43%
Pasture Hayland	17197.4	8.71%
Row Crops	102,147.47	51.73%
Woody Wetland	27101.87	13.72%
Emergent Herbaceous Wetlands	3207.28	1.62%
Total	197,476.11	100.00%

Figure 2.17: Land Use/ Land Cover in Fawn River Watershed



2.5.1 Tillage Transect Data

Tillage transects are a method of data collection concerning the use of various tillage practices used within the agricultural community. They are typically performed to gage the adoption of various conservation tillage practices and to get an accurate count of crop acreage. The amount of land utilizing cover crops is often collected during tillage transects as well. Indiana counties typically perform tillage transects on a biennial basis due to the high percentage of agricultural land use in the State. Michigan counties do not regularly perform any farm field transect data and the State has not performed a tillage transect since 1993. Jerry Grigar, the MI NRCS State Agronomist, believes there are more beans and small grains in no-till currently than when the data was last collected. The St. Joseph County NRCS District Conservationist has not noted a change in tillage over the past several years; however the Branch County SWCD believes that no-till is on the rise in their county. Steuben County has been very successful at encouraging and implementing conservation tillage practices with 80% of all corn fields and 96% of all soybean fields being in some form of conservation tillage. However, LaGrange County has been more successful at implementing cover crops as a management technique. This may be due to the high number of Amish farmers located within LaGrange County who have a harder time implementing no-till due to equipment constraints. Table 2.8 shows the number of acres in conservation tillage in St. Joseph and Branch counties, and Table 2.9 shows the percentage of fields utilizing conservation tillage and those utilizing cover crops in Steuben and LaGrange counties.

Table 2.8: Tillage Transect Data for Michigan Counties in 1993

County	Year Data Collected	No-Till		Ridge Till (All fields)	Mulch Till (All fields)
		Corn	Soybeans		
St. Joseph	1993	20000	14000	430	41800
Branch	1993	10600	11750	330	21018

Acreage is conventional tillage is not available for MI counties.

Table 2.9: Tillage Transect and Cover Crop Data for Indiana Counties in 2013

Tillage Type	Crops	Steuben	LaGrange
No-Till	Corn	31%	31%
Strip Till		0%	0%
Ridge Till		0%	0%
Mulch Till		23%	7%
Reduced Till		26%	8%
Cover Crops		1%	7%
Conventional Tillage		20%	54%
No-Till	Beans	68%	63%
Strip Till		0%	0%
Ridge Till		0%	0%
Mulch Till		18%	4%
Reduced Till		10%	10%
Cover Crops		1%	12%
Conventional Tillage		4%	24%

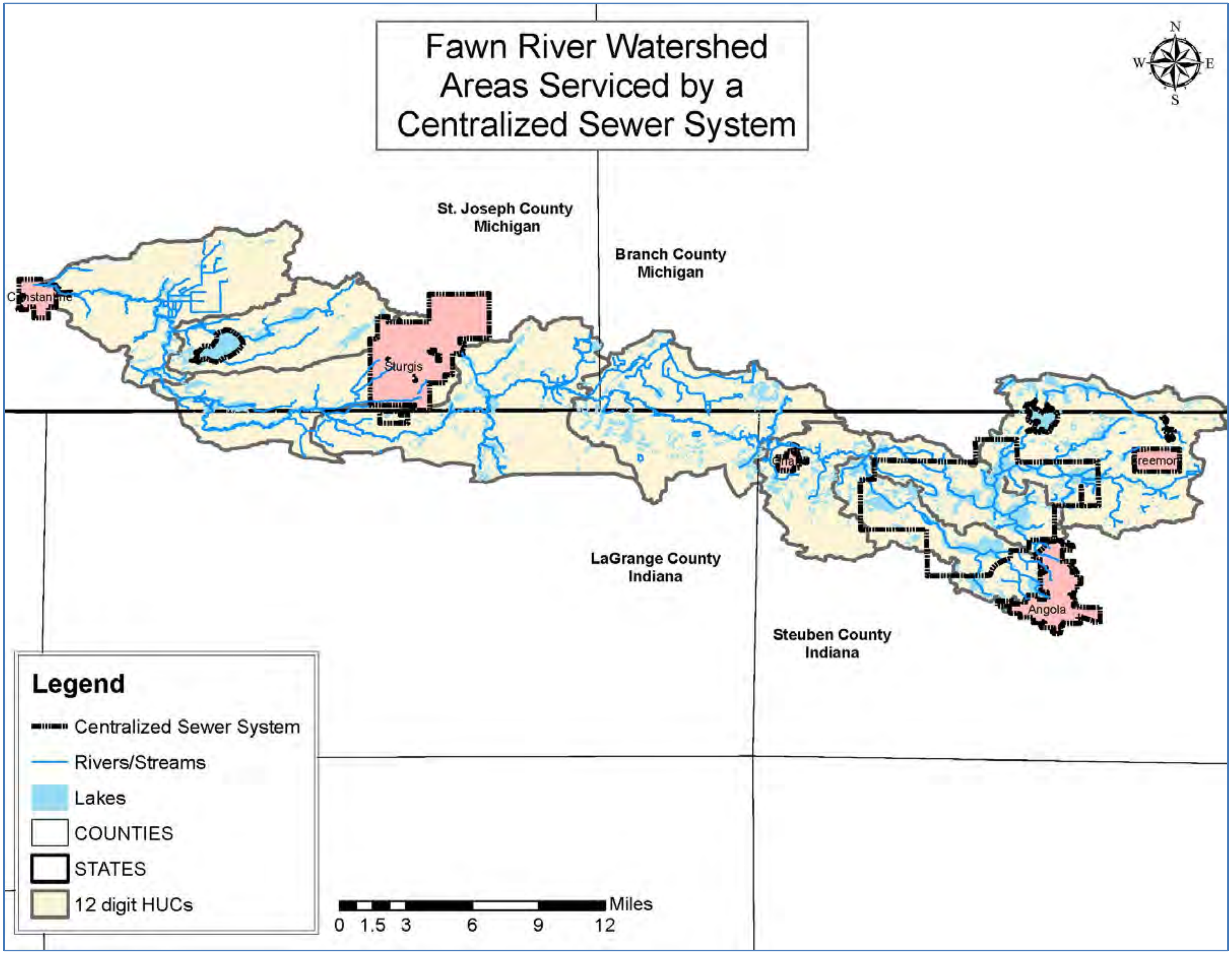
2.5.2 Septic System Usage

There are 10 populated areas that are served by a centralized sewer system. Most of the built-up lakes in the watershed are serviced by the Regional Sewer District with the exception of some homes along Lake George, Long Beach Lake, Barton Lake (both south west of Lake George), and Lime Lake which is located just northeast of Orland. The populated area of Waldon Woods, north of Lake Gage is also not serviced at this time. The Steuben Lakes Regional Waste District (SLRWD) is working to supply sewers to all the populated areas within the near future, including Snow Lake, Big Otter and Little Otter Lake, Lake Charles East and West. The SLRWD does currently supply sewers to some homes surrounding Lake Pleasant, and are in the planning process of running sewers to more of the Lake Pleasant homes. Also, all towns and cities located within the watershed are currently serviced by a sewer system. Figure 2.18 below, outlines all the areas where a centralized sewer system is currently being used. However, it is important to note that all rural areas located within the Fawn River watershed rely on on-site sewage disposal. It should also be noted that many of the smaller, built-up lakes are not currently serviced by a sewer system.

Much of the population in the Fawn River watershed currently relies on on-site waste disposal which can cause a contamination problem of surface and groundwater if the system is not properly installed and/or maintained. The number of failing or leaking septic systems is hard to estimate, as many of the systems are not on record with the local health departments. The county Health Departments located in the Fawn River Watershed were unable to provide an accurate estimate of leaking, failed or straight-piped septic systems for their counties. However, according to the US EPA, about 25% of households in the United States utilize on-site sewage disposal and anywhere from 1% - 5% of those systems are failing. Another study conducted by the National Environmental Service Center in 1992 and 1998 estimated that approximately 25% to 30% of on-site sewage treatment systems in Ohio, a similar landscape to that found in Indiana and Michigan, are failing. Though, due to the majority of the population in the Fawn River watershed being located within the rural community, it is expected that higher than 25% to 30% of the population within the watershed utilize on-site waste disposal systems. Septic system leachate may increase nutrient levels, as well as, fecal coliform, including the harmful *E. coli* bacteria, in both surface water and ground water, which is the sole source of drinking water within the project area.

It should also be noted that failing or leaking septic systems within the Fawn River Watershed are likely due to them being placed in areas where the soil in deemed as not suitable for a septic system. The soil located within the project area is predominantly sandy and/or gravelly which allows for rapid permeation of septic effluent.

Figure 2.18: Communities Served by a Centralized Sewer System



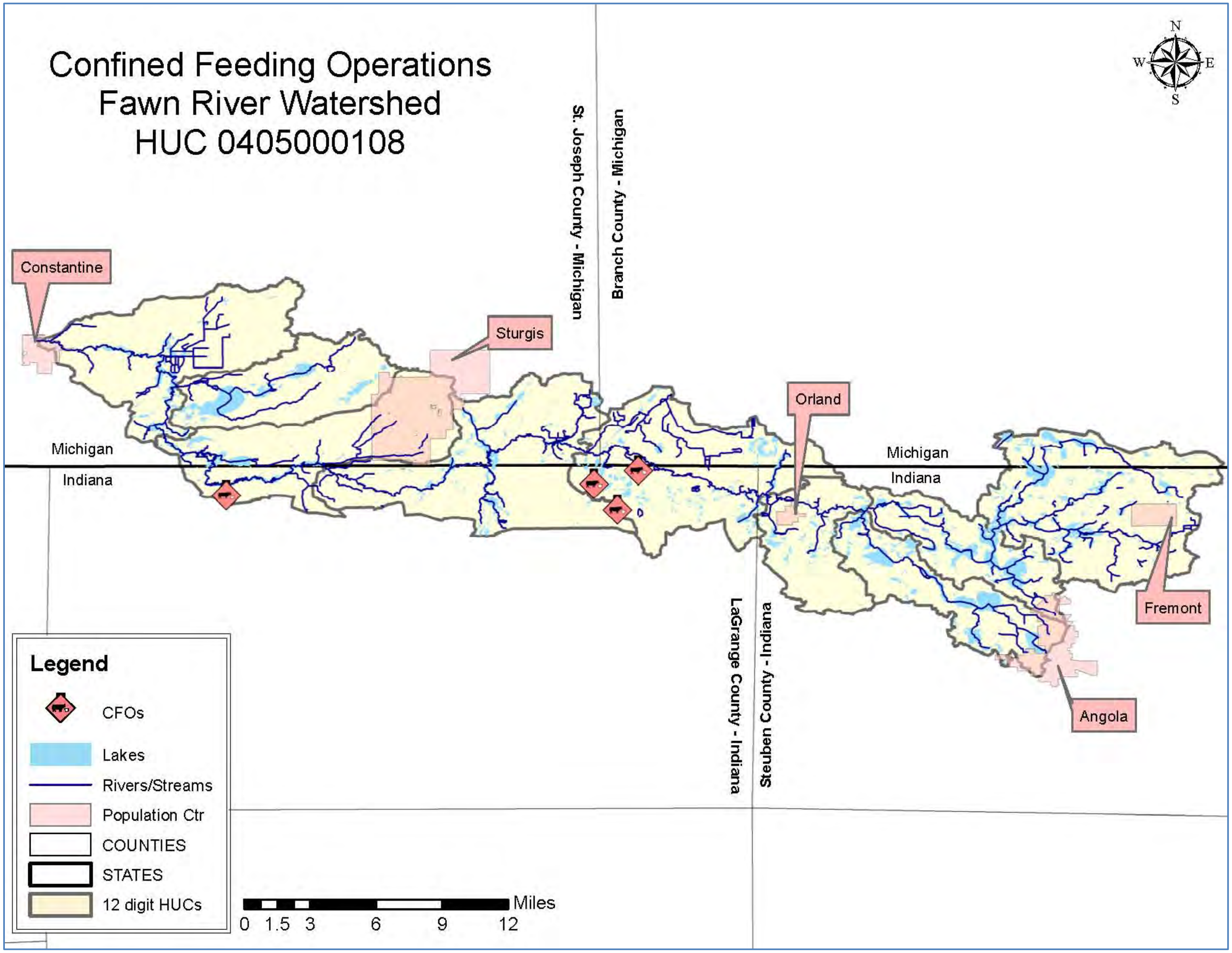
2.5.3 Confined Feeding Operations

Stakeholders voiced concern about stormwater runoff from livestock operations located within the project area as they can present a significant pollution problem if animal waste is not properly managed, such as proper storage of the manure and application of the manure as fertilizer on crop fields. There are four permitted confined feeding operations (CFOs) located within the project area; one in Wegner Ditch and three in Himebaugh Drain sub-watershed, all in Indiana. The four CFOs have a combined animal count of nearly 250,000. A confined feeding operation is so designated if there are 300 cattle, 500 horses, 600 swine or sheep, or 30,000 fowl present on the property and confined for at least 45 days during the year where there is no ground cover or vegetation present over at least half of the animals' confinement area. If the size of the operation is very large, or there have been compliance issues with an operation in the past, the CFO may be designated as a Concentrated Animal Feeding Operation (CAFO), and will be required to obtain a National Pollution Discharge Elimination System (NPDES) permit. The Steering Committee voiced concern regarding animal feeding operations, both regulated and non-regulated facilities. There are several smaller livestock operations located within the project area. Though, most are not located directly adjacent to a stream and therefore, were not inventoried during the WMP planning process. Those that were identified as a potential pollution problem in the watershed are listed as such in the respective sub-watershed Section. Table 2.10 below is a list of all CFOs in the project area and Figure 2.19 shows their location.

Table 2.10: Confined Feeding Operations in the Fawn River 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
N & M Incorporated Fawn River Farm	Lagrange	Wegner Ditch	CFO	Broilers	240,000

Figure 2.19: Confined Feeding Operations in the Fawn River Watershed



2.5.4: Windshield Survey

A windshield survey was conducted throughout the watershed to identify areas where nonpoint source pollution (NPS) may be an issue. The survey was conducted in May 2014, with two people per vehicle, driving each road within each sub-watershed, and making note of any areas of significant soil loss, lack of riparian buffer, livestock access to open water, or other potential pollution sources. The notes taken during the windshield survey were then verified via a "desktop survey" of the watershed using 2011 aerial photography. The most significant potential NPS source identified during the windshield survey was a lack of riparian buffer along open water. However, other issues were also noted including conventionally tilled fields, sea walls and fetilized turf grass directly along the shoreline of built-up lakes, and some livestock issues, including one site where livestock have direct access to open water. It was also observed that many row crop farmers in the watershed are using irrigation on their fields. The windshield survey will be discussed in further detail, at the sub-watershed level, in Section three of this WMP.

2.5.5 National Pollution Discharge Elimination System

Facilities that discharge directly into a water body are required to obtain an National Pollution Discharge Elimination System (NPDES) permit from the overseeing state agency (IDEM and MDEQ). The permit regulates the amount of contaminants a facility can discharge into surface water and requires the facility to conduct regular water quality monitoring (typically monthly). While these facilities are regulated by the State, there is the potential that they may have accidental discharges above permit limits, or in some cases, the facilities may release a substance that they are not required to report to the State which may pose a threat to water quality; phosphorus is a common parameter not required to be reported. There are 11 NPDES permitted facilities located within the Fawn River. The NPDES facilities were obtained from the US EPA's Enforcement and Compliance History Online (ECHO) website. ECHO allows the user to search for various permitted facilities by HUC 12 and will supply myriad data. Table 2.9 lists each facility, their permit number and address, the number of quarters the facility was in non-compliance over the past three years, as well as the reason for the violation. Pollutants in bold in Table 2.11 are those pollutants that caused a significant violation. Figure 2.17 is a map showing the location of each of the permitted facilities. The NPDES permitted facilities will also be mapped in their respective sub-watershed in Section 3 of this WMP.

It should be noted that there are two facilities located within the Fawn River watershed, with discharge points in the neighboring Pigeon River/Pigeon Creek watershed. Those facilities are listed in Table 2.11 and are highlighted in yellow.

Table 2.11: NPDES Permitted Facilities in the Fawn River Watershed

Permit Name	Permit #	County Name	Address	City	HUC 12	Lat.	Long.	Receiving Water Body Name	Qrts in Non-compliance (3 yrs)	Pollutant
Fremont WWTP	IN 0022942	Steuben	1715 SR 120	Fremont	0405000108 01	41.729681	-85.023148	Crooked Creek via Marsh Lake via Trib	5	BOD, E. coli, N, P, and TSS
Pokagon State Park	IN 0030309	Steuben	450 Lane 100 Lake James	Angola	0405000108 03	41.718028	-85.03667	Crooked Creek via Snow Lake	4	BOD, E. coli, P, and TSS **T Ammonia**
Angola Travelers Mall Mobil	IN 0032891	Steuben	7265 N Baker Rd	Fremont	0405000108 01	41.746056	-84.991417	St. Joseph via Big Otter Lake/ Walters Lake/ unnamed trib	10	**Chlorine**, E. coli, **T Ammonia**, **P**
Western Con-solidated Technologies	IN 0054011	Steuben	700 W Swagger Dr	Fremont	0405000108 01	41.712017	-84.979955	Unnamed Trib to Marsh Pond	4	**Chlorine**, Oil and Grease
Meridian Automotive Systems	IN G250062	Steuben	3000 Woodhull Dr	Angola	0405000108 03	41.6713	-85.0039	Pigeon Creek via Croxton Ditch	5	Temp
Sturgis-Big Hill Rd LF	MI 0047716	St. Joseph	US 12 and Big Hill Rd	Sturgis	0405000108 06	41.801944	-85.387778	Moe Drain	0	N/A
Travel Plaza - Ernie Pyle	IN 0050300	LaGrange	5000 E 750 N	Howe	0405000108 06	41.745194	-85.329083	Pigeon River via Unnamed Trib	2	non-RNCV
City of Sturgis WWTP	MI 0020451	St. Joseph	70250 Treatment Plant Rd	Surgis	0405000108 07	41.773611	-85.432778	Fawn River	1	non-RNCV/C

Permit Name	Permit #	County Name	Address	City	HUC 12	Lat.	Long.	Receiving Water Body Name	Qrts in Non-compliance (3 yrs)	Pollutant
Abbott Nutrition	MI 0025313	St. Joseph	901 N Centerville Rd	Sturgis	040500010807	41.8095	-85.426	Nye Drain	1 (RCRA) 0 (CWA)	Sulfuryl Flouride
Sturgis Well Field - SF	MI 0053465	St. Joseph	309 N Prospect St	Sturgis	040500010807	41.804444	-85.414722	Fawn River via Nye Drain	0	N/A
MI Milk Producers Assoc.	MI 0001414	St. Joseph	125 Depot St	Constantine	040500010809	41.843611	-85.665278	St. Joseph River	1	pH

2.5.6 Brownfields

Brownfields are defined by the USEPA as "real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant". Examining these sites in closer detail to determine potential future uses for the sites by cleaning up environmental hazards present, will help to protect the environment, can improve the local economy, and reduces pressure on currently undeveloped lands for future development. The EPA, States, and local municipalities often offer assistance in the form of grants and low interest rate loans for the cleanup and redevelopment of identified and potential brownfield sites.

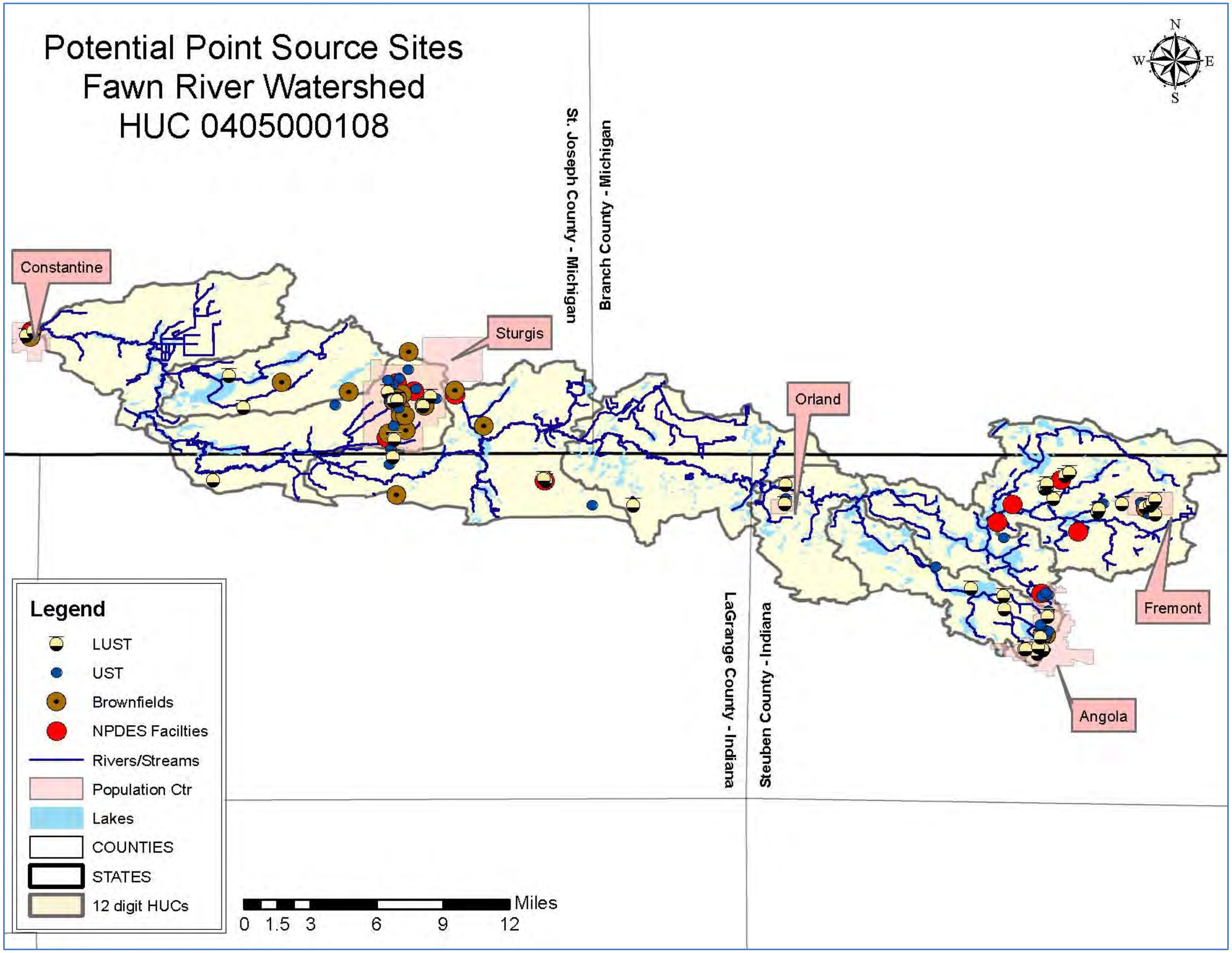
There are no brownfield sites that have a Brownfield Redevelopment Plan or that have received funding according to the state Brownfield district offices located within the Fawn River watershed. However, IDEM and MI DEQ have lists of potentially contaminated sites. There are four sites listed by IDEM as being a Brownfield and MI DEQ has listed 16 sites that are considered potentially contaminated within the Fawn River watershed. Figure 2.20 is a map delineating each specific brownfield site. The specific brownfield sites will be discussed in further detail in Section 3 of this WMP.

2.5.10 Underground Storage Tanks

An underground storage tank (UST) is a container placed under ground to store chemicals necessary to run a business or provide a service. Most USTs store gasoline, diesel, kerosene, or dry cleaner chemicals, though USTs are not limited to those chemicals alone. USTs pose a risk to the surrounding environment as they have the potential to leak (LUSTs) their contents into the soil which can leach into groundwater or surface water and contaminate them or leach into surrounding soils.

USTs are managed by the IDEM Office of Land Quality's Underground Storage Tank program and the MI Department of Licensing and Regulatory Affairs. The states are charged with insuring all USTs meet state and federal regulations so as to not contaminate surrounding land and/or water resources. The states are also responsible for making sure those tanks that do not meet requirements are properly closed or upgraded. There are currently 125 USTs located in the project area, 94 of which are currently leaking. All USTs and LUSTs located within the Fawn River Watershed are identified on the map of potential point sources of pollution in Figure 2.20. LUSTs will be discussed further in Section 3 under the respective sub-watershed.

Figure 2.20: Potential Point Sources of Pollution in the Fawn River Watershed



2.5.11: Parks

Thirty-eight parks and preserves are located within the project area totaling over 3,356 acres of land. Many of the parks are small municipal parks which are predominantly used by local residents and are supplied with playground equipment and picnic tables for the public to enjoy. However, there are a few larger trails, parks and nature preserves of note including the 1,260 acre Pokagon State Park, a large forested area along the shores of Lake James managed by the Indiana DNR, the 120 acre Fawn River Fen which provides prime habitat to many wetland animals, managed by The Nature Conservancy, the 135.2 acre Fawn River Nature Preserve managed by Acres Land Trust, and many other large preserves which provide habitat to many rare, threatened, or endangered species. The Fawn River is noted as one of the cleanest navigable rivers in Indiana by recreational enthusiasts, likely due to the amount of natural land surrounding the river and areas lakes, so preservation of these pristine properties is vital to the area's flora and fauna. Table 2.12 lists all parks located within the project area, how many acres or miles they encompass, who manages them and what type of activities are available at each site. Figure 2.21 is a map showing the location of each of the parks.

Table 2.12: Parks and Nature Preserves in the Fawn River Watershed

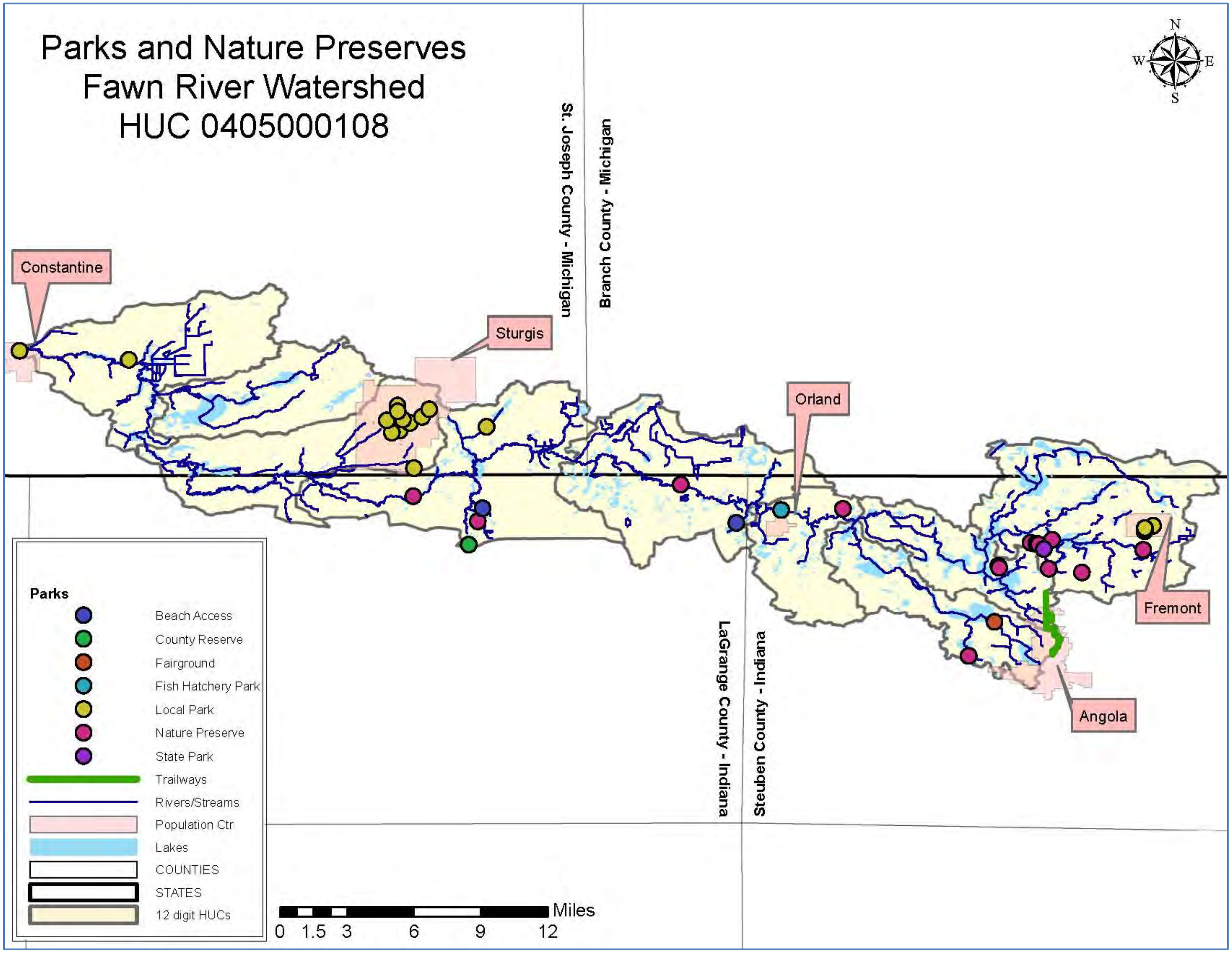
Name	Area	Ownership	Facilities/Activities
Cade Lake County Park	98 acres	St. Joseph County	Camping, hiking, beach on Cade Lake, fishing, boating, picnic area, playground
Jim Timm County Park	95 acres	St. Joseph County	Natural Area (woodland and wetland) hiking trail (more trails and boardwalk planned)
Riverview Park	Unknown	Constantine Township	Wooded Area, playground, basketball courts
Oaklawn Terrace Park	26 acres	City of Sturgis	Tree canopy, ice skating/roller skating, ampitheater, playground, picnic shelters
Arthur Carls Park	1.9 acres	City of Sturgis	playground, basketball court, picnic area
Franks Park	19.5 acres	City of Sturgis	sports complex, playground, restrooms
Free Church Park	0.6 acres	City of Sturgis	benches and floral display
Shadowlawn Park	0.5 acres	City of Sturgis	open green space
Memorial Park	3.7 acres	City of Sturgis	open green space, tree canopy, playground
Pioneer Park	0.5 acres	City of Sturgis	Marker for Judge John Sturgis, flower beds, green space
Thurston Woods	27 acres	City of Sturgis	paved trail, picnic areas, open green space, picnic shelters, wooded area, and playground

Name	Area	Ownership	Facilities/Activities
Old Depot Park	2.3 acres	City of Sturgis	Museum, gazebo, picnic area, and playground
Langrick Park	1.8 acres	City of Sturgis	Playground, basketball, sand volleyball, tennis, and handball courts
Cedar Lake Beach	Unspecified	LaGrange County	Unstaffed lake swimming access
Wall Lake Beach	Unspecified	LaGrange County	Unstaffed lake swimming access
Duff Nature Preserve	Unspecified	LaGrange County/Acres Land Trust	Wetland Nature Preserve on Cedar Lake
Pine Knob Park	99 Acres	LaGrange County	Hunting and fishing, archery targets, hiking, fishing, picnic area, wetlands
McClue Nature Preserve	80 acres	Steuben County Commissioners/ Acres Land Trust	30 acres of old growth forest, nature trails, parking lot
Steuben 4-H and Campground	Approx. 60 acres	Steuben County	Buildings and facilities for the annual Steuben County 4-H Fair and seasonal recreation/education. Horse and Pony arenas, managed turf grass/green space. Large oak trees along shore of Crooked Lake.
Fremont Town Park	Unspecified	Town of Fremont	Baseball diamonds, open green space, playground, and pavilion
Fremont Moose Skate Park	Unspecified	Town of Fremont	Open green space, skateboarding facility
Fremont Vistula Park	Unspecified	Fremont Schools	Baseball diamonds, tree cover, walking trails, playground
Broad Street Youth Park (proposed)	Unspecified	Town of Fremont	Open green space, tree canopy, pond, paved walking trail, semi-natural setting, pavilion, ball diamond, (connects to Moose Skate Park)
Angola Recreational Trailway	Approximately 1.5 miles (add. 1.3 mi. proposed)	City of Angola	Paved walking/biking trail
Fawn River Nature Preserve	135.2 acres	Acres Land Trust	Old growth and 2nd growth forest, Fawn River, 1.5 mile walking trails, wildlife and bird watching, parking lot
Beechwood Nature Preserve	89.8 acres	Acres Land Trust	Forest and meadow, 1.7 mile walking trail, wildlife and bird watching, parking lot

Name	Area	Ownership	Facilities/Activities
Foster Nature Preserve	2.7 acres	Acres Land Trust	Little Otter Lake, forest, access from Beechwood NP, 0.1 mile walking trail, wildlife and bird watching
Manjeri Nature Preserve	0.8 acres	Acres Land Trust	Little Otter Lake, forest access from Beechwood NP, 0.1 mile walking trail, wildlife and bird watching
Ropchan Wildlife Refuge and Nature Preserve	184 acres	Acres Land Trust/ INDNR Division of Fish and Wildlife	Cemetary Lake, adjacent to INDNR wetland conservation area, old and new growth forest, wetlands, 4.7 mile walking trail, platform at lake for wildlife and bird watching, parking lot
Ropchan Memorial Nature Preserve	79 acres	Acres Land Trust	Forest, wetland, wildlife and bird watching, wildlife viewing, 1.3 mile walking trail, parking lot
Wing Haven Nature Preserve	262.5 acres	Acres Land Trust	Seven Sisters Lake, 19th century log buildings, 1.9 mile walking trail, wetland fens, forest, meadows, wildlife and bird watching, wildlife viewing, parking lot
Fawn River Fen	120 acres	The Nature Conservancy	Fawn River, grass sedge fen, wildlife and bird watching
Pokagon State Park	1,260 acres	IN Dept. of Natural Resources	Lake James and Snow Lake access, Lake James beach, 1.6 mile bike trail, 11 mile walking trail, boat rental, camping, fishing, inn/lodge, nature center, picnic areas, saddle horses and 2 mile trail, Tobaggan Run, cross country sking, sledding, ice skating, wetlands and forest
Trine State Recreation Area	186 acres	IN Dept. of Natural Resources/ 101 Lakes Trust	Forest, 3.5 mile walking trail, sledding, Gentian Lake access and canoe rental, lodge and cabins
Loon Lake Nature Preserve	99 acres	INDNR, Division of Nature Preserves	North shore of Loon Lake, parking lot, walking trail, forest, meadow, and wetland areas (home to several threatened and endangered plant species), wildlife and bird watching
Potawatomi Nature Preserve	256 acres	INDNR, State Parks and Reservoirs	Located within Pokagon State Park, old growth forest, marsh and wetland areas, forest, Pokagon hiking trails pass through the preserve

Name	Area	Ownership	Facilities/Activities
Marsh Lake Nature Preserve	103 acres	INDNR, Division of Fish and Wildlife	Parking lot, no hiking trails, hunting in season, wetland habitats, old growth forest
Fawn River Fish Hatchery	Unspecified	INDNR	Fish rearing ponds, green space, access to Fawn River and fishing along property from the River, self-guided tour of facility and informational signs at each pond

Figure 2.21: Parks and Nature Preserves in the Fawn River Watershed



2.6 Previous Watershed Planning Efforts

The Fawn River watershed is a unique watershed due to the many lakes and natural setting of the Fawn River. The hydrologic features of the watershed are used extensively by local residents and tourists, which puts additional stress of the water resources. For these reasons, the Fawn River and its tributaries, as well as the lake system are important to understand and protect. There have been many studies conducted on the lakes of the area to control invasive aquatic plant species and sedimentation, but few studies of the river system and the surrounding land uses have been conducted. There are also few city and county master plans that have been written to outline problems and threats to our natural resources, and propose ways of protecting those resources in the watershed. This section provides a description of each of the previous studies and watershed planning efforts that have been conducted over the past decade. Figure 2.23 delineates the jurisdiction of each of the studies or plans that have been conducted in the watershed.

2.6.1 City and County Management Plans

The purpose of Municipal Management Plans is to identify potential issues in the area and determine a means of addressing those issues. All counties within the Fawn River Watershed have comprehensive or master plans, however not all populated areas do; Orland and Constantine do not have Plans.

Branch County Master Land Use Plan

The Branch County Master Plan was first written in 1974 and updated in 1997 by the Branch County Planning Commission in cooperation with the South-central Michigan Planning Council. The Master Plan outlines two concerns that can be connected to this project including prime agricultural land being utilized for development and the lack of tourism opportunities in the county relating to the many lakes located within the county. The Master Plan identified several potential opportunities to address the concerns, which are listed below.

- Encourage cooperation between agriculture and lake property owners with regard to water issues, where water quality is the most important issue for the future.
- Land that is not suited for agriculture should be developed for recreation.
- Work with Tourism Bureau to promote advantages of the county including the great fishing opportunities in the many lakes of the county.
- Provide recreation facilities to preserve and enhance the County's natural features by encouraging:
    - Control lakeshore and stream bank development
    - Encourage conservation and protection of natural areas
    - Prohibit floodplain development except for recreational purposes

The objectives outline in the Branch County Master Plan will help to address identified stakeholder concerns including an increase in impervious surfaces, lakes in the area becoming more developed, wetland conservation and streambank erosion.

St. Joseph County Michigan Master Plan

The St Joseph County Planning Commission, recognizing the fertile soil and abundance of ground water for irrigation, developed a County Master Plan in 1997 focusing on the protection of prime farmland within the county, while also taking into account the natural resources of the area. Several of the goals established during the development of the Master Plan are directly related to concerns expressed by the Fawn River Project Steering Committee. Those goals are listed below.

- "Provide for the development of sanitary sewers, improved sanitary disposal systems…"
- "…encourage long-term commitments to environmentally sound agricultural activities…"
- "Encourage intensive livestock operations …to locate away from areas prone to flooding."
- "Do not over-plan or over-zone for commercial (or industrial) development."
- "Establish a minimum setback for vegetative buffer along lakeshore or stream (and septic tanks and drainfields)."
- "Direct animal grazing landward of the vegetative buffer strip (along lakeshores and streams)."

The St. Joseph County Planning Commission has been updating their Master Plan regularly. The last update was completed in 2007 and it had a stronger focus on environmental conservation and preservation including such goals as maintaining a 1:1 ratio of "built-up" area and open and/or green space. The 2007 update also included a map of areas where increased sewer system capacity is necessary to maintain the integrity of the surrounding natural resources. Figure 2.20 is a map, taken from the 2007 Master Plan update, showing where the current wastewater treatment plants are and where new or expanded systems should be constructed to meet the projected population growth. The blue oval drawn on the map represents the approximate area of St. Joseph County located within the Fawn River project area.

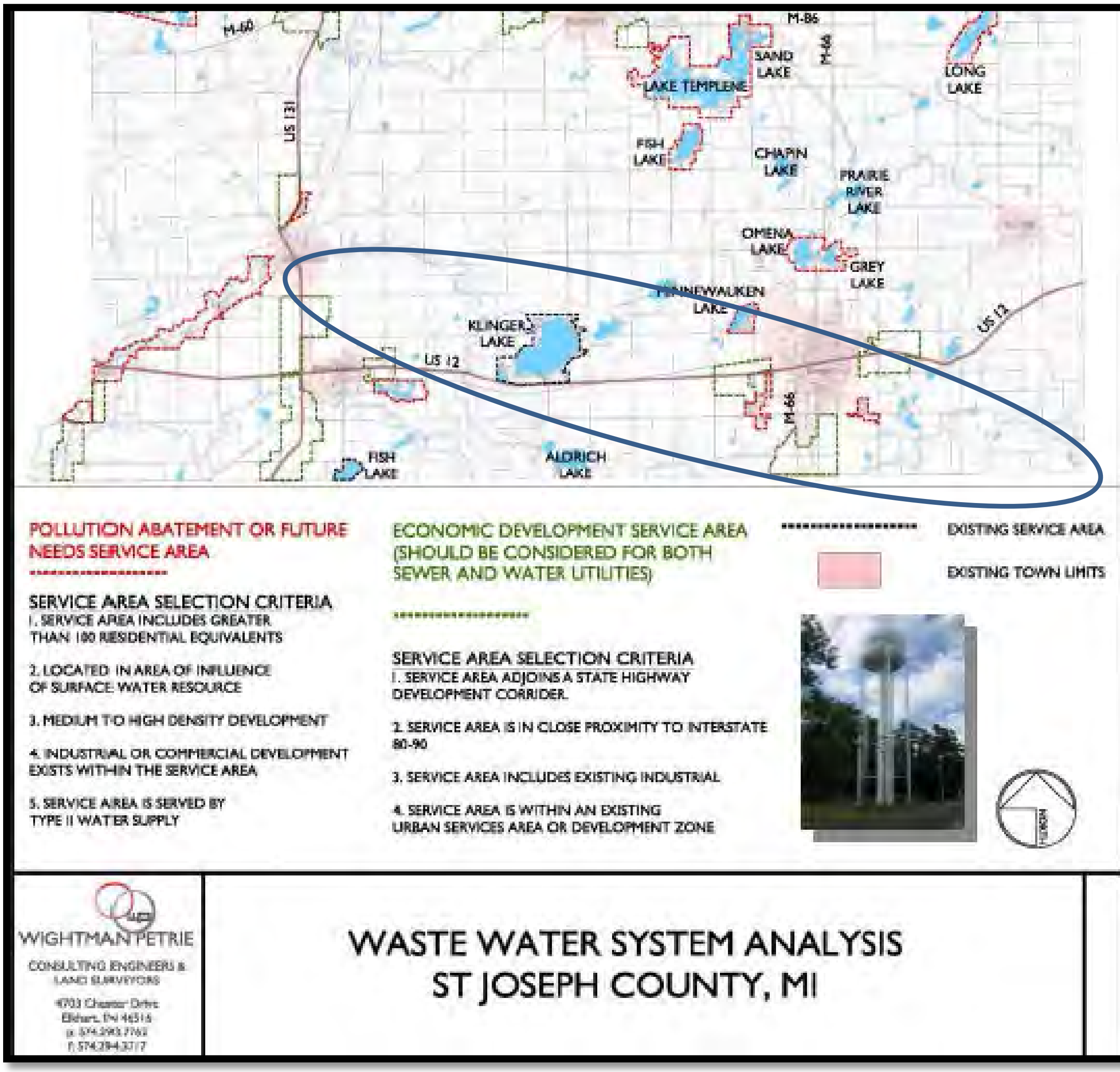
<u>LaGrange County Comprehensive Plan</u>

On December 6, 2010, the LaGrange County released their Comprehensive Plan. The Plan consists of two major subsections; the Planning Foundation and the Land Use Plan. The Planning Foundation takes natural resources into account, recognizing the uniqueness of the landscape of the county, where the Land Use Plan outlines strategies to limit the impact of urban sprawl and other construction activities on the natural environment. Goals and concerns outlined in the Plan that relate to the concerns of stakeholders in the watershed are:

- "New development will be built in a manner that maintains the integrity of the natural environment"
- "Water and water quality are valuable resources to the county both as a source of recreation and lifestyle but also as a life necessity"
- "…Urban sprawl will be minimized"
- "…poorly installed groundwater wells, placement of waste removal systems, improper manure management, or uncontrolled storm water runoff can create safety hazards…"
- "Encourage commercial uses, which are not associated with homes or farms, to locate on paved roadways"
- "Development of residential uses should be permitted at densities not to exceed two units per acre where adequate sanitary sewer services are available…housing units that have no access to sanitary sewer services should be restricted to one unit per acre…"

LaGrange County recognizes the value of the lake system and natural resources they have available in the county and have planned for their preservation to the best of their ability in the County Comprehensive Plan.

Figure 2.22: Existing and Planned Waste Water Treatment Services in St. Joseph County



Steuben County Comprehensive Plan

The Steuben County government saw a need to update the Old County Master Plan in 2005 as the area continued to grow due to the high quality of life, lakes, and other natural resources in the county. The Steuben County Comprehensive Plan was completed and adopted by the county government in 2006. Two aspects of the county Plan are relevant to the Fawn River

Watershed planning project, those are to manage growth of the county and nurture environmental quality.
Several objectives and actions in the Plan address issues described by the Fawn River stakeholders. Those objectives and/or actions are as follows:

- Require cluster designed residential development and allow incentives to developers who do so while protecting and enhancing environmental features
- Establish policies that require new residential properties to connect to centralized sewer systems when developed within a reasonable proximity to infrastructure
- Discourage residential sprawl
- Update the Zoning Ordinance to aid in the preservation of natural areas
- Create a visioning audit to identify ecological resources, open spaces, agricultural districts, buffer zones, green ways, and wildlife areas
- Buffer sensitive land uses from new commercial and industrial developments.
- Protect the water quality in the streams, lakes, and their watersheds
- Encourage the planting of native shade trees and evergreen trees to soften the impact of noise (which will also aid in stormwater uptake)
- Minimize conflicts between growth and the environment
- Conserve existing natural areas including woodlots, wildlife habitat, riparian corridors, littoral corridors, open spaces, wetlands, and floodplains

Steuben County Ordinance for Storm Drainage and Erosion Control

Under Ordinance number 673, Steuben County was responsible for the development of a plan to manage storm water runoff in the county. As stated in the ordinance the purpose of the ordinance is to "reduce the hazard to public health and safety caused by excessive stormwater runoff, to enhance economic objectives, and to protect, conserve and promote the orderly development of land and water resources within the regulatory area". The regulatory area of the ordinance includes all of Steuben County.

The ordinance outlines regulations regarding open channel design, stormwater detention, and erosion and sediment control. All activities in the ordinance will not only meet the objectives outlined above, but will also improve water quality by limiting the amount of stormwater which can carry pollutants to open water sources.

Angola Indiana Comprehensive Plan

Recognizing the importance of strategic planning to a vital and thriving city, Angola Planning Commission worked with consultants to devise a comprehensive plan for the City of Angola. The Plan was adopted by the Angola City Council in October, 2012. Part Two of the Plan outlines concerns and objectives, some of which relate to Fawn River stakeholder concerns including:

- Requiring all new structures to connect to public waste disposal system
- Encourage use of abandoned and under-utilized buildings prior to permitting new construction for businesses
- Require setbacks of development from environmentally sensitive areas
- Incentivize for conservation and preservation of environmentally sensitive areas
- Maintain stormwater management and erosion control ordinances

- Encourage development that reduces the city's environmental footprint

Fawn River Watershed stakeholder concerns, such as the increase in impervious surfaces, septic system discharge, wetland conservation, and streambank erosion will be partially addressed in the City of Angola if the objectives outlined in the Comprehensive Plan are met.

Angola Parks and Recreation 5-Year Master Plan

The City of Angola Parks and Recreation Master Plan was adopted in 2013 and is due to be updated in 2017. The Master Plan addresses several concerns of the Fawn River watershed stakeholders including:

- Preventing development on floodplains and in wetlands
- Maintaining their "Tree City USA" program
- Acquisition of the "center Lakes" area on the northwest edge of the city to add it to the city's park system as a nature preserve.

While the Angola Parks Department has some plans to maintain existing environemental projects and possibly acquire additional natural areas, it does not seem to take full advantage of the potential of the environmental resources of the area including prime wetland locations and other green spaces.

Fremont Comprehensive Plan

The Town of Fremont developed a draft Comprehensive Plan in 2013 with input from the Town of Fremont government and over 200 residents of the town. The Plan recommends a thorough review of the Comprehensive Plan by the Fremont Plan Commission and Town Council before 2024. There are several recommendations in the Comprehensive Plan that are in line with concerns expressed by the Fawn River stakeholders including:

- Require all new construction within the Town limits be hooked up to a centralized sewer system
- Protect conservation areas and provide incentives to preserve environmentally sensitive areas
- Establish stormwater management and erosion control ordinances
- Encourage development practices that reduce the town's footprint on the environment
- Encourage the use of native plants for new developments

If the above objectives in the Comprehensive Plan are met some of the stakeholder concerns will be addressed including wetland conservation, streambank erosion, increase in impervious surfaces, and septic system discharge.

(Sturgis) Master Plan of Future Land Use

The city of Sturgis, Michigan developed a landuse master plan to address concerns of residents, as well as, maintain and improve existing conditions of the city. The Master Plan addresses two if the Fawn River Watershed's stakeholder's concerns including an increase in impervious surfaces and wetland conservation by listing the following objectives within the Master Plan;

- "Preserve, protect, and improve historic, natural, scenic, or environmentally sensitive areas for appropriate public use and enjoyment and habitat protection."
- "Upgrade and maintain existing industrial areas" with the intention of utilizing existing structures prior to construction of new industrial facilities.

2.6.2 Watershed Management Plans

St. Joseph River Watershed Management Plan

There is only one watershed management plan that includes any of the Fawn River; the St. Joseph River Watershed Management Plan. The Friends of the Saint Joe River Association, a 501(c)3 organization, completed a watershed management plan for the entire St. Joseph River watershed (HUC 04050001) in 2005. The watershed is 4,685 square miles and includes 15 counties in Michigan and Indiana. Because of the large size of the watershed, the WMP is vague in its description of the Fawn River watershed and the water quality problems in the watershed. However, the plan noted the Fawn River watershed as being critical for agricultural practices that degrade water quality. Using a SWAT model, it was determined that the most effective BMPs to limit NPS pollution from entering the Fawn River are no-till practices, and edge of field filter strips. The WMP also recognizes the LaGrange County SWCD for its efforts to reduce sediment, nutrient, and pathogen contamination of surface water by implementing a livestock management program.

Michigan Great Lakes Plan

The Great Lakes provide vast opportunities to Michigan and are the driving force to its economy. Due to the importance of the Great Lakes to the economy and health of the state of Michigan, the Michigan Office of the Great Lakes prepared the MI Great Lakes Plan (MiGLP) which was completed in January, 2009. Many problems outlined in the MiGLP are in line with concerns voiced by Fawn River stakeholders such as controlling NPS, protecting and restoring wetlands, sustainable living (including development), and excluding phosphorus from lawn fertilizers. The MiGLP outlines specific objectives and recommendations to accomplish the goal of protecting the overall health of the Great Lakes, including reducing pollution discharging into the Great Lakes via their tributaries. The MiGLP also describes potential partners and funding sources to accomplish the goals.

2.6.3 Lake Management Plans

There are eleven lakes located within the Fawn River watershed that have had studies and/or management plans written for them. Most of the plans involve sediment control and/or removal, and aquatic vegetation management. A brief description of those plans is below. A

Crooked Lake

- Crooked Lake Monitoring Study
  - JF New, an environmental consulting firm, was hired by the Crooked Lake Association to conduct water quality analysis at three sample sites in 2003. One on a Loon lake tributary, on Carpenter Drain, and on Palfreyman Drain. Parameters collected included pH, Dissolved Oxygen, Temperature, Nitrogen, Phosphorus, Total Suspended Solids, and *E. coli*. The water quality analysis indicated that the water feeding into Crooked Lake is in full support of aquatic life as the parameters tested measured below the recommended target limits.

- Crooked Lake Engineering Feasibility Study
    - Based on a previous monitoring study of Crooked Lake, the Crooked Lake Engineering Feasibility Study looked at five potential projects to address sedimentation issues in Crooked Creek. These included streambank stabilization of Carpenter Drain, stormwater management at the 4-H Park, stream reconstruction at Palfreyman Drain at the Highway Department, facility, and eight potential wetland restoration projects. The study concluded that all projects were feasible except for the wetland restoration due to the lack of landowner participation. Completed projects are described below.
- Carpenter Drain Design/Build Report
    - In 2005, JF New, an environmental consulting firm, stabilized approximately 200 lineal feet of eroded bank and removed large pieces of debris in the channel which were the major sources of the erosion problem. JF New recommended monitoring of the site for the next five years. A follow-up report was not completed for this site.
- Steuben County 4-H Park, Stormwater and Sediment Reduction Design Project
    - JF New, an environmental consulting firm installed four raingardens, 462 linear feet of french drains which empty into the raingardens, adjacent to two service roads, 200 feet of eroding roads were paved including the addition of a curb to direct stormwater runoff, two catch basins (dry wells were installed, the project also called for the installation of a woodland berm for stormwater storage. Construction of most of the features was completed by November 2006.
- Crooked Lake Aquatic Vegetation Management Plan (AVMPs)
    - Crooked Lake Association began hiring a consultant to write AVMPs in 2007 when the DNR first identified nuisance plants within the Lake, specifically the invasive species including Starry Stonewart, Eurasion Watermilfoil, and Curly Pondweed. The latest AVMP for Crooked Lake was written in 2013. It is estimated that approximately 10% of Crooked Lake has been invaded by these three invasive plant species. The AVMP provides suggestions on the best use of funds and treatment areas to control the spread of the nuisance aquatic plants.

Lake George

- Aquatic Vegetation Management Plan Update 2013; Lake George
    - The Lake George Cottagers Association hired a contractor in 2006 to develop an AVMP for Eurasion watermilfoil. Most of the areas of concentrated watermilfoil have been treated annually since 2007. However, in 2009 Starry stonewart, another invasive plant species was discovered on Lake George. The AVMP was then updated to include the new plant species. The AVMP provides suggestions on the best use of funds and treatment areas to control the spread of the nuisance aquatic plants.

Lake James Chain

- Lake Diagnostic Study; Lake James, Snow Lake, Big Otter Lake, and Little otter Lakes
    - A diagnostic study was conducted on four lakes in the Lake James chain of lakes in 2006 to measure water quality and assess land use in the watershed that may impact water quality. Water quality and land use results indicated a need to control nutrient loading and invasive aquatic plant species in the lakes. Several recommendations were made to help improve water quality including;
        - Control invasive wetland and aquatic plant species
        - Network with Lake associations to improve overall water quality
        - Investigate the possibility to conduct a monitoring study to determine the impact of wastewater effluent

    - Avoid the redirection of stormwater drainage from other watersheds to the Lake James watershed
    - Implement a Lake resident education program about proper land and shoreline management
    - Work with NRCS and SWCD to implement best management practices on highly erodible land
    - Increase water quality sampling on the Lakes
  - Other more specific recommendations were also provided in the study including the following, a map of priority areas can be found on page 176 of the Study;
    - Stabilize the shore of Lake James, Croxton Ditch, Walter's Lake Drain, Follet Creek, and Crooked Creek watersheds.
    - Restore wetlands in Croxton Ditch and Walter's Lakes Drain watersheds
    - Protect wetlands and insure the practice of proper erosion control on disturbed lands
- Phase II – Engineering Feasibility Study and Engineering Design
  - The Middle Croxton Ditch running through the Lake James Golf Club properties has a lot of sediment due to streambank erosion. This study was conducted to learn the feasibility of reducing sediment loading into the Croxton Ditch, thus into the Lake James Chain. A engineering design was developed to restore approximately 840 linear feet of Croxton Ditch within the Golf Club property. The Steuben County Surveyor was granted funds to implement the design in 2014. The Study also determined that it would be feasible to conduct four dredging projects at an irrigation pond and sediment trap at the Gold Club.

<u>Jimmerson Lake</u>

- Jimmerson Lake Diagnostic Study
  - The Jimmerson Lake Association received a IN DNR grant to conduct a diagnostic study to learn the potential problems in the Lake and hired Commonwealth Biomonitoring to conduct the study. Problems identified within the Jimmerson Lake watershed and potential solutions include;
    - High percentage of highly erodible land surrounding the land which accounts for excessive erosion of land surrounding the lake and may contribute to the sediment loading in the lake
    - Stormwater runoff from Buena Vista area on the north shores of the lake contributing high nutrient and sediment loadings
    - More speed boats are used on Jimmerson Lake when compared to other Indiana lakes which may disrupt native emergent aquatic vegetation in the lake.
    - Concrete seawalls contribute to shoreline erosion and loss of aquatic plant and animal diversity
    - The many wetland and forested areas surrounding the lake should be purchased by the Jimmerson Lake association and be managed as conservation areas
    - Over 90% of the watershed upstream of Jimmerson Lake does not have any landuse planning. All lakes in the watershed should implement a lake management plan, including surrounding landuse management.

- Lake and River Enhancement Engineering Feasibility Study for Jimmerson Lake
    - Donan Engineering, Inc was contracted by the Jimmerson Lake Association to conduct and engineering feasibility study to install management practices that would prolong the life of the lake. The proposed practices to mitigate pollution problems in Jimmerson Lake include;
        - Sediment basins to capture sediment from the highly erodible land used for agriculture in the watershed in Section 5 of Pleasant Township
        - Conserve the many valuable wetlands surrounding Jimmerson Lake by purchasing a conservation easement for wetland areas that are slated for development
        - Install “No Wake” buoys at key locations to protect aquatic vegetation beds and the lake’s shoreline
        - Implement an education and outreach program to educate the public about stormwater discharges and their impacts on water quality
        - Develop and enforce construction site ordinances to prevent erosion and ensure sediment does not discharge into open waters
- 2013 Aquatic Plant Management Plan Update for Jimmerson Lake
    - The first AVMP written for Jimmerson Lake was in 2005 and an update was written in 2006, 2008, 2012, and 2013. According to the 2013 update, Jimmerson Lake is oligotrophic, which indicated relatively good water quality. The lake has been colonized by the invasive species of Eurasion watermilfoil, curlyleaf pondweed, and starry stonewort. Another, non-native plant has been identified in the lake, spiny naiad, however it does not appear to be a prolific grower and does not appear to be a threat. Over 20% of the lake was noted as having starry stonewort. Eurasion watermilfoil and curlyleaf pondweed are prolific growers, though do not cover as much of the lake as does starry stonewort. The Jimmerson Lake Association has received IN DNR funding since 2005 to treat invasive aquatic vegetation in the lake. The 2013 update provides recommendations of where the most effective area of the lake is to treat invasive species.

West Otter Lake

- West Otter Lake Aquatic vegetation Management Plan Update 2013
    - The West Otter Lake Association acquired IN DNR funding to complete an AVMP, which was completed in 2005. An update to the AVMP was completed in 2006, 2012 and 2014. The invasive species of Eurasion watermilfoil and curlyleaf pondweed have colonized in West Otter Lake. Spiny naiad, another non-native aquatic plant species, is present in the Lake but does not pose a threat to the integrity of the lake. The 2013 update recognizes that in areas of dense growth of the lake, surface mats of the invasive species exist and impede recreational activities, specifically in the northwest portion of the lake near the public access site and on lake channels. The AVMP update provides recommendations of areas to treat the invasive species that would make the greatest impact to controlling the spread of the plants.

Lake Gage and Lime Lake

- Lake Gage and Lime Lake Engineering Feasibility Study
    - The Lake Gage and Lime Lake Association received an IN DNR grant to conduct an engineering feasibility study to determine the most effective means of reducing sedimentation of the two lakes in 2004. The study was conducted in three parts; 1) Habitat restoration of Concorde Creek, the main tributary to Lime Lake, 2) Wetland

integrity scoring and how the Concorde Creek project would affect the wetlands, 3) Restoration of a natural watercourse which was dredged and straightened that flows through a natural wetland area at the southeast end of Lake Gage. It was determined that streambank restoration of Concorde Creek would reduce sedimentation of Lime lake and improve the quality of surrounding wetlands and that restoring the natural watercourse would also reduce erosion and sedimentation of Lake Gage.

- Concorde Creek Channel Restoration Project Design Report
    - Following design specifications outlined in a 2008 Design project for Concorde Creek by JF New for the Lake Gage and Lime Lake Association, approximately 578 feet of channel in Concorde Creek was restored to its historic meander. To accomplish this, three earthen dams and reconstruction of the channel took place. The restored stream has better access to the natural floodplain which will allow for nutrients and sediment to settle out prior to being discharged into the lake. Also, nearly 400 feet of eroding channel was filled and native vegetation was planted to eliminate sedimentation from that area. It is expected that native flora and fauna habitat has been restored in this section of Concorde Creek and that nutrient and sediment loading to Lake Gage will be significantly reduced.
- Lake Gage and Lime Lake Aquatic Vegetation Management Plan
    - The Lake Gage and Lime Lake Association contracted Aquatic Weed Control to conduct a vegetation survey and propose a management plan to address any invasive species colonies found during the survey in 2012. Eurasian watermilfoil was found in the two lakes, mainly in areas with depths less than 10 feet and curlyleaf pondweed was found in Lime Lake. The frequency of Eurasian watermilfoil was up to 11.4% in Lake Gage and 30% in Lime Lake. The frequency of the plant in the two lakes is relatively low when compared to other Indiana lakes, so recommendations were made to monitor the growth of the plant only, and not spend funds to treat it at this point. However, specific recommendations were provided in the AVMP to maintain the lakes' integrity.
        - Reduce Eurasian watermilfoil to 10% or less in Lime Lake
        - Maintain Eurasian watermilfoil below 10% in Lake Gage
        - Maintain 8 native plant species in Lime Lake
        - Maintain 6 native plant species in Lake Gage

<u>Wall Lake</u>

- Lake Diagnostic Study
    - The Wall Lake Fisherman's Association, in conjunction with the IN DNR Division of Fish and Wildlife, contracted Aquatic Enhancement and Survey, Inc in 2005 to conduct a study of the lake's biological and chemical integrity. Based on findings during the water quality and landuse investigation the following recommendations were given;
        - Seek long term, legal protection of surrounding wetlands and woodlands
        - Begin a program to control purple loosestrife and prevent the spread of invasive plants into wetlands
        - Continue fish management activities and assess the 2005 walleye stocking of Wall Lake
        - Seek to connect Wall Lake residents to a central sewer system
        - Enhance wetland habitat in the watershed
        - Work with NRCS and SWCD staff to install best management practices on agricultural land in the watershed
- Aquatic Vegetation management Plan Update 2014

    - Wall Lake Fisherman's Association first acquired grant funds from the IN DNR in 2005 to write an AVMP, which was completed in 2006. Since the first AVMP, an update has been completed in 2007, 2008, 2009, 2012, and 2014. Eurasion watermilfoil, starry stonewort, and curlyleaf pondweed have all been introduced to Wall Lake. Starry stonewort is a relatively new species in Wall Lake and treatment for this species first began in 2010. A terrestrial invasive plant species, purple loosestrife, has also begun to establish itself in surrounding wetland areas. Recommended treatment areas and rates of application are outlined in the AVMP. Specific recommendations to control the growth of invasive plant species in Wall Lake include;
        - Limit the occurrence of curlyleaf pondweed and Eurasian watermilfoil in late season sampling to 5% or less
        - Maintain a minimum of 10 native plant species with a diversity rate of 0.80

Cedar Lake

- Cedar Lake Diagnostic Study
    - The IN DNR Lake and River Enhancement staff performed a diagnostic study of Cedar Lake in 2009 and 2010, with the final report being released in 2010. The study found that the water quality is generally good and clear. There is little diversity in aquatic vegetation, and presents few recreational barriers, except for a few midsummer algae blooms. There is a diverse group of fish species found in Cedar Lake, which keeps the fishery at a satisfactory level. The study state's that the lake is only 70% built-up, which is far less built up than surrounding lakes and the Lake is surrounded by pristine wetlands which may filter many pollutants out prior to stormflow reaching Cedar Lake. The study suggests several steps to take to maintain the high quality of Cedar Lake including:
        - Promotion of BMPs to Lake residents such as;
            - Phosphorus free fertilizer
            - Shoreline habitat improvement
            - Installation of rain gardens and rain barrels to capture stormflow
            - And preventative maintenance of septic systems
        - Take precautions to avoid spreading aquatic invasive species
        - Maintain a volunteer base to take regular water quality samples through Hoosier Riverwatch
        - Protect and promote the importance of surrounding wetlands
        - Partner with LaGrange county SWCD and surveyor to promote BMPs to limit erosion of nutrients and sediment from agriculture, timber harvest, and construction projects.

    Following the above recommendations, not only in the Cedar Lake watershed but throughout the lake community, will help to address Fawn River stakeholder concerns such as wetland conservation, lack of no-till and cover crop practices, septic system discharge, and urban fertilizer use .

2.6.4 Other Studies

St. Joseph River Watershed Fish Migration Barrier Inventory

The Potawatomi Resource Conservation and Development Council (RC&D) conducted a study, which was published in 2011, of culvert, dams, and bridges located within the St. Joseph, Lake Michigan watershed to determine if the structures posed a problem for the necessary migration of aquatic life. The study used a scoring method on the impact the structures had on aquatic habitat, whether or not a partner agency or organization put priority on a particular structure, the cost of removal or modification to the structure, and a social score to determine the purpose of the structure. Then the scores were used to determine the priority of removal or modification to the structure.

Results from the study indicated that one hydroelectric dam, the Star Mill Dam, located on the Fawn River in LaGrange County was a high priority for removal or modification. The results of the study also indicated that there were four culverts located on the Fawn River that did not allow the passage of some aquatic species (three in LaGrange County and one in St. Joseph County) and one culvert that became a barrier at high flows in LaGrange County. The study suggests further investigation of these sites to determine the best means of modifying them to allow for the safe passage of aquatic life.

Fawn River Restoration

It has been estimated that approximately 100,000 cubic yards of sediment was released in 1998 from the Fawn River Fish Hatchery when their fish pond dams needed to be lowered to allow for repairs. The sediment covered what was a gravel floor, and filled a deep thalweg, which buried prime aquatic habitat. Landowners adjacent to the Fawn River sought funding for restoration efforts, which was awarded to the landowners in 2011. The funds were put into the Fawn River Restoration and Conservation Charitable Trust (Trust).

The Trust hired an environmental consulting firm to do the restoration. Sediment was removed and the thalweg was restored. Additionally, large woody debris structures were installed to restore the sinuosity of the stream. The restoration work looks to be effective and the Trust plans to expand restoration efforts to other areas of the Fawn River.

2.6.5 Wellhead Protection Plans

The majority of the rural community utilizes private water wells located on their property. Smaller incorporated areas and villages also acquire their drinking water from groundwater wells; however those wells are overseen by the State environmental regulating agency. Those communities are commonly known as community public water supply systems (CPWSS). A CPWSS is designated as such if it has 15 service connections or supplies drinking water to at least 25 people, according to the federal Safe Drinking Water Act. The entity controlling the system is required to develop a Wellhead Protection Plan (WHPP). A WHPP must contain five elements; 1) Establishment of a local planning team, 2) Wellhead Protection Area Delineation of where ground water is being drawn from, 3) Inventory of existing and potential sources of contamination to identify known and potential areas of contamination within the wellhead protection area, 4) Wellhead Protection Area Management to provide ways to reduce the risks found in step three, and 5) Contingency Plan in case of a water supply emergency. It is also important to identify areas for new wells to meet existing and future water supply needs. There are two phases of wellhead protection. Phase I is the development of the WHPP which involves delineating the protection area and determining sources of potential contamination. Phase II is the implementation of the WHPP. Table 2.13 identifies those CPWSSs located within the project area and which phase they are currently in. A map of well head protection areas in Indiana is not available since the delineation of such areas is not made public; however an approximate location of the WHPP was used and is delineated on a map which can be found in Figure 2.23. Michigan has made available the delineation of wellhead protection plans which are also outlined in the below figure.

Table 2.13: Wellhead Protection Plans in the Fawn River Watershed

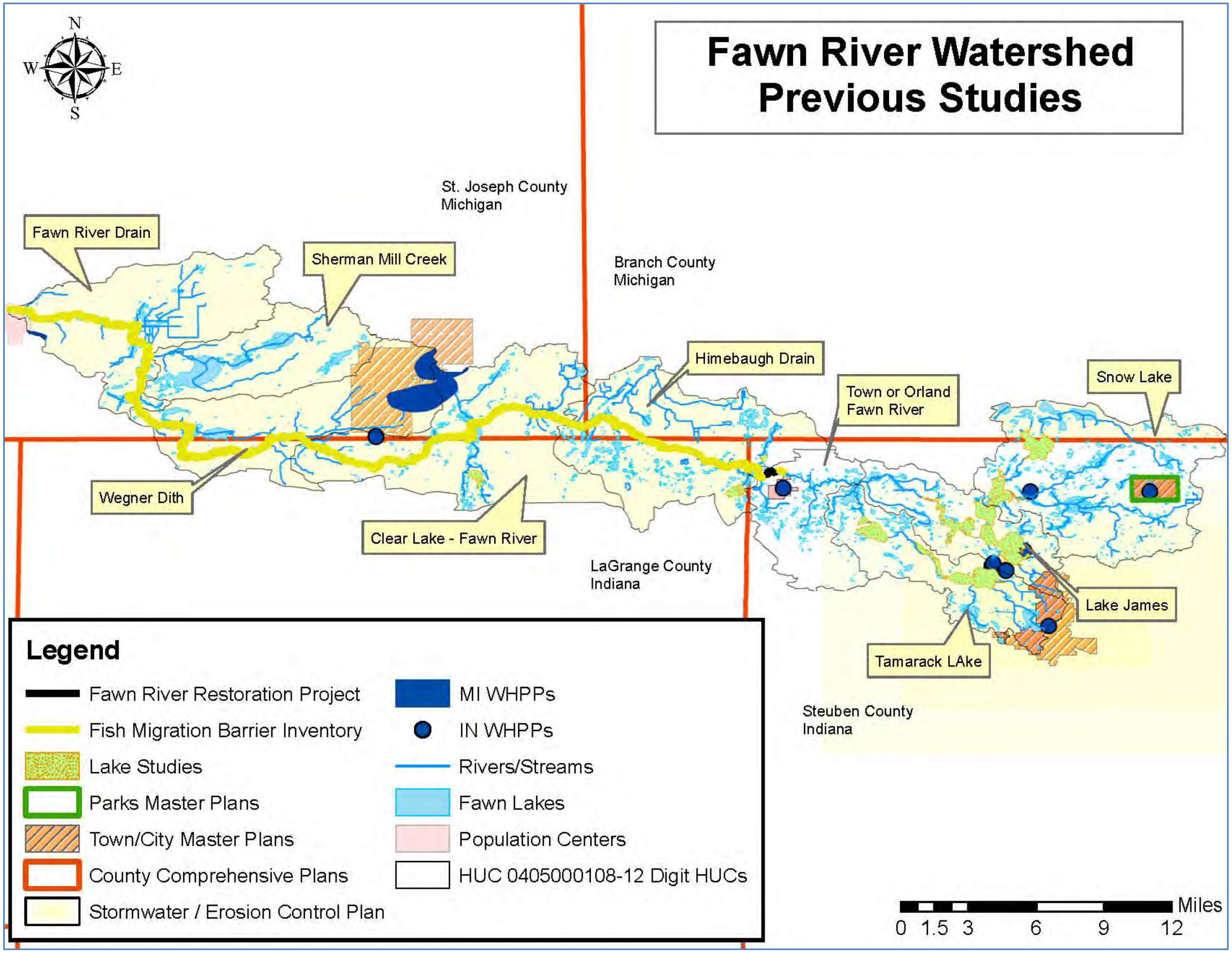
System Name	Population Served	Source	Phase	Watershed
Constantine	2095	GW	Unknown	Fawn River Drain
Sturgis	11920	GW	Unknown	Wegner Ditch
Memory Lane Mobile Home Park	568	GW	Unknown	Wegner Ditch
Fawn River Crossing	587	GW	Phase II	Wegner Ditch
Angola Water Department	8276	GW	5 yr update	Tamarack Lake
Fremont Water Department	1697	GW	Phase II	Snow Lake
Mobil-Rama	30	GW	Phase II	Snow Lake
Or-An Tc/Cleveland Tr. S.	46	GW	Phase II	Lake James
Linda Ann Mobile Home Court	30	GW	Phase II	Tamarack Lake
Leisure Lakes Mobile Home Court	27	GW	Phase II	Lake James
Orland Water Works	341	GW	Phase II	Town of Orland-Fawn River
Coachlight Mobile Home Court (Lots 1-18)	48	GW	Phase II	Lake James
Glen Eden Association	35	GW	Phase II	Lake James

2.6.6 Municipal Separate Storm Sewer System

The federal Clean Water Act requires storm water discharges from larger urbanized areas to be permitted under the National Pollutant Discharge Elimination System (NPDES) program. These communities are referred to as Municipal Separate Storm Sewer System (MS4) Communities and are required to develop a Storm Water Quality Management Plan.

The City of Angola and Trine University are co-permitted and is the only entity located within the project area designated as an MS4 community. IDEM describes a MS4 as “a conveyance or system of conveyances owned by a state, city, town, or other public entity that discharges to waters of the United States and is designed or used for collecting or conveying storm water.” The reason that MS4s are required is that urban storm water runoff has one of highest potentials for carrying pollutants to our waterways and as such, the Federal Clean Water Act requires that certain storm water dischargers acquire a National Pollutant Discharge Elimination System (NPDES) permit. Being an MS4 community, Angola was required to develop a Storm Water Quality Management Plan (SWQMP). The SWQMP must include six management techniques, referred to as “minimum control measures” (MCMs) including; 1) Public education and outreach; 2) Public participation and involvement; 3) Illicit discharge, detection and elimination; 4) Construction site runoff control; 5) Post-construction site runoff control; and 6) Pollution prevention and good housekeeping. Essentially, the MCMs list several management practices to limit the amount of storm water entering the sewers on a regular basis. Only about half of the City of Angola is located in Fawn River watershed, and the sewer conveyance system discharges storm water to the Pigeon Creek watershed. However, since the Pigeon Creek is also part of the larger St. Joseph River watershed, promotion of the MCMs outlined in the SWQMP should be promoted through this project for the portion of the MS4 community located within the project area, at a minimum.

Figure 2.23: Historic and Existing Studies in the Fawn River Watershed



2.7 Endangered Species

The Fawn River watershed is home to many federally and state listed endangered and threatened species. The US Fish and Wildlife Service (USFWS) maintains a database of those species that are either endangered, threatened, or candidates to become endangered on the federal level which can be seen in Table 2.14. There are several species of significance located within the Fawn River watershed which rely on wetland and upland forested areas for habitat, including the three mussel species, two butterflies, two snakes, an important plant species and the Indiana Bat.

According to the USFWS, the Indiana Bat population has decreased by over half since it was originally listed as endangered in 1967. This decrease in population can be attributed to human activities disturbing the Indiana Bat's habitat. Indiana Bats are very vulnerable to disturbances in their hibernation grounds as they hibernate in mass numbers (20,000 to 50,000) in caves in southern Indiana. The reason the bats population has declined in northern Indiana is mainly due to their breeding and feeding grounds, riparian and upland forests, being cleared for agricultural land and expanding urbanization. The Eastern Massasauga Rattlesnake lives in wetland areas, many of which have been drained to be used for agriculture. With much of the Eastern Massasauga's habitat being converted for other uses, the snakes numbers have declined dramatically. Many of the species listed as endangered at the federal level rely on wetland habitat for survival, and the clearing of that key land feature has caused the decline in those species numbers. State's Fish and Wildlife Agencies have listed several additional species not found on the federal list as endangered or threatened. The protection of the habitat in which all the species listed in Table 2.12 live is essential to their survival.

Table 2.14: Federally Listed Endangered Species

County	Species	Common Name	Status	Habitat	Image
		Mammal			
St. Joseph, Branch, LaGrange	*Myotis sodalis*	Indiana Bat	Endangered	Hibernation in caves, swarming in wooded areas and stream riparian corridors	
		Mussels			
Steuben	*Pleurobema clava*	Clubshell	Endangered	Fresh water, Rivers	
LaGrange	*Epioblasma triquetra*	Snuffbox	Endangered	Small to medium sized creeks with swift current and sand, gravel or cobble substrate (can be found in Lake Erie and some larger rivers)	
LaGrange	*Villosa fabalis*	Rayed Bean	Endangered	Smaller headwater creeks, sometimes larger rivers	

County	Species	Common Name	Status	Habitat	Image
Insects					
St. Joseph, Branch, Steuben, LaGrange	*Neonympha mitchellii mitchellii*	Mitchell's Satyr	Endangered	Fens	
LaGrange	*Lycaeides melissa samuelis*	Karner Blue	Endangered	Pine and oak savanna/barrens supporting wild lupine and nectar plants	
Reptiles					
St. Joseph, Branch, Steuben, LaGrange	*Sistrurus catenatus catenatus*	Eastern Massasauga	Candidate	Wetlands and adjacent uplands	
St. Joseph, Branch, Steuben, LaGrange	*Nerodia erythrogaster neglacta*	Copperbelly Watersnake	Threatened	Wooded and permanently wet areas such as oxbows, sloughs, brushy ditches, and floodplain woods	
Birds					
LaGrange	*Haliaeetus leucocephalus*	Bald Eagle	Threatened, Proposed for Delisting	Near water with old trees	

County	Species	Common Name	Status	Habitat	Image
Plants					
St. Joseph, Steuben, LaGrange	*Platanthera leucophaea*	Prairie White-fringed Orchid (Eastern Prairie Fringed Orchid)	Threatened	Mesic praire to wetlands, grassy habitat with little to no woody encroachment	

2.11 Invasive Species

Invasive species are those organisms that do not naturally occur in a specific area and when introduced will cause deleterious effects on the ecology of the area. Invasive species may be one of the greatest threats to the natural areas within the Fawn River Watershed. Due to the fact that the newly introduced organism does not have natural predators, the organism can spread through an area quickly and can out compete native organisms that make an ecosystem thrive. Invasive species are of particular concern to the lake communities as invasive plants and aquatic organisms have already caused a decline in native plants and fish. Invasive species are also easily transported through the lake community as seeds, eggs, and actual organisms will attach themselves to boats which are then used in multiple different lakes, essentially transporting the organisms between different lakes. Table 2.15 is a list of invasive species that are located throughout the greater St. Joseph – Lake Michigan watershed, and can likely be found within the Fawn River watershed. That list of invasive species was obtained from the USDA-NRCS electronic Field Office Technical Guide (eFOTG). Table 2.16 is a list of invasive plant species that can be found in one or more of the four counties in which the Fawn River watershed is located. The eFOTG does not have the invasive plants listed for Indiana; therefore, the invasive plants list for Indiana was obtained from the Purdue University Extension website.

Table 2.15: Invasive Species in the St. Joseph-Lake Michigan Watershed

Common Name	Scientific Name	Habitat	Exotic / Native / Transplant	Source of Species	Image
Coelenterates					
Freshwater jellyfish	*Craspedacusta sowerbyi*	Freshwater	Exotic	Tranported with ornamental aquatic plants from China	
Crustacean					
scud	*Echinogammarus ischnus*	Freshwater- Marine	Exotic	Ballast water from Black Sea and Caspian Sea drainage	
Fish					
American shad	*Alosa sapidissima*	Freshwater - Marine	Native	Stocking in non-native waters	
Oscar	*Astronotus ocellatus*	Freshwater	Exotic	Stocking in non-native waters	
unidentified pacu	*Colossoma or Piaractus sp.*	Freshwater	Exotic	Aquarium releases or escapes from fish farms	
Grass carp	*Ctenopharyngodon idella*	Freshwater	Exotic	Stocking in non-native waters	

Common Name	Scientific Name	Habitat	Exotic / Native / Transplant	Source of Species	Image
Common carp	*Cyprinus carpio*	Freshwater	Exotic	Unauthorized stocking in non-native waters in 1800s	
Redear Sunfish	*Lepomis microlophus*	Freshwater	Native	Stocking in non-native waters	
Round goby	*Neogobius melanostomus*	Freshwater	Exotic	Ballast water from Black Sea	
Rainbow trout	*Oncorhynchus mykiss*	Freshwater - Marine	Native	Stocking in non-native waters	
Chinook Salmon	*Oncorhynchus tshawytscha*	Freshwater - Marine	Native	Stocking in non-native waters	
Coastal rainbow trout	*Oncorhynchus mykiss irideus*	Freshwater - Marine	Native	Stocking in non-native waters	
Sea Lamprey	*Petromyzon marinus*	Freshwater - Marine	Non-native to freshwater	Possibly introduced through the Erie Canal	

Common Name	Scientific Name	Habitat	Exotic / Native / Transplant	Source of Species	Image
pirapatinga, red-bellied pacu	*Piaractus brachypomus*	Freshwater	Exotic	Aquarium releases	
Atlantic Salmon	*Salmo salar*	Freshwater - Marine	Native	Stocking in non-native waters	
Brown trout	*Salmo trutta*	Freshwater	Exotic	Imported from Germany for sportfishing stock	
Brook Trout	*Salvelinus fontinalis*	Freshwater	Native	Stocking in non-native waters	
Lake Trout	*Salvelinus namaycush*	Freshwater	Native	Stocking in non-native waters	
Saugeye	*Sander canadensis x vitreus*	Freshwater	Native hybrid	Unknown	
Mullusks					
zebra mussel	*Dreissena polymorpha*	Freshwater	Exotic	Ballast water from Black Sea ship to Great Lakes	

Common Name	Scientific Name	Habitat	Exotic / Native / Transplant	Source of Species	Image
quagga mussel	*Dreissena rostriformis bugensis*	Freshwater	Exotic	Ballast water from Dneiper River drainage of Unkrain and Caspian Sea	
Chinese mysterysnail	*Cipangopaludina chinensis malleata*	Freshwater	Exotic	Sold in Chinese food markets in 1800s, possible aquarium release	
Reptiles					
American Alligator	*Alligator mississippiensis*	Freshwater	Native	Escaped or released pets	
Alligator Snapping Turtle	*Macrochelys temminckii*	Freshwater	Native	Released pets	
Insects					
Common Pine Shoot Beetle	*Tomicus piniperda*	Pine trees	Exotic	Native to Europe. Discovered in Ohio in 1992	

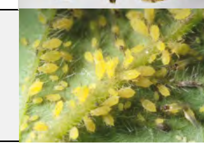
Common Name	Scientific Name	Habitat	Exotic / Native / Transplant	Source of Species	Image
Emerald Ash Borer	*Agrilus planipennis*	Ash Trees	Exotic	Likely cargo ships from eastern Russia, northern China, Japan or Korea. Discovered in 2002	
European Gypsy Moth	*Lymantria dispar dispar*	Temperate Forests	Exotic	Native to temperate forest of western Europe. Discovered in US in 1869	
Soybean Aphid	*Aphis glycines*	Underside of Soybean leaves	Exotic	Native to Asia. Discovered in 2000	

Table 2.16: List of Invasive Plant Species per County

Counties	Common Name	Scientific Name	Habitat
St. Joseph, Branch, Steuben, LaGrange	Asian Bush Honeysuckle(s)	*Includes many Lonicera*	Forest
	Autumn Olive	*Elaeagnus umbellata*	Openland
	Black Locust	*Robinia pseudoacacia*	Openland
	Canada Thistle	*Cirsium arvense*	Openland
	Common Reed; Phragmites	*Phragmites australis*	Wetland
	Curly-Leaf Pondweed	*Potamofeton crispus*	Wetland
	Eurasian Watermilfoil	*Myriophyllum spicatum*	Wetland
	Garlic Mustard	*Alliaria periolata*	Forest
	Japanese Knotweed	*Polygonum cuspidatum*	Forest
	Multiflora Rose	*Rosa multiflora*	Forest, Openland
	Norway Maple	*Acer platanoides*	Forest
	Purple Loosestrife	*Lythrum salicaria*	Wetland
	Reed Canary Grass	*Phalaris arundinacea*	Wetland
	Tree of Heaven	*Ailanthus altissima*	Forest

Counties	Common Name	Scientific Name	Habitat
St. Joseph, Branch, Steuben	Japanese Honeysuckle	*Lonicera japonica*	Forest
St. Joseph, Branch, LaGrange	Oriental Bittersweet	*Celastrus orbiculatus*	Forest
St. Joseph, Branch	amur cork-tree	*Phellodendron amurense*	Forest and Openland
	Baby's breath	*Gypsophila scorzonerifolia*	alkaline or limestone shores
	Bell's honeysuckle	*Lonicera x bella*	Forests, Openland
	Black jetbead	*Rhodotypos scandens*	Forest, Openland
	Black swallowwort	*Cynanchum louiseae*	Forest and open land
	Common buckthorn	*Rhamnus cathartica*	Forest, wetlands, Openland
	European fly honeysuckle	*Lonicera xylosteum*	Forest and Openland
	European frog-bit	*Hydrocharis morsus-ranae*	Wetland
	Flowering rush	*Butomus umbellatus*	Wetland
	Giant hogweed	*Heracleum mantegassianum*	Openland
	Giant knotweed	*Fallopia sachalinensis*	Floodplain forests, Openland
	Glossy buckthorn	*Rhamnus frangula*	wetlands, prairie, forests
	Hydrilla	*Hydrilla verticillata*	Wetland
	Japanese barberry	*Berberbis thunbergii*	Forest, Openland
	Japanese silt grass	*Microstegium vimineum*	Forests, riparian cooridor, openland
	kudzu	*Pueraria montana*	Openland
	Leafy spurge	*Euphorbia esula*	Openland and riparian areas
	Morrow's honeysuckle	*Lonicera morrowii*	Forest

Counties	Common Name	Scientific Name	Habitat
	pale swallowwort	*Cynanchum rossicum*	Upland forests and openland
	Reed mannagrass	*Glyceria maxima*	Wetland
	Russian Olive	*Elaegnus angustifolia*	Riparian areas, fields, openland
	Scotch pine	*Pinus sylvestris*	Openland
	Spotted knapweed	*Centaurea maculosa*	Openland
	Tartarian honeysuckle	*Lonicera ttatarica*	Forest
	Variable-leaf watermilfoil	*Myriophyllum heterophyllum*	Wetland
	water-hyacinth	*Eichornia crassipes*	Wetland
Steuben	Creeping Jenny	*Lysimachia nummularia*	Forest, Wetland
Steuben, LaGrange	Buckthorn(s)	*Rhamnus (frngula) cathartica)*	Wetland, openland
	Crown Vetch	*Securigera varia*	Openland
	Dame's Rocket	*Hesperis matronalis*	Forest, Openland
	Periwinkle	*Littorina littorea*	Forest
	Privet(s)	*Ligustrum obtusifolium*	Forest
	Purple Winter Creeper	*Euonymus fortunei*	Forest
	Siberian Elm	*Ulmus pumila*	Forest
	Smooth Brome	*Bromus inermis*	Forest, Openland
	Star-of-Bethlehem	*Ornithogalum nutans and O. umbelatum*	Wetland and riparian areas
	Sweet Clover(s)	*Melilotus officinalis*	Openland
	Tall Fescue	*Festuca arundinacea*	Openland
	White Mulberry	*Morus alba*	Openland

2.12 Summary of Watershed Inventory

All of the elements described above, when combined, can provide a larger picture of how the watershed functions and what activities may pose a greater threat to our water resources. This section will summarize the characteristics of the project area and describe how they relate to each other. This will be examined more closely in subsequent sections.

The predominant land use in the Fawn River watershed is agriculture due to the fertile soils, much of which used to be wetlands as can be seen by the amount of hydric soil present within the watershed (Figure 2.6). Hydric soils are not ideal for agricultural use due to the frequency of ponding and/or flooding. When soils are over saturated, excess nutrients and animal waste often wash off the field and may discharge directly into surface waters. Many landowners install field tiles or petition to convert open water to legal drains to be maintained by the county surveyor or engineer to prevent crop land from becoming over saturated. As can be seen in Figure 2.12, many streams and ditches have been converted to be on regular maintenance by the County, especially in Steuben County; 66.86 miles of open drain and 44.18 miles of tiled drains. However, this practice provides a direct means for nutrients, sediment, and bacteria to enter surface water, or depending on the depth to the water table, to groundwater resources used for crop irrigation or drinking water. For these reasons best management practices should be implemented on agricultural land with hydric soils, especially those using field tiles to drain the crop land.

Although only a little more than 7% of the watershed is considered developed, it is important to focus water quality improvement efforts in the urban areas specifically surrounding developed lakes. Fertilizer used on urban lawns can exacerbate aquatic plant growth which can alter the aquatic ecosystem, as well as inhibit regular recreational activities on the lakes. Many lakes in the watershed have begun to implement a “no phosphorus” fertilizer program as phosphorus is considered the limiting agent to algae growth. Also, many residents on the lakes have installed concrete sea walls at their property’s shoreline. The hard surface sea walls often destroys the gradual transition from shallow to deep water, and the crashing of the waves on the wall causes bottom sediments to stir up which increases turbidity. The use of sea walls can destroy habitat for many fish species, including their spawning areas, and block access to and from the water for turtles, frogs and other creatures that need access to land for feedings, resting and nesting.

There are several populated areas located within the Fawn River watershed including Fremont and Angola, IN and Sturgis, MI. While only Angola is required to have education and outreach regarding stormwater control due to it being an MS 4 community, stormwater management should be promoted in all populated areas, as urban stormwater has the greatest potential to carry many pollutants to open water including oil, grease, lawn fertilizer, salts, sediment, and other pollutants that can be harmful to the aquatic ecosystem.

Nearly ¼ of all soils in the watershed are considered HEL or PHEL, as can be seen in Figure 2.45. Since so much of the farmed land in the watershed is considered to be erodible, special precautions should be taken by those producers working HEL and PHEL land to limit the amount of soil erosion. As soil erodes, it can increase stream and lake sedimentation. The eroding soil particles often carry nutrients that bind to the particles to open water sources as well. This may cause an increase in phosphorus and nitrogen levels within the water system, leading to unsuitable water quality.

Since the majority of the land use in the Fawn River watershed is agriculture, specifically row crops (greater than 48% of the watershed); sedimentation can have a major effect on water quality and biota. Tillage data collected by each county (except those in MI in which a transect has not been conducted in decades) in the watershed indicates a relatively fair adoption of conservation tillage practices, especially in Steuben County with 80% of corn and 96% of beans utilizing conservation tillage. Conservation tillage requires a minimum of 30% residue cover on the land. This type of tillage decreases the potential for soil erosion, decreases soil compaction, and can save the producer time and money by minimizing the number of passes made on each field while preparing for the next planting season.

It was noted during the windshield survey that many producers are utilizing field irrigation sprinklers to water their crops, and also that many fields lack an adequate buffer to slow stormwater and absorb fertilizer and other pollutants prior to reaching open water. As mentioned above, conventional tillage increases erosion of farm fields, and irrigations, without proper management can do the same, as well as wash off nutrients meant for plant uptake. For these reasons, it is important to install adequate riparian buffers adjacent to crop fields.

There are 10 populated areas that are currently served by a centralized sewer system including all towns and cities located in the watershed, as well as some of the built up lakes. However, much of the watershed, approximately 82% is rural and therefore, many homes utilize on-site sewage treatment for their household effluent. While accurate estimates of the number of failing or failed septic systems could not be obtained for the project area, the US EPA estimates that up to 5% of all septic systems are currently failing. The USDA soil survey for Steuben, LaGrange, St. Joseph and Branch counties lists less than 10% of the soil in the project area as being suitable for septic system treatment as can be seen in Figure 2.7 on page 17. These two facts may lead one to believe that bacteria contamination, and excessive nutrients found within the water samples may be partly due to improperly sited septic systems and/or failing systems.

The entire population of the Fawn River watershed obtains their drinking water from groundwater, including the major population centers of Angola, Fremont, Orland, Sturgis, and Constantine from wells. Field tiles and improperly placed or faulty septic systems can seriously affect the integrity of the groundwater aquifer to be used for drinking water as the contaminated effluent may not be entirely filtered as it percolates through the soil. Leaking underground storage tanks can also pollute groundwater, contaminating drinking water with various harmful chemicals. For this reason, special precautions must be taken to ensure that the watershed's populations drinking water source in not polluted.

As stated earlier, the majority of the land within the project area is used for agriculture and many of the wetlands that were once present have been drained for pasture land or row crops.

As mentioned in Section 2.4.3, it is estimated that the entire St. Joseph River Watershed has lost 53% of its historic wetlands. Wetlands play an important role in our ecosystem, not only as flood water traps and pollution sinks, but also as prime habitat for many of the species listed as endangered or threatened. For instance, the Indiana Bat, Copperbelly Water Snake, and Massasauga Rattlesnake all prefer the habitat provided by wetlands. Forest land, much of which has been cleared for agriculture, is also a vital habitat for endangered species, such as the Indiana Bat. Leaving some agricultural land fallow and replanting the fields with native vegetation to allow the landscape to return to forest or wetland will provide more vital habitat for those endangered and threatened species. Many of the strategic and comprehensive planning efforts by local governments and interest groups have made goals for conserving and protecting natural areas including LaGrange and Steuben County Master Plans, the Fremont and Angola Comprehensive Plans, the Angola Parks and Recreation Master Plan, and the City of Sturgis Master Plan.

Table 2.16, below, links those concerns that stakeholders from the public meetings had regarding the project area and water resources, to evidence found during the initial project area inventory. More evidence will be provided in subsequent sections at the 12 digit HUC level.

Table 2.16: Stakeholder Concerns and Relevant Evidence for Concern

Concerns	Evidence	Potential Problem
Livestock access to open water	One site was noted during the windshield survey that allowed for livestock to have direct access to open water.	*E. coli* contamination, excess nutrients, erosion, sediment
Stormwater runoff from livestock operations	A few livestock issues were noted during the windshield survey (discussed in more detail in subsequent Sections). There are four CFOs located within the watershed. Nearly 10% of the watershed land use is considered to be pasture/hayland which would indicate the presence of livestock in those areas. Gently rolling hills of the watershed and the lack of riparian buffers allow for runoff to reach open water easily.	*E. coli* contamination, excess nutrients, and sediment
Increase in impervious surfaces	70 built-up lakes located within the watershed which increases the number of driveways, patios, and access roads.	Oil and grease, Excess sediment, nutrients

Concerns	Evidence	Potential Problem
Fertilizer used on urban lawns	70 built-up lakes in the project area. Many lake residences have lush and green lawns which indicate the use of commercial fertilizers. The same situation can be seen in many naighborhoods and residential areas in Angola, Fremont, and Sturgis.	Excess nutrients and impaired biotic communities
Lakes in the area becoming more developed	Lakes within the area continue to allow for construction of new homes as well as there already being 70 built-up lakes in the watershed.	Excess sediment, nutrients, impaired biotic communities, *E. coli*
Septic system discharge	There are 10 populated areas in the watershed that are serviced by a centralized sewer system. Many built-up lakes located throughout the watershed are utilizing on-site waste disposal systems and the entire rural population utilizes on-site waste disposal. It is estimated that nearly 5% of all septic systems in the US are currently failing.	Excess nutrients, sediment, *E. coli*
Lack of no-till and cover crop practices	MI counties has not performed a tillage transect since 1993 and District Conservationist could not provide an estimate of current tillage usage 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.	*E. coli* contamination, excess nutrients and sediments
Wetland Conservation	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 and comparing 1979 wetland data to 2005 data, the Fawn River watershed has lost approximately 616 acres of wetlands within that time.	Flooding, lack of wildlife and aquatic habitat and pollution sequestration, and impaired biotic communities
Stream Bank Erosion	The windshield survey revealed a lack of riparian buffer throughout the watershed which may increase streambank erosion.	Sedimentation, turbidity, impaired biotic community

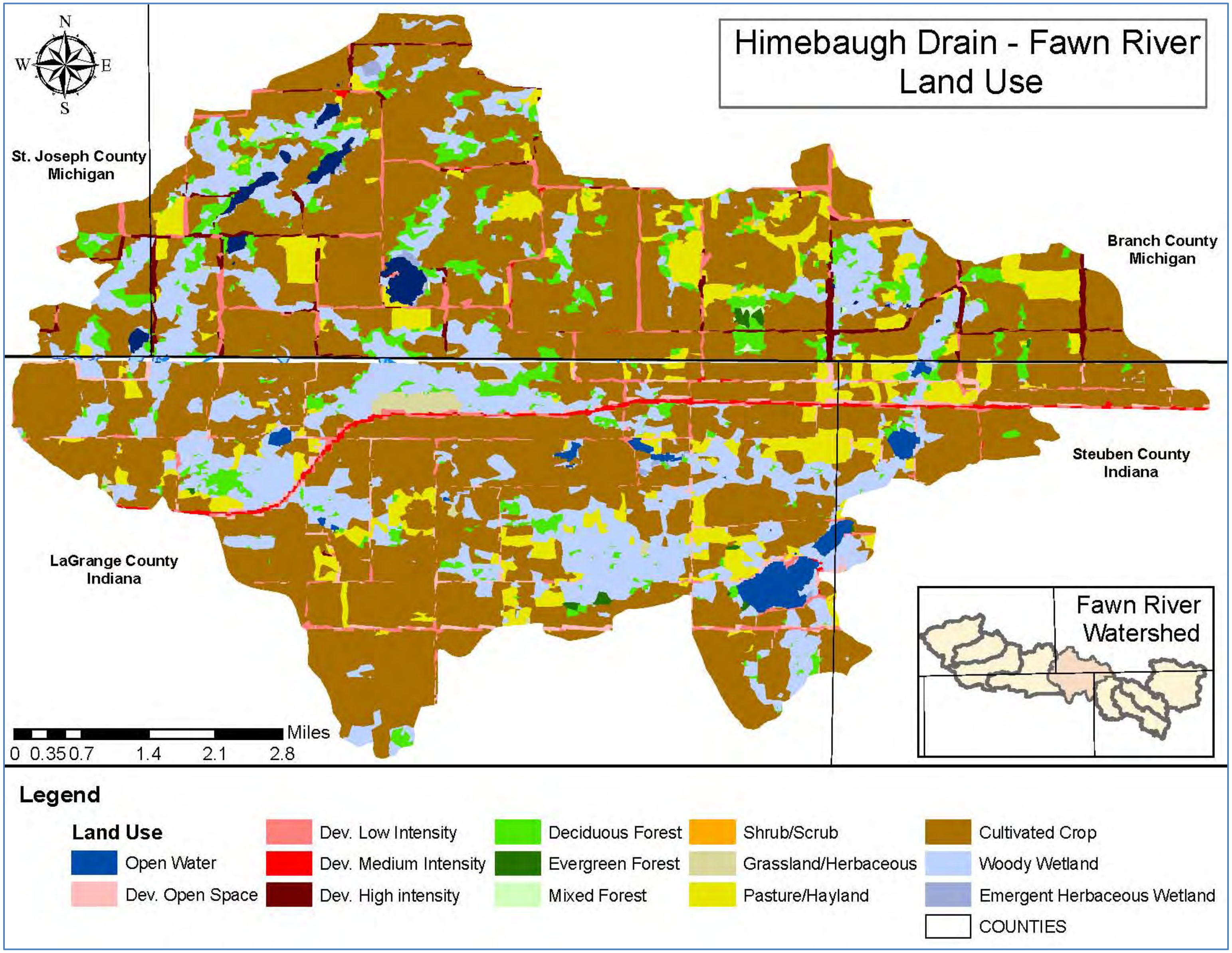
3.4.5 Himebaugh Drain – Fawn River Sub-watershed Land Use

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

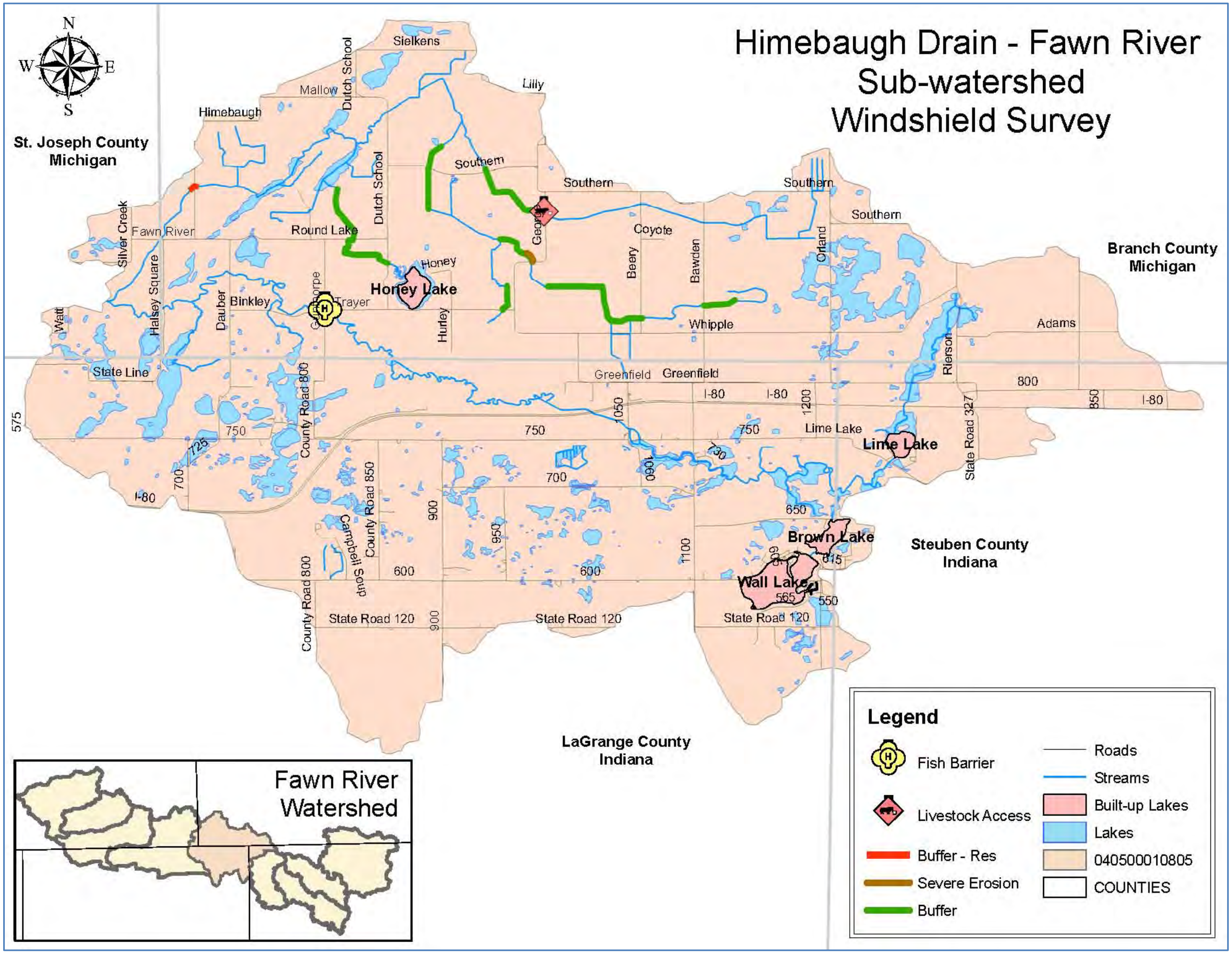
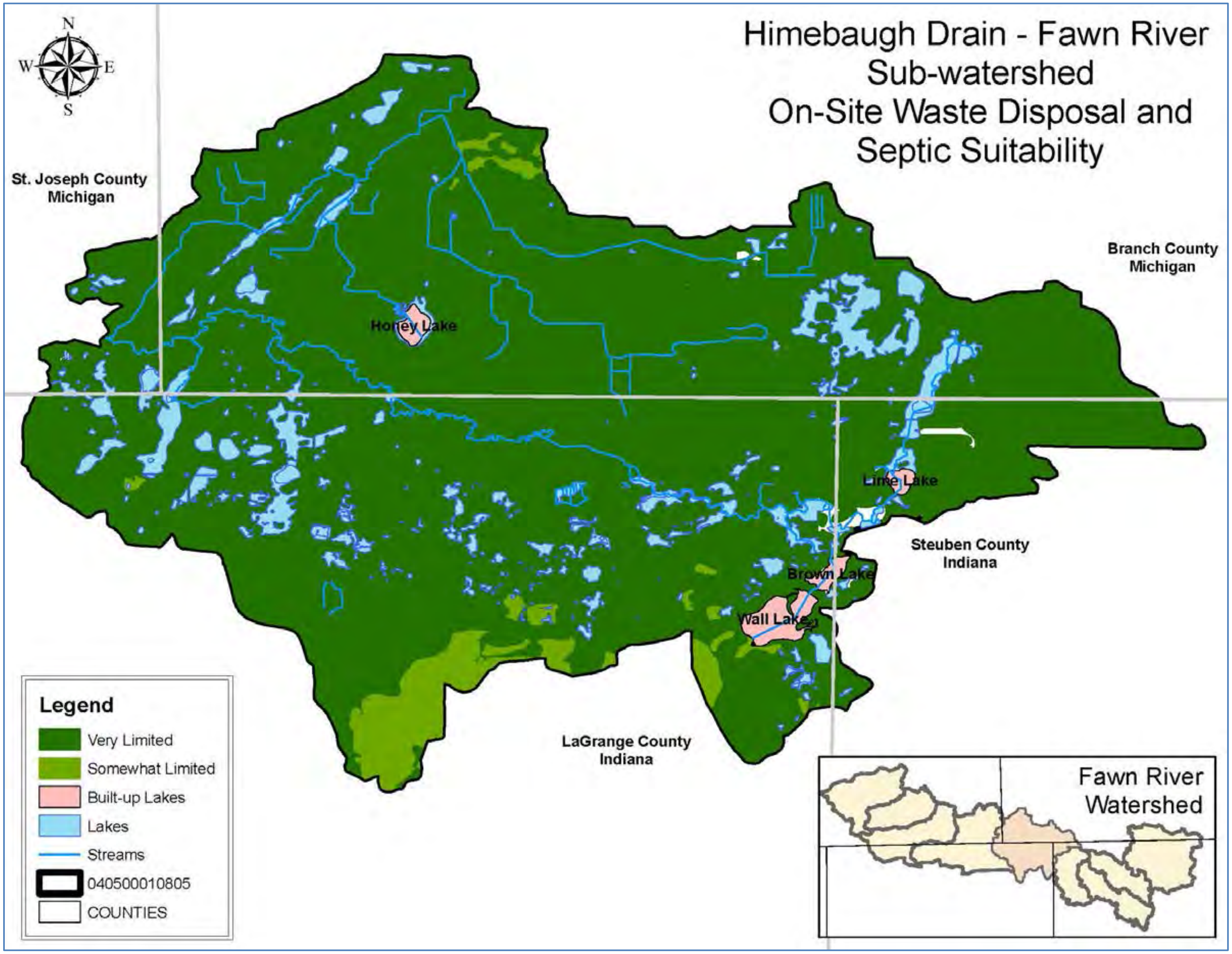


Figure 3.37: Septic Suitability in the Himebaugh Drain Sub-watershed



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

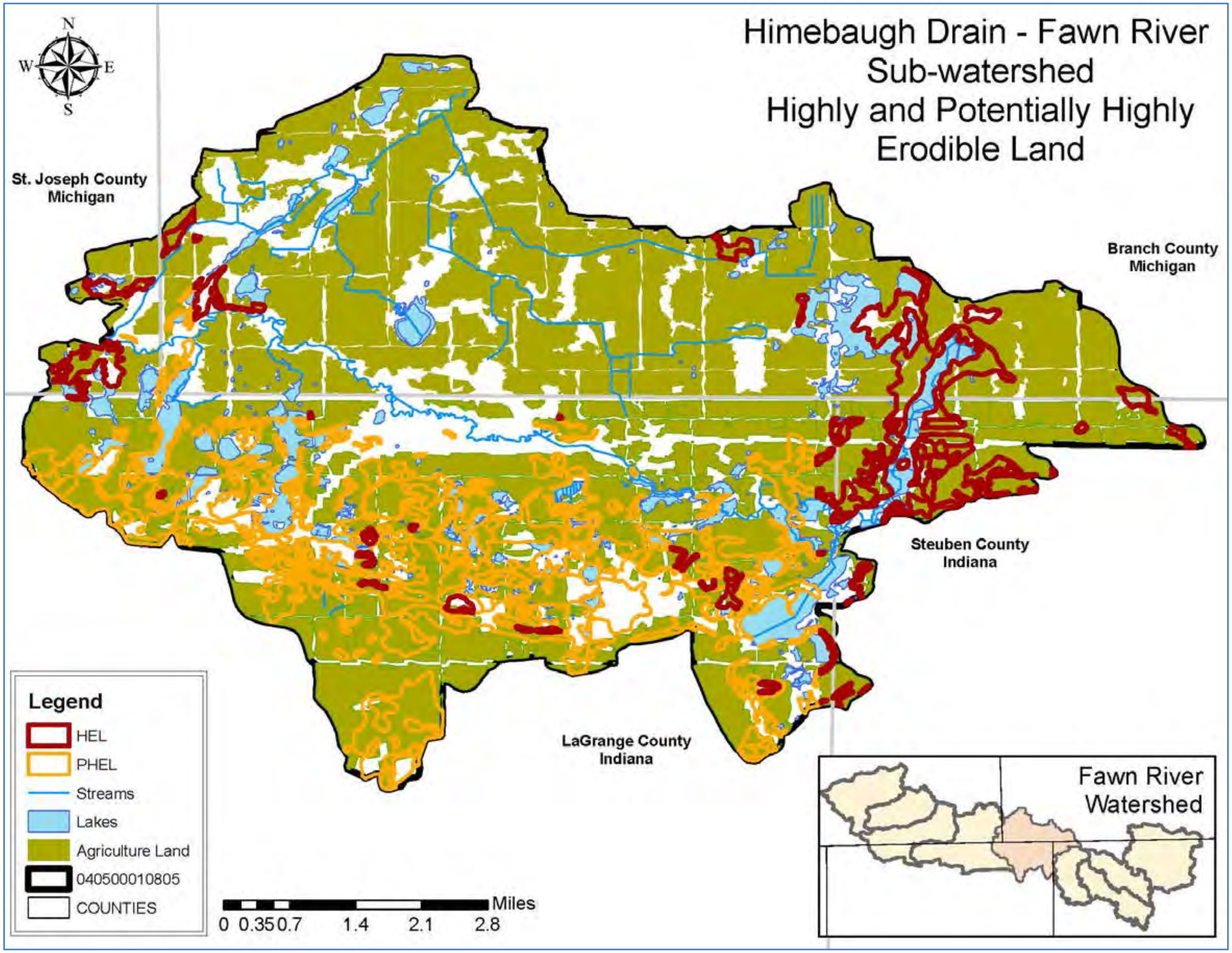
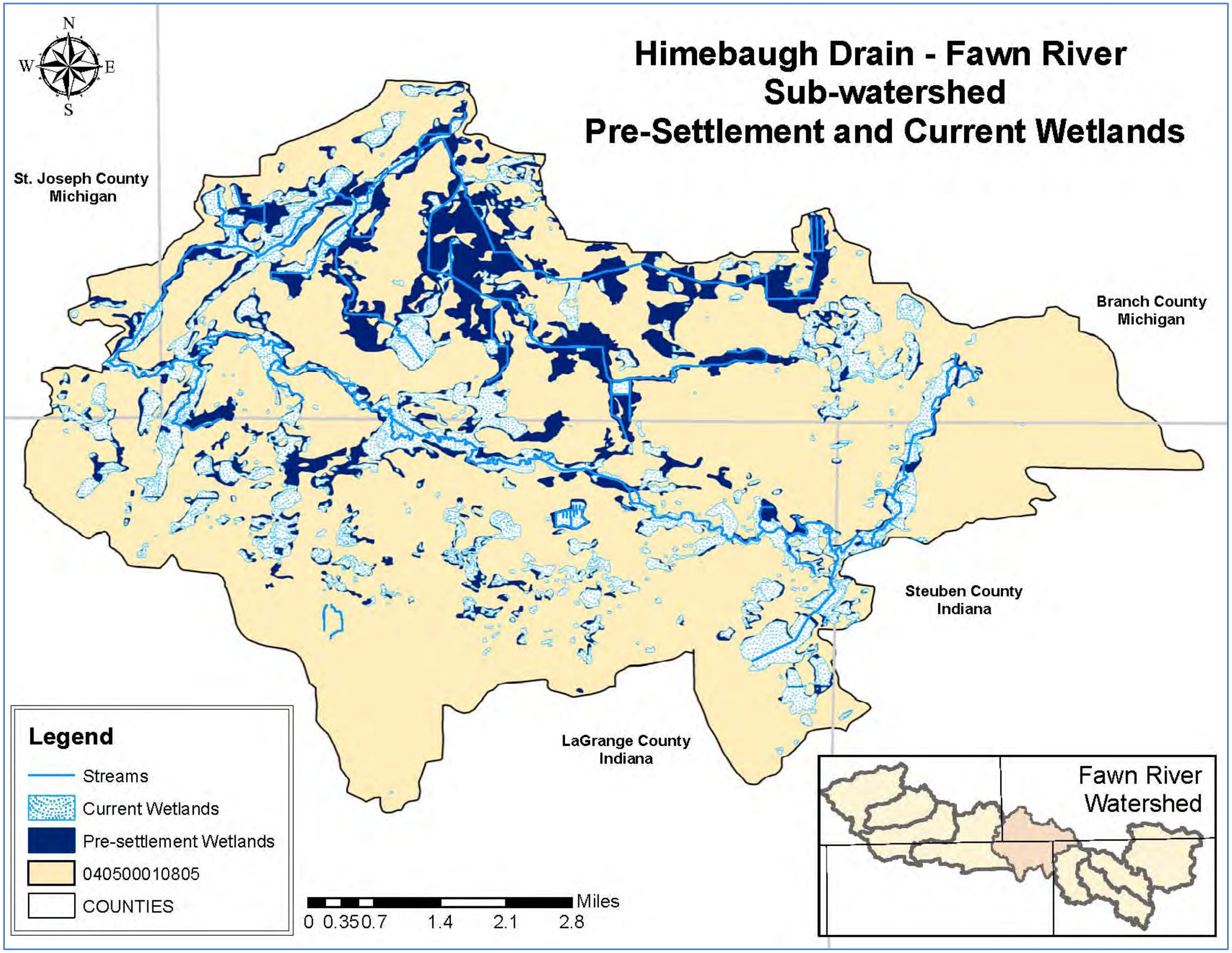


Figure 3.39: Wetlands in Himebaugh Drain Sub-watershed



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

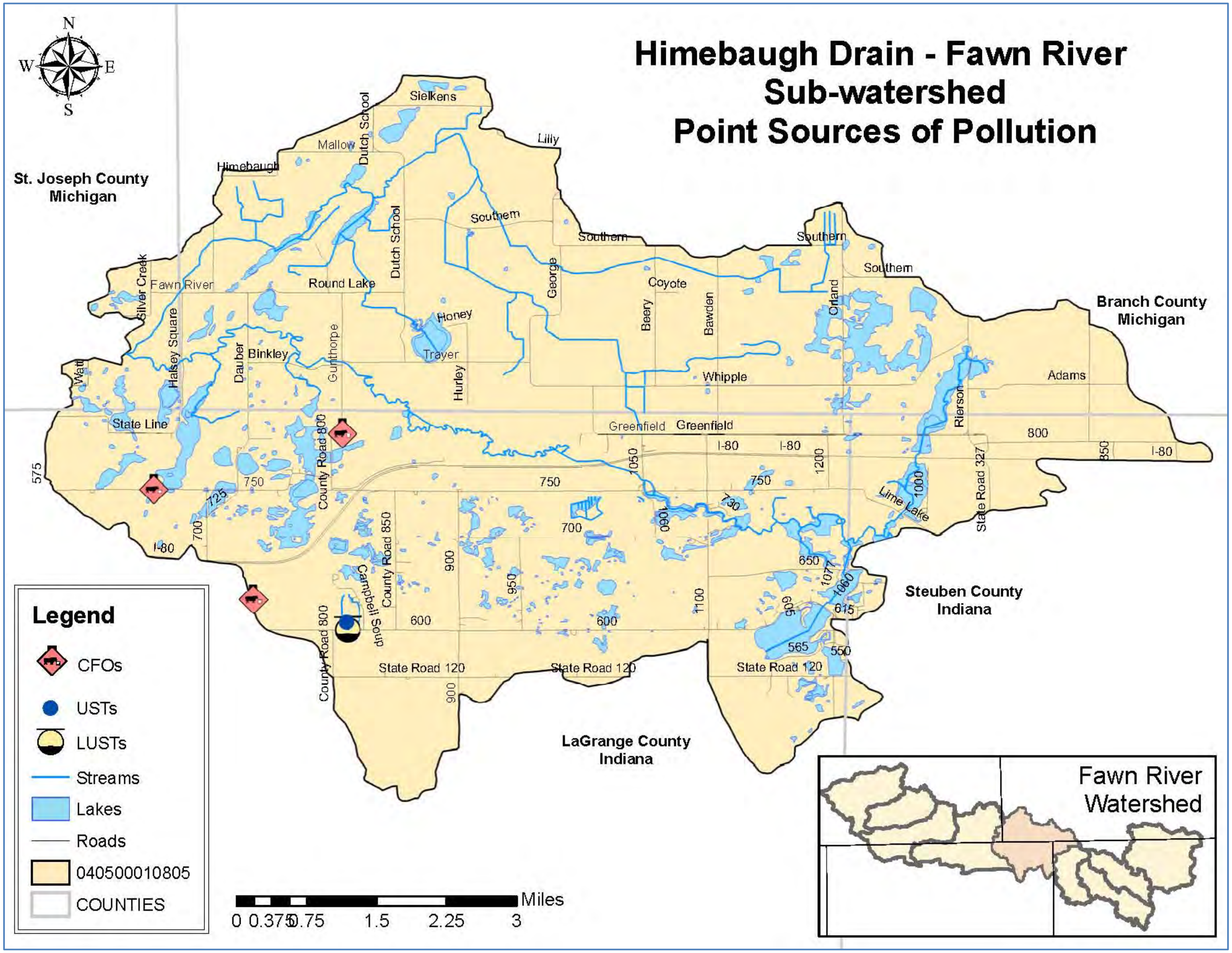
UST FACILITY ID	INCIDENT NUMBER	NAME	PRIORITY DESC	TANK STATUS DESCRIPTION	AFFECTED AREA NAME
16869	199004525	Campbell's Mushroom's, Inc.	Medium	Active	Soil
	199004525		Medium	Active	Groundwater

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.

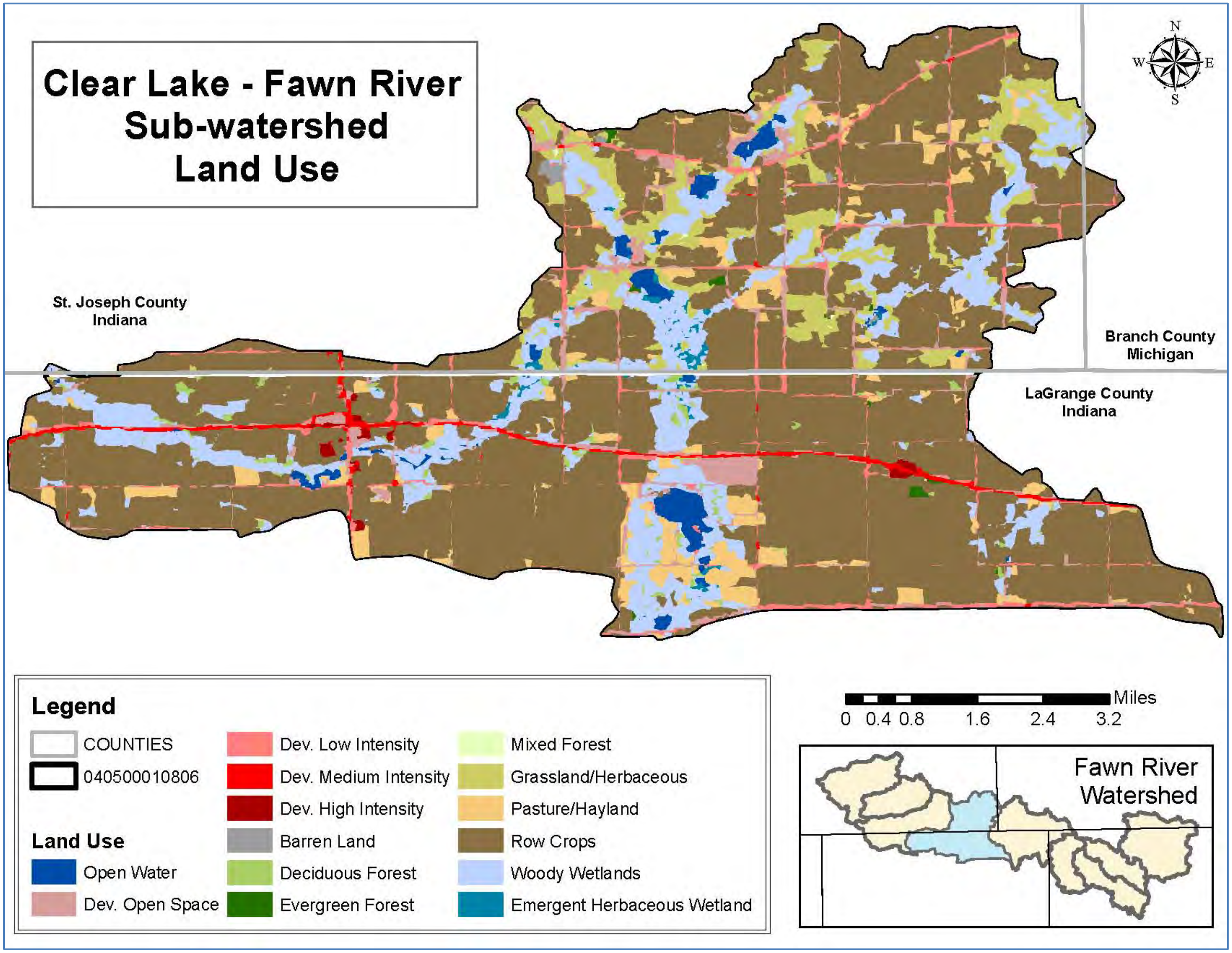
3.4.6 Clear Lake – Fawn River Sub-watershed Land Use

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

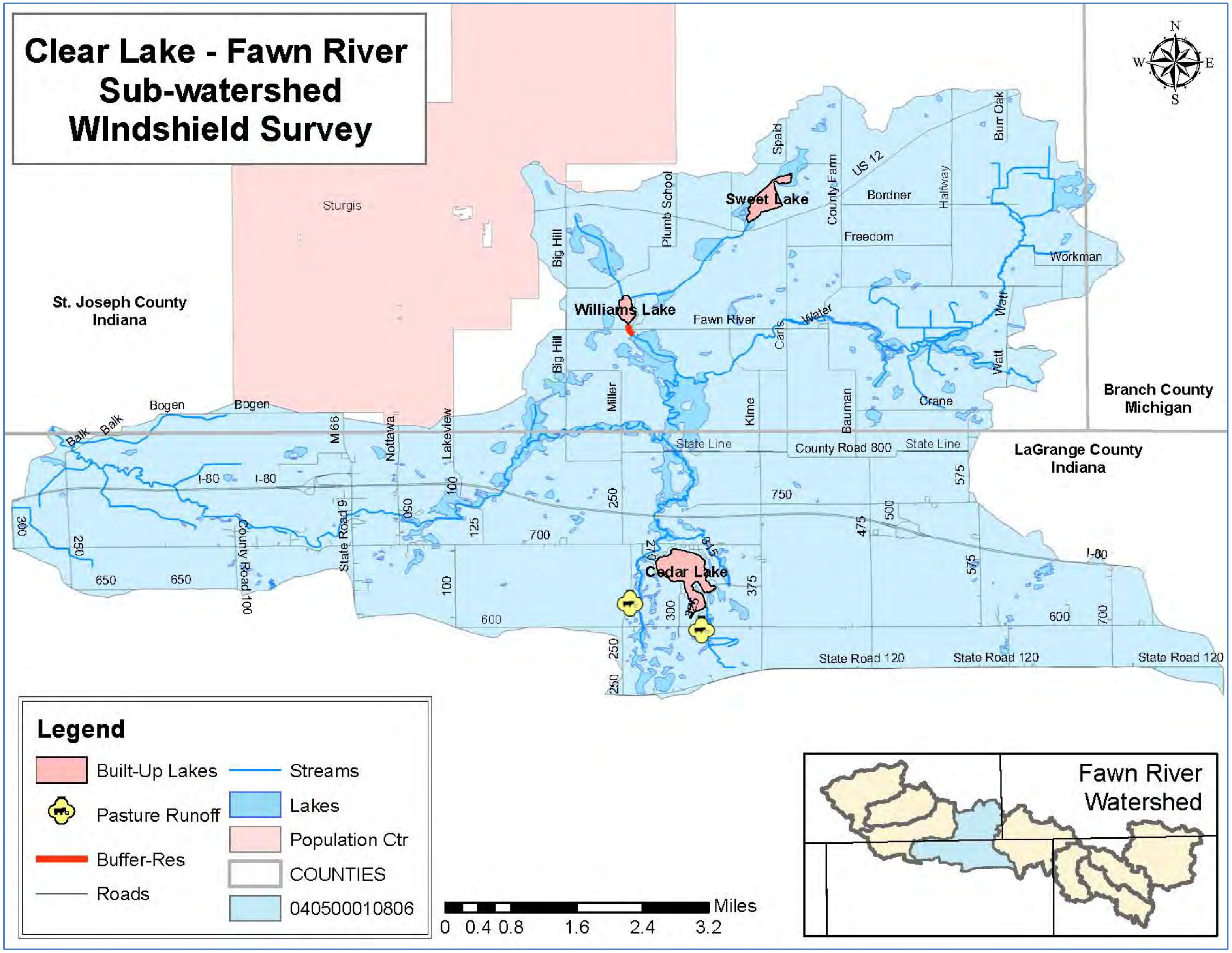
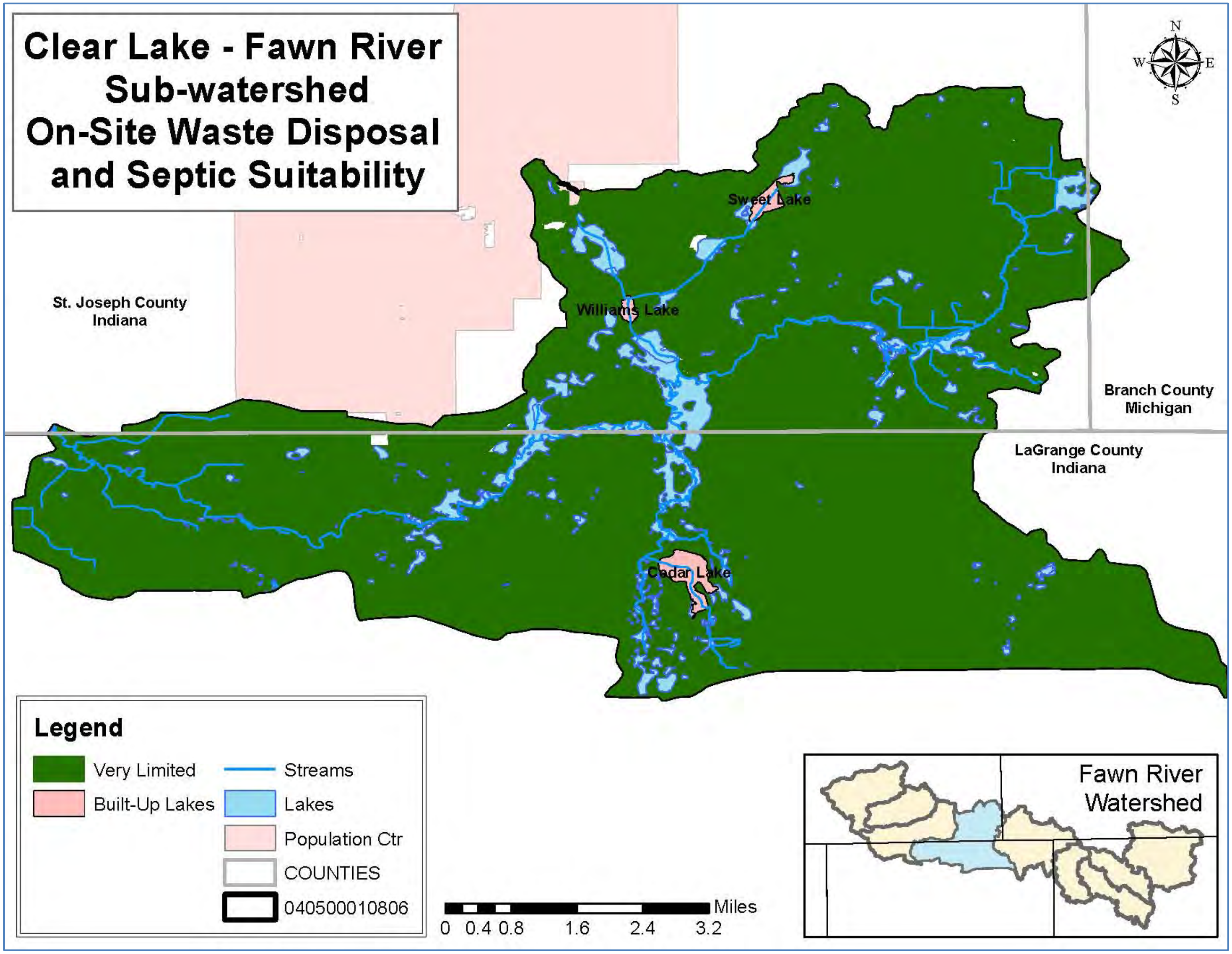


Figure 3.43: Septic Suitability in the Clear Lake Sub-watershed



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

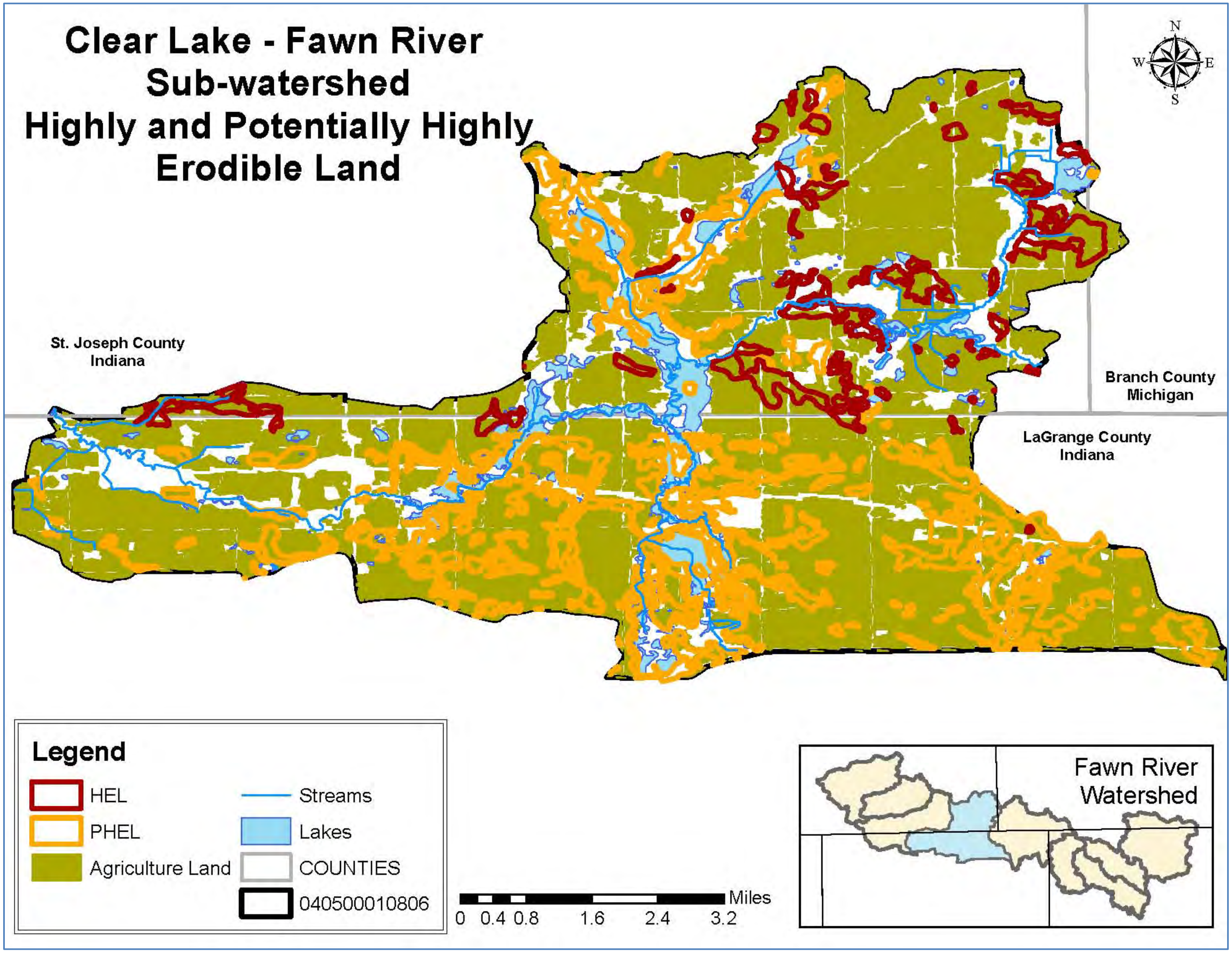
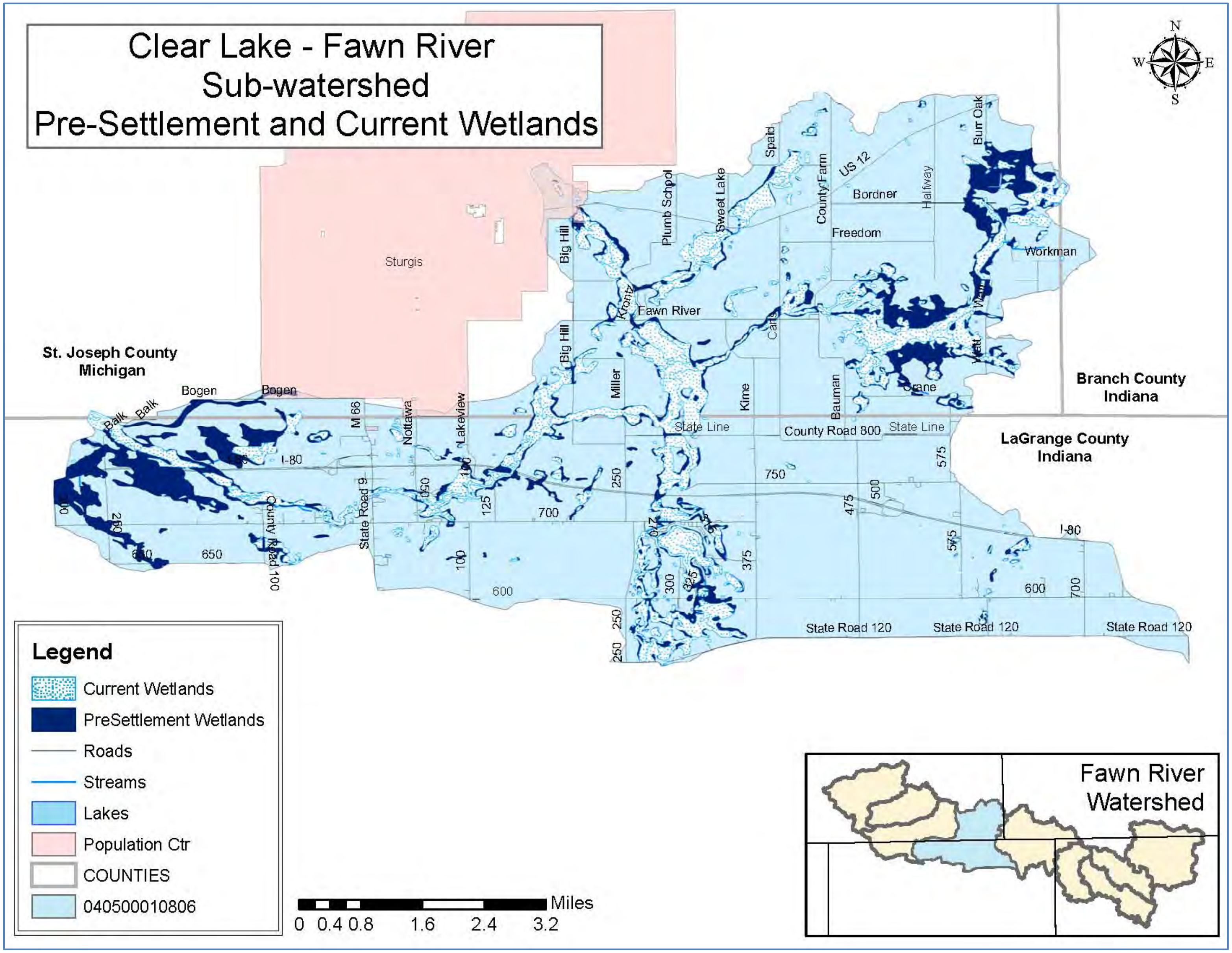


Figure 3.45: Current and Pre-Settlement Wetlands in the Clear Lake Sub-watershed



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

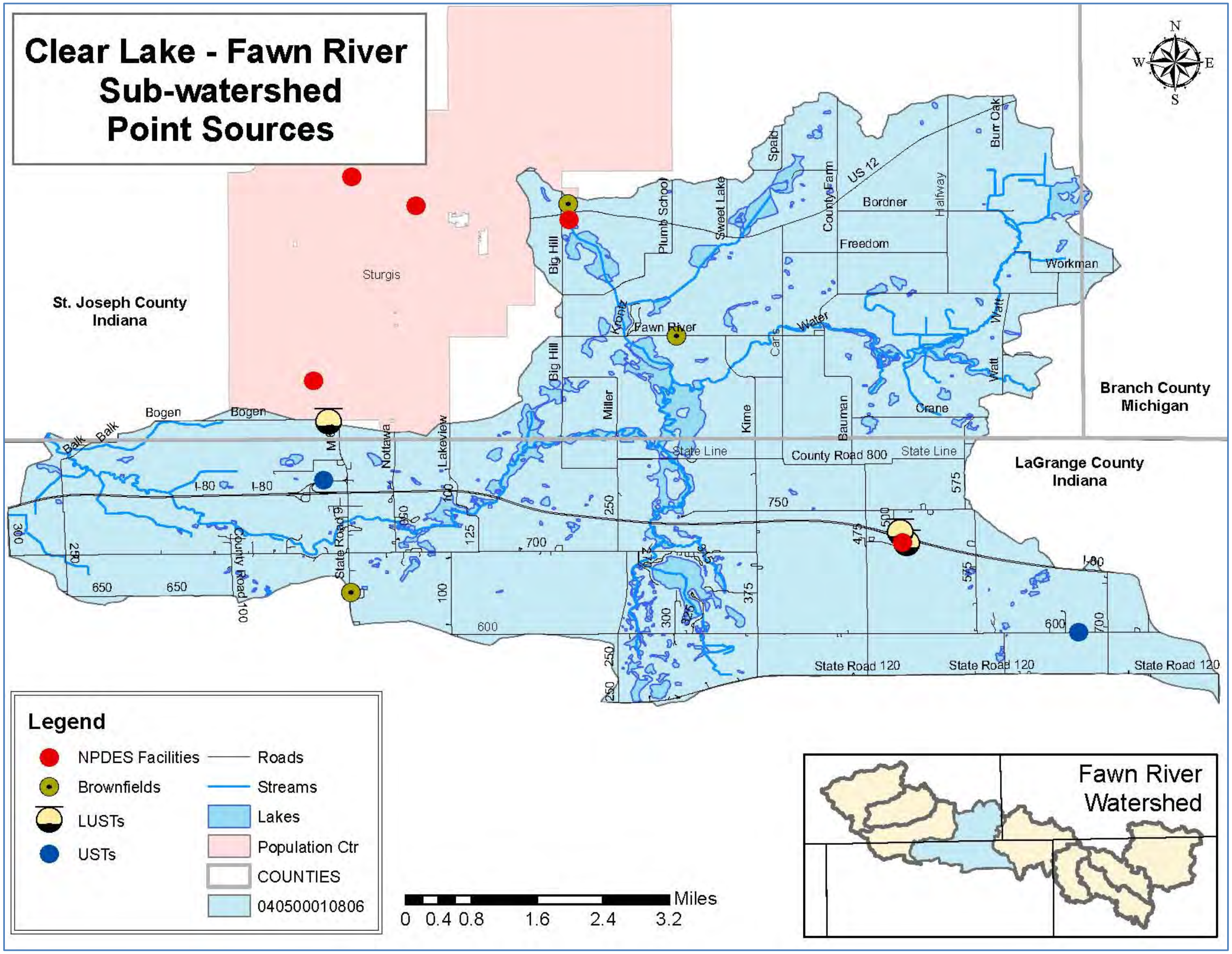
There are three sites in the Clear lake sub-watershed that are potential Brownfield sites and should be examined closer to determine if the sites are contaminated. Since these sites are listed as potential brownfields, they are eligible for funding to do further studies on the properties to determine 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.

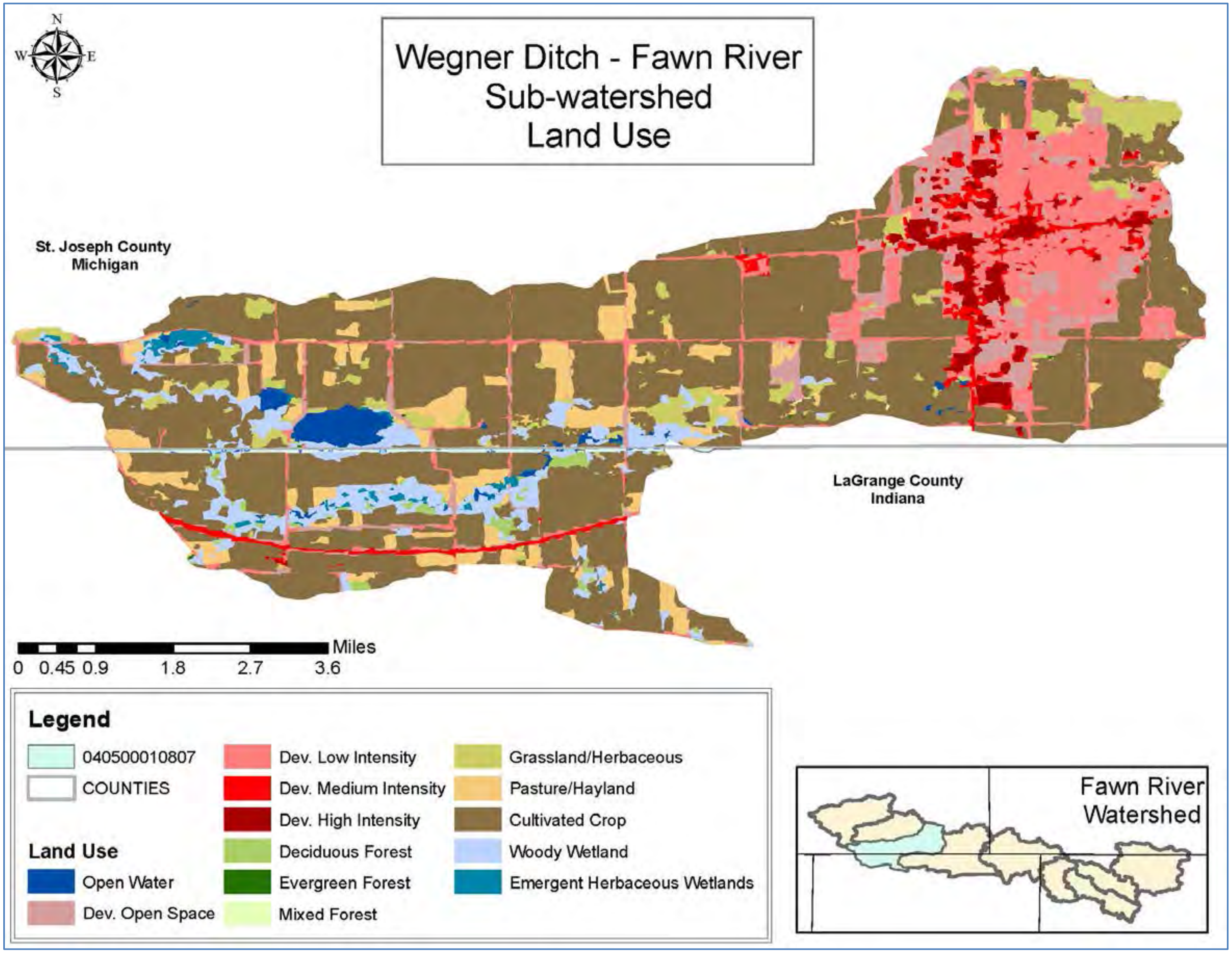
3.4.7 Wegner Ditch Sub-watershed Land Use

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

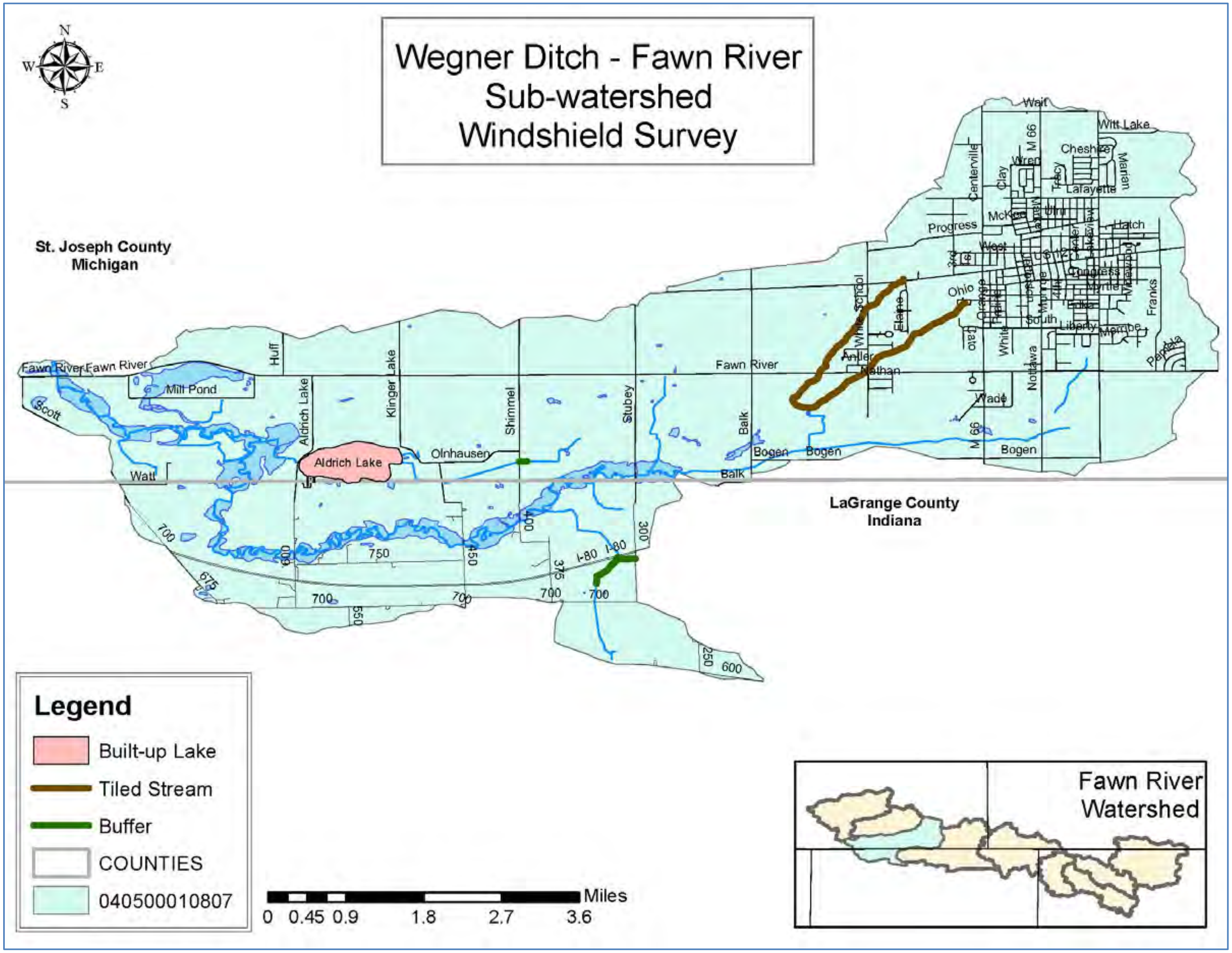
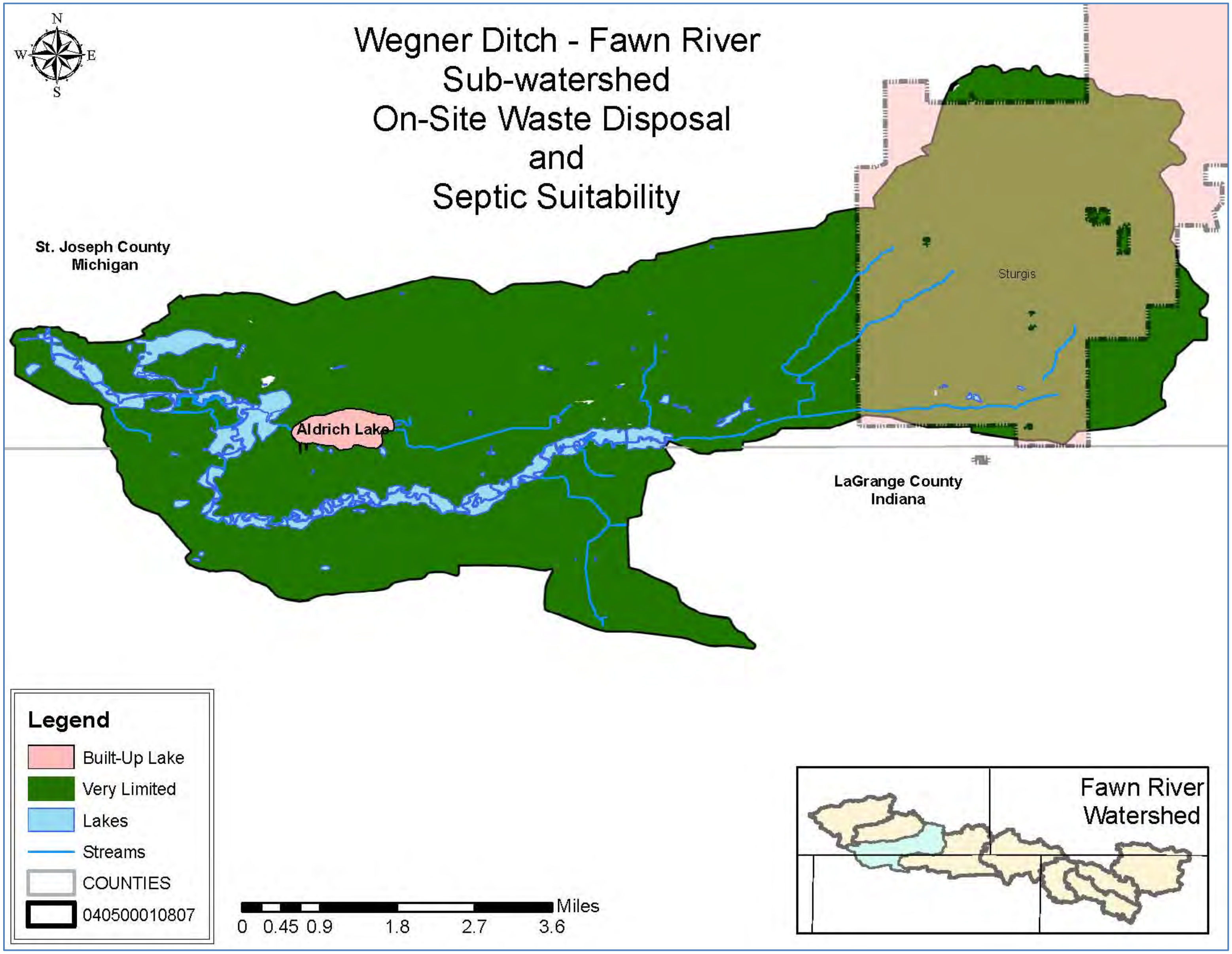


Figure 3.49: Septic Suitability in the Wegner Ditch Sub-watershed



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

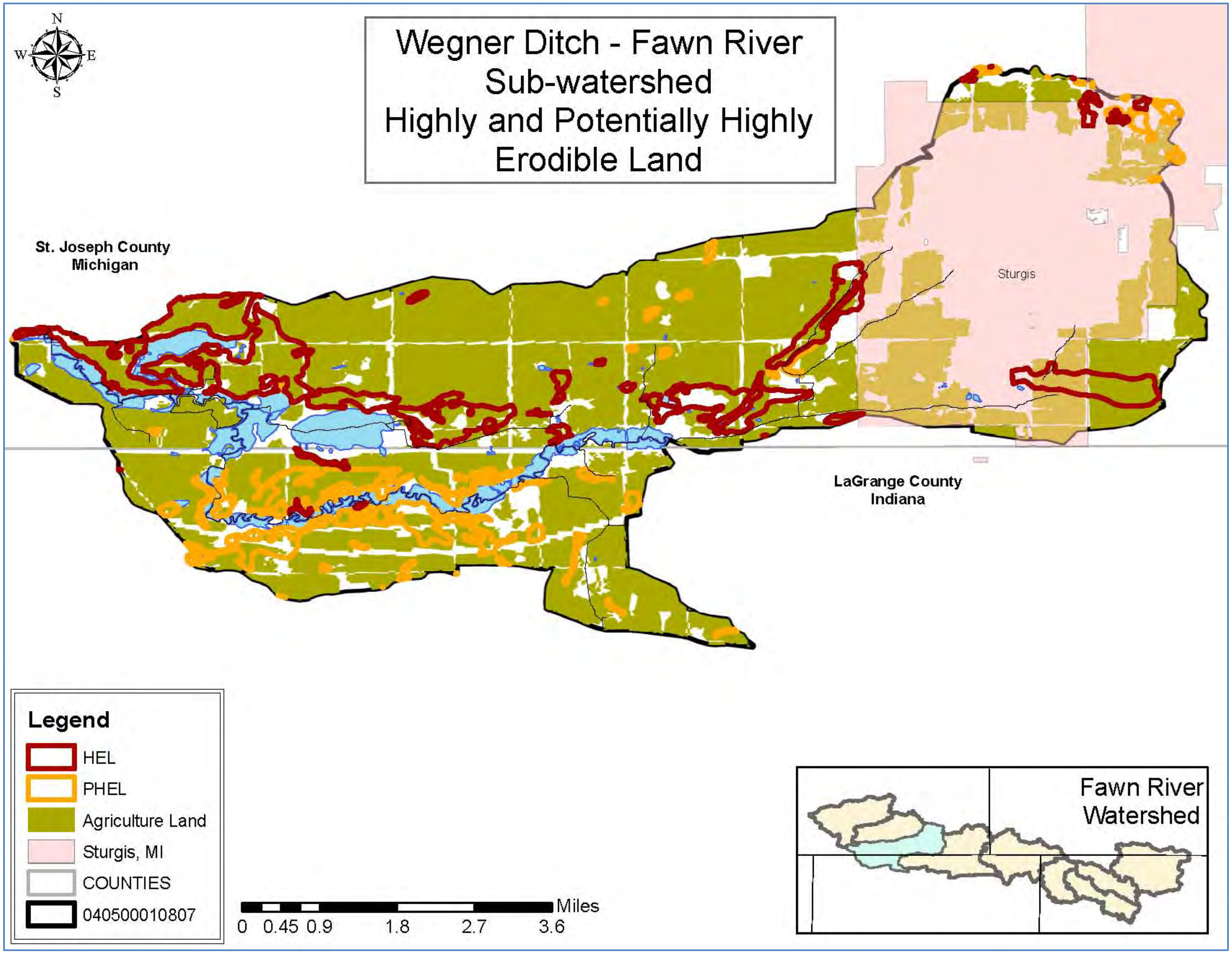
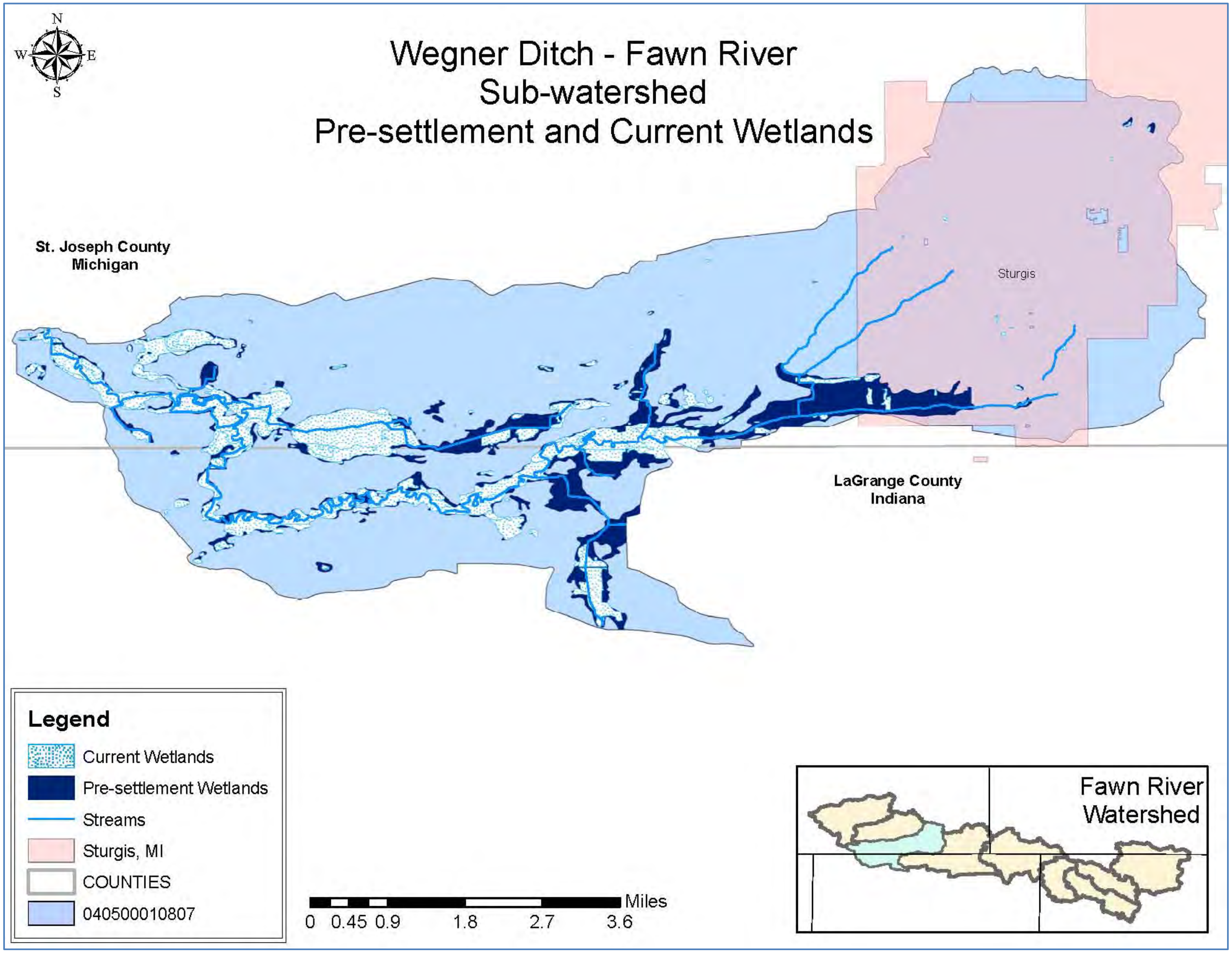


Figure 3.51: Current and Pre-Settlement Wetlands in the Wegner Ditch Sub-watershed



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

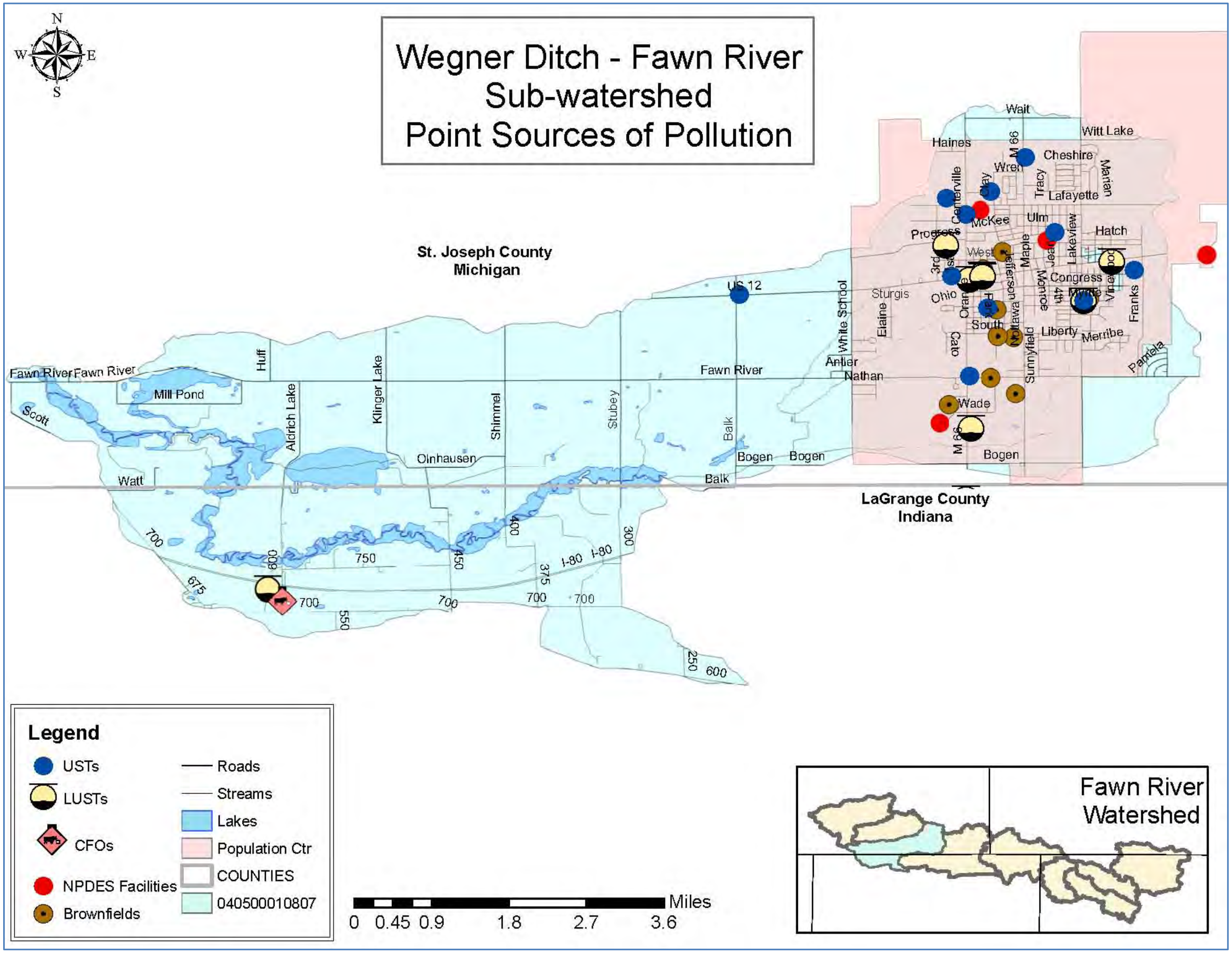
There are eight sites in the Wegner Ditch sub-watershed that are potential Brownfield sites and should be examined closer to determine if the sites are contaminated. Since these sites are listed as potential brownfields, they are eligible for funding to do further studies on the properties to determine 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.

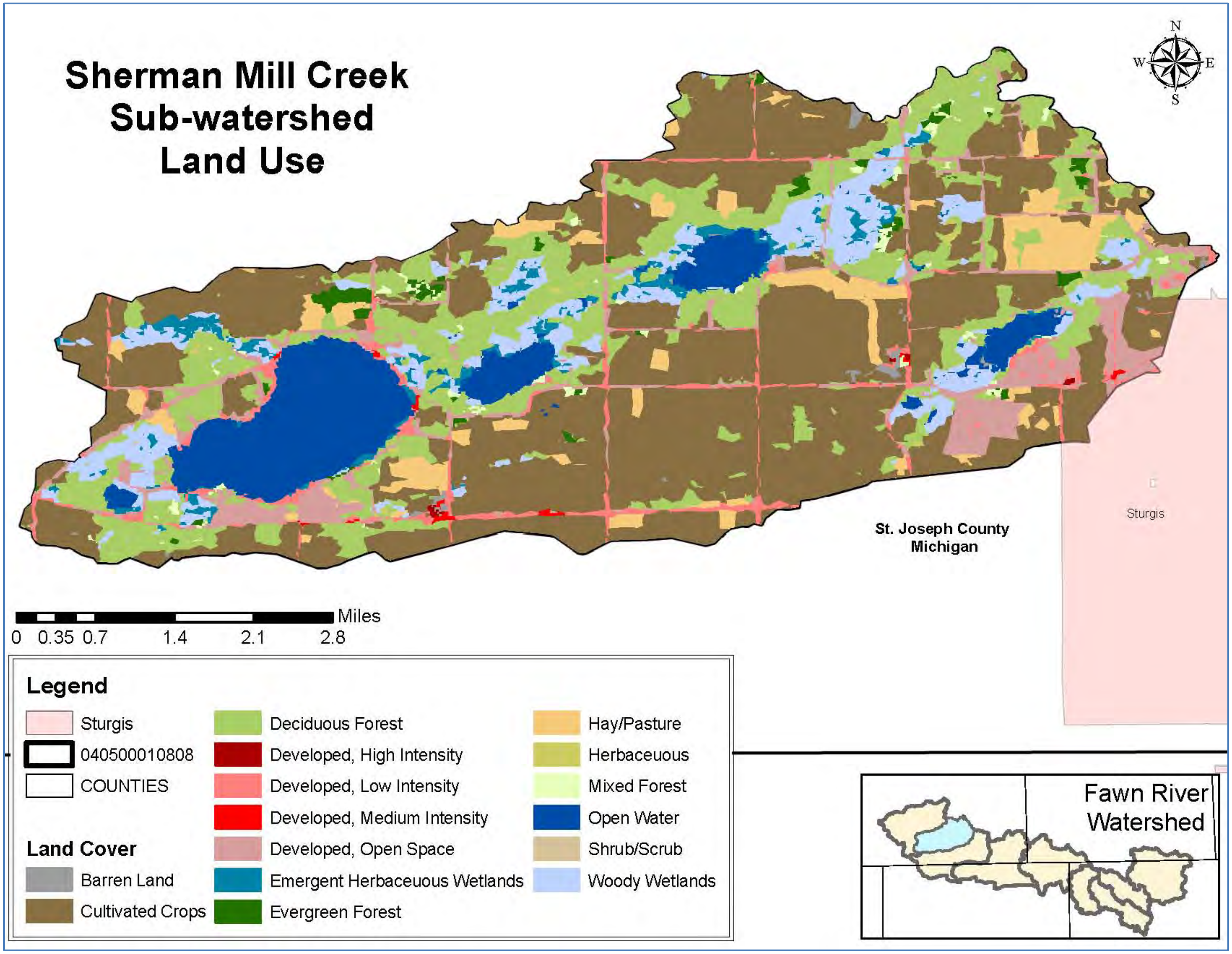
3.4.8 Sherman Mill Creek Sub-watershed Land Use

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

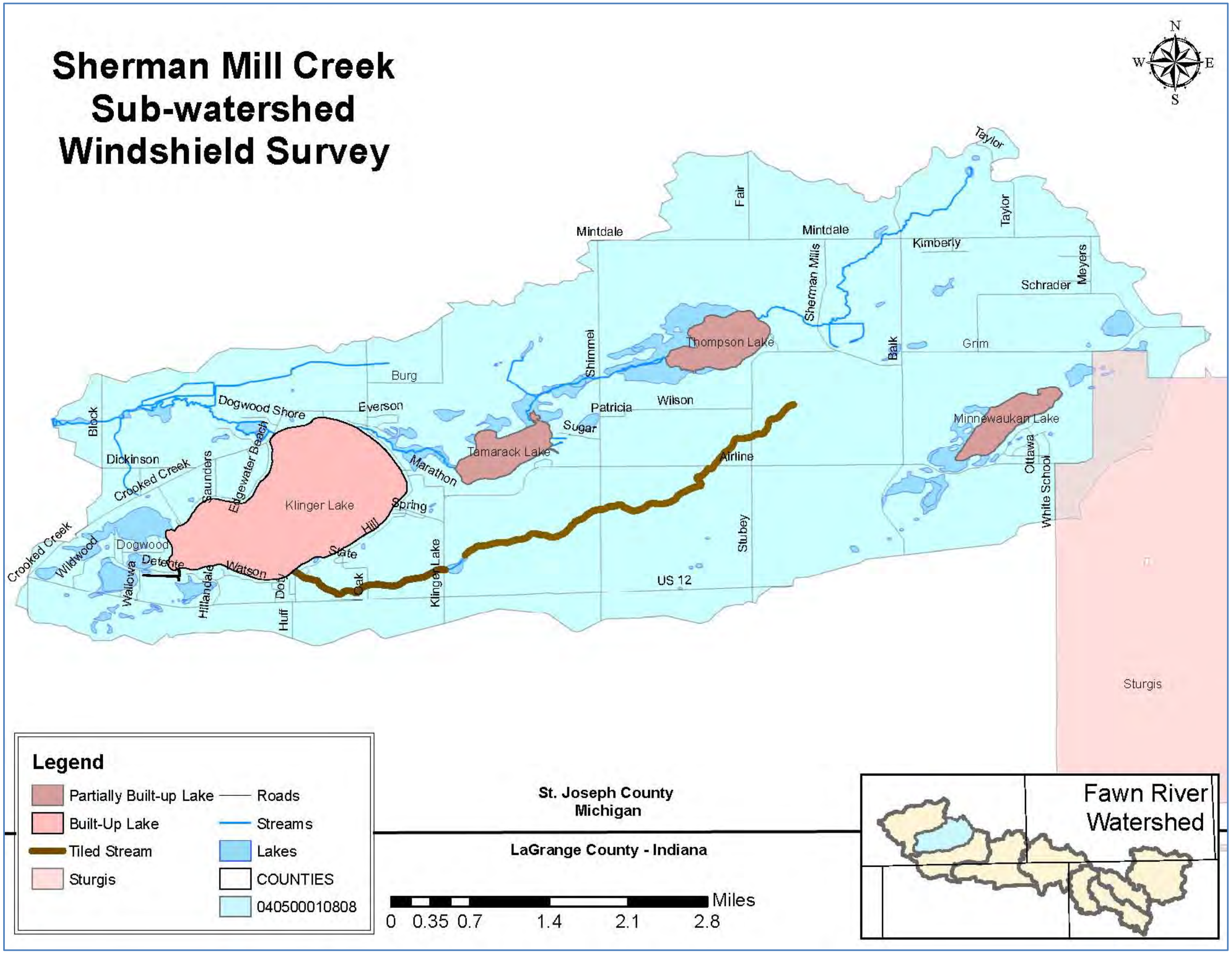
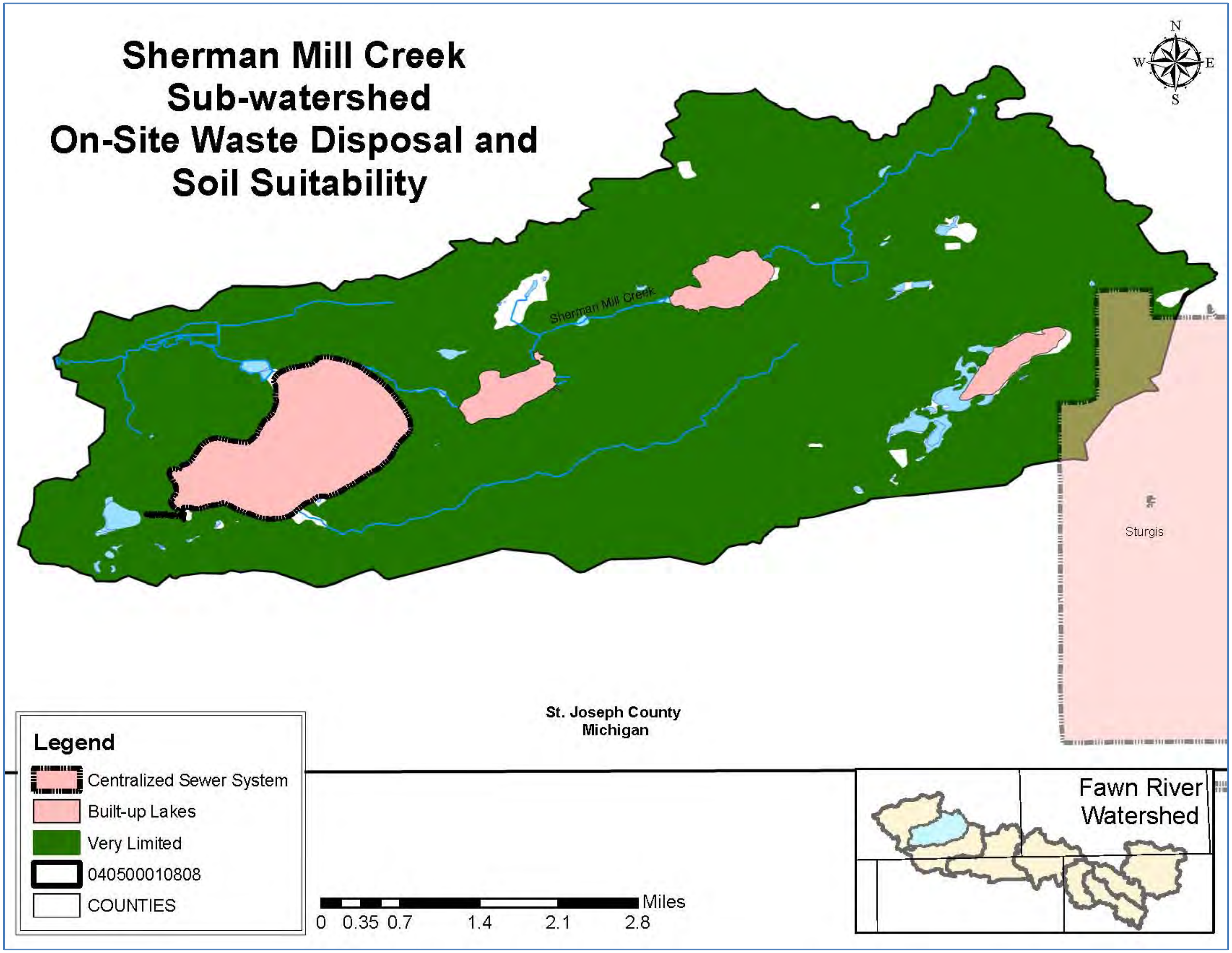


Figure 3.55: Septic Suitability in the Sherman Mill Creek Sub-watershed



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

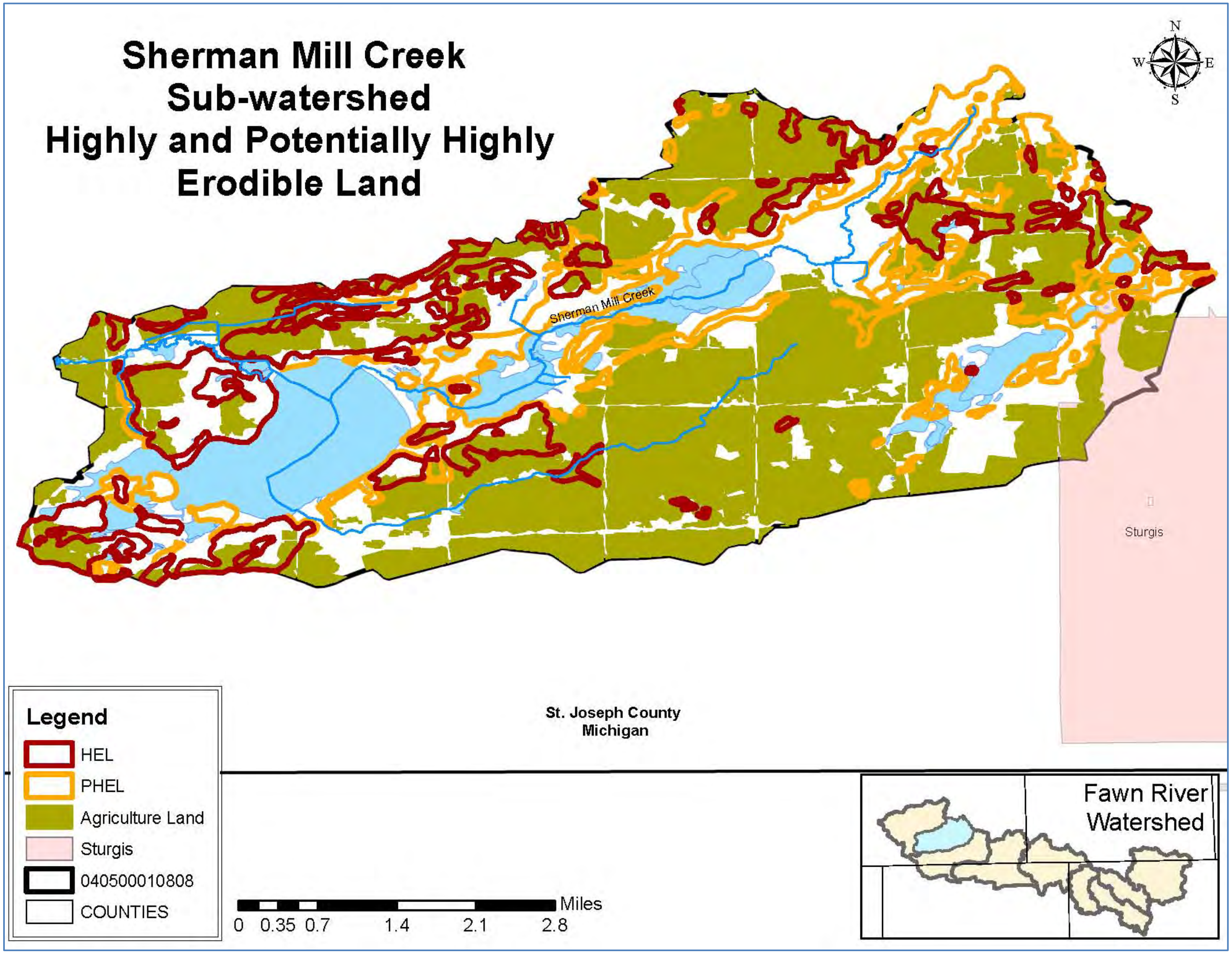
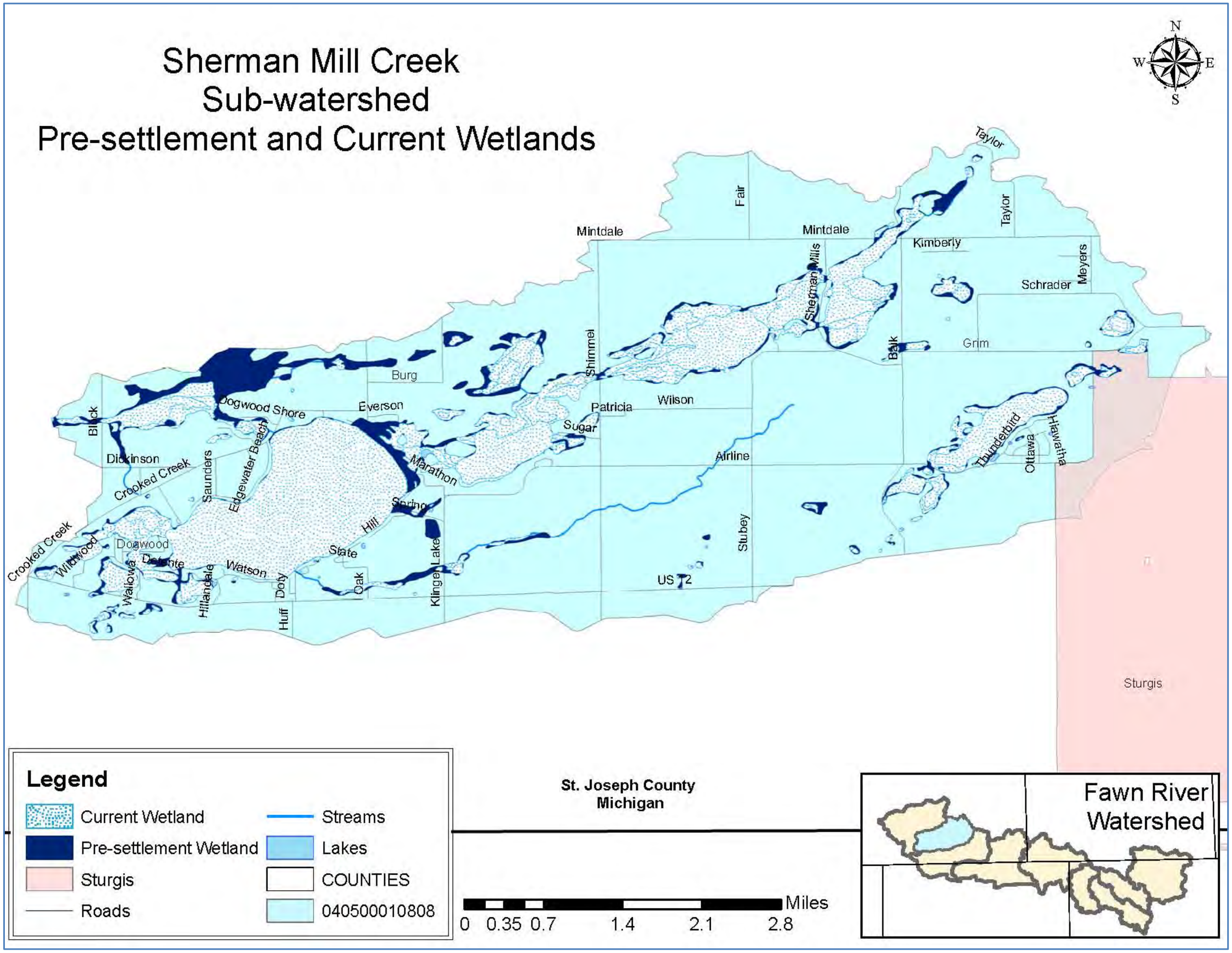


Figure 3.57: Wetlands in the Sherman Mill Creek Sub-watershed



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

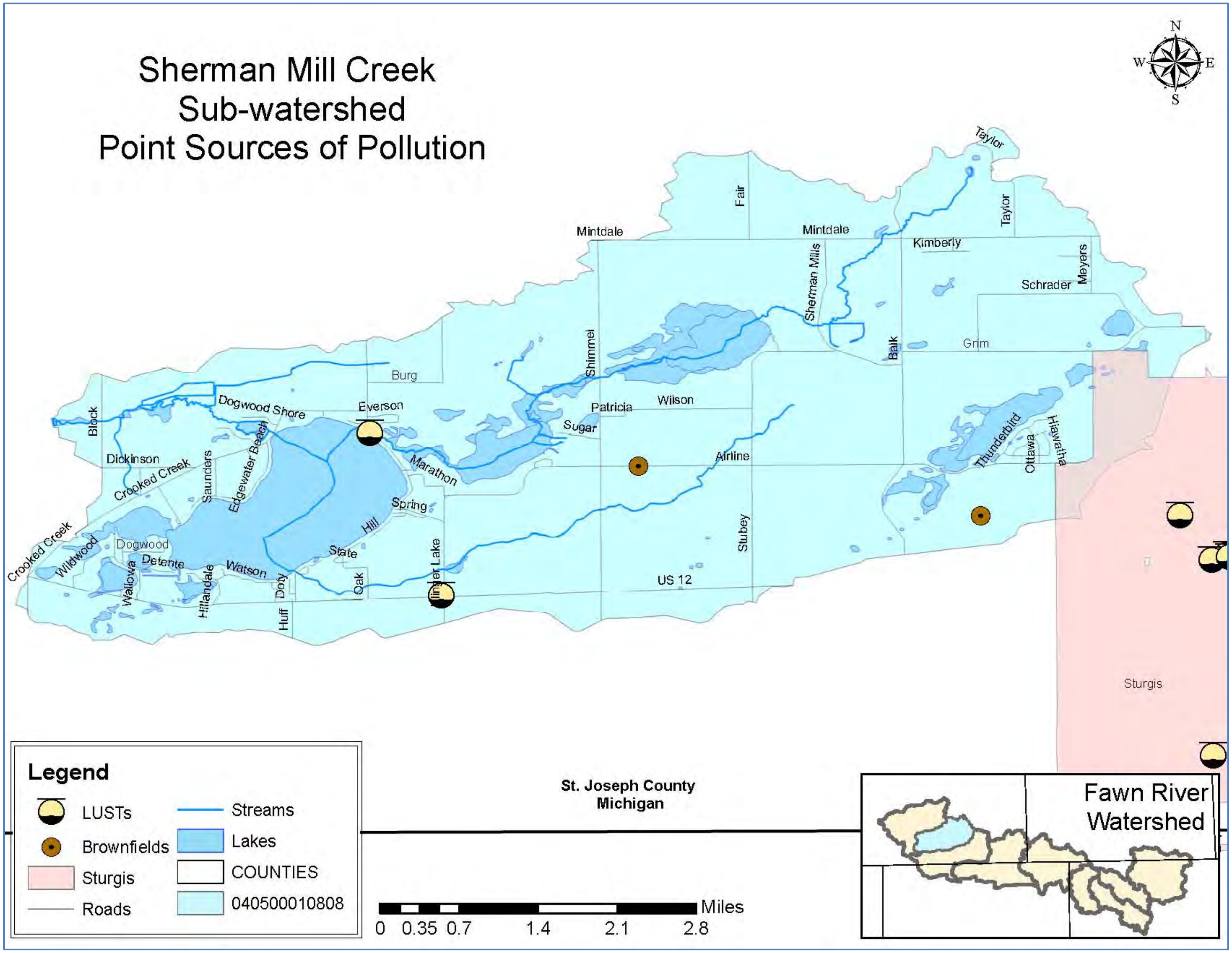
There are two sites in the Sherman Mill Creek sub-watershed that are potential Brownfield sites and should be examined closer to determine if the sites are contaminated. Since these sites are listed as potential brownfields, they are eligible for funding to do further studies on the properties to determine 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.

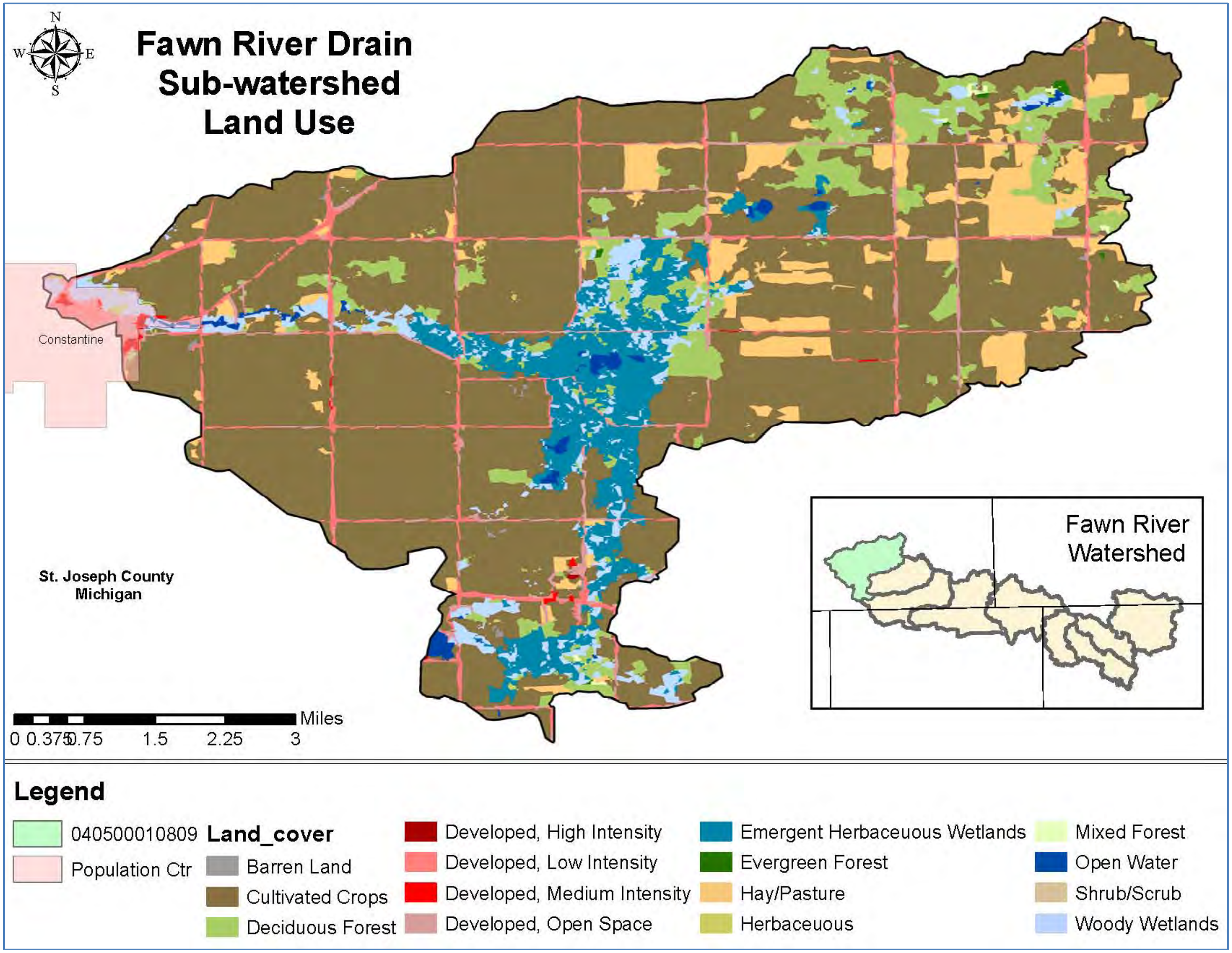
3.4.9 Fawn River Drain Sub-watershed Land Use

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

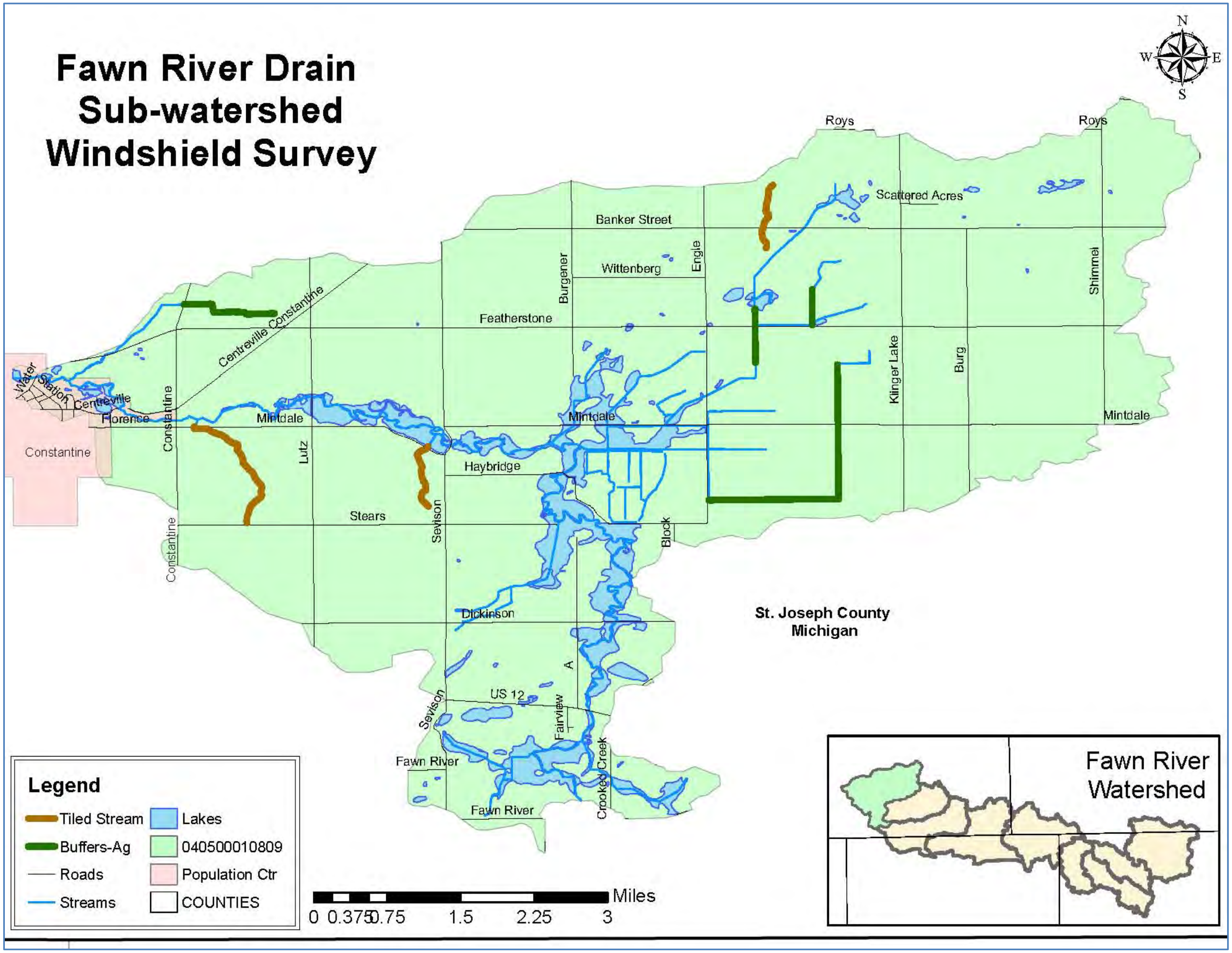
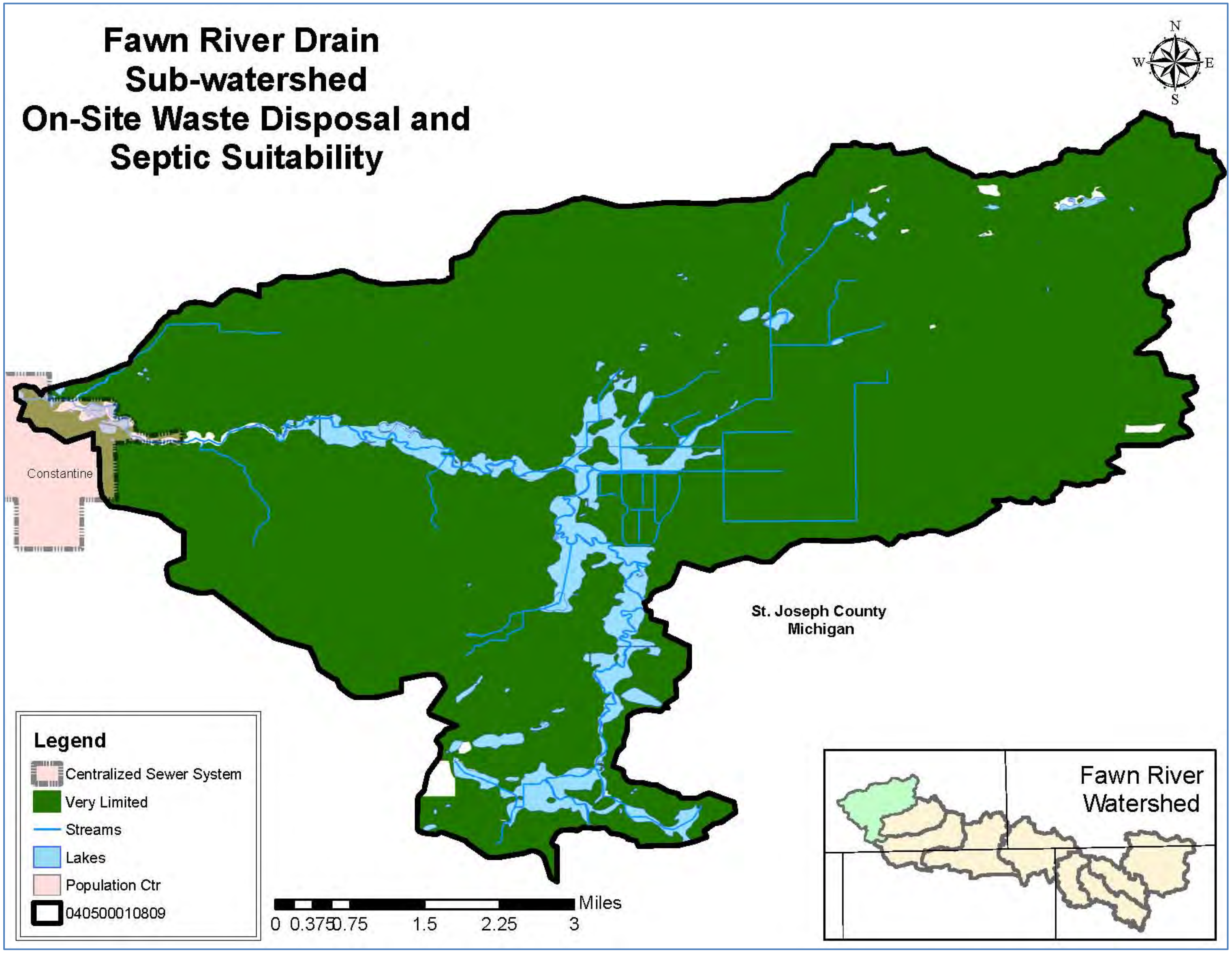


Figure 3.61: Septic Suitability in the Fawn River Drain Sub-watershed



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

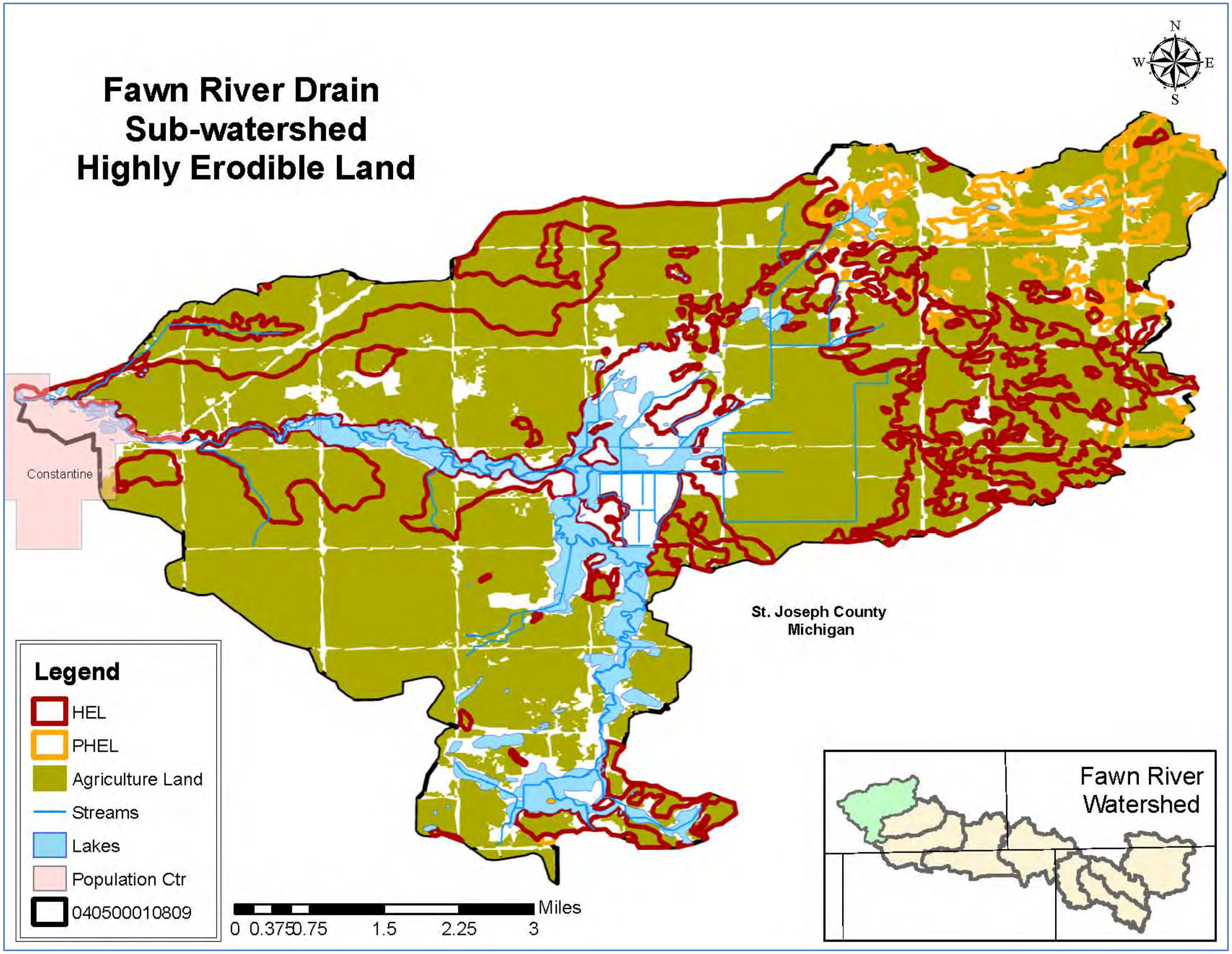
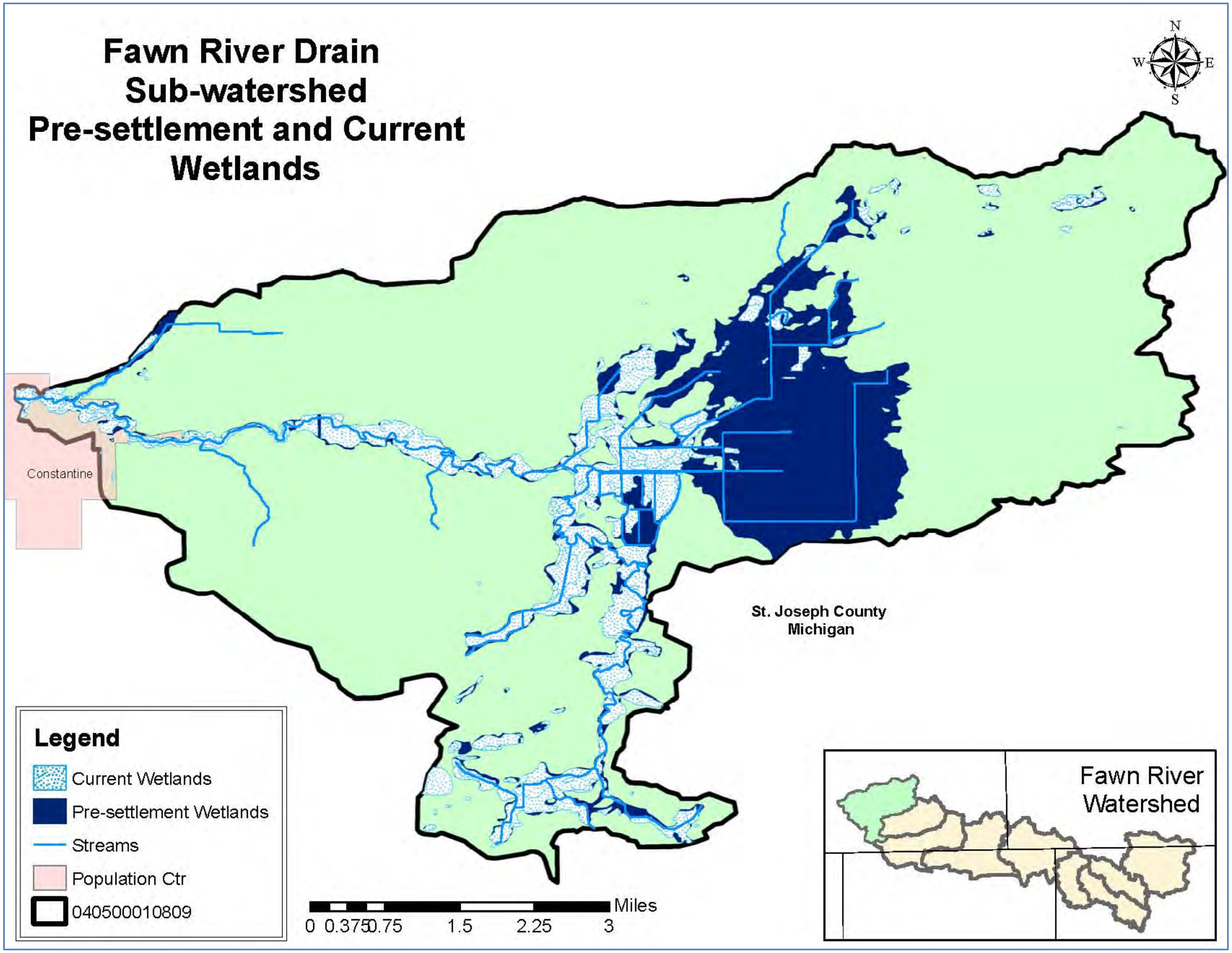


Figure 3.63: Wetlands in the Fawn River Drain Sub-watershed



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

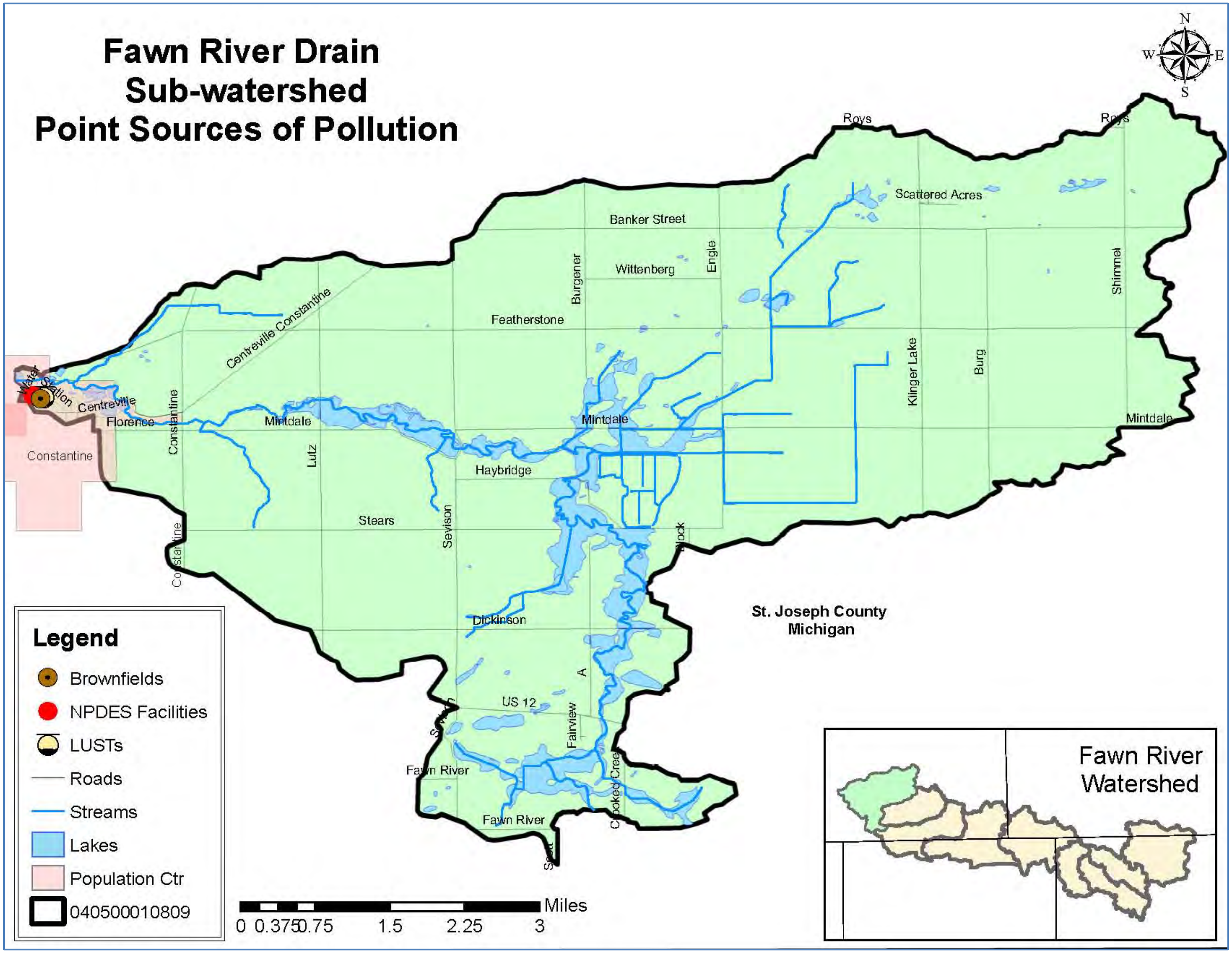
There is one site in the Fawn River drain sub-watershed that is a potential Brownfield site and should be examined closer to determine if the sites are contaminated. Since the site is listed as a potential brownfield, it is eligible for funding to do further studies on the property to determine the correct 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

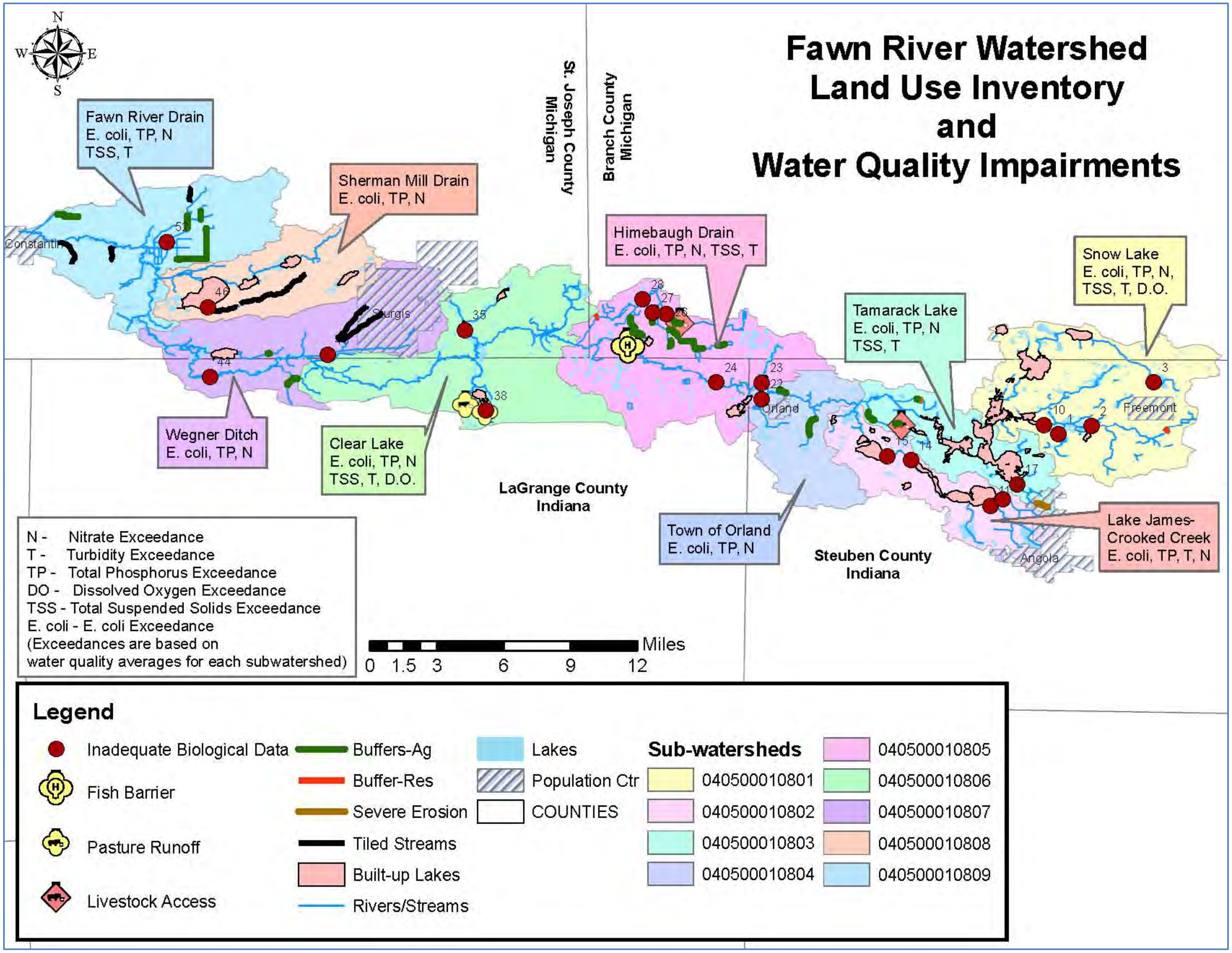
To better understand the water quality problems in the Fawn River Watershed and what influences may be contributing to those problems, a map was developed outlining the water quality issues in each sub-watershed, as well as showing the results of the land use inventory, specifically those sites that 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

4.0 Pollution Sources and Loads

4.1 Potential Causes of Water Quality Problems

In this section concerns identified by stakeholders in the watershed and through the watershed inventory will be linked to problems found through the watershed investigation. Additionally, potential causes for the problems identified will be expressed. Finally, potential sources will be identified. Table 4.1.1 shows the connection between those concerns the stakeholders have chosen to focus efforts on, problems found in the watershed, and the potential causes of those problems.

Table 4.1.1: Connection between Stakeholder Concerns, Problems, and Potential Causes

Concern(s)	Problem	Potential Cause(s)
- Livestock Access to open water - Stormwater runoff from livestock operations - Lakes in the area becoming more built-up - Septic system discharge - Tiled streams in ag. fields and un-buffered tiled inlets - Wetland Conservation	High levels of E. coli were discovered in areas streams after reviewing historic and current water quality data	- E. coli levels exceed the state standard - Area producers are unaware of the water quality threat of not having adequate manure storage and allowing livestock access to open water - There is a lack of education and outreach regarding septic management - There has been little effort to address urban issues in the watershed - There is a lack of education and outreach regarding urban stormwater issues
- Livestock Access to open water - Stormwater runoff from livestock operations - Lakes in the area becoming more built-up - Septic system discharge - Tiled streams in ag. fields and un-buffered tiled inlets - Increase in impervious surfaces - Fertilizer used on urban lawns - Lack of no-till and cover crop practices - Wetland Conservation	Area streams have nutrient levels exceeding the target level set by this project	- Nitrogen levels exceed the target set by this project - Phosphorus levels exceed the target set by this project - There is a lack of education and outreach regarding septic maintenance - There has been little effort to address urban issues in the watershed - Area producers are unaware of the cumulative effects of best management practices - Livestock operators are unaware of the effects to water quality from "traditional" management techniques used in the watershed

Concern(s)	Problem	Potential Cause(s)
- Septic system discharge	Historic design and lack of maintenance of septic systems is an issue in the watershed	- There is a lack of education and outreach regarding septic system maintenance
- Livestock access to open water - Stormwater runoff from livestock operations - Lack of no-till and cover crop practices - Wetland conservation - Streambank erosion - Tiled Streams in Ag. fields and un-buffered tile inlets	Best management practices to limit nonpoint source pollution are underutilized in the watershed	- There is a lack of education and outreach regarding the benefits of best management practices - Area producers are unaware of the cumulative effects of best management practices
- Streambank Erosion - Wetland Conservation - Lack of no-till and cover crop practices - Tiled streams in ag. fields and un-buffered tile inlets - Livestock access to open water - Stormwater runoff from livestock operations - Increase in impervious surfaces - Fertilizer used on urban lawns - Lakes in the area becoming more built-up - Septic system discharge	Sections of the Fawn River and its tributaries are listed as impaired on the IN or MI 303(d) list for IBC	- There has been little effort to address urban issues in the watershed - There is a lack of education and outreach regarding the benefits of best management practices - There is a lack of education and outreach regarding septic system maintenance - Area producers are unaware of the cumulative effects of best management practices - Livestock operators are unaware of the effects to water quality from "traditional" management techniques used in the watershed such as direct access to open water - Nutrient and *E. coli* levels exceed the targets set by this project - CQHEI scores were very low for several water quality sampling sites throughout the watershed - Lack of stream buffers/filter strips

Concern(s)	Problem	Potential Cause(s)
- Stream bank erosion - Wetland Conservation - Lakes in the area becoming more developed - Increase in impervious surfaces	Ten species in the watershed are on the Federal Endangered Species list	- Nitrates and phosphorus exceeded the target set by this project, thus lowering the quality of aquatic habitat - Lack of riparian buffer for adequate habitat - Land conversion / segmentation - CQHEI scores were very low for several water quality sampling sites throughout the watershed

4.2 Potential Sources Resulting in Water Quality Impairment

Now that stakeholder concerns have been linked to water quality problems and potential causes of those problems, and a thorough watershed inventory has been conducted, sources to the problems can be determined. Outlining the sources to the problems found in the watershed will help to narrow the land area of where to focus implementation efforts to have the greatest impact on improving water quality in the Fawn River Watershed. Table 4.2.1 lists the problems, potential cause(s), and potential source(s) of the problems.

Table 4.2.1: Problems, Causes, and Sources

Problem	Potential Cause(s)	Potential Source(s)
High levels of E. coli were discovered in areas streams after reviewing historic and current water quality data	- E. coli levels exceed the state standard - Area producers are unaware of the water quality threat of not having adequate manure storage and allowing livestock access to open water - There is a lack of education and outreach regarding septic management - There has been little effort to address urban issues in the watershed - There is a lack of education and outreach regarding urban stormwater issues	- Pet waste in urban areas including built-up lakes and Fremont, Angola, Sturgis, Constantine, and Orland - It is estimated that greater than 25% of the households in the watershed are utilizing on-site waste disposal and up to 5% of those are failing - Many built-up lakes utilize on-site waste disposal (Snow Lake sub-watershed-3 lakes, Tamarack Lake sub-watershed-2 lakes, Himebaugh Drain sub-watershed-4 lakes, Clear Lake sub-watershed-3 lakes, Wegner Ditch sub-watershed-1 lake, Sherman Mill Creek sub-watershed-3 lakes) - Over 84% of the soils in the watershed are considered to be very limited for septic system placement and over 6% is considered somewhat limited for septic placement - There are four CFOs located in the watershed totaling 250,000 animals (Wegner Ditch, and Himebaugh Drain) which produces multiple tons of manure each year that may be land applied in an unsustainable manner, during wet weather, on frozen ground, or in close proximity to open water - Livestock access to open water (Lake James-1, Himebaugh Drain-1) - Pasture runoff issues (Clear Lake-2)

Problem	Potential Cause(s)	Potential Source(s)
Area streams have nutrient levels exceeding the target level set by this project	- Nitrogen levels exceed the target set by this project - Phosphorus levels exceed the target set by this project - There is a lack of education and outreach regarding septic maintenance - There has been little effort to address urban issues in the watershed - Area producers are unaware of the cumulative effects of best management practices - Livestock operators are unaware of the effects to water quality from "traditional" management techniques used in the watershed	- Lack of proper management measures on ag. land on PHEL (6.05% of soils) and HEL (20.17% of soils) - It is estimated that greater than 25% of the households in the watershed are utilizing on-site waste disposal and up to 5% of those are failing - Many built-up lakes utilize on-site waste disposal (Snow Lake-3, Tamarack Lake-2, Himebaugh Drain-4, Clear Lake-3, Wegner Ditch-1, Sherman Mill Creek-3) - Over 84% of the soils in the watershed are very limited for septic system placement and over 6% is considered somewhat limited for septic placement - Pasture runoff issues (Clear Lake) - Livestock with direct access to open water (Lake James, Himebaugh Drain) - 49% of the watershed is in cultivated crops which are fertilized to promote plant growth. Unsustainable farming techniques increase fertilizer runoff - 13% of the watershed is developed. Over fertilization of turf grass leads to excess fertilizer runoff - Over fertilization of turf grass at lake properties on the 32 built-up lakes in the watershed (Snow Lake, Lake James, Tamarack Lake, Himebaugh Drain, Clear Lake, Wegner Ditch, and Sherman Mill Drain sub-watersheds) - Excessive use of irrigation without irrigation management plans in place throughout the watershed - Only 8% of corn and 13% of bean fields also utilize cover crops which aids in nutrient uptake and prevents soil erosion - 56,796 lf of natural streams have been tiled in ag fields which, if not properly managed and buffered, allow for nutrients to leach through the tiles - 20% of corn fields in Steuben and 54% in LaGrange are conventionally tilled (4% and 24%, respectively for beans).

Problem	Potential Cause(s)	Potential Source(s)
Historic design and lack of maintenance of septic systems is an issue in the watershed	- There is a lack of education and outreach regarding septic system maintenance	- There is a lack of education and outreach regarding septic system maintenance - Over 84% of the soils in the watershed are considered to be very limited for septic system placement and over 6% is considered somewhat limited for septic placement - It is estimated that greater than 25% of the households in the watershed are utilizing on-site waste disposal and up to 5% of those are failing - Many built-up lakes utilize on-site waste disposal (Snow Lake-3, Tamarack Lake-2, Himebaugh Drain-4, Clear Lake-3, Wegner Ditch-1, Sherman Mill Creek-3)
Best management practices to limit nonpoint source pollution are underutilized in the watershed	- There is a lack of education and outreach regarding the benefits of best management practices - Area producers are unaware of the cumulative effects of best management practices	- There is a lack of education and outreach regarding the benefits of best management practices - Federal and local funding for the implementation of agricultural management measures have been cut significantly over the past decade including Farm Bill programs such as CREP, CRP and WRP, Counties have lowered funding to SWCDs, LARE, 319, and GLRI and GLC funding is not consistent - There is limited education and outreach regarding urban best management practices and stormwater control
Sections of the Fawn River and its tributaries are listed as impaired on the IN or MI 303(d) list for IBC, Mercury and PCBs in Fish Tissue	- There has been little effort to address urban issues in the watershed - There is a lack of education and outreach regarding the benefits of best management practices - There is a lack of education and outreach regarding septic system maintenance - Area producers are unaware of the cumulative effects of	- Lack of proper management measures on agriculture land on PHEL (6.05% of soils) and HEL (20.17% of soils) in the watershed - It is estimated that greater than 25% of the households in the watershed are utilizing on-site waste disposal and up to 5% of those are failing - Many built-up lakes utilize on-site waste disposal (Snow Lake-3, Tamarack Lake-2, Himebaugh Drain-4, Clear Lake-3, Wegner Ditch-1, Sherman Mill Creek-3)

Problem	Potential Cause(s)	Potential Source(s)
Sections of the Fawn River and its tributaries are listed as impaired on the IN or MI 303(d) list	best management practices - CQHEI scores were very low for several water quality sampling sites throughout the watershed - Livestock operators are unaware of the effects to water quality from "traditional" management techniques used in the watershed direct access to open water - Nutrient and E. coli levels exceed the targets set by this project	- Over 84% of the soils in the watershed are considered to very limited for septic system placement and over 6% is considered somewhat limited for septic placement - Pasture runoff issues (Clear Lake -2) - Livestock with direct access to open water (Lake James - 1 and Himebaugh Drain - 1) - 49% of the watershed is in cultivated crops which are fertilized to promote plant growth. Unsustainable farming techniques increase fertilizer runoff - 13% of the watershed is developed. Over fertilization of turf grass leads to excess fertilizer runoff - Over fertilization of turf grass and extensive use of seawalls at lake properties on the 32 built-up lakes in the watershed (Snow Lake, Lake James, Tamarack Lake, Himebaugh Drain, Clear Lake, Wegner Ditch, and Sherman Mill Drain sub-watersheds) - Excessive use of irrigation without irrigation management plans in place throughout the watershed - Only 8% of corn and 13% of bean fields utilize cover crops which aids in nutrient uptake and prevents soil erosion - 56,796 lf of natural streams have been tiled in ag fields which, if not properly managed and buffered, allow for nutrients to escape the fields through the tiles - There are four CFOs located in the watershed totaling 250,000 animals (Wegner Ditch, and Himebaugh Drain) which produces multiple tons of manure each year that may be land applied in an unsustainable manner, during wet weather, on frozen ground, or to close to open water - There is a lack of riparian buffer on 49,027 lf of stream within the ag. community and 2,176 lf in the urban areas

Problem	Potential Cause(s)	Potential Source(s)
Sections of the Fawn River and its tributaries are listed as impaired on the IN or MI 303(d) list		- 74% of the corn fields and 28% of the bean fields between Steuben and LaGrange counties utilize conventional tillage techniques
Ten species in the watershed on the Federal Endangered Species list	- Nitrates and phosphorus exceeded the target set by this project, thus lowering the quality of aquatic habitat - Lack of riparian buffer for adequate habitat - Land conversion / segmentation	- The watershed has lost a 39% of the presettlement wetlands equaling a habitat functional use loss of 44%. - The windshield survey revealed 51,203 lf of stream lacking a riparian buffer, most of which also exhibited slight to moderate streambank erosion - Less than 9% of the watershed is considered to be forested

4.3 Pollution Loads and Necessary Load Reductions

After close review of historic water quality data from the IDEM, Steuben County Lakes Council, MI DEQ, and current water quality data collected by the Fawn River Project as part of the development of this WMP, for consistency of parameters measured in each of the sub-watersheds, as well as quality assurance techniques and weather conditions, pollution loads and subsequent load reductions would be based on data collected by the FRP only, which was funded through the 319 grant used for this project. Current pollution loads were determined for each HUC12 sub-watershed, and when compared to the water quality targets set by the Fawn River steering committee and outlined in Section 3, provides detail on how much pollution loads will need to be reduced to meet the targets set for the project area.

Water quality samples were taken by the FRP from 54 sites; several sites in each of the nine HUC12 sub-watersheds. Adequate water quality samples were taken to provide a baseline look at water quality in each of the sub-watersheds. Current pollution loads and load reductions were analyzed for nitrate, total phosphorus, TSS and TDS only, as turbidity and *E.coli* loads cannot be accurately determined, and loads determined for the other parameters measured by the Initiative as part of this project would not be useful to this project. However, it is important to note that both turbidity and *E. coli* are a concern of the Fawn River steering committee.

Loads were determined by using the following equation; (cfs * (X * 0.001) * 984.2589781), where cfs equals the average flow of the stream measured in cubic feet per second, X equals the average parameter measurement in mg/l, and 984.2589781 is the conversion factor used to make the outcome equal tons per year. Table 4.3.1 is a reminder of the target concentrations for each of the parameters of concern that were set by this project's steering committee. Table 4.3.2 through Table 4.3.5 show the current and target loads and load reductions needed for nitrate, total phosphorus, TDS, and TSS, respectively. Turbidity and E. coli, while loads cannot be determined, are important parameters to consider when evaluating the health of the watershed. Turbidity is an indicator of sediment, as well as other pollutants that can cause water to become murky and inhibit plant growth and effect aquatic habitat and *E. coli* is used as an indicator to determine the amount of fecal material making its way to open water. Therefore, Table 3.4.6 shows the average concentration of turbidity and *E. coli* for each sub-watershed as well as the percentage of target concentration exceedance per sub-watershed.

Table 4.3.1: Target Concentration for Parameters of Concern

Parameter of Concern	Target Concentration
Nitrate	< 1.5 mg/l
Total Phosphorus	< 0.08 mg/L (tributaries) and <0.3 mg/L (mainstem)
Total Dissolved Solids	< 750 mg/l
Total Suspended Solids	< 20 mg/l
Turbidity	< 10.4 NTU
E. coli	< 235 CFU/100ml

Table 4.3.2: Nitrate Pollution Load Reductions Needed to Meet Target Loads

Subwatershed		Mean Flow (ft^3/sec)	Nitrate (tons/year)		
HUC	Name		Current	Target	Reduction Needed
040500010801	Snow Lake	5.96	6.9	8.8	0
040500010803	Lake James	35.53	36.28	52.45	0
040500010802	Tamarack Lake	39.24	48.9	57.9	0
040500010804	Town of Orland	39.24	50.68	57.93	0
040500010805	Himebaugh Drain	10.76	23.14	15.89	7.25
040500010806	Clear Lake	123.78	208.64	182.75	25.89
040500010807	Wegner Ditch	156.91	429.12	231.66	197.46
040500010808	Sherman Mill Creek	111.51	329.51	164.63	164.87
040500010809	Fawn River Drain	247.02	454.3	364.69	89.6
		Total	**1587.47**	**1136.7**	**485.07**

Table 4.3.3: Phosphorus Pollution Load Reductions Needed to Meet Target Loads

Subwatershed		Mean Flow (ft^3/sec)	Total Phosphorus (tons/year)		
HUC	Name		Current	Target	Reduction Needed
040500010801	Snow Lake	5.96	1.4	0.5	0.9
040500010803	Lake James	35.53	5.59	2.79	2.79
040500010802	Tamarack Lake	39.24	7.3	3.09	4.21
040500010804	Town of Orland	39.24	7.52	3.09	4.43
040500010805	Himebaugh Drain	10.76	2.16	0.85	1.32
040500010806	Clear Lake	123.78	27.16	36.55	0
040500010807	Wegner Ditch	156.91	35.47	46.33	0
040500010808	Sherman Mill Creek	111.51	19.22	32.93	0
040500010809	Fawn River Drain	247.02	57.59	72.94	0
		Total	**163.41**	**199.07**	**13.65**

Table 4.3.4: Total Dissolved Solids Pollution Load Reductions Needed to Meet Target Loads

Subwatershed		Mean Flow (ft^3/sec)	Total Dissolved Solids (tons/year)		
HUC	Name		Current	Target	Reduction Needed
040500010801	Snow Lake	5.96	3282.14	4250	0
040500010803	Lake James	35.53	20371.17	26227.24	0
040500010802	Tamarack Lake	39.24	19866.94	28966.74	0
040500010804	Town of Orland	39.24	21911.73	28963.17	0
040500010805	Himebaugh Drain	10.76	6456.893	7946.292	0
040500010806	Clear Lake	123.78	65851.24	91377.07	0
040500010807	Wegner Ditch	156.91	94762.78	115830.1	0
040500010808	Sherman Mill Creek	111.51	49048.16	82317.37	0
040500010809	Fawn River Drain	247.02	134942.6	182346.1	0
		Total	**416493.653**	**568224.082**	**0**

Table 4.3.5: Total Suspended Solids Pollution Load Reductions Needed to Meet Target Loads

Subwatershed		Mean Flow (ft³/sec)	Total Suspended Solids (tons/year)		
HUC	Name		Current	Target	Reduction Needed
040500010801	Snow Lake	5.96	47.2	117.3	0
040500010803	Lake James	35.53	151.54	699.39	0
040500010802	Tamarack Lake	39.24	242.3	772.45	0
040500010804	Town of Orland	39.24	170.58	772.35	0
040500010805	Himebaugh Drain	10.76	66.72	211.9	0
040500010806	Clear Lake	123.78	728.45	2436.63	0
040500010807	Wegner Ditch	156.91	874.24	3088.8	0
040500010808	Sherman Mill Creek	111.51	336.58	2195.13	0
040500010809	Fawn River Drain	247.02	1904.53	4862.56	0
		Total	**4522.14**	**15156.51**	**0**

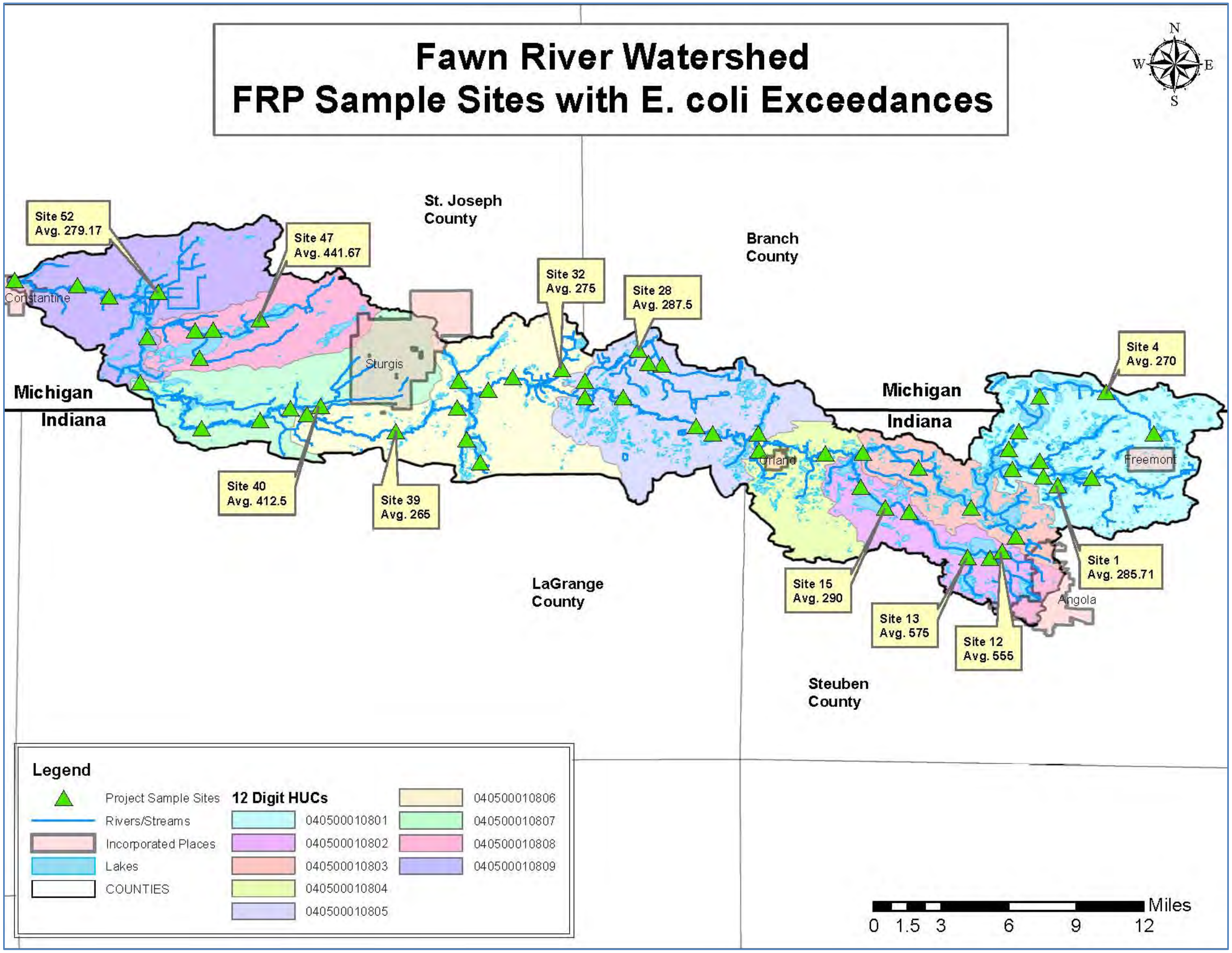
Table 3.4.6: E. coli and Turbidity Concentrations and Percent Exceedance per Sub-watershed

Sub-watershed	Parameter			
	E. coli		Turbidity	
	CFU	%	NTU	%
Snow Lake	257.02	22	2.4	4
Lake James	193.01	16	4.78	13
Tamarack Lake	499.3	44	3	3
Town of Orland	77.15	13	2	0
Himebaugh Drain	115.5	13	3.27	2
Clear Lake	146.35	19	2.58	1
Wegner Ditch	177.68	26	2.95	0
Sherman Mill Drain	168.89	17	1.18	0
Fawn River Drain	132.41	17	3.35	4

*The concentrations highlighted in pink either exceeded the target for that parameter or the percentage of exceedances was greater than 20%.

Examining the average *E. coli* levels for each sub-watershed does provide information about which sub-watersheds may have the most problem with *E. coli* contamination; however there are several Fawn River Project sample sites that also had average *E.coli* measurements that exceeded the state standard. The drainage area to those sample sites should be considered for the remediation of potential *E.coli* pollution sources. Figure 4.1 shows the location of the FRP sample sites, with the sites that had high *E.coli* measurements labeled with what the average *E. coli* measurements were for that site.

Figure 4.1: Fawn River Project Sample Sites with E.coli Exceedances



5.0 Critical Areas

Critical areas are defined by IDEM as those areas that have been identified through historical studies, land use information, and water quality data, in the project area as needing implementation efforts to improve current water quality or that will mitigate the impact of potential sources of NPS to protect water quality. This Section will identify the critical areas within the Fawn River Watershed and outline the reason why those areas are most important to focus implementation efforts.

5.1 Critical Areas to Focus Implementation Efforts.

Identifying critical areas and goals to address those critical areas will focus efforts in the watershed on the areas that will have the greatest impact on improving water quality in the Fawn River Watershed. Please note that if there are several areas that are considered critical for a particular practice or parameter, a "priority" may be assigned to those areas so that implementation efforts will be focused on the areas that will have the biggest impact on water quality first. Once all possible implementation efforts have been exhausted in Priority Area 1, efforts will be focused on Priority Area 2, and so on.

5.1.1 Pollutant Based Critical Areas

The Fawn River Watershed Steering Committee expressed concern regarding several problems, land uses and practices that can be observed throughout the watershed that may be contributing to the high nutrient and bacteria levels demonstrated by water quality data. These problems include runoff from livestock operations, increase in impervious surfaces, fertilizer used on urban lawns, increased development on built-up lakes, septic system discharge, lack of conservation tillage and cover crop practices, wetland conservation, streambank erosion and sedimentation. An additional issue was discovered during the windshield survey that may contribute to high nutrient levels; unbuffered tiled inlets and tiled ditches and streams through agriculture fields. Analysis of water quality data show that nitrate and phosphorus load reductions are needed throughout the project area. Additionally, there are several water quality sample sites spread throughout the watershed, except for in the Town of Orland and Lake James-Crooked Creek sub-watershed, whose *E. coli* averages exceed the state standard of 235 cfu/100ml.

The windshield survey conducted as part of this project revealed several areas of concern to help validate stakeholder concerns. It was also noted during the survey that many streams and ditches have been straightened and have lost their natural shelf and flood plain and much of the woody riparian area has been cleared, thus many area ditches and streams are lacking an adequate riparian buffer to reduce the pollutant loading to the stream. This practice does a great job to quickly move water away from farm fields; however it also increases stream flow causing bank erosion further downstream, increases water temperatures, and decreases aquatic and riparian habitat. In addition to those areas, 74% of the corn fields and 28% of the bean fields within Steuben and LaGrange counties utilize conventional tillage techniques, which allows for surface flow of sediment, fertilizers, and pesticides to discharge into open water.

The land cover of the Fawn River watershed is 13% urban due to the fact that Angola, Fremont, Orland, and Sturgis are all fully or mostly located within the watershed. Additionally, there are 37 built-up lakes within the watershed where heavy lawn fertilizer use is common practice. Sea walls are also common along the shorelines of the lakes, which allows for runoff from turf grass to run directly into the lakes, increases wave action which may contribute to more shoreline erosion, as well as stir up settled sediment carrying nutrients that then get released into open water.

There were only four livestock issues observed during the windshield survey which were located within the Lake James – Crooked Creek, Himebaugh Drain, and Clear Lake sub-watersheds. Therefore, it can be assumed that much of the high *E. coli* levels measured throughout the watershed are from leaking septic systems, wildlife, improperly applied manure as fertilizer, or pet waste runoff from urban lawns; however livestock are an obvious contributor of excessive nutrients and *E. coli* at the sample sites directly downstream of the four livestock issues that were observed in the project area.

For the reasons listed above, the FRP Steering Committee has decided to make certain sub-watersheds critical for implementation of BMPs to reduce nutrient loadings based on water quality data, necessary load reductions to meet water quality targets, and observations made during the windshield survey, as well as the likelihood that BMPs will be accepted by landowners within the sub-watershed. Table 5.1 lists each sub-watershed, the calculated load reduction for each, and the priority given to each sub-watershed for implementation efforts to mitigate the nutrient loads reaching open water. Priorities were determined based on the extent of the load reduction needed and the number of parameters that need to be addressed. Due to previous experience working with landowners within these subwatersheds by area conservation districts and NRCS offices, priorities were also based on the likelihood of being successful in implementation efforts in each sub-watershed. Each sub-watershed will be addressed differently, and implementation efforts for each sub-watershed will be discussed in Section 7.

Table 5.1: Implementation Prioritization for Nutrient Load Based Critical Areas

Sub-watershed	Load Reduction (Tons/year)		Implementation Priority
	Nitrates	TP	
Himebaugh Drain	7.25	1.32	1
Wegner Ditch	197.46	0	1
Sherman Mill Drain	164.87	0	1
Fawn River Drain	89.6	0	1
Tamarack Lake	0	4.21	2
Clear Lake	25.89	0	2
Town of Orland	0	4.43	2
Lake James	0	2.79	2
Snow Lake	0	0.9	[redacted]

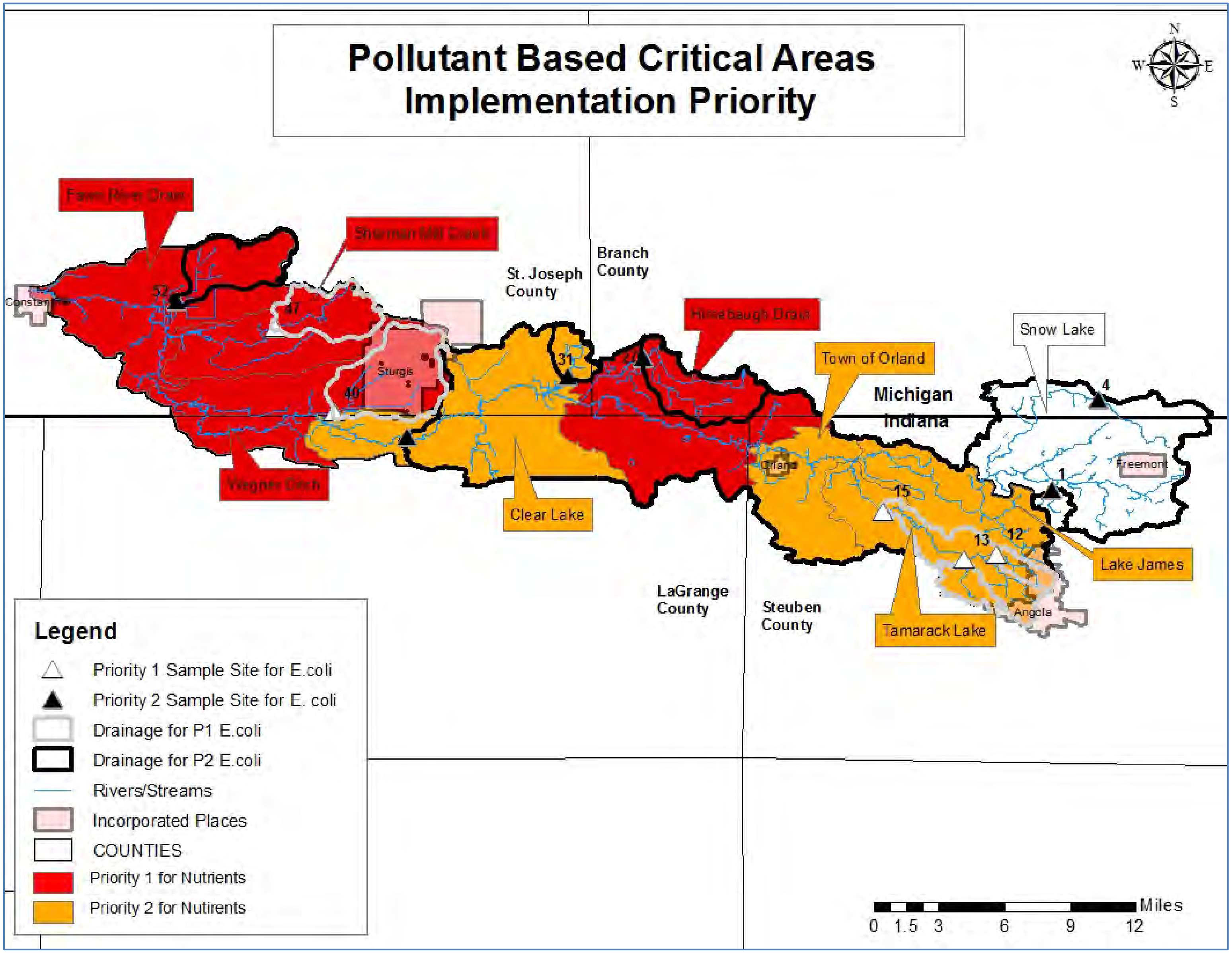
Critical areas for *E. coli* were determined based on those sub-watersheds that contained water quality samples sites whose average measurement was greater than the state standard of 235 cfu/100ml. The high *E. coli* measurements are likely due to leaking or failed septic systems, pet waste from urban lawns, or livestock. Table 5.2 lists the subwatersheds, as well as the sample site numbers within those sub-watersheds whose *E. coli* averages were greater than the state standard and whose drainage area is considered to be critical for education and outreach regarding septic system maintenance, pet waste disposal, and BMPs to lessen the impact of livestock operations and manure used as fertilizer. Priority of implementation efforts were determined based on the amount in which the sample averages exceeded the state standard and the likelihood of landowners to adopt various BMPs.

Table 5.2: Implementation Prioritization for E. coli Based Critical Areas

Sub-watershed	E. coli Averages Greater than Target by Site	Implementation Priority
Tamarack Lake	Site 12 - 555 cfu/100ml Site 13 - 575 cfu/100ml Site 15 - 290 cfu/100ml	1
Sherman Mill Drain	Site 47 - 441.67 cfu/100ml	1
Wegner Ditch	Site 40 - 412.5 cfu/100ml	1
Himebaugh Drain	Site 28 - 287.5 cfu/100ml	2
Snow Lake	Site 1 - 285.71 cfu/100ml Site 4 - 270 cfu/100ml	2
Fawn River Drain	Site 52 - 279.17 cfu/100ml	2
Clear Lake	Site 32 - 275 cfu/100ml Site 39 - 265 cfu/100ml	2
Town of Orland	0	[redacted]
Lake James	0	[redacted]

Figure 5.1, below, shows the location of critical sample sites for pollutants (nitrogen, phosphorus, and *E. coli*). Sub-watersheds in red are priority one for addressing nutrients, and those in orange are priority two. The USGS Stream Stats program is able to delineate drainage areas to a particular point for many states; however, it is not able to do so for points located in MI. Therefore, the following map has actual delineations for the drainage areas to the critical sample sites for *E. coli* in IN, and an approximate drainage area was drawn on the map for those critical sample sites for *E. coli* located in MI.

Figure 5.1: Implementation Priority for Pollutant Based Critical Areas



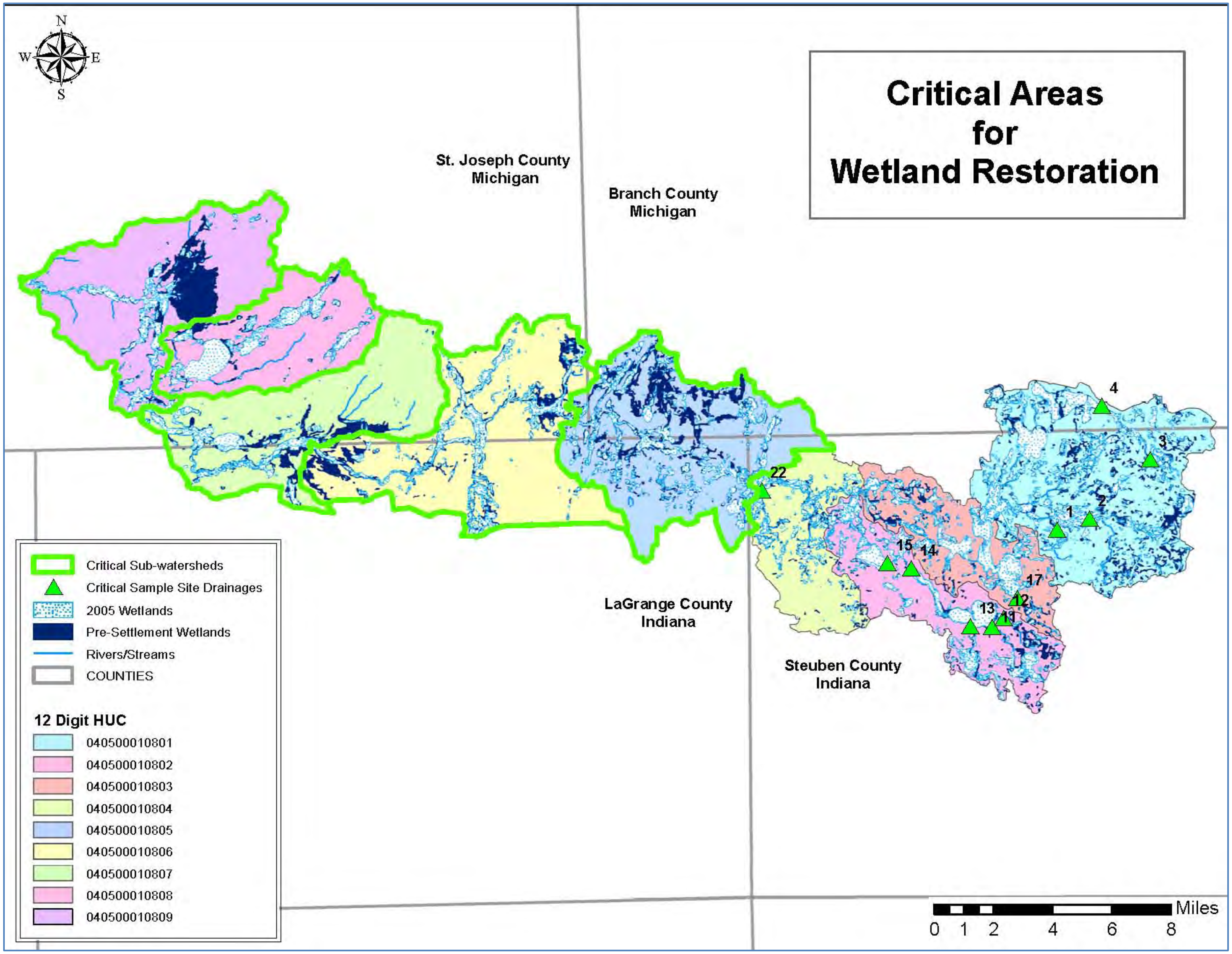
5.1.2 Wetland Based Critical Areas

Wetlands play an important role in the natural environment as they provide prime habitat for many species of flora and fauna, including eight of the ten endangered species listed in Section 2.7. Wetlands also act as sponges absorbing excess nutrients preventing its discharge into lakes and streams, as well as absorbing the impact of floodwaters which can prevent damage to homes and other structures. The wetland functional use study outlined in Section 2.4.3, and in each sub-watershed under Section 3.4, determined that the Fawn River Watershed has lost 40% of its floodwater control, 36% of its shoreline stabilization, 44% of its habitat, 36% of its combined water quality functional use, and 61% of its ability to retain harmful pathogens. Therefore, it is important to protect the remaining wetlands and restore wetlands that have disappeared since the last National Wetland Inventory was conducted in 1979. Protecting existing wetlands, especially in the more populated areas will help to mitigate any flooding issues as area lakes become more built-up and help to absorb nutrients and pathogens from leaking on-site waste disposal systems and fertilizer runoff. Restoring the wetlands present before settlement of the area will play an important role in improving water quality in the Fawn River Watershed's streams and lakes. Table 5.3 lists the sub-watersheds within the Fawn River Watershed and the percent of functional use loss since pre-settlement times for water quality and habitat in each sub-watershed. Note the last column in the Table shows the priority level given to each sub-watershed based on the functional use loss and the water quality data collected as part of this project. Figure 5.3 is a map depicting the 1979 NWI with the 2005 wetland inventory overlaid on top. The dark blue wetland areas visible in the map are critical for wetland restoration.

Table 5.3: Implementation Prioritization for Wetland Restoration Critical Areas

Sub-watershed	Wetland Functional Use Loss		Implementation Priority
	Water Quality	Habitat	
Clear Lake	47%	53%	1
Sherman Mill Creek	47%	61%	1
Fawn River Drain	59%	73%	1
Himebaugh Drain	42%	44%	1
Wegner Ditch	43%	43%	1
Town of Orland	32%	36%	2
Snow Lake	21%	28%	2
Lake James	29%	25%	2
Tamarack Lake	22%	21%	2

Figure 5.3: Critical Areas for Wetland Restoration



6.0 Goals, Management Measures, and Objectives

6.1 Goal Statements and Progress Indicators

The FRP steering committee used historic studies, land use, and water quality data, as well as current data, stakeholder input, problems found during the watershed investigation, and identified critical areas to determine overall goals for the watershed. The overarching goal of the project is to reduce pollutant loads and mitigate pollution sources so that water quality measurements will meet the project's target levels and/or state or federal water quality standards. However, to reach that principle goal of improving the quality of water in the Fawn River Watershed smaller, more attainable, goals were written. Each of the goal statements in the following Section is written to take small steps toward meeting the main goal of this project. It is also important to be able to measure the progress being made toward meeting each of the goals. Therefore, indicators were determined that will be used as a measurement tool and are listed in the following section as well.

6.1.1 Reduce Nitrogen Loading

The average historic nitrate levels measured in the Fawn River Watershed exceeded the target level in five of the nine sub-watersheds in the project area including Himebaugh Drain, Clear Lake, Wegner Ditch, Sherman mill Creek, and the Fawn River Drain sub-watersheds. The Nitrate loading calculations indicated that a combined 485.07 ton/year load reduction is needed in those sub-watershed mentioned above. To reach the target loading of 1136.7 tons/year or less, a 30.6% nitrate load reduction will need to be achieved. Much of the nitrate pollution may be coming from farm fields, urban fertilizer use, and leaking septic systems. Best management practices and an education and outreach program will need to be implemented in the critical areas identified for Nitrate loading to achieve the water quality goal for Nitrate.

<u>Goal Statement – Nitrate</u>

The goal of this project is for Nitrate levels in sampled water to be reduced by 15% within 5 years and 31% within 15 years.

<u>Indicator</u>

Water quality and administrative indicators will be used to show the progress toward meeting the goal for nitrogen levels in the Fawn River Watershed.

> <u>Water Quality Indicator</u>
>
> Nitrate will be measured at a minimum monthly throughout the year at the historic sample sites located within critical areas for nitrate. Sampling efforts will begin after three to five years of implementation. To determine if the milestones set for the nitrogen goal are being met, it would be expected to see that more water quality samples are meeting the target level for nitrate of 1.5 mg/L each year of sampling after three to five years of implementation.

Administrative Indicator

The load reductions as a result of best management practices that are installed in the watershed, as determined by the load reduction models, will be monitored to determine if the BMPs that are being installed are working adequately to reduce overall loadings of nitrate to reach the 30.6% reduction needed to meet the target load.

Administrative Indicator

The number of best management practices that can reduce nitrate levels that are installed in the watershed will be monitored. Annual goals for each of the various BMPs that can reduce nitrate levels are described in the Action register in Section 6.3.

6.1.2 Reduce Total Phosphorus Loading

The average historic total phosphorus levels measured in the Fawn River Watershed exceeded the target level in five of the nine sub-watersheds in the project area including Snow Lake, Lake James, Tamarack Lake, Town of Orland and Himebaugh Drain. The phosphorus loading calculations indicated that a combined 13.65 ton/year load reduction is needed in those sub-watersheds mentioned above. To reach the target loading of 72.94 tons/year or less, a 17.9% phosphorus load reduction will need to be achieved. Much of the phosphorus pollution may be coming from farm fields, urban fertilizer use, and leaking septic systems. Best management practices and an education and outreach program will need to be implemented in the critical areas identified for phosphorus loading to achieve the water quality goal for phosphorus.

Goal Statement – Total Phosphorus

The goal of this project is for phosphorus levels in sampled water to be reduced by 10% within 5 years and 18% within 15 years.

Indicator

Water quality and administrative indicators will be used to show the progress toward meeting the goal for total phosphorus levels in the Fawn River Watershed.

Water Quality Indicator

Phosphorus will be measured at a minimum monthly throughout the year at the historic sample sites located within critical areas for phosphorus. Sampling efforts will begin after three to five years of implementation. To determine if the milestones set for the phosphorus goal are being met, it would be expected to see that more water quality samples are meeting the target level for phsohphorus of 0.08 mg/L in tributaries and 0.3 mg/L in the mainstem of the Fawn River each year of sampling after three to five years of implementation.

Administrative Indicator
The load reductions as a result of best management practices that are installed in the watershed, as determined by the load reduction models, will be monitored to determine if the BMPs that are being installed are working adequately to reduce overall loading of total phosphorus to reach the 17.9% reduction necessary to meet the target load.

Administrative Indicator
The number of best management practices that can reduce total phosphorus levels (as described in Section 6.3) that are installed in the watershed will be monitored. Annual milestones for each of the various BMPs that can reduce phosphorus levels are described in the Action register in Section 6.3.

6.1.3 Reduce *E. coli* Loading

After analyzing both water quality data collected by this project and all historical water quality data, average *E. coli* levels exceeded the state standard of 235 CFU/100ml in three sub-watersheds located within the project area. Though, 11 of the 54 sample sites, in seven different sub-watersheds, including Tamarack Lake, Sherman Mill Drain, Wegner Ditch, Himebaugh Drain, Snow Lake, Fawn River Drain, and Clear Lake, exceeded the state standard. Excessive *E. coli* could be from wildlife, leaking failed or straight pipe on-site waste management, or animal operations located within the Fawn River Watershed.

Goal Statement – *E. coli*
The goal of this project is to have 30% of water quality samples meet the state standard of 235 CFU/100ml for *E. coli* within 5 years, and 50% of water quality samples meet the state standard within 15 years.

Indicator
Water quality and administrative indicators will be used to show the progress toward meeting the goal for *E. coli* levels in the Fawn River Watershed.

Water Quality Indicator
E. coli will be measured at a minimum monthly throughout the year at the historic sample sites located within critical areas for *E. coli*. Ideally weekly samples will be collected during the recreational season at the 11 sample sites where historically *E. coli* levels exceeded the state standard. Sampling efforts will begin after three to five years of implementation. To determine if the milestones set for the *E. coli* goal are being met, it would be expected to see that water quality samples are showing a decreasing trend in *E. coli* with more samples meeting the target level for *E. coli* of 235 CFU/100ml for a single sample each year of sampling after three to five years of implementation.

Administrative Indicator
The number of best management practices that can reduce *E. coli* levels that are installed in the watershed will be monitored. Annual milestones for each of the various BMPs that can reduce *E. coli* levels are described in the Action Register in Section 6.3.

6.1.4 Increase Wetland Acreage throughout the Watershed

The wetland functional use loss study that took place in 2005 revealed that the Fawn River Watershed has lost over 42% of its wetlands since pre-settlement times. With the loss in wetland acreage in the Fawn River Watershed also comes a functional use loss in excess of 35% for floodwater absorption, shoreline stabilization, water quality, and natural habitat. In a watershed dotted with lakes that are increasingly becoming built-up, and prime habitat for so many species of flora and fauna, including eight of the ten federally endangered species found within the project area, the protection and restoration of wetlands play a very important role in the health of the aquatic ecosystem in the Fawn River Watershed.

Goal Statement – Wetland Restoration and Protection
The goal of this project is to protect all existing wetlands immediately and increase the acreage of wetlands in the Fawn River Watershed by 500 acres within 5 years, and by 5,500 acres within 15 years.

Indicator
Administrative indicators will be used to show the progress toward meeting the goal for *E. coli* levels in the Fawn River Watershed.

Administrative Indicator
The acres of wetlands restored each year will be monitored. Annual milestones for wetland restoration are described in the Action Register in Section 6.3.

Administrative Indicator
The acres of wetlands that are protected will be monitored. It would be expected that no remaining wetlands in the Fawn River Watershed will be negatively altered or destroyed.

6.1.4 Reduce the Number of Faulty Septic Systems

Nearly 85% of the soils located within the Fawn River Watershed are considered to be very limited for the placement of septic systems, and another 6.8% of the soils are considered to be somewhat limited which means that significant alterations to the soil would need to be done in areas where a septic system is being installed to make it suitable. The rural community in the project area relies on on-site waste disposal systems, most of which were likely installed in soils that cannot support such a system. The majority of the urban and built-up areas are serviced by the Steuben Lakes Regional Sewer District (SLRSD) or municipal utilities; however not all homes located on populated lakes within the SLRSD's jurisdiction are currently serviced; there are still five populated areas in need of service from the SLRSD. There are also six other populated areas within the project area that are not currently serviced. High nitrate, phosphorus, and *E. coli* levels found in the watershed may be a result of leaking and faulty septic systems.

Goal Statement – Septic Systems

It is the goal of this project to reduce the number of failing and leaking septic systems in the Fawn River Watershed by working with area decision makers on a comprehensive septic system ordinance and developing and promoting an education and outreach program regarding septic system maintenance.

Indicator

Water Quality, social and administrative indicators will be used to show the progress toward meeting the goal for reducing the impact on water quality from septic systems in the Fawn River Watershed.

Water Quality Indicator

Nitrate, phosphorus, and *E. coli* will be measured at a minimum monthly throughout the year at the historic sample sites located within critical areas for nutrients and *E. coli*. Ideally weekly samples for *E. coli* will be collected during the recreational season at the 11 sample sites where historically *E. coli* levels exceeded the state standard. Sampling efforts will begin after three to five years of implementation. To determine if the milestones set for the septic system goal are being met, it would be expected to see that water quality samples are showing an increasing trend in water quality with more samples meeting the target levels each year of sampling after three to five years of implementation.

Social Indicator

A pre and post indicator survey regarding septic system functionality and maintenance will be conducted at workshops to determine individuals knowledge regarding septic systems and the amount in which that knowledge increases as a result of the workshop. It would be expected that 80% of the attendants of the workshops would have a better understanding of septic systems after the workshop.

Administrative Indicator

The number of people who attend septic system maintenance workshops will be monitored. It is a goal to have 25% of targeted households, including those located in populated areas known to still be using septic systems for their waste disposal and rural homeowners, show representation at the septic system outreach events.

Administrative Indicator

The number of failing, leaking, or straight pipe septic systems reported to the local health departments will be monitored. It is expected that the education and outreach program will increase the number of reported septic issues to the health departments.

Administrative Indicator
The number of households that enlist septic system companies to provide regular maintenance and/or repair leaking, failed, and straight-piped septic systems will be monitored. It is expected that the education and outreach program will increase the number of households performing regular septic maintenance and repairing improperly functioning systems. The goal is that at least 30% more maintenance and repairs occur after 3 to 5 years of implementation of the education program.

Administrative Indicator
A comprehensive septic system ordinance is passed within each county of the project area within five years of implementation.

6.2 Management Practices to Address Critical Areas and Accomplish Goals

In order to address the concerns leading to the designation of the above mentioned critical areas, best management practices and conservation measures will need to be taken. The Fawn River Watershed Steering Committee considered the plethora of management practices and measures available to address the critical area concerns and determined that certain practices will have the greatest impact on the water quality in the critical areas and will be the focus of phase two of the FRW project. In the table below, several practices and measures are outlined, and the predicted load reduction is presented for each BMP. Load reduction estimates were determined using either the Region 5, or STEP-L and assumptions that were used to determine the load reductions in each of the models is outlined in the table as well. A few of the load reductions were determined using the Soil and Water Assessment Tool (SWAT) that has recently been recalibrated by Purdue University. The reductions that are presented from the SWAT model were calculated for the Upper St. Joseph River Watershed – Maumee River Basin and were used for the Fawn River project due to the fact that variables are very similar between the two watersheds, and it is believed that the SWAT model is more accurate than the other two available load reduction models. The following list is not all inclusive and other practices and management measures may be added to the list in the future.

Table 6.1: Management measures to Address Critical Areas and Project Goals

BMP or Management Measure	Critical Area to be Addressed by BMP	Reason for Being Critical	Assumptions Used	Estimated Load Reduction per BMP		
				Sediment	Total Phosphorus	Nitrogen
Agriculture, Urban, and Septic System Education Program	All Critical Sub-watersheds	Nutrients, E. coli, and Wetlands		N/A	N/A	N/A
Lake resident education and outreach on their impact to lake water quality		Nutrients, E. coli, and Wetlands		***	***	***
Annual Ag. And Urban Workshops/Field Days		Nutrients, E. coli, and Wetlands		N/A	N/A	N/A
Wetland (Restoration/Creation)	Clear Lake, Sherman Mill Creek, Fawn River Drain, Himebaugh Drain, Wegner Ditch, Town of Orland, Snow Lake, Lake James, Tamarack Lake	Wetland	100 acres contributing area/BMP	5.93 ton/yr	8 lbs/yr	48 lbs/yr

BMP or Management Measure	Critical Area to be Addressed by BMP	Reason for Being Critical	Assumptions Used	Estimated Load Reduction per BMP		
				Sediment	Total Phosphorus	Nitrogen
Nutrient / Pesticide Management	Himebaugh Drain, Wegner Ditch, Sherman Mill Drain, Fawn River Drain, Tamarack Lake, Clear Lake, Town of Orland, Lake James	Nutrient	Estimated 20% reduction of fertilizer and pesticides provided by Purdue University ona per acre basis	0.614 ton/yr	1.10 lbs/yr	6.67 lbs/yr
Cover Crops[1]		Nutrient	Planted a day after harvest. Cover crop killed and left as residue on field, one week prior to next crop planting	11 ton/yr	12lbs/yr	22 lbs/yr
Two-stage ditch[1]		Nutrient	1000 linear foot with a depth of 10'	80 ton/yr	80 lbs/yr	160 lbs/yr
Conservation Tillage/Mulch Till[3]		Nutrient	Presented on a per acre basis	0.77 ton/yr	.12 lbs/yr	2.37 lbs/yr
Conservation Tillage/No-Till[3]		Nutrient	Presented on a per acre basis	0.36 ton/yr	0.08 lbs/yr	1.13 lbs/yr
Soil Ammendments (Gypsum)[5,6]		Nutrient	Presented on a per acre basis	0.47 ton/yr	1.49 lbs/yr	***
Native Vegetation Planting (Switch Grass)[3]		Nutrient	Continuously grown, with one time planting. 75% is harvested and urea is applied annually at 122 kg/ha	2.68 ton/yr	4.65 lbs/yr	26.72 lbs/yr
Streambank Stabilization[1]		Nutrient	1000 linear feet of stabilization on both banks	160 ton/yr	160 lbs/yr	320 lbs/yr
Replace Seawalls with Natural Shoreline		Nutrient		***	***	***
Rain Barrels[2]		Nutrient	1 Acre contributing area to a 50 gallon rain barrell	0.2 ton/yr	0.15 lbs/yr	0.81 lbs/yr
Rain Gardens (Residential)[2]		Nutrient	1 acre of contributing area/BMP	0.18 ton/yr	0.1 lbs/yr	2 lbs/yr
Rain Gardens (Commercial)[2]		Nutrient	10 acres of contributing	4.63	6 lbs/yr	42 lbs/yr

BMP or Management Measure	Critical Area to be Addressed by BMP	Reason for Being Critical	Assumptions Used	Estimated Load Reduction per BMP		
				Sediment	Total Phosphorus	Nitrogen
			area/BMP	ton/yr		
Curb Cuts (In combination with other LID practices)	Himebaugh Drain, Wegner Ditch, Sherman Mill Drain, Fawn River Drain, Tamarack Lake, Clear Lake, Town of Orland, Lake James	Nutrient		***	***	***
Bioswale[2]		Nutrient	10 acres of contributing area/BMP	0.1 ton/yr	0.3 lbs/yr	0.6 lbs/yr
Infiltration Trench[2]		Nutrient	10 acres of contributing area/BMP	0.2 ton/yr	0.7 lbs/yr	4.0 lbs/yr
Pervious Pavement[2] (Commercial)		Nutrient	10 acres of contributing area/BMP	1.13 ton/y	4.35 lbs/yr	56.9 lbs/yr
Pervious Pavement[2] (Residential)		Nutrient	1 acre of contributing area/BMP	1.68	7.54	79.86
Encourage the Sale of Phosphorus Free Fertilizers at Local Retailers		Nutrient		N/A	N/A	N/A
Urban Fertilizer Education Program		Nutrient		N/A	N/A	N/A
Tree Planting[4]		Nutrient		N/A	N/A	N/A
Wildlife Exclusion at Stormwater Basins	All Critical Sub-watersheds	Nutrient and E. coli		***	***	***
Pet Waste Disposal Receptacle		Nutrient and E. coli		***	***	***
Native Vegetation Planting		Nutrient and E. coli		***	***	***
Extended Wet Detention[2]		Nutrient and E. coli	10 acres of contributing area/BMP	0.12 ton/yr	0.59 lbs/yr	5.56 lbs/yr
Riparian Buffers[1]		Nutrient and E. coli	LR model for streambank protection was used for 1000 linear feet on both banks of the stream	190 ton/yr	190 lbs/yr	320 lbs/yr
Filter Strip[2]		Nutrient and E. coli	1 acre of contributing area/BMP	2.10 ton/yr	3.42 ton/yr	11.63 lbs/yr

BMP or Management Measure	Critical Area to be Addressed by BMP	Reason for Being Critical	Assumptions Used	Estimated Load Reduction per BMP		
				Sediment	Total Phosphorus	Nitrogen
Repair/replace Leaking On-Site Waste Disposal Systems	All Critical Sub-watersheds	Nutrient and E. coli	4 people per household who use 60 gallons of water per day	248.2 lbs/yr	6.5 lbs/yr	55 lbs/yr
Drainage Water Management		Nutrient and E. coli		***	***	***
Blind Inlets		Nutrient and E. coli		***	***	***
Septic System Workshop		Nutrient and E. coli		N/A	N/A	N/A
Education Program Geared Toward Livestock Operators		Nutrient and E. coli		N/A	N/A	N/A
Limited Access Stream Crossing/Exclusion Fencing (along with Streambank Erosion Practices and/or Alternative Watering Facility)[2]		Nutrient and E. coli	30 head of dairy and/or beef cattle and 10 horses present on 50 acres of agriculture land	9.7 ton/yr	24.1 lbs/yr	194.2 lbs/yr
Rotational Grazing		Nutrient and E. coli		***	***	***
Manure Holding Facilities / Dry Stack Areas[1]		Nutrient and E. coli	40 head of dairy cows, 10 young heifers, and 10 horses and <24% paved/BMP	***	129 lbs/yr	1,426 lbs/yr
Comprehensive Nutrient Management		Nutrient and E. coli		***	***	***
Runoff Management System[1]		Nutrient and E. coli	40 head of dairy cows, 10 young heifers, and 10 horses and <24% paved/BMP	***	284 lbs/yr	***
Repair/replace Leaking On-Site Waste Disposal Systems[8]		Nutrient and E. coli	4 people per household who use 60 gallons of water per day	248.2 lbs/yr	6.5 lbs/yr	55 lbs/yr

BMP or Management Measure	Critical Area to be Addressed by BMP	Reason for Being Critical	Assumptions Used	Estimated Load Reduction per BMP		
				Sediment	Total Phosphorus	Nitrogen
Septic System Education and Outreach	All Critical Sub-watersheds	Nutrient and E. coli		N/A	N/A	N/A
Work With Local Planners to Establish Rules for Proper Septic System Usage/Placement/Inspection		Nutrient and E. coli		N/A	N/A	N/A

[1]Region 5 Load Reduction Model; [2]STEP-L Load Reduction Model; ***Too many variables, too new of a technology to estimate, or a model does not exist to estimate load reductions; [3]SWAT Load Reduction Model, [4]A medium sized tree is estimated to uptake 2380 gallons of water annually (Center for Urban Forest Research, Pacific Southwest Research Station, USDA Forest Service, Davis, California. July 2002); [5]TP loss estimated to be cut by 57% according to a study in the periodical Agricultural and Food Science, [6]DRP loss is estimated to be cut by 66% and sediment by 56% compared to controls fields reported in the National Soil Erosion Research Laboratory, [7]Extensive Green Roofs have the capacity to absorb 50% of rainfall, [8]Estimates found in the Onsite Wastewater Treatment Systems Manual, US EPA, 2002.

6.3 Action Register to Accomplish Goals

The goals set by the Fawn River Watershed Steering Committee are ambitious; therefore the steering committee determined objectives to help the project reach the goals set by the steering committee. Each objective has milestones to reach within a certain timeframe to determine the progress toward achieving each of the goals. The following tables are Action Registers which outline the management measures that will need to be implemented in order to reach the goals set for this project. The first Table is a general Action Register for the project as a whole, identifying specific tasks that need to be accomplished to implement the entire WMP including hiring personnel and acquiring funding, providing education and outreach, acquiring necessary partnerships, and developing and promoting a cost-share program. The following Tables are Action Registers for each critical area to address the pollutants or management measures that are causing the areas to be impaired. The critical area Action Registers outline the number of BMPs that will need to be installed within critical area to reach the necessary load reductions to meet target levels. Milestones are set for each of the BMPs stating how many, and/or what size of BMP will be installed to meet the goals set by this project. BMPs are not determined per sub-watershed as it is unknown where implementation will be successful, but rather the total number, or size, or BMP needed to reach the total load reduction necessary to meet the target load is presented.

6.3.1 General Action Register for Implement

The following table consists of general objectives necessary to implement the Fawn River Watershed Management Plan and reach all goals outlined in Section 6.1 on this WMP including reducing nutrient and E. coli loading, and protect and restore wetlands within the critical areas.

Table 6.1: General Action Register for Personnel and Funding

Hire Personnel and Acquire Necessary Funding					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Implement the Fawn River Watershed Management Plan	Fawn River Watershed Stakeholders	Within the First Two Years after WMP Approval then ongoing	Hire personnel to implement the WMP (6 months)	$50,000/ year	County SWCD and NRCS offices, Friends of the St. Joe River Assoc., IDEM, IN DNR, MDEQ and MI DNR, OEPA (P and TA)
			Secure Funding to Implement the WMP including any office overhead and salaries (6 months)	$1,000	
			Secure funding to promote education and outreach programs (6 months)	***	
			Secure Funding to Begin Water Quality Sampling Efforts (2 years)	***	

*** Cost included in salary.

Table 6.2: General Action Register for Education and Outreach

Provide Education and Outreach in Critical Areas					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Develop and Implement an Agriculture Education and Outreach Program	Fawn River Watershed Stakeholders Located within Critical Areas	Within the First 12 Months after WMP Approval then ongoing	Compile an ag. Education/Outreach Plan (6 months)	***	County Lakes Councils, SWCD, FSA, and NRCS offices (P, TA) Friends of the St. Joe River Assoc. (P, TA), The Nature Conservancy (P, TA)
			Develop and/or Disseminate an Ag. Education Brochure (8 months)	$4,000	
			Hold First Annual Ag. BMP Workshop/Field Day (12 months)	$1,500 / year	
			Meet with Amish Bishops to Get "buy-in" for Education Programs Within the Amish Community (6 months)	***	
Develop and Implement an Agriculture Education and Outreach Program Specific to Livestock Operators	Fawn River Watershed Livestock Operators	Within the First 12 Months after WMP Approval then ongoing	Compile a livestock education/outreach plan (6 months)	***	County Lakes Councils, SWCD, FSA, and NRCS offices (P, TA) Friends of the St. Joe River Assoc. (P, TA)
			Develop and/or disseminate a livestock education brochure (8 months)	$2,000	
			Hold first annual pasture walk (12 months)	$500 / year	
			Meet with Amish Bishops to Get "buy-in" for Education Programs Within the Amish Community (6 months)	***	
Develop and Implement an Urban Education and Outreach Program	Fawn River Watershed Stakeholders in Critical Areas (Sturgis, Angola)	Within the First 24 Months after WMP Approval then ongoing	Compile an urban education and outreach plan (12 months)	***	County Planning Commissions (P) Angola, Fremont, Sturgis, Administrators, MS4 coordinators and Decision
			Develop and/or disseminate an urban education brochure (12 months)	$4,000	

Provide Education and Outreach in Critical Areas					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
			Hold first Annual urban BMP Workshop (18 months)	$1,000 / year	Makers (P), County Lakes Councils and SWCDs (P, TA)
			Install a Demonstration Urban BMP that has not yet been utilized in that urban setting (18 months)	$2,000	
Develop and Implement a Septic System Educational Program	Fawn River Watershed Stakeholders who Utilize Septic Systems	Within the First 18 Months after WMP Approval then ongoing	Develop and/or Disseminate a Septic System Maintenance Brochure (18 months)	$4,000	County Health Departments and SWCDs (P,TA) Area Septic System Businesses (P, TA)
			Hold First Annual Septic System Workshop for homeowners (18 months)	$1,000/ year	
Develop and Implement a Wetland Educational Program	Fawn River Watershed Stakeholders	Within the First 12 Months after WMP Approval then ongoing	Compile a Wetland Education and Outreach Plan (6 months)	***	County SWCD and NRCS Offices (P, TA), IN DNR and MI DNR (P), The Nature Conservancy (P, TA), Friends of the St. Joe River Assoc. (P, TA), County Planning Offices (P)
			Develop and/or Disseminate a Brochure Discussing the Ecological and Environmental Services Offered by Wetlands (8 months)	$4,000	
			Hold First Annual Wetland Field Day to Promote Preservation and Construction of Wetlands. (12 months)	$500	

*** Cost included in salary.

Table 6.3: General Action Register for Partnerships

Partner with Key Organizations to Assist with WMP Implementation					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Partner with Organizations who are Providing Education/Outreach or cost assistance with Septic Issues	Fawn River Watershed Septic System Stakeholders	Within the First 18 Months after WMP Approval	Meet with County Health Departments Annually to Discuss Septic Issues (12 months)	***	County and State Health Departments and SWCDs (P,TA), EPA (TA), Local Septic System Businesses (P)
			Work with Local Septic System Businesses to offer discounts to stakeholders who sign up for regular septic maintenance including pump-outs and inspections. (12 months)	$500/ year	
Partner with Municipalities and other Organizations who are Providing Education and Outreach or Cost Assistance with Urban Stormwater Issues	Fawn River Watershed Urban Stormwater Stakeholders	Within the First 18 Months after WMP Approval	Make contact with City and County Planners / MS4 Coordinators (12 months)	***	County Planning Commissions and SWCDs (P) Angola, Fremont, and Sturgis Administrators, MS4 coordinators and Decision Makers (P)
			Meet with City and County Decision Makers Bi-annually (12 months)	***	
			Work with City and County Planners to Encourage Low Impact Design for New Developments (18 months)	***	
			Partner with organizations that currently provide urban education and outreach (12 months)	***	

Partner with Key Organizations to Assist with WMP Implementation					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Partner with County Lakes Councils	Fawn River Watershed Recreation Stakeholders	Within the First 12 Months after WMP approval then ongoing	Make contact with Lakes Councils and Lake Associations to discuss enforcing a phosphorus free fertilizer policy and replacement of seawalls with natural shorelines (6 months)	***	Steuben and LaGrange County Lake Councils (P), County SWCDs (P), All Private Lake Associations (P), IN DNR and MI DNR (P, TA)
			Meet with Organizations who have agreed to be partners bi-annually (12 months)	***	

*** Cost included in salary.

Table 6.4: General Action Register for Tracking Indicators

Milestones for Indicators of Reaching Goals (not covered elsewhere)					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Disseminate and Analyze Social Indicator Study for Septic Systems	Fawn River Watershed Stakehodlers who Utilize Septic Systems	Within 2 Years after WMP Approval	Social Indicator Study for Septic Systems Developed and Disseminated at Workshops (18 months)	$1,000	County SWCDs and Health Departments (P, TA)
			Social Indicator Study Analyzed (24 months)		
Water Quality Sampling	Fawn River Watershed Stakeholders	Within 5 Years after WMP Approval	Water Quality Sampling Begins at historic critical sites for Turbidity, TDS, TSS, Nitrate+Nitrite, TP, and *E. coli* at a minimum	$25,000/ year	County SWCDs (P), County Lakes Councils (P), Regional Sewer Districts and Cities of Angola and Sturgis (P)

Table 6.5: General Action Register for Cost-Share Program

Develop and Promote Cost-share Programs					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Develop, and Promote a Cost-share Program on BMPs to Reduce Pollutant Loadings	Fawn River Watershed Stakeholders	Within the First 18 Months after WMP Approval	Secure Funding to Implement the Cost-share Program (12 months)	***	County SWCD, FSA, and NRCS Offices (P) City and County Parks Departments (P) MS4 Coordinators and LTCP Implementers (P), The Nature Conservancy (P, TA), Purdue and Michigan State Extensions (P, TA), IDEM, IN DNR, MDEQ, MI DNR (P, TA)
			Program Developed for Agriculture Cost Share Opportunities (6 months)	***	
			Develop and disseminate an Ag. Cost-share Brochure (8 months)	$1,500 / year	
			Program Developed for Urban Cost Share Opportunities (12 months)	***	
			Develop and disseminate an Urban Cost-share Brochure (18 months)	$1,500/ year	
			Program Developed for Lake homeowner Cost Share Opportunities (8 months)	***	
			Develop and disseminate a Lake Cost-share Brochure (10 months)	$1,500/ year	
			Program Developed for Wetland Restoration Cost Share Opportunities (6 months)	***	
			Develop and disseminate a Wetland Cost-share Brochure (8 months)	$1,500/ year	

*** Cost included in salary.

6.3.2 Action Registers to Implement Cost-share Program in Each Sub-watershed

The following sub-sections include action registers for the implementation of a cost-share program in the critical areas outlined in Section 5 of this WMP. The Action Registers include information regarding the number of BMPs that will be installed annually, the total that will be installed over the next 15 years, the total cost of implementation over the 15 year period, as well as the total load reduction that will be achieved annually should all the BMPs be installed as outlined within the Action Register. It is important to note that the load reduction of each BMP often compounds year after year. For example, the annual load reduction from implementation of no-till will be greater in year three of no-till farming than it was during the initial year of implementation. Therefore, the overall load reduction may be greater than is projected from the models. Water quality testing after 3-5 years of implementation will aid in understanding what the actual load reduction is from BMP efforts. Additionally, not all the BMPs that will be implemented in the project area can be modeled in one of the available load reduction models, and therefore, not all BMPs listed in the following Action Registers will have load reductions associated with them.

Table 6.6: Implementation Action Register for Urban and Lake Residents

Nutrient and E. coli Critical Areas: Priority 1 - (Nutrients) Himebaugh Drain, Sherman mill Creek, Fawn River Drain (E. coli) Sample Sites 12, 13, 15, 40, 47; Priority 2 - (Nutrients) Lake James, Tamarack Lake, Clear Lake (E. coli) Sample Site 1, 4, 28, 32, 39, 52										
Objective	Target Audience	Imple-mentation Timeframe	Action	Milestone	Quantity		Load Reduction			Estimated Total Cost
					Annual	Total	Sediment (tons/yr)	Phosphorus (lbs/yr)	Nitrogen (lbs/yr)	
Implement Urban BMPs to Reduce Pollutant Loads in Critical Areas	Urban and Lake Home-owners	Within 15 Years of WMP Approval	Rain Barrels	Install 10 rain barrels/year	10	150	2	1.5	8.1	$7,500
			Rain Gardens (Residential)	Install 5 gardens/year	5	75	0.9	0.5	10	$15,000
			Rain Gardens (Commercial)	Install 2 garden/year	2	30	9.26	12	84	$30,000
			Curb Cuts (in combination with other LID practices)	1 project every 2 years	0.5	7	***	***	***	$55,000
			Bioswale	1 project every 2 years	0.5	7	0.05	0.15	0.3	$35,000

Nutrient and E. coli Critical Areas: Priority 1 - (Nutrients) Himebaugh Drain, Sherman mill Creek, Fawn River Drain (E. coli) Sample Sites 12, 13, 15, 40, 47; Priority 2 - (Nutrients) Lake James, Tamarack Lake, Clear Lake (E. coli) Sample Site 1, 4, 28, 32, 39, 52										
Objective	**Target Audience**	**Imple-mentation Timeframe**	**Action**	**Milestone**	**Quantity**		**Load Reduction**			**Estimated Total Cost**
					Annual	**Total**	**Sediment (tons/yr)**	**Phosphorus (lbs/yr)**	**Nitrogen (lbs/yr)**	
Implement Urban BMPs to Reduce Pollutant Loads in Critical Areas	Urban and Lake Home-owners	Within 15 Years of WMP Approval	Extended Wet Detention	1 project every 3 years	0.33	5	0.0396	0.1947	1.8348	$75,000
			Infiltration Trench	1 project every 3 years	0.33	5	0.066	0.231	1.32	$75,000
			Pervious Pavement (Residential)	Install 1 every 2 years	0.5	7	0.565	2.175	28.45	$55,000
			Pervious Pavement (Commercial)	Install 1 every 5 years	0.2	3	0.336	1.508	15.972	$30,000
			Native Vegetation Planting	Install 1 acre every 2 years	0.5	7	***	***	***	$35,000
			Pet Waste Disposal Receptacles	Install 2 in each urban park	2	20	***	***	***	$2,000
			Wildlife Exclusion at Stormwater Basins	Install 1 exclusion every 2 years	0.5	7	***	***	***	$35,000
			Encourage the sale of phosphorus free fertilizers at local retailers	Meet with all local retailers within 24 months of WMP approval						***

Nutrient and E. coli Critical Areas: Priority 1 - (Nutrients) Himebaugh Drain, Sherman mill Creek, Fawn River Drain (E. coli) Sample Sites 12, 13, 15, 40, 47; Priority 2 - (Nutrients) Lake James, Tamarack Lake, Clear Lake (E. coli) Sample Site 1, 4, 28, 32, 39, 52										
Objective	Target Audience	Imple-mentation Timeframe	Action	Milestone	Quantity		Load Reduction			Estimated Total Cost
					Annual	Total	Sediment (tons/yr)	Phosphorus (lbs/yr)	Nitrogen (lbs/yr)	
Implement Urban BMPs to Reduce Pollutant Loads in Critical Areas	Urban and Lake Home-owners	Within 15 Years of WMP Approval	Encourage Lake associations to institute a ban on the use of phosphorus fertilizers	Meet with all lake associations within 18 months of WMP approval						***
			Begin an urban tree planting program	Plant 10 trees annually	10	150				$15,000
			Replace sea walls with Natural Shoreline protection	Install 1 natural shoreline within 2 years and 1 annually thereafter	1	14				$100,000

Table 6.7: Implementation Action Register for Agriculture Producers

Objective	Target Audience	Imple-mentation Timeframe	Action	Milestone	Quantity		Load Reduction			Estimated Total Cost
Nutrient and E. coli Critical Areas: Priority 1 - (Nutrients) Himebaugh Drain, Sherman mill Creek, Fawn River Drain (E. coli) Sample Sites 12, 13, 15, 40, 47; Priority 2 - (Nutrients) Lake James, Tamarack Lake, Clear Lake (E. coli) Sample Site 1, 4, 28, 32, 39, 52										
					Annual	Total	Sediment (tons/yr)	Phosphorus (lbs/yr)	Nitrogen (lbs/yr)	
Implement Agricultural BMPs to Reduce Pollutant Loads	Agriculture Producers in Critical Areas	Within 15 Years of WMP Approval	Nutrient / Pesticide Management	1000 new acres annually	1000	15,000	614	1100	6670	$300,000
			Cover Crops	1500 new acres/yr	1500	22,500	16500	18000	33000	$700,000
			Two-stage Ditch	1 project every 2 years	1000 lf/ 2 years	7000 lf	80	80	160	$250,000
			Conservation Tillage	1000 acres annually	1000	15000	770	120	2370	$300,000
			Blind Inlets	2 annually	2	30				$30,000
			Drainage Water Management	2 annually	2	30				$60,000
			Soil amendments - Gypsum	500 new acres annually	500	7500	235	745	-	$300,000
			Native Vegetation Planting	200 new acres annually	200	3000	536	930	5344	$500,000
			Filter Strips	Install 2 annually with 150 acre contributing area	2 / 300 acres	30 / 4500 acres	63	102.6	348.9	$120,000

Nutrient and E. coli Critical Areas: Priority 1 - (Nutrients) Himebaugh Drain, Sherman mill Creek, Fawn River Drain (E. coli) Sample Sites 12, 13, 15, 40, 47; Priority 2 - (Nutrients) Lake James, Tamarack Lake, Clear Lake (E. coli) Sample Site 1, 4, 28, 32, 39, 52										
Objective	**Target Audience**	**Imple-mentation Timeframe**	**Action**	**Milestone**	**Quantity**		**Load Reduction**			**Estimated Total Cost**
					Annual	**Total**	**Sediment (tons/yr)**	**Phosphorus (lbs/yr)**	**Nitrogen (lbs/yr)**	
Implement Agricultural BMPs to Reduce Pollutant Loads	Agriculture Producers in Critical Areas	Within 15 Years of WMP Approval	Riparian Buffers	Install 1500 lf annually	1500	22,500	285	285	480	$400,000
			Streambank Stabilization	500 lf annually for 10 years	500	5000	80	80	160	$500,000
			Livestock Exclusion	2 annually until no access exists	2	2	19.4	48.2	388.4	$15,000
			Comp. Nutrient Management	2 annually	2	20				$60,000
			Runoff Management Systems	2 annually until no access exists	2	2				$15,000

Table 6.8: Implementation Action Register for Wetland Restoration

Wetland Restoration Critical Area: Priority 1 - Clear Lake, Sherman Mill Creek, Fawn River Drain, Himebaugh Drain, Wegner Ditch; Priority 2 - Town of Orland, Snow Lake, Lake James, Tamarack Lake										
Objective	Target Audience	Imple-mentation Timeframe	Action	Milestone	Quantity		Load Reduction			Estimated Total Cost
					Annual	Total	Sediment (tons/yr)	Phosphorus (lbs/yr)	Nitrogen (lbs/yr)	
Restore Pre-Settlement Wetlands	Stake-holders Located Within the Fawn River Watershed	Within 15 Years of WMP Approval	Wetland Restoration	Restore 100 acres of wetlands annually for 5 years, then 500 acres annually for 10 years	100	5,500	5.93	8	48	$1,000,000

7.0 Potential Annual Load Reductions after Implementation

Actions outlined in Section 6 were determined by taking a combination of aspects of watershed management including how likely it is that landowners will be willing to participate in a cost-share program to implement BMPs and the potential load reductions that would result from their implementation. Using the Spreadsheet Tool for Estimating Pollution Load (STEPL), the Region 5 load reduction model, which both can be found at http://it.tetratech-ffx.com/steplweb/, and the recalibrated SWAT model provided by Purdue University, potential load reductions were determined for nitrogen, phosphorus, and sediment on a per BMP basis.

The two load reduction models available for public use at this time do have some limitations in that not all BMPs can be modeled and as stated earlier in this WMP, estimates for *E. coli* cannot be determined accurately. Therefore, narrative assumptions for the benefit of certain BMPs and possible load reductions will be provided.

It is important to note that assumptions were made for the model inputs as exact acreage of implementation is dependent on the support for participation that is received by landowners in the critical areas as outlined in Section 5. The load reductions presented in this document are derived from a model and are best guess scenarios only, and only account for the BMPs which planned to be installed as part of this project, assuming that no BMPs were installed in the past, or are currently being used. It is understood throughout the conservation community that load reductions from BMPs have a cumulative effect and that the reductions in pollutant loads will increase exponentially as they are implemented year after year or in combination with other BMPs. Accurate load reductions will be determined when the water quality analysis is performed on historic sample sites in the Fawn River Watershed after three to five years of implementation. Table 7.1 shows the estimated load reduction after implementation of the Action Registers outlined in Section 6 for all critical areas. As can be seen in Table 7.1, according to estimated load reductions from various models the sediment, total phosphorus and nitrogen goals as outlined in Section 6.1 will not only be met, but likely exceeded by the end of the 15 year Fawn River Watershed Management Plan implementation.

Table 7.1: Estimated Load Reductions after Implementation

	Load Reduction			**Estimated Total Cost**
	Sediment (tons/yr)	**Phosphorus (lbs/yr)**	**Nitrogen (lbs/yr)**	
Estimated Total	19201.5466	21517.0587	49119.2768	$5,114,500
Necessary Annual Load Reduction	0	27300	970,140	
Annual Percent Reduction	-	78.82%	5.06%	
Estimated Load Reduction at Project End	288,023	322,756	736,789	
Percent Reduction at Project End	-	100.00%	75.95%	

8.0 Future Activities

After extensive research conducted over two and a half years in the Fawn River Watershed, the resulting Watershed Management Plan is full of valuable information regarding common land uses and practices, as well as historic and present day water quality issues found in each subwatershed located within the Fawn River watershed. However, this information is not common knowledge therefore; key findings in the WMP and the cost-share program will be introduced to the public through at least one annual public meeting held in Indiana and Michigan, within months of the final WMP approval by the IDEM, MDEQ, and US EPA. The meetings will be advertised through local media outlets including newspapers, Lake Associations, SWCD, NRCS, and FSA offices. Other means of advertisement will be pursued as well. Informing the Fawn River stakeholders on the extent of the water quality problems within the watershed will hopefully illicit concern as well as a willingness to change behaviors to have a positive impact on water quality.

Next steps in the Fawn River Watershed project is for the Steering Committee to develop a cost-share program that will include, at a minimum, those management measures outlined in the Action Register in Section 6.3 of this WMP, and the various incentive levels that will be used to encourage the adoption of those management measures. The Steering Committee will work closely with all Conservation Districts located within the project area, as well as the partners outlined in the Action Register to make sure their cost-share recommendations are realistic for the demographic of the area, and to utilize their help for promoting the program. A key component of the cost-share program's success is the education and outreach aspect of the Fawn River Watershed project. Field days and workshops regarding agricultural, lake and urban land uses and BMPs will be held annually, as part of this project, however, partnering with other organizations such as other county SWCD and NRCS offices, The Nature Conservancy, the IN and MI DNR, and smaller non-profit groups that focus on water quality and sustainable land uses, will prove to be integral in promoting practices to improve the health of the watershed.

It is anticipated and encouraged that this WMP be reviewed and utilized by other organizations within the Fawn River Watershed including the Friends of the St. Joe River Association, LaGrange and Steuben County Lake Associations, Steuben, LaGrange, and St. Joseph County SWCDs, The Nature Conservancy, County Drainage Boards, Surveyors and Engineers, City and County Planning Departments, and other organizations concerned about the water quality of the Fawn River Watershed. The Fawn River Watershed project's first priority will be to obtain funding to pursue the objectives outlined in the Action Register; however we hope to work with other organizations that plan to do the same. As the point of contact for this WMP, the LaGrange County SWCD will distribute the document to all stakeholder organizations (a distribution list is located at the end of this document), as well as have hard copies of the document available to borrow, or purchase at the SWCD office located at 910 S. Detroit St. LaGrange, IN.

A watershed is continually changing as land uses change, towns begin to expand, new businesses organize in the area, farmland is converted to other uses, or wetlands are drained or moved to accommodate development or farming. These changes in the Fawn River Watershed particularly have continued to have an enormous impact on water quality and the aquatic habitat in area lakes, and in the river itself. As the watershed continues to change so must the actions taken to maintain and/or improve the integrity of the water quality. Therefore, the Fawn River Watershed Management Plan must remain a 'living document' and goals, objectives, and actions outlined in the WMP must be revisited by the LaGrange SWCD, or its partners, at a minimum, every ten years. However, as area stakeholders including residents, conservation organizations and planners, City and Town governments, or others working on the implementation of the Fawn River Watershed Management Plan observe land uses and/or water quality changing, the WMP must be revised to meet the area conservation needs and provide a refocus of efforts if necessary, at that time.

References

Angola Parks and Recreation Department. Angola Parks and Recreation 5-Year Park and Recreation Master Plan; 2013 – 2017. 2013.

Aquatic Control for Crooked Lake Association. Crooked Lake Aquatic Vegetation Management Plan. 2013 Update. Steuben County, IN. February 4, 2013.

Aquatic Enhancement and Survey, Inc. for Jimmerson Lake Association. Aquatic Plant Management Plan Update - 2013. February 25, 2014.

Aquatic Enhancement and Survey, Inc. for Wall Lake Fisherman's Association. Aquatic Plan Management Plan Update – 2013. February 27, 2014.

Aquatic Enhancement and Survey, Inc. for Wall Lake Fisherman's Association. Lake Diagnostic Study: Wall Lake. March 21, 2006.

Aquatic Enhancement and Survey, Inc. for West Otter Lake Association. West Otter Lake Aquatic Vegetation Management Plan Update, Steuben County, Indiana 2013. February 27, 2014.

Aquatic Enhancement and Survey, Inc. Lake Diagnostic Study: Lake James, Snow Lake, Big Otter and Little Otter Lakes. Steuben County, Indiana. October 24, 2006.

Aquatic Weed Control for lake Gage and Lime Lake Association, Inc. Lake Gage and Lime Lake Aquatic Vegetation Management Plan 2012 - 2016.

Aquatic Weed Control for Lake George Cottagers Association. Aquatic Vegetation Management Plan Update 2013. November 15, 2013.

Branch County Commissioners. Branch County Master Land Use Plan. 1997.

California Environmental Protection Agency: Ecotoxicology Program, Integrated Risk Assessment Branch, Office of Environmental Health. Microcystins: A Brief Overview of Their Toxicity ad Effects, with Special Reference to Fish, Wildlife, and Livestock. January, 2009.

Commonwealth Biomonitoring for Jimmerson Lake Association. Jimmerson Lake Diagnostic Study. January, 2003.

Davey Resource Group for Lake James Association. Phase II – Engineering Feasibility Study and Engineering Design: Middle Croxton Ditch Watershed, Pleasant Township, Steuben County, Indiana. January, 2014.

DeGraves, Andrew for Friends of the St. Joe River Association. St. Joseph River Watershed Management Plan. 2005.

Donan Engineering, Inc. for Jimmerson Lake Association. Lake and River Enhancement Engineering Feasibility Study for Jimmerson Lake. January 6, 2005.

Gensic Engineering, Inc. et. al. for Lake Gage and Lime Lake Association, Inc. Lake Gage and Lime Lake Engineering Feasibility Study. December 16, 2005.

Ground Rules. Angola Indiana Comprehensive Plan. 2012. City of Angola Planning Commission.

Ground Rules. Steuben County, IN. Comprehensive Plan. 2006.

Ground Rules. Town of Fremont Comprehensive Plan. 2013

Indiana Dept. of Natureal Resources: Lake and River Enhancement Program, for Cedar Creek Cottage Owners Association. Cedar Lake Diagnostic Study. September 2010.

JF New. Carpenter Drain Design/Build Report. June 20, 2005.

JF New for Lake Gage and Lime Lake Association Inc. Concorde Creek Channel Restoration Project Design Report. May 26, 2008.

JF New for Lake Gage and Lime Lake Association Inc. Concorde Creek Channel Restoration Project Design Report. December 2, 2009.

JF New. Crooked Lake Engineering Feasibility Study. April 19, 2005.

JF New. Crooked Lake Monitoring Study. May 26, 2003.

JF New. Steuben County 4-H Park; Stormwater, Sediment, and Nutrient Reduction Project Design Report. January 11, 2007.

Lewis, Neal, et. al. Fawn River Restoration. Land and Water. Pages 48-52. May/June 2013

LSL Planning, Inc for the City of Sturgis. Master Plan for Future Land Use. 2010

McBride Dale Clarion and Teree Bergman, FAICP. LaGrange County Comprehensive Plan. 2005.

Office of the Great Lakes, Michigan. MI Great Lakes Plan: Our Path to Protect, Restore, and Sustain Michigan's Natural Treasures. January, 2009.

Purdue University. Indiana's Most Unwanted Invasive Plant Pests.

http://extension.entm.purdue.edu/CAPS. 09 June, 2014.

St. Joseph County Commissioners. St. Joseph County Michigan Master Plan, 2007 Update, *A Smart Growth Approach to Urban Development, Open Space Preservation, and Agricultural Production.* 2007.

United States Department of Agriculture. Natural Resource Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/fotg/. 06, February 2014.

United States Department of Agriculture. Natural Resource Conservation Service. May, 2010. http://efotg.sc.egov.usda.gov/references/public/MI/invasive_species_with_MI_map.pd 09 June 2014.