4.0 Watershed Inventory 3 – Subwatersheds

The LCEB watershed contains three 12-digit HUC subwatersheds: Reynolds Creek (040400010401), Kemper Ditch (040400010402), and Coffee Creek (040400010403) (Figure 6). Land use, which is a driver for nonpoint source pollution, differs among these subwatersheds. Figure 39 highlights the differences in dominant land uses among the three subwatersheds in the LCEB watershed. Understanding differences in land use can be a starting point to help to explain differences in water quality or potential sources for water pollution.

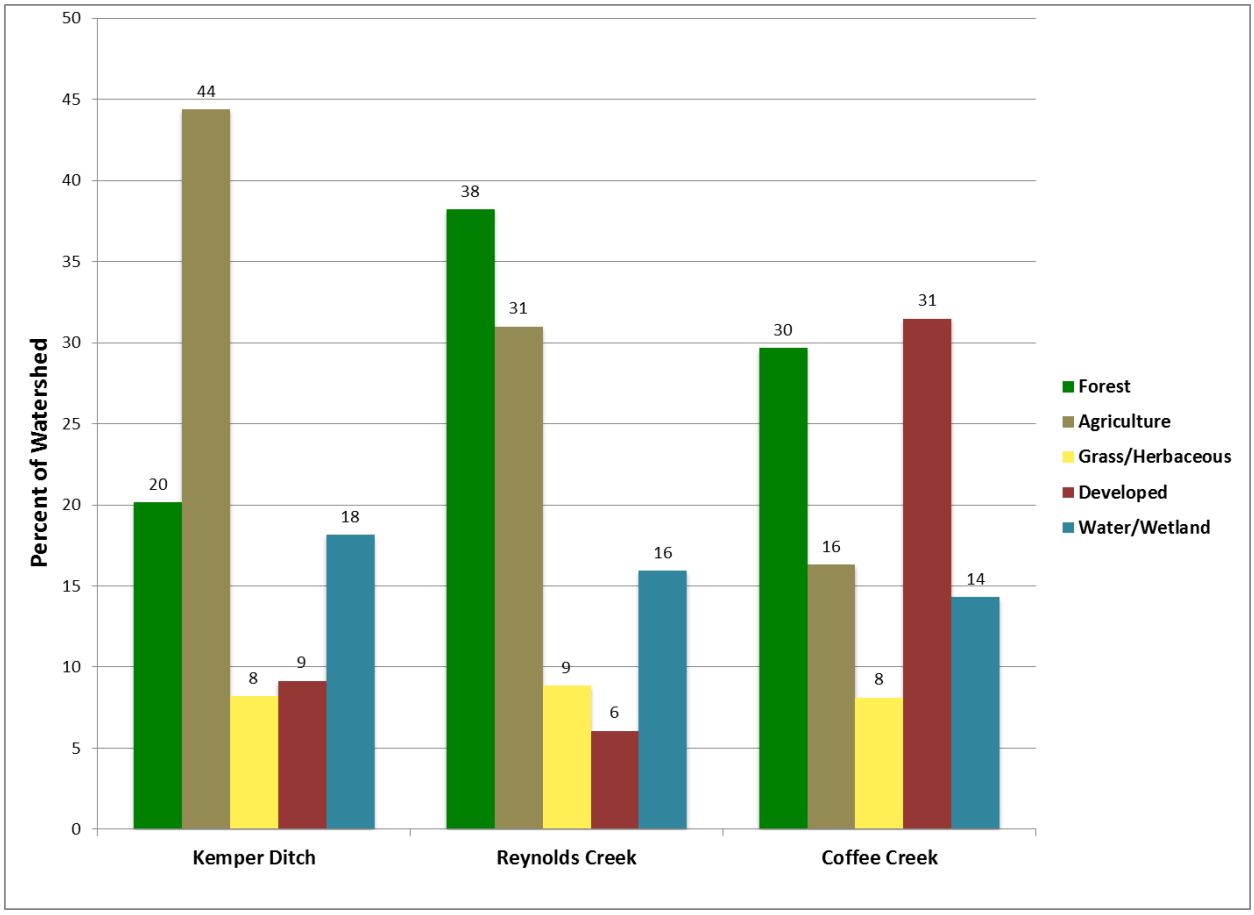

Figure 39. 2010 Land Cover by subwatershed

4.1 Reynolds Creek Subwatershed (HUC12- 040400010401)

The Reynolds Creek subwatershed contains the headwaters of the LCEB. This watershed is 12,780 acres, which is 27% of the entire watershed. Named waterbodies include the LCEB mainstem, Reynolds Creek, Lake Lee, Massauga Creek, Spring Branch, Hildebrandt Lake, Round Lake, Ryden Lakes, Swede Lake, and Walton Lake. There are no National Pollutant Discharge Elimination System (NPDES) permit program facilities in the Reynolds Creek

watershed. Purdue University's North Central (PNC) Campus was a NPDES facility from 1974 through 2007. The university's wastewater was then added to Westville's water treatment system, which led to the termination of the university's wastewater permit. There is no indication of legacy water quality problems related to this permitted discharge.

Sampling Sites 38, 39, 40, 41, 42, 43, 44, 45, 46 and 47 are within the Reynolds Creek subwatershed.

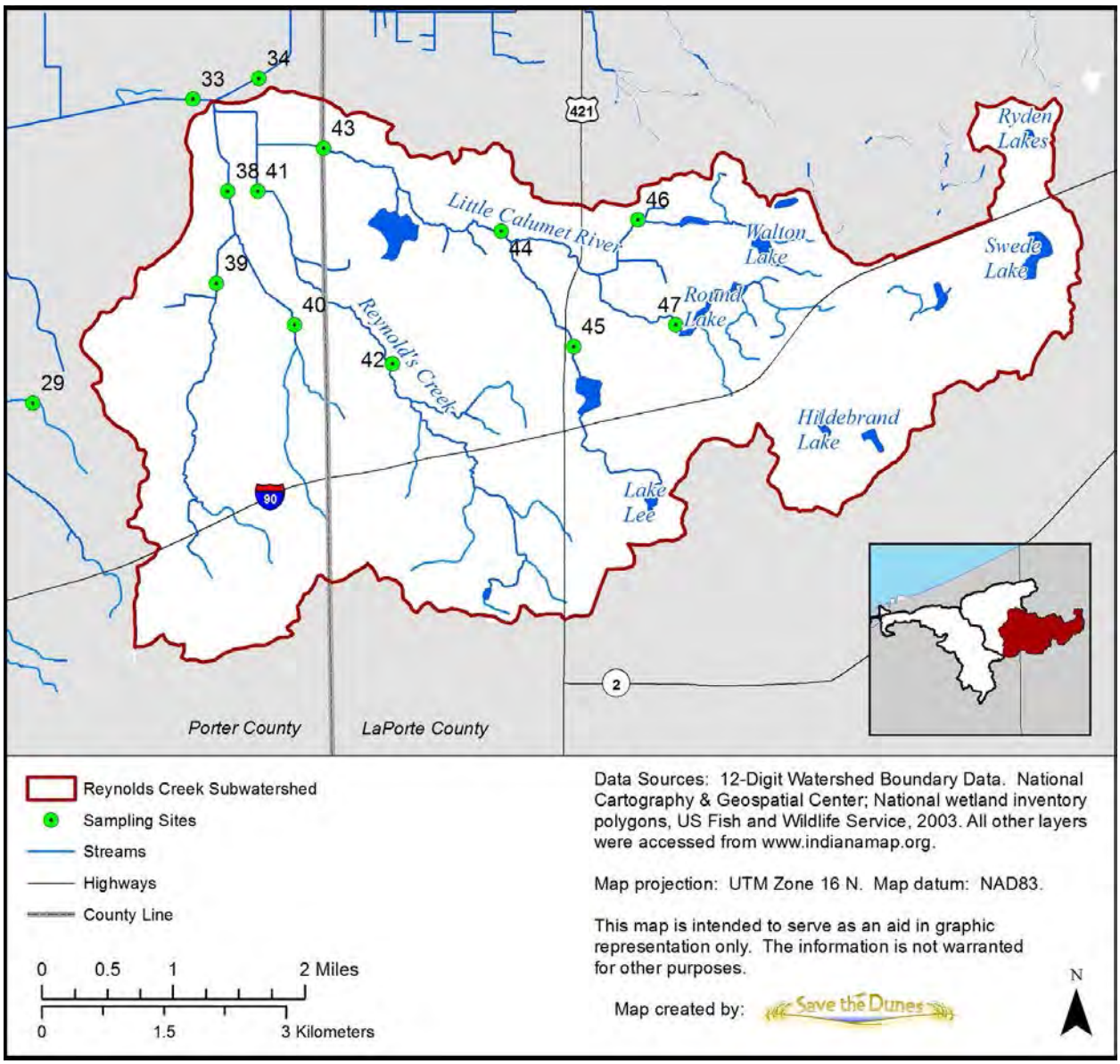

Figure 40. Reynolds Creek subwatershed sampling sites

4.1.a Water Quality Information

Past Studies
Sites in the Reynolds Creek subwatershed were included in two older studies conducted by IDEM: the 2000 Little Calumet East Branch River study, and the 2000 Pesticide study. Two sites on the mainstem (site 44 and at the crossing of Highway 421) and an unnamed tributary (site 45) were included in IDEM's 2000 LCEB Assessment. The geometric mean for *E. coli* exceeded the IAC standard (125 CFU/ 100mL) at site 44 (180 CFU/100mL) and at site 45 (330 CFU/100mL), but not where the mainstem crosses US-Highway 421 (106 CFU/100mL). It should be noted that this data is over 14 years old, as of the writing of this plan, and indicates historic trends as opposed to current conditions. IDEM also conducted a pesticide study in the year 2000 that included sites 44 and 45. No pesticides were detected at either site during that study.

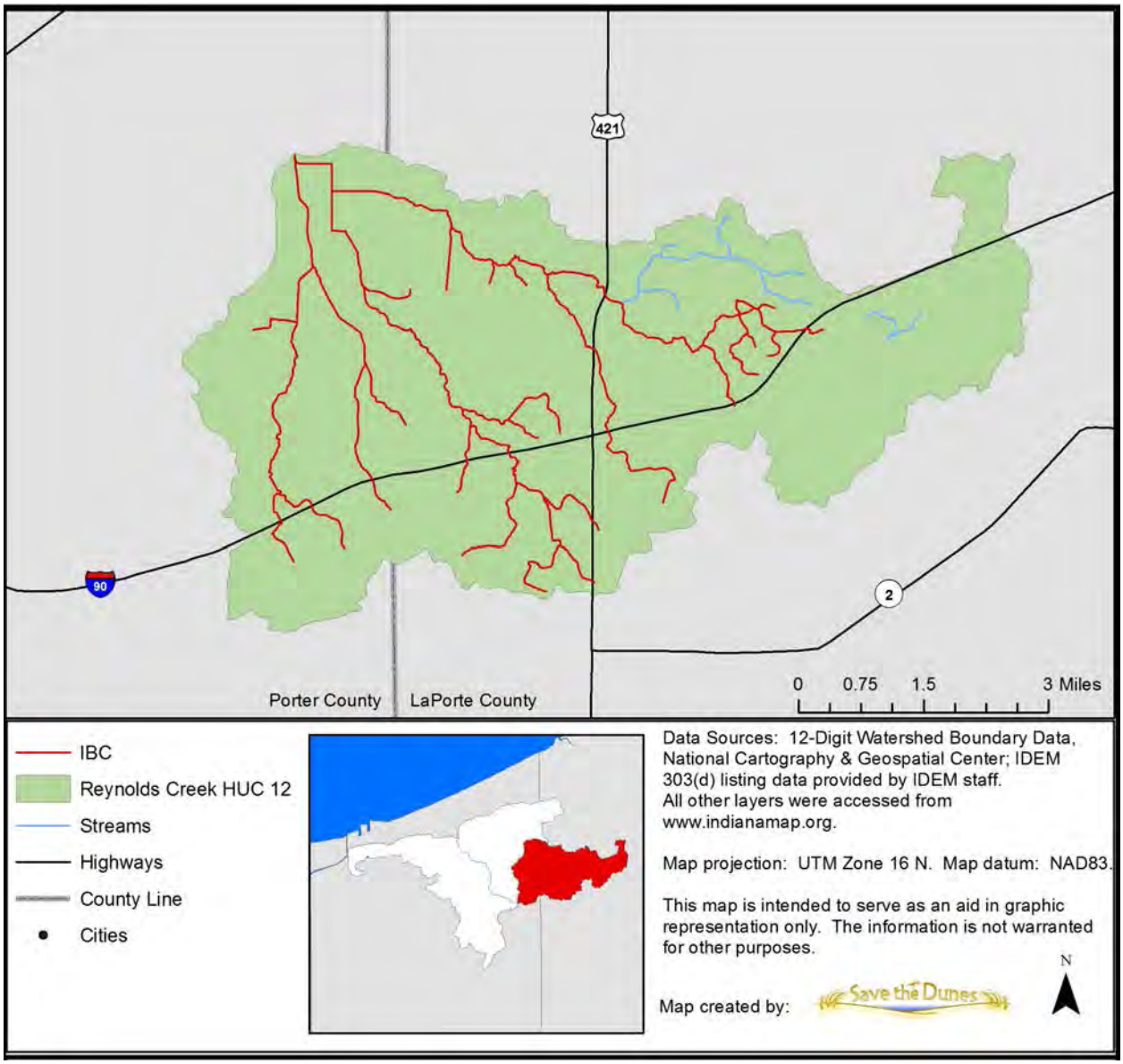

Figure 41. Reynolds Creek subwatershed 2014 draft 303(d) listing for impaired biotic communities

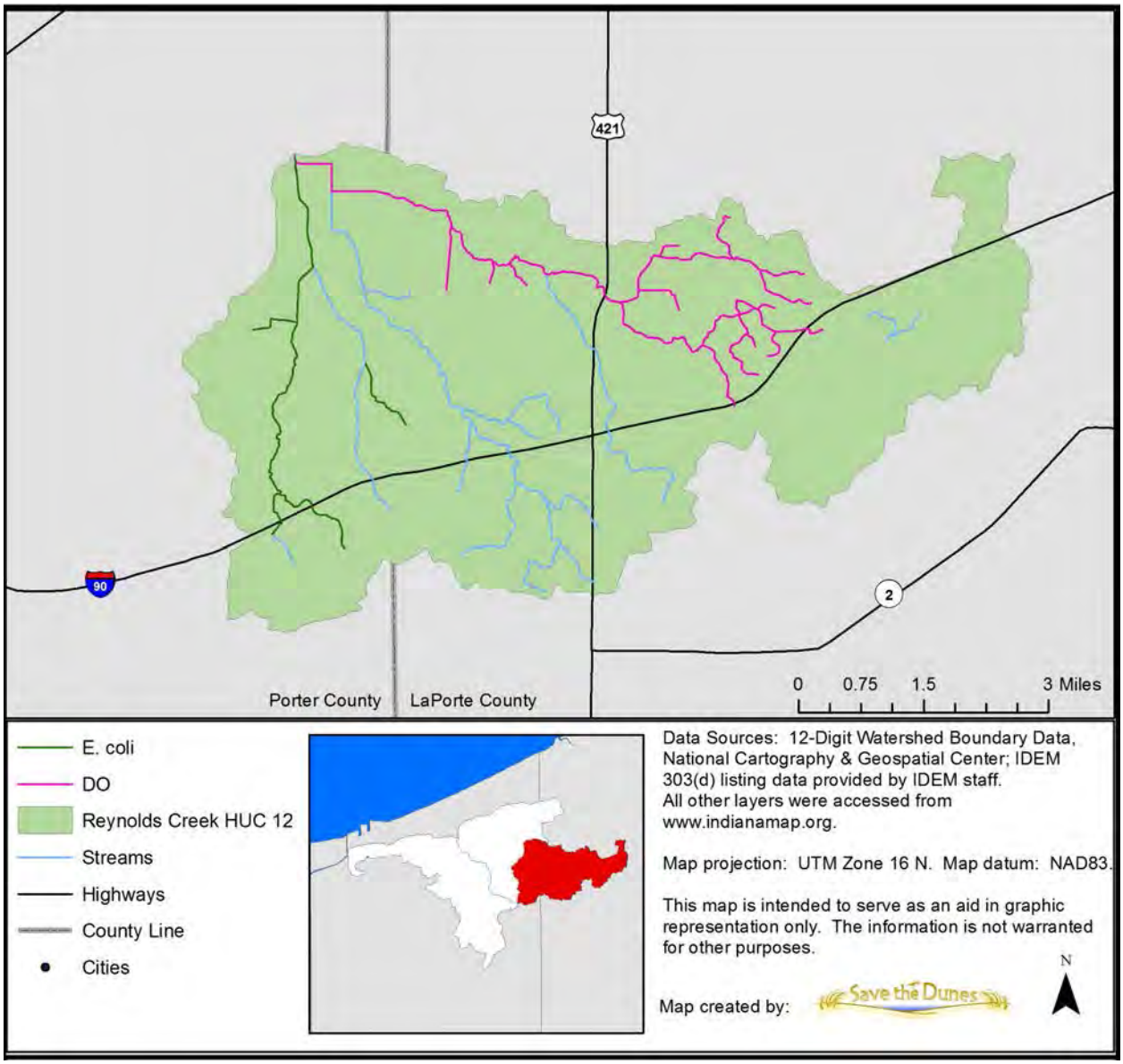

Figure 42. Reynolds Creek subwatershed 2014 draft 303(d) listings for E. coli and dissolved oxygen

Current Studies

All stream segments within the Reynolds Creek subwatershed are included on the 2014 (draft) 303(d) listing. For impaired biotic communities (Figure 41), nearly the entire subwatershed is listed, except the headwater tributary monitored by site 46 (Walton Lake Outlet). The headwater tributaries of the LCEB (sites 43, 45, 46 and 47) are also listed for dissolved oxygen (Figure 42). The Spring Branch tributary (including sites 38 and 39) and Massauga Creek Upstream (site 40) are listed for *E. coli* (Figure 42).

Temperatures in Reynolds Creek and its tributaries were generally low in 2012. Only 8% of samples exceeded the target temperature (21.1° C) Site 39 (Spring Branch), site 40

(Massauga Creek Upstream), site 42 (Reynolds Creek Upstream), and Site 44 (Little Calumet River East Branch 1), all had zero exceedances of the temperature standard for cold water aquatic communities (21.1° C). Site 40 (Massauga Creek Upstream) had the second lowest temperature mean in the LCEB watershed. Site 45 (Lake Lee Outlet) had the third lowest temperature mean in the LCEB. However, site 47 had the highest individual temperature of 23.3˚ C with 43% of samples exceeding the target.

Two sites had dissolved oxygen (DO) exceedances for the Reynolds Creek subwatershed during the 2012 sampling period (sites 46 and 47). Site 46 also had the lowest mean for DO concentrations (8.32 mg/l). The highest mean concentration for dissolved oxygen was 11.44 mg/l at site 45(Lake Lee Outlet). There was no evidence of oversaturation because DO readings greater than 12 mg/L always occurred when the water was very cold, which allows the water column to hold more oxygen than under warmer conditions. There were no pH violations at any site in the Reynolds Creek subwatershed during the 2012 baseline sampling events: all samples fell within the six to nine pH units range from the IAC.

Nitrate + nitrite levels were generally low in the Reynolds Creek subwatershed. Sites 39, 41, 42, 46 and 47 had the lowest nitrate means in the LCEB watershed. Site 41 had the lowest calculated mean for the LCEB (0.074 mg/l), and sites 39, 42, 46, and 47 had values that were consistently low such that they could not be detected over 90% of the time. Because of this, means could not be calculated. Consequently, nitrate levels at these sites were very low during the sampling period. Data was available to calculate loads for only 3 sites in this subwatershed (sites 38, 43, and 45). Annual and areal loads require at least twelve monthly water quality data with detected values and corresponding flow data. Site 45 (Lake Lee Outlet) had the lowest nitrate annual load (562 lb/yr) for the entire LCEB.

Twenty-nine percent of all phosphorus samples collected in the Reynolds Creek subwatershed exceeded the target of 0.08 mg/l. Fifty percent of all samples were below the analytical detection limit. Every site had exceedances. Means for each site ranged from 0.06 to 1.0 mg/l. Six sites had enough data to calculate loads (38, 39, 41, 43, 45, and 46). Site 41 (Reynolds Creek Downstream) had the lowest load (414 lb/yr), while site 43 (LCEB mainstem) had the highest phosphorus load (1,964 lb/yr) in the Reynolds Creek subwatershed.

TSS was relatively low for Reynolds Creek sites. Only 8% of samples exceeded target concentrations (30 mg/l). Several sites (39, 40, 42, 46 and 47) had no TSS exceedances during 2012 sampling events. Over 26% of samples were below the analytical detection limit. The lowest mean for TSS was 4.4 mg/l at site 42 (Reynolds Creek upstream) and the highest mean was 35 mg/l at site 43 (LCEB mainstem). Loads and areal loads for TSS were calculated for five sites in this subwatershed (38, 39, 41, 43, and 47). Of these, the lowest annual TSS load (15,229 lb/year) was site 47 (Round Lake Outlet). The highest annual load was 340,180 lb/yr at site 43.

E. coli concentrations exceeded the target for 47% of samples in the Reynolds Creek subwatershed. Every site had exceedances. Sites 38 (Massauga Creek Downstream), 41 (Reynolds Creek Downstream), and 43 (mainstem) had the highest number of violations

(17, 16, and 15, respectively). The lowest mean concentration was 69 CFU/100 ml at site 47, while the highest mean was 1,506 CFU/100 ml at site 43. Annual loads were not calculated for *E. coli* in the LCEB watershed based on this data.

4.1.b Habitat/Biological Information

Red Mill County Park, located in the headwaters of the LCEB, was the site of a Great Lakes Fishery and Ecosystem Restoration (GLFER) ecosystem restoration project. The site encompasses a 108-acre Indiana Nature Preserve and is considered to be a high quality ecosystem. In 1833, an earthen dam was built that created a large native pond and wetland community. The GLFER restoration project preserved and restored over 120 acres of wetland habitat by maintaining existing water levels, restoring native plant species and improving fish habitat. Removing a section of the dam and creating a new stream channel restored natural hydrology and stream connectivity. The project, which was completed in 2011, protects the hydrology of this high quality ecosystem for the plants and animals that rely on it.

Benthic macroinvertebrates were analyzed using IDEM's mIBI metric, and fish communities were assessed using the IDEM's IBI methodology. Benthic macroinvertebrates were not supported at any Reynolds Creek site. All sites scored less than 36 for the mIBI. Site 40 was the only sampling location that was supporting for fish communities in the subwatershed (IBI=36). All other sites scored less than 36 for the IBI. QHEI scores for habitat were calculated for each site to help determine the cause of impaired biotic communities. Sites 41 and 44 yielded habitat scores that were not supportive of aquatic life. This suggests that in-stream habitat could be the reason aquatic communities are not healthy at sites 41 and 44. However, sites 38, 39, 42, 43, 45, 46 and 47 had QHEI scores indicating the habitat should be suitable for fish and macroinvertebrate communities. These findings indicate that water pollution is the most likely stressor affecting these populations. Site 42 had the best habitat rating in the LCEB watershed. There were no biological assessments performed by IDEM at site 46 for the baseline study due to drought conditions.

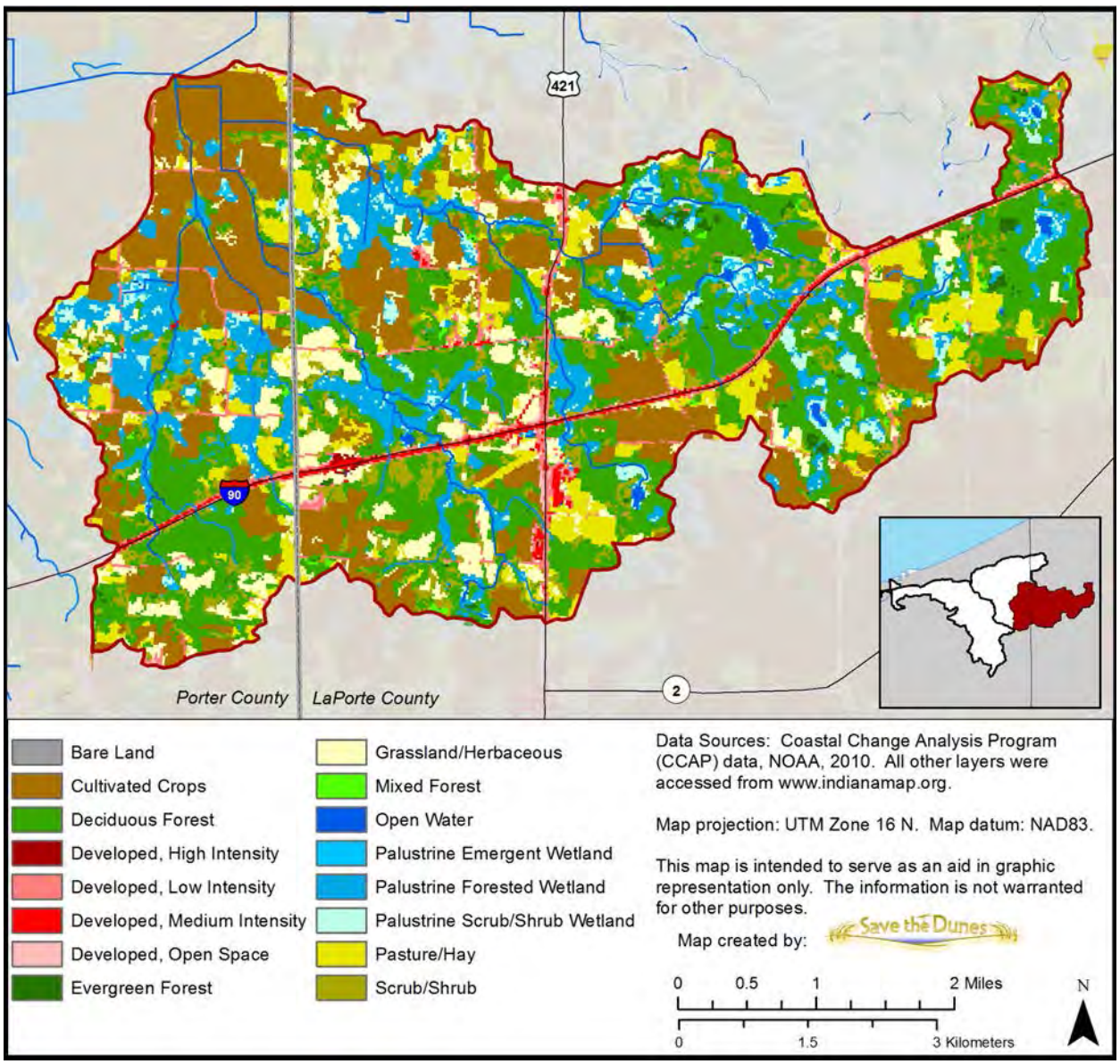

Figure 43. Land cover in the Reynolds Creek subwatershed

4.1.c Land Use Information

Land cover in the Reynolds Creek subwatershed is predominantly forested (38%) and agriculture (31%). Developed land cover is limited (6% of the subwatershed) with the exception of Purdue North Central Campus and adjacent development along Highway 421. Proposed zoning maps for LaPorte County indicate that the majority of the watershed in LaPorte County is zoned agricultural. The area surrounding the highway 421 and I-80 interchange is zoned for general commercial, low-density rural residential, and light industrial. ***

The Indiana Toll Road (I-80) runs through this subwatershed. Protected areas in the Reynolds Creek subwatershed include an Izaak Walton League property around Walton Lake, the LaPorte County Little Calumet Headwaters Nature Preserve, several LaPorte County Parks, and The Nature Conservancy's Hildebrandt Lake. Izaak Walton League's local chapter also owns several protected natural properties in the LCEB headwaters. These are located along County Line Road. The older of the two is the Massauga acquisition. The Little Calumet River enters the 10-acre property at the north end, just south of the railroad tracks. Land cover on this property is primarily wet woods, with Massauga Creek entering the parcel underneath CR 1100 North. The Frame Conservation Area is a parcel of 19.5 acres that lies along the LCEB mainstem. It extends to both sides of the river, but the majority of the parcel is on its south side. The Frame Conservation Area also includes part of the east side of Reynolds Creek up to its terminus with the Little Calumet River. The Izaak Walton League recently purchased another 40 acres adjacent to the Frame Conservation Area. This property includes 660 feet of Reynolds Creek and ½ mile of the Little Calumet River. These properties are adjacent to the new DNR Reynolds Creek Wildlife Area, which is a 1,250-acre game bird preserve. Due to the recent acquisition of this property and its recent conversion from cropland to prairie grassland habitat (post 2012 IDEM baseline study), these acres have been added to the list of BMPs in section 9.

There is no large industry or plans for major development in this subwatershed. There are no fairgrounds or kennels. Low-density rural residential homes and agriculture are scattered throughout this watershed. Agriculture accounts for approximately 31% of land use. There are six hobby farms located in the Reynolds Creek subwatershed (five with horses and one with buffalo) (Figure 44). The combined acreage of these farms is ~148 acres with a sum of approximately 85 horses and 20 buffalo. Conventional fertilizer is the dominant form of fertilizer applied to agricultural fields in the Reynolds Creek subwatershed. Manure is generally not applied to agricultural fields in this subwatershed.

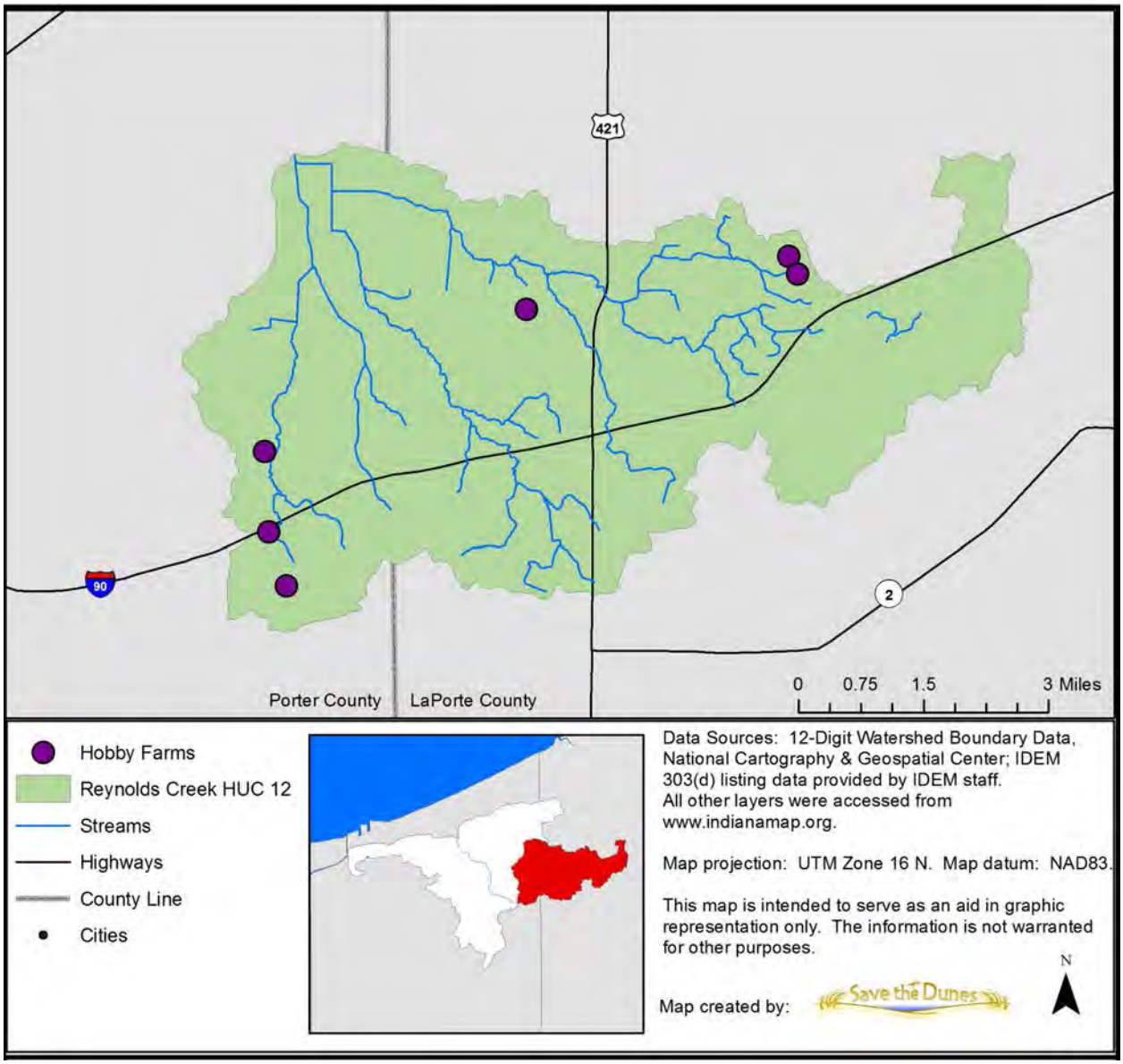

Figure 44. Hobby farms in the Reynolds Creek subwatershed

Windshield surveys in the Reynolds Creek subwatershed highlighted land uses due to their potential effect on water quality. Beneficial land uses noted by the surveyors included the presence of a fen, protected natural areas including classified habitat, and 2 wildlife preserves, at least 5 wetlands, 2 rain gardens, 2 stormwater detention ponds, and several in-stream lakes. Other land uses reported by surveyors included two construction sites, the presence of the toll road, livestock, Canadian geese and other waterfowl in ponds, several large turf grass areas, lawns maintained up to stream or lake edges, homes and lawns in close proximity to rivers, several large impervious areas, occasional steep banks, and conventional farming practices. The windshield survey combined with desktop analysis reported 1.67 miles of absent or insufficient riparian buffers (Figure 45). Utilizing both the QHEI (habitat) analysis and the windshield survey, approximately 266 ft. of stream bank

are eroding throughout in the Reynolds Creek subwatershed (Figure 45). Moderate to heavy siltation was also reported for 340 ft. of streambed.

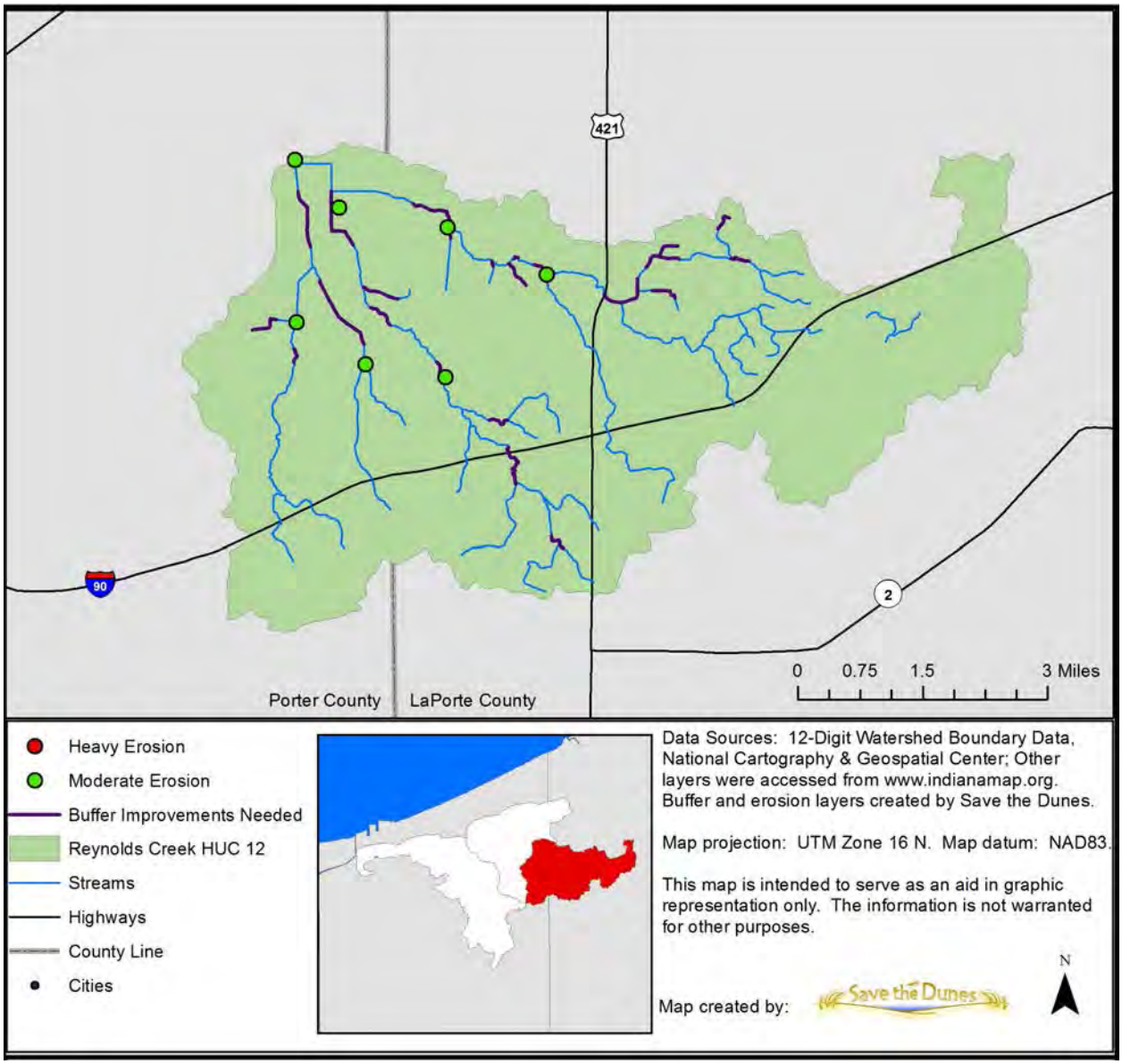

Figure 45. Streambank erosion and buffers needed for the Reynolds Creek subwatershed

4.1.d Summary

The Reynolds Creek subwatershed is somewhat sparsely developed and contains abundant high quality natural lands. However, this subwatershed also contains a notable amount of agriculture (conventional agriculture and hobby farms) that may be exporting nutrients and sediment. This rural landscape may also be contributing large amounts of *E. coli* through poorly functioning onsite septic systems from the abundant low-density rural residential homes checkered throughout this subwatershed's landscape. Most of the streams in this subwatershed are 303(d) listed for biotic communities, while others are listed for dissolved oxygen and *E. coli*. Due to the drought, the 2012 baseline study might under-report water quality impairments such as nutrients and sediment. However, the impairment of biological communities may demonstrate established water quality issues in this subwatershed.

4.2 Kemper Ditch Subwatershed (HUC12- 040400010402)

The Kemper Ditch subwatershed is 14,157 acres, which is nearly 30% of LCEB watershed. Named waterbodies within the Kemper Ditch subwatershed include the LCEB mainstem, Carver Ditch, Kemper Ditch, Rice Lake, and Mar Mac Lake. There are no NPDES permitted facilities in the subwatershed.

Sampling Sites 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 49 and 50 are within the Kemper Ditch subwatershed.

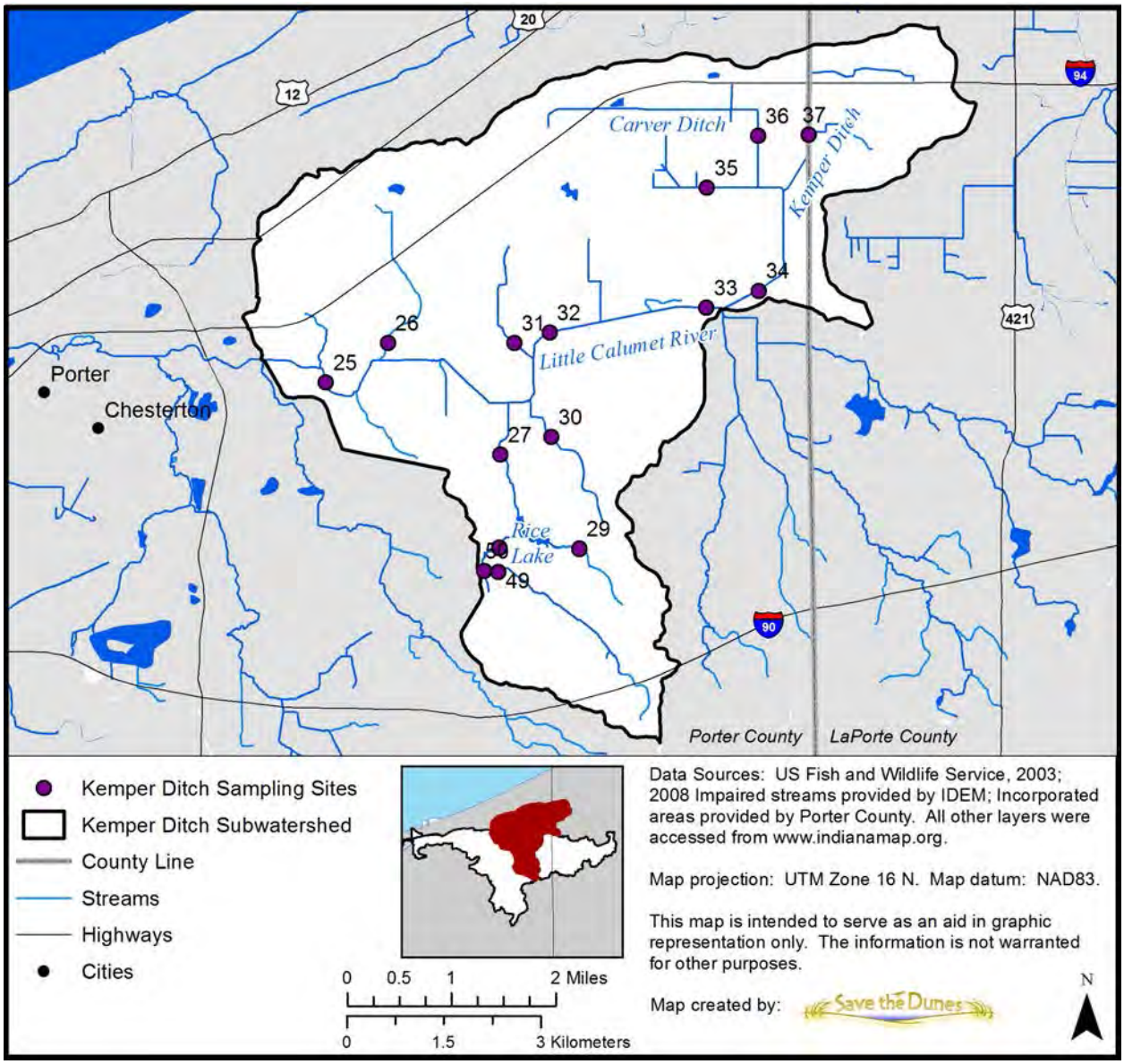

Figure 46. Kemper Ditch subwatershed sampling sites

4.2.a Water Quality Information

Past Studies

Three studies have been conducted in the Kemper Ditch subwatershed: IDEM's 2000 Little Calumet River East Branch study, the 2000 LCEB *E. coli* study, and the 2010 Corvallis Probabilistic Monitoring study. The 2000 LCEB study included two mainstem sites: 32 and 33. Site 32 exceeded the *E. coli* target for 50% of the samples. Temperature and DO had no violations. Site 33 had one temperature violation and exceeded the *E. coli* target for 80% of the samples taken. There were no DO violations. It should be noted that this data is over 14

years old, as of the writing of this plan, and indicates historic trends, not current conditions. Only one site from the Kemper Ditch subwatershed was examined for the 2000 *E. coli* study: a location near site 32. *E. coli* concentrations exceeded target concentrations with 80% of samples collected. The 2010 Corvallis study included one location in the Kemper Ditch subwatershed: site 32 (LCEB mainstem). All *E. coli* samples exceeded the target concentration, however, there were no violations for temperature or dissolved oxygen. A third of samples taken for TSS, phosphorus and nitrate exceeded target concentrations.

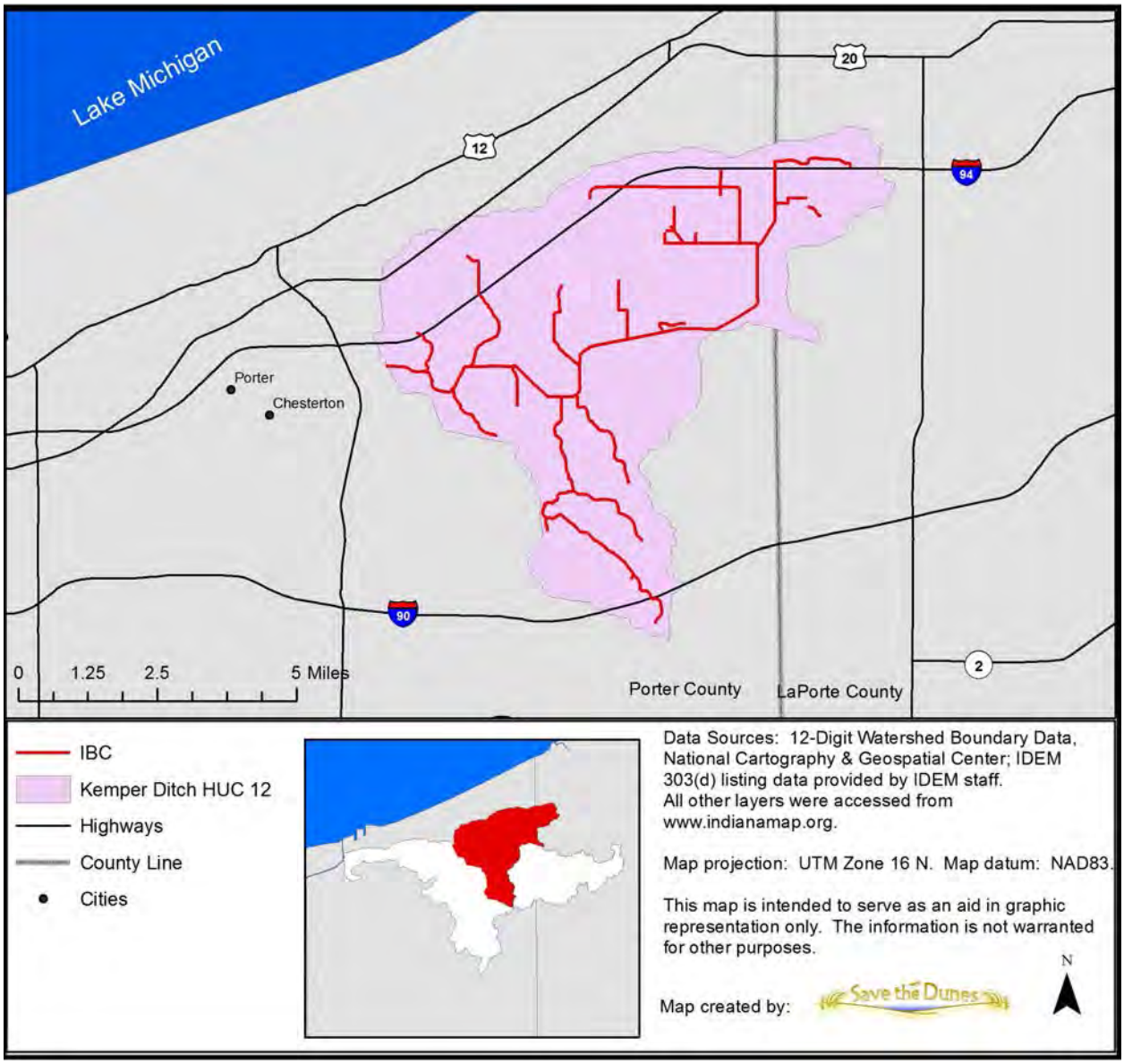

Figure 47. Kemper Ditch subwatershed 2014 draft 303(d) listing for impaired biotic communities

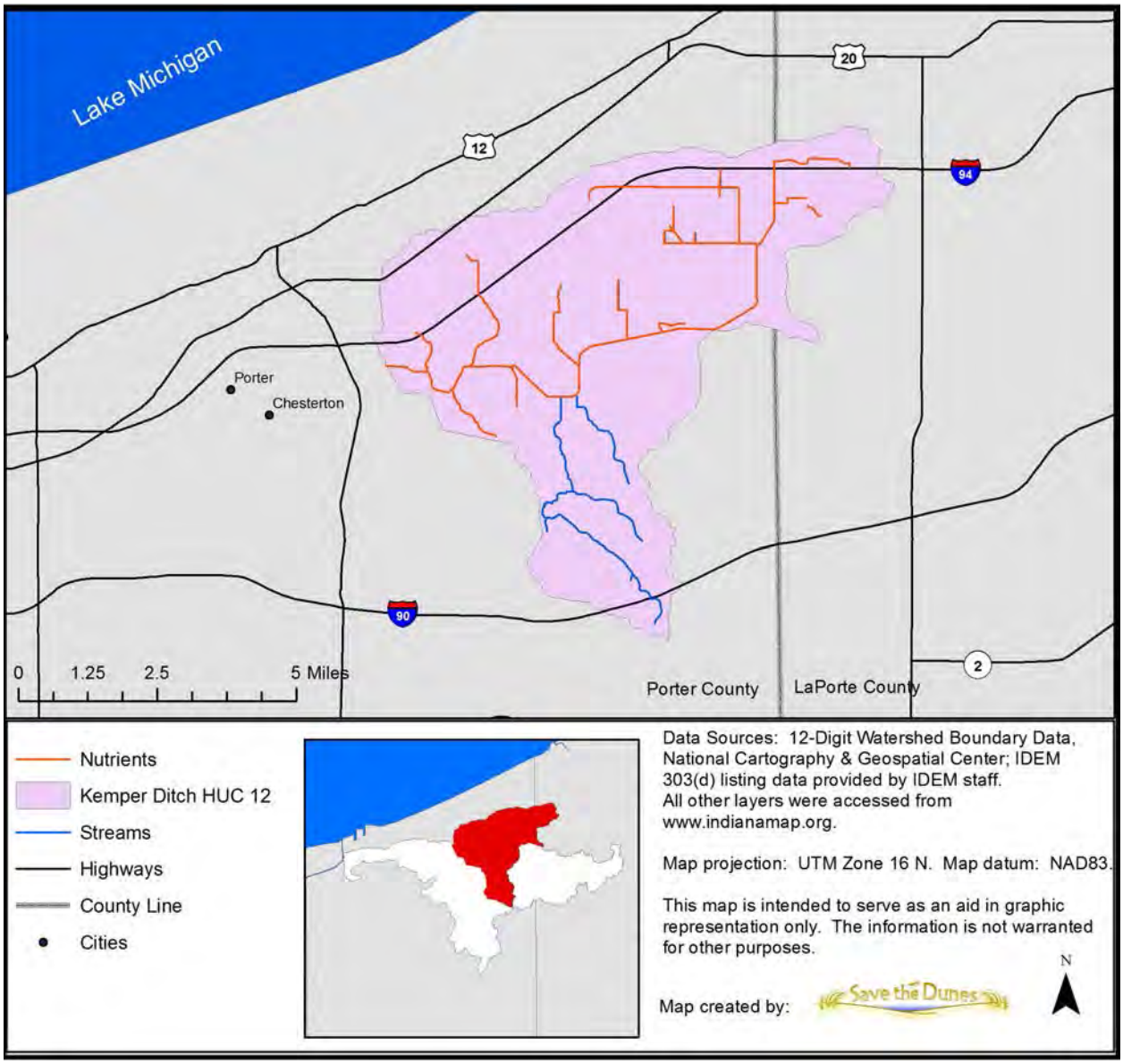

Figure 48. Kemper Ditch subwatershed 2014 draft 303(d) listings for nutrients

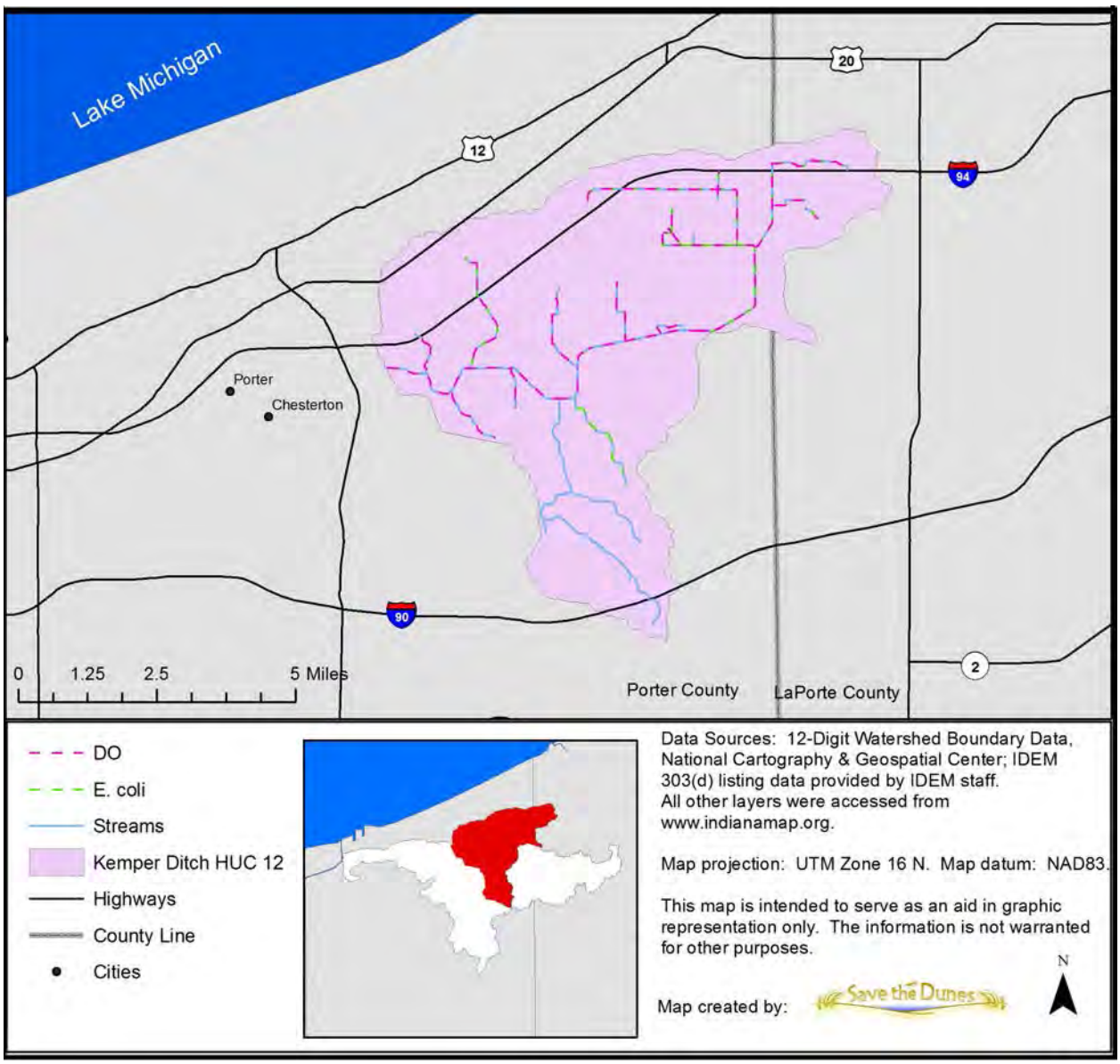

Figure 49. Kemper Ditch subwatershed 2014 303(d) listing for *E. coli* and dissolved oxygen

Current Studies

All stream segments within the Kemper Ditch subwatershed are included on the 2014 (draft) 303(d) listing. For impaired biotic communities (Figure 47), the entire subwatershed is listed. The Carver Ditch (sites 35 and 36) and Kemper Ditch (sites 34 and 37) tributaries, mainstem locations (sites 25, 32 and 33), and other tributaries (sites 26 and 31) are also listed for nutrient impairment (Figure 48). Tributaries listed for *E. coli* (Figure 49) include: the Carver Ditch (sites 35 and 36) and Kemper Ditch (sites 34 and 37) tributaries and other tributaries (sites 26 and 30). Sites impaired by dissolved oxygen (DO) (Figure 49) include: the Carver Ditch (sites 35 and 36) and Kemper Ditch (sites 34 and 37) tributaries, mainstem locations (sites 25, 32 and 33), and other tributaries (sites 26 and 31).

Water temperature in the Kemper Ditch subwatershed was variable depending on location. Overall, only 15% of samples collected in this watershed exceeded the target. All of the means were below the temperature standard (21.1° C), but there were very high temperatures measured during the recreational period at a few sites. Sites 31 (unnamed tributary) and 33 (mainstem) had zero temperature violations. Sites 26 (Tributary West), 30 (tributary), 32 (mainstem) and 35(Kelleys Ditch) all had one temperature exceedance. The highest summertime temperature was 25.8° C at site 27(Rice Lake Outlet). This site also had the highest number of target violations (10), followed by site 28 (Mar Mac Lake Creek) with 8 exceedances. Sites 34(Carver Ditch Downstream) and 37(Kemper Ditch) also had temperature violations (4 and 3, respectively) with higher summertime values.

Dissolved oxygen (DO) concentrations in the Kemper Ditch subwatershed varied based on location. The mean concentration was 8.8 mg/l but means for each site were typically higher. Several sites had zero exceedances of the target concentration (6 mg/l): sites 25 (mainstem), 27 (Rice Lake Outlet), 29 (Rice Lake Inlet), 30 (unnamed tributary), 32 (mainstem) and 33 (mainstem). Site 28 (Mar Mac Lake Creek) only had one low DO violation. This indicates that the mainstem and the Rice Lake tributaries maintained relatively good DO concentrations. The Carver Ditch and Kemper Ditch tributaries had more target concentration violations. Sites 34 (Carver Ditch Downstream) and 36 (Carver Ditch Upstream) both had 6 DO violations, while sites 37 (Kemper Ditch) and 35 (Kelleys Ditch) had 4 and 2 violations, respectively. The lowest mean was at site 28 (Mar Mac Lake Creek, 9.1 mg/l). Site 37 (Kemper Ditch) had the highest mean in this subwatershed (12.8 mg/l). The high DO readings typically corresponded with extremely low water temperatures during the winter months, which allowed the water to hold more oxygen than it would under warmer temperatures. These samples were not designated as oversaturated, even though some values were as high as 15.8 mg/l (corresponding with 2.3°C water temperature.) This site also had extreme low values of DO in 2012- the lowest was 1.78 mg/l, which corresponded to a very warm water temperature (24.1° C). Site 37 also had the only high DO violations for the subwatershed (18.4 mg/l at 24.8° C and 14.3 mg/l at 13.2° C). The extreme DO values at this site should be examined further. There were no pH violations for the Kemper Ditch subwatershed during the 2012 baseline sampling events: all samples fell within the six to nine pH units range from the IAC.

Nitrate + nitrite levels were relatively low in the Kemper Ditch subwatershed in 2012. Only 3% of samples exceeded the target concentration of 1.0 mg/l, while nearly 34% of samples were below the analytical detection limit. The model used to generate annual loads requires at least twelve data points with associated stream flow. Consequently, nitrate loads were calculated at only 4 sites in this subwatershed (sites 25, 27, 28, and 32). The highest load was 16,178 lb/yr at site 25 (mainstem), while the lowest calculated load was 678 lb/yr at site 27 (Rice Lake Outlet). The highest sample concentration was 4.8 mg/l (at site 34, Carver Ditch Outlet) during a storm event. However, nitrate concentrations were below the analytical detection limit (censored) at this site for more than half of the 2012 sampling events. Because of this, no total annual load was calculated for sites on or draining from Carver Ditch. The one time high value after the storm event suggests that nitrate may have accumulated on the landscape during the historic 2012 drought. The

baseline data that has been reported for this parameter may underestimate normal pollution levels for this watershed.

Phosphorus concentrations were variable for this subwatershed. Over 50% of samples exceeded the target concentration of 0.08 mg/l, yet 32% of samples collected were below the analytical detection limit. Six sites had calculated annual loads (sites 25, 27, 28, 32, 33, and 34). The highest annual load was 7,387 lb/yr at site 25 (mainstem) and the lowest annual load was 184 lb/yr at site 28 (Mar Mac Lake Creek). The highest mean phosphorus concentration was 0.46 mg/l at site 35 (Kelleys Ditch). This site also had the highest concentration for a single sample (1.3 mg/l). The lowest mean was 0.07 mg/l at site 28 (Mar Mac Lake Creek).

Total suspended solids (TSS) concentrations were low on the mainstem and high in the agricultural area of the Kemper Ditch subwatershed. Nearly 18% of samples exceeded the target concentration (30 mg/l), and 30% of samples were below the analytical detection limit. Only four sites had enough data to calculate annual loads: sites 25 (mainstem), 27 (Rice Lake Outlet), 32 (mainstem), and 33 (mainstem). The highest sediment load was 1,066,138 lb/yr at site 25 and the lowest load was 31,086 lb/yr. The highest mean was 116.5 mg/l at site 35 (Kelleys Ditch) and the lowest mean was 3.7 mg/l at site 28 (Mar Mac Lake Creek). The agricultural areas drained by Carver Ditch (sites 34, 35, and 36) had the highest number of samples exceed target concentrations (6, 5, and 6, respectively). Three sites had zero violations of the target TSS concentration (site 25, 26, and 28).

E. coli concentrations for the Kemper Ditch subwatershed were generally high. Eighty-six samples (48%) exceeded the target concentration of 235 CFU/100 ml. All sites had multiple exceedances. Sites 32 (mainstem) and 28 (Mar Mac Lake Creek) had the most exceedances. The agricultural sites of 35 (Kelleys Ditch) and 37 (Kemper Ditch) had the fewest *E. coli* violations. Site 34 (Carver Ditch Outlet) had the highest mean of 1,905 CFU/100 ml, while the lowest mean was at site 27 (218 CFU/100 ml, Rice Lake Outlet).

Mar Mac Lake and Rice Lake Study

As part of the 2012 GLISTEN study, four study sites were privately funded to assess the tributaries for Mar Mac Lake and Rice Lake. Sites 27 and 28 (the inlet and outlet tributaries for Rice Lake) are also IDEM sampling locations for the 2012 LCEB baseline study. The data collected for these sites and the other GLISTEN collected sites was added to the IDEM baseline study, except sites 49 and 50 (the inlet and outlet tributaries for Mar Mac Lake). Sites 49 and 50 do no overlap with any IDEM sampling locations and were only collected during the summer of 2012. Consequently, these two sites were not included in the baseline study.

Temperatures were relatively high for sites 49 and 50. Eighty-six percent and 90% of samples collected for sites 49 and 50 (respectively) exceeded the target temperature. However, it should be noted that water quality data for these sites was only collected during the summer months. The mean temperature was 24.6˚ C and 26.0˚ C for sites 49 and 50, respectively. There were zero violations for dissolved oxygen for these two sites. However, their mean DO concentrations were fairly low (7.1 and 7.8 mg/l, respectively).

Nitrate concentrations were fairly low. There were zero exceedances and the mean concentration was 0.08 and 0.01 mg/l for sites 49 and 50, respectively. Site 49 had 3 samples exceed the target concentration for phosphorus (0.08 mg/l). Nonetheless, the mean concentration for both sites was below the target (0.03 and 0.00 mg/l, respectively). Total suspended solids and *E. coli* concentrations followed a similar pattern for the inlet (site 49) and outlet (site 50) for Mar Mac Lake. Both pollutant concentrations were higher upon entering the lake and are largely reduced at the outlet. The mean TSS concentration was 8.0 mg/l at the inlet and reduced to 3.6 mg/l at the outlet. Similarly, the mean *E. coli* concentration was 545 CFU/100 ml upon entering Mar Mac Lake and reduced to 95 CFU/100 ml at the outlet. Site 49 exceeded the *E. coli* target concentration for over 78% of samples collected, while site 50 had zero violations.

4.2.b Habitat/Biological Information

IDEM assessed habitat and biotic communities in 1990 at the Heron Rookery and in 2010 at site 32, just downstream of the Heron Rookery. In 1990, the Heron Rookery site rated a mIBI score of 2.8 (moderately impaired using KICK metric) and a QHEI of 82 (excellent). The 2010 Corvallis study (site 32) rated a mIBI score of 20 (very poor using multihabitat metric) and a QHEI of 50 (fair). Site 32 received an IBI score of 34 (poor) and a QHEI score of 58 (good).

IDEM utilized two biotic indices during the recreational period in 2012 to analyze two aquatic communities. Benthic macroinvertebrates were analyzed using IDEM's mIBI methodology, and fish communities were assessed using IDEM's IBI methodology. All sites in the Kemper Ditch subwatershed received a not supporting rating for macroinvertebrates. Site 35 (Kelleys Ditch) was not assessed due to drought conditions. For fish communities, only two sites were found to support this community: sites 32 (mainstem) and site 33 (mainstem). QHEI scores were calculated for each site to determine if the lack of aquatic communities support was due to water pollution or habitat degradation. Four sites were found to have supporting habitat: sites 25 (mainstem), 27 (Rice Lake Outlet), 28 (Mar Mac Lake Creek), and 32 (mainstem).

4.2.c Land Use Information

Land cover in the subwatershed is predominantly agricultural (44%), followed by forested (20%). Developed land cover is limited (9% of the subwatershed), yet many low-density residential homes are scattered throughout the rural/agricultural areas. Urban land cover is primarily comprised of Interstate 94 and the landfill (located south of I-94 and near site 37) Proposed zoning maps for LaPorte County indicate that the area surrounding the highway 421 and I-94 interchange is zoned for general commercial and highway commercial. Protected areas include the INDU Heron Rookery, which protects a significant (~ 543-acre) wetland complex along the LCEB mainstem. A large (~ 4,700 acres) agricultural area of hydric soils is present along Carver and Kemper ditches. This area is also a floodplain. This area of hydric soils is being examined as a potential wetland

mitigation area. Kemper Ditch, Carver Ditch, and the mainstem of the LCEB are regulated drains within the Kemper Ditch subwatershed. The LCEB is also designated as a legal drain within the Heron Rookery. Save the Dunes, NPS, and the Porter County Surveyor have met to begin discussing strategies to ensure that adequate drainage is maintained while also protecting the Heron Rookery.

There is no large industry or plans for major development in this subwatershed. There are no fairgrounds or kennels. Conventional agriculture is the dominant land use (44%) in this subwatershed. Low-density rural residential homes are also abundant throughout this landscape. There are no hobby farms in this subwatershed. Conventional fertilizer is the dominant form of fertilizer applied to agricultural fields. Manure is not used as a fertilizer for conventional agriculture in this subwatershed.

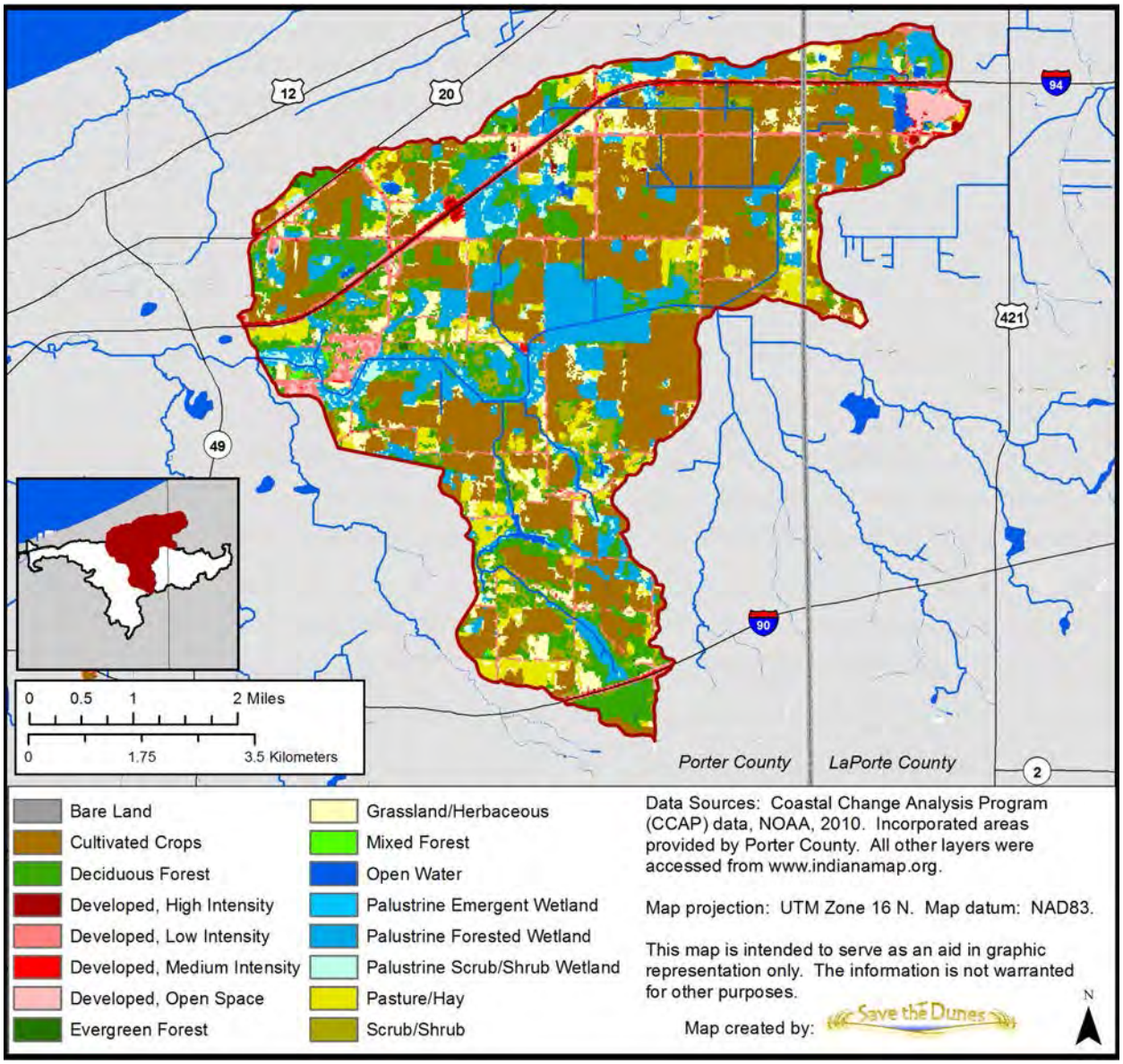

Figure 50. Land cover in the Kemper Ditch subwatershed.

Windshield surveys in the Kemper Ditch subwatershed highlighted land uses due to their potential effect on water quality. Beneficial land uses noted by the surveyors included INDU land, several small forest preserves, several wooded wetlands, buffer strips along several agricultural ditches, a natural prairie area, and at least 3 wetlands. Other land uses observed by surveyors included 2 sites with piles of loose fill material, 4 steep streambanks, three suspected eutrophic waterbodies, 2 demolition activities, turbid ditch water at 4 sites, 2 home construction sites, the presence of duckweed at 4 sites, numerous discharging pipes, ditch-side plowing of a crop at one site, large turf lawns up to stream edges at more than 6 sites, livestock close to rivers, Canadian geese and other water fowl in ponds, conventional agriculture at many sites, dredging, 2 illegal dump sites, and a landfill. Nearly 8 miles of absent or insufficient riparian buffers were identified from the windshield survey combined with desktop analysis (Figure 51). Utilizing both the QHEI (habitat) measurements and the windshield survey, approximately 456 ft. of stream bank are eroding throughout in the Kemper Ditch subwatershed (Figure 51). Moderate to heavy siltation was also reported for 835 ft. of streambed.

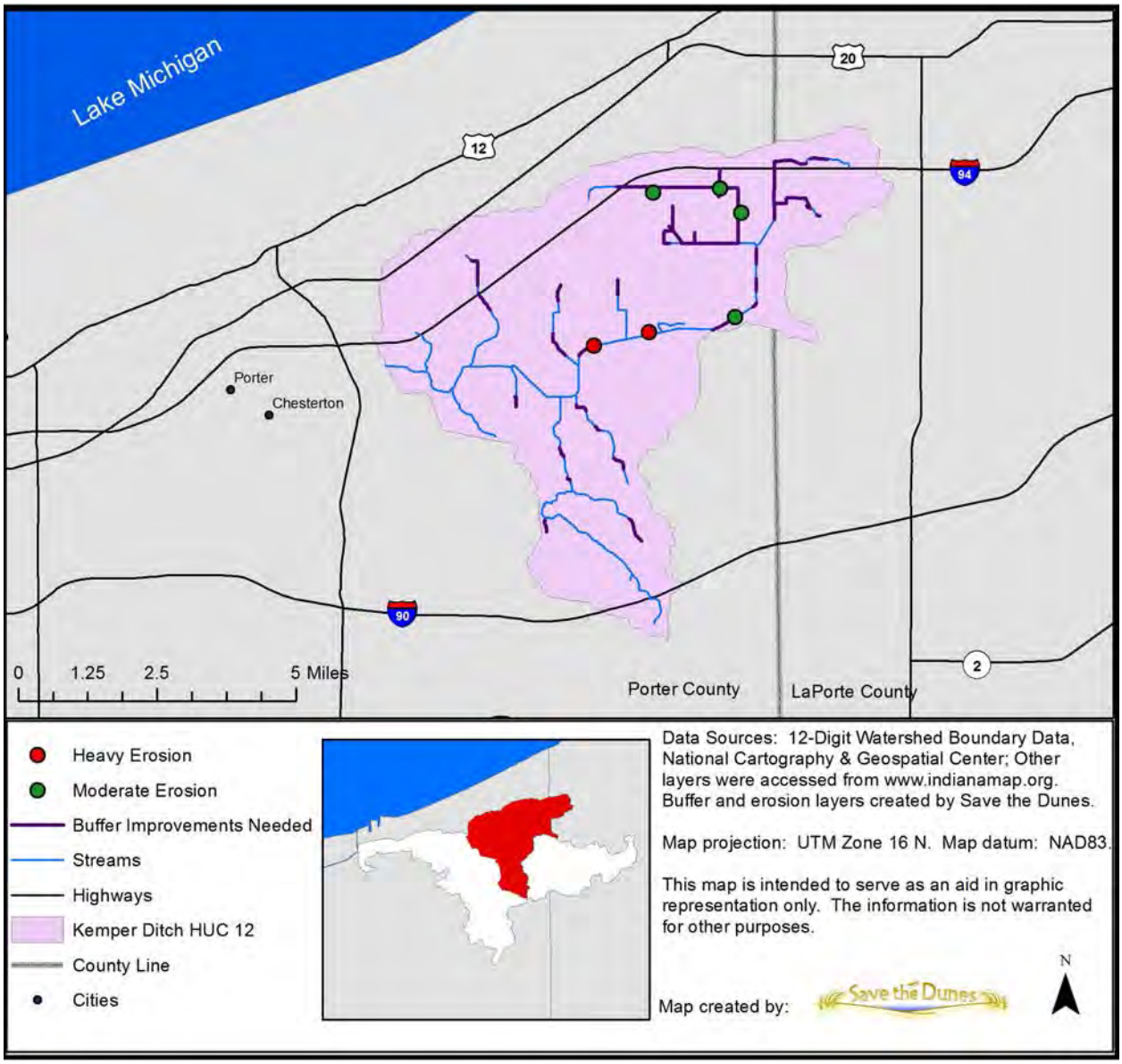

Figure 51. Streambank erosion and buffers needed in the Kemper Ditch subwatershed

4.2.d Summary

The Kemper Ditch subwatershed is sparsely developed and contains the most agricultural land in the LCEB. However, this subwatershed also contains high quality natural lands, such as the Heron Rookery. The agricultural lands in this subwatershed are contributing abundant nutrients and sediment to streams and rivers in the Kemper ditch subwatershed. This rural landscape may also be contributing large amounts of *E. coli* through poorly functioning onsite septic systems from the many low-density rural residential homes checkered throughout this subwatershed's landscape. All the streams in this subwatershed are 303(d) listed for biotic communities, while others are listed for nutrients, dissolved

oxygen, and *E. coli*. Due to the drought, the 2012 baseline study may underestimate water quality parameters such as nutrients and sediment. However, the impairment of the biological communities may demonstrate established water quality problems in this subwatershed.

4.3 Coffee Creek Subwatershed (HUC 12: 040400010403)

The Coffee Creek subwatershed is 20,393 acres, which is approximately 43% of the LCEB watershed. Named waterbodies within the Coffee Creek subwatershed include the LCEB mainstem, Coffee Creek, Peterson Ditch, Pope O'Connor Ditch, Shooter Ditch, Johnson Ditch, Suman Tributary, Chubb Lake, Morgan Lake, Chestnut Lakes, Mud Lake, Carlson Pond, and Moore Swamp. There are several NPDES permits in the Coffee Creek subwatershed: The Chesterton Wastewater Treatment Plant main outfall and additional overflow outlets (INM022578), the Town of Porter lift station overflow (INJ046949), and the outlets for the Burns Harbor WWTP and ArcelorMittal (IN0000175).

Sites 1, 3, 4, 48, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, and 24 are in the Coffee Creek Subwatershed.

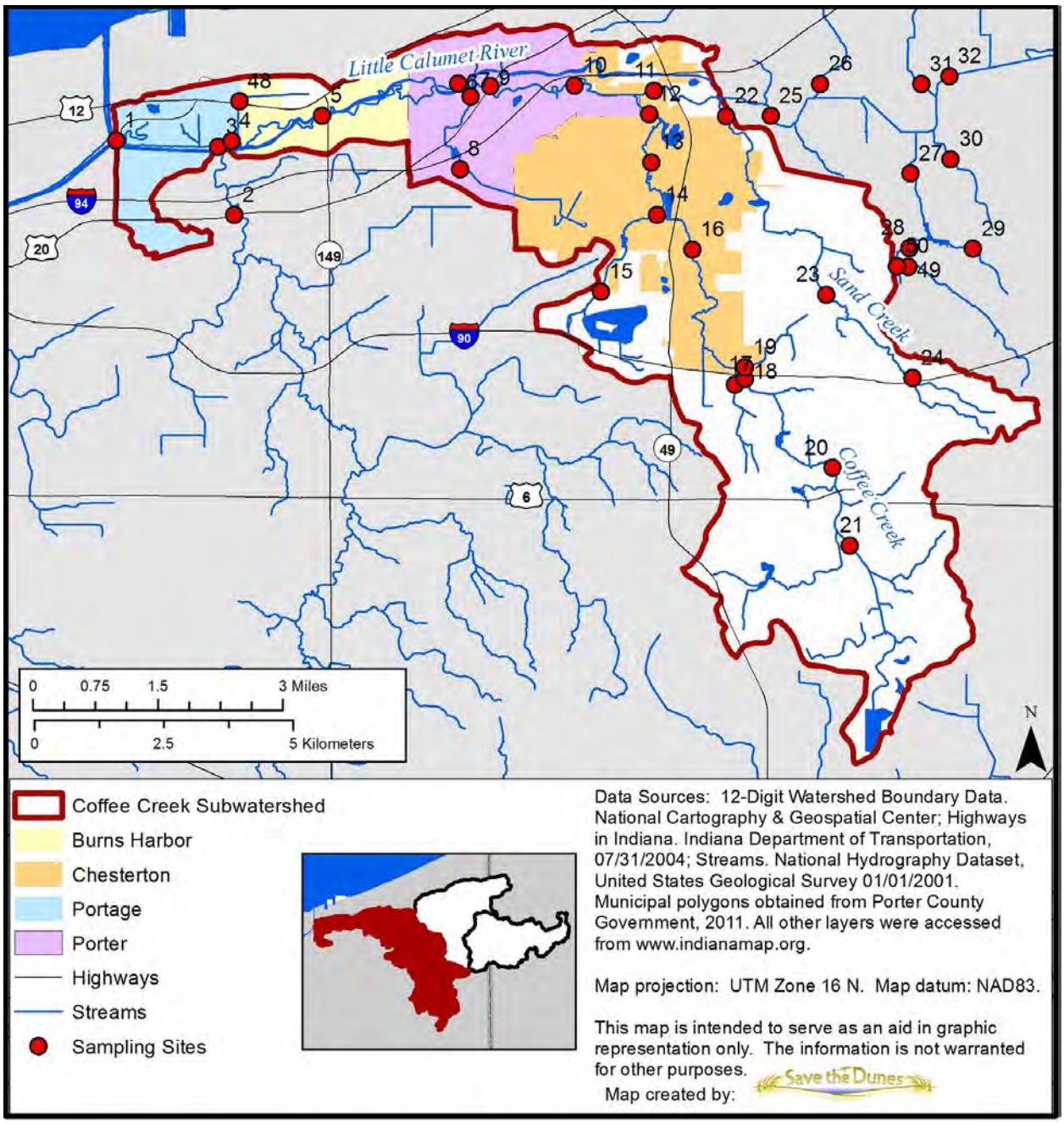

Figure 52. Coffee Creek subwatershed sampling sites

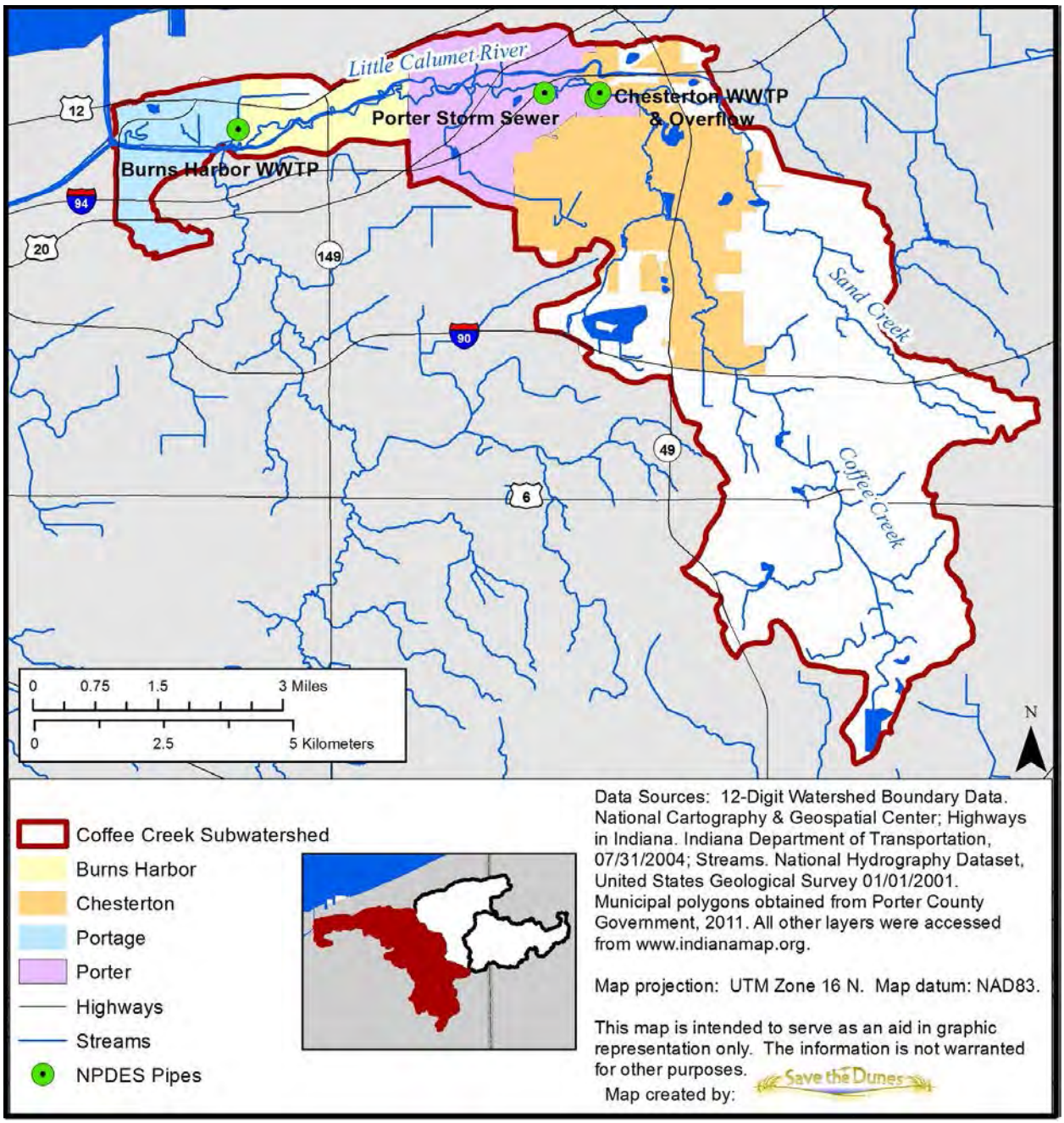

Figure 53. NPDES permits in the Coffee Creek subwatershed

4.3.a Water Quality Information

Past Studies

Several water quality studies have been conducted in the Coffee Creek subwatershed. From 1990 to present, IDEM has maintained fixed stations at sites 1 and 5 on the LCEB mainstem. The fixed stations have examined metals, basic water chemistry, and other environmental

variables. IDEM also performed the Burns Waterway TMDL assessment in 2000, which measured chemistry, environmental variables, and organics at Site 1. Brief summaries for these studies are located in Section 3.1 Historic Water Quality Sampling Campaigns.

IDEM's 2000 *E. coli* study included sites 1, 5, and 13 in the Coffee Creek subwatershed. Sixty-two percent of samples collected at these sites exceeded the target concentration (235 CFU/100 ml). The 2000 Corvallis study examined a location near site 9. Target concentrations were exceeded for phosphorus, temperature, nitrate, sediment, and dissolved oxygen. The 2010 Corvallis study examined site 16 in the Coffee Creek subwatershed. State water quality standards were exceeded for temperature, *E. coli*, sediment, and total phosphorus. The 2000 East Branch Little Calumet River study examined six sites in the Coffee Creek subwatershed (1, 5, 9, 10, 23, and 48). Forty-four percent of samples exceeded the IAC standard for *E. coli a*nd 61% exceeded the target for temperature. There were no dissolved oxygen violations.

In 2000, IDEM tested for 103 different pesticides on one LCEB mainstem location (near site 9). Six pesticides: Atrazine, Acetoclor, Cyanazine, Desethylatrazine, Metolachlor, and Simazine were detected during May and June of that year. This corresponds to the seasonality of pesticide use. Pesticides, when present in surface waterways, can contribute to the impairment of biotic communities, since they can kill aquatic plants and animals. Of the six pesticides detected in the study from 2000, only Metolachlor, classified as an EPA class C pesticide and carcinogen, has an EPA aquatic life benchmark. Metolachlor had two violations of IAC criteria.

The Coffee Creek Watershed Management Plan (2003) examined water quality at 8 sites within the Coffee Creek subwatershed. Overall, water quality in the tributaries was more degraded than the mainstem. High temperatures and elevated *E. coli* concentrations, combined with high nutrient and sediment loads were cited as problems for water quality and biological communities. Shooter Ditch and Pope O'Connor Ditch were selected as critical areas.

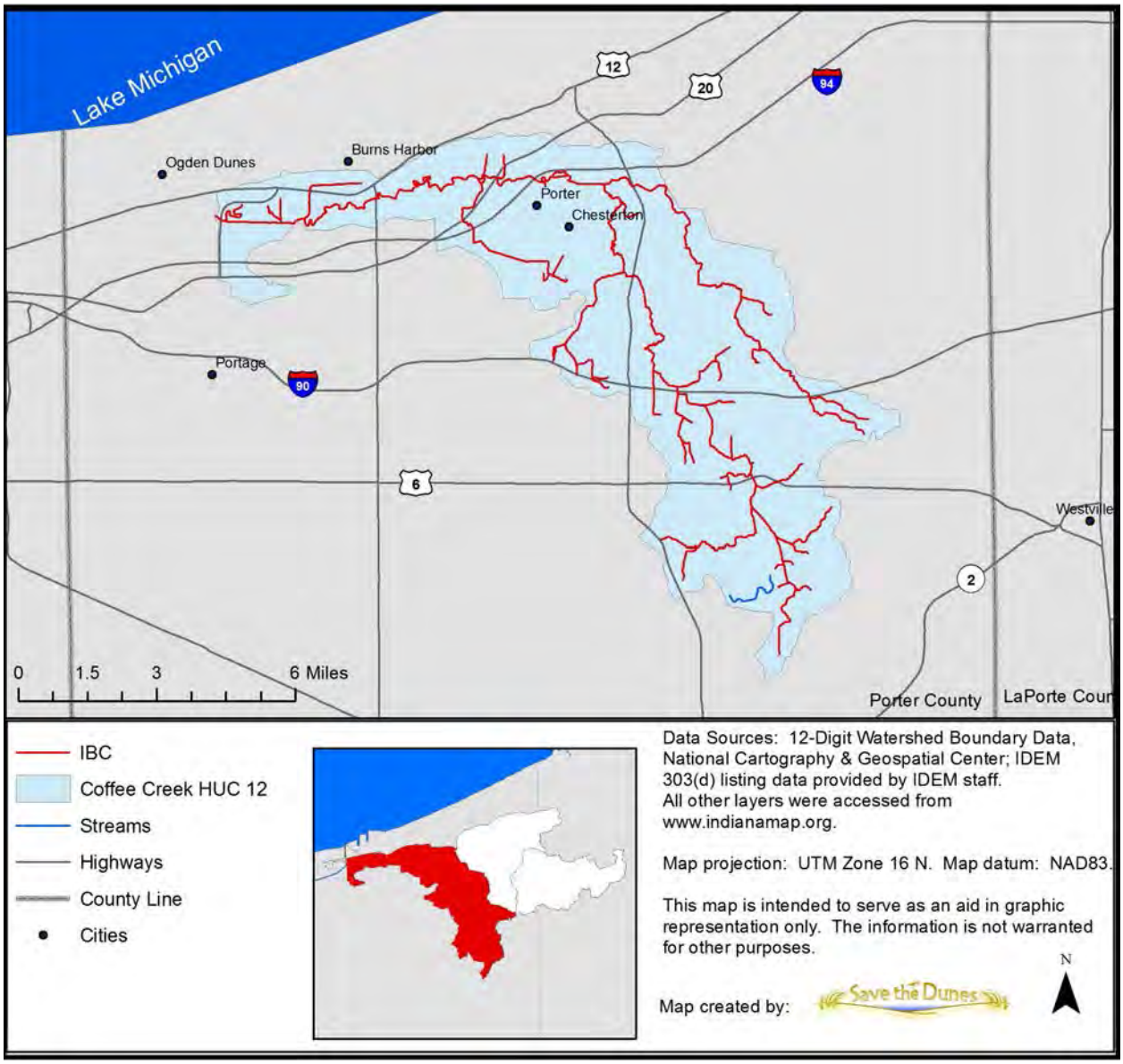

Figure 54. Coffee Creek subwatershed 2014 draft 303(d) listing for impaired biotic communities

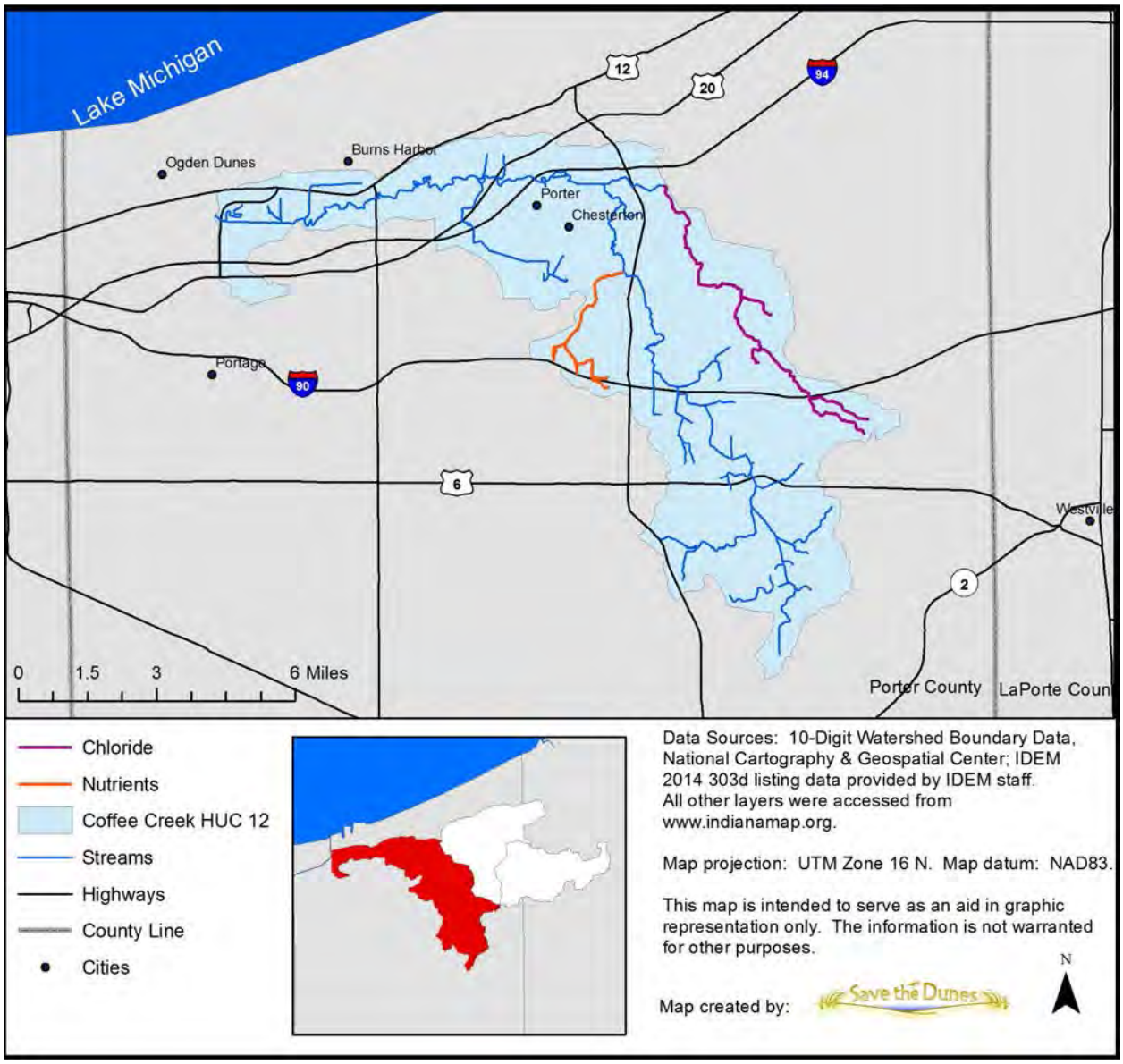

Figure 55. Coffee Creek subwatershed 2014 draft 303(d) listings for nutrients and chloride

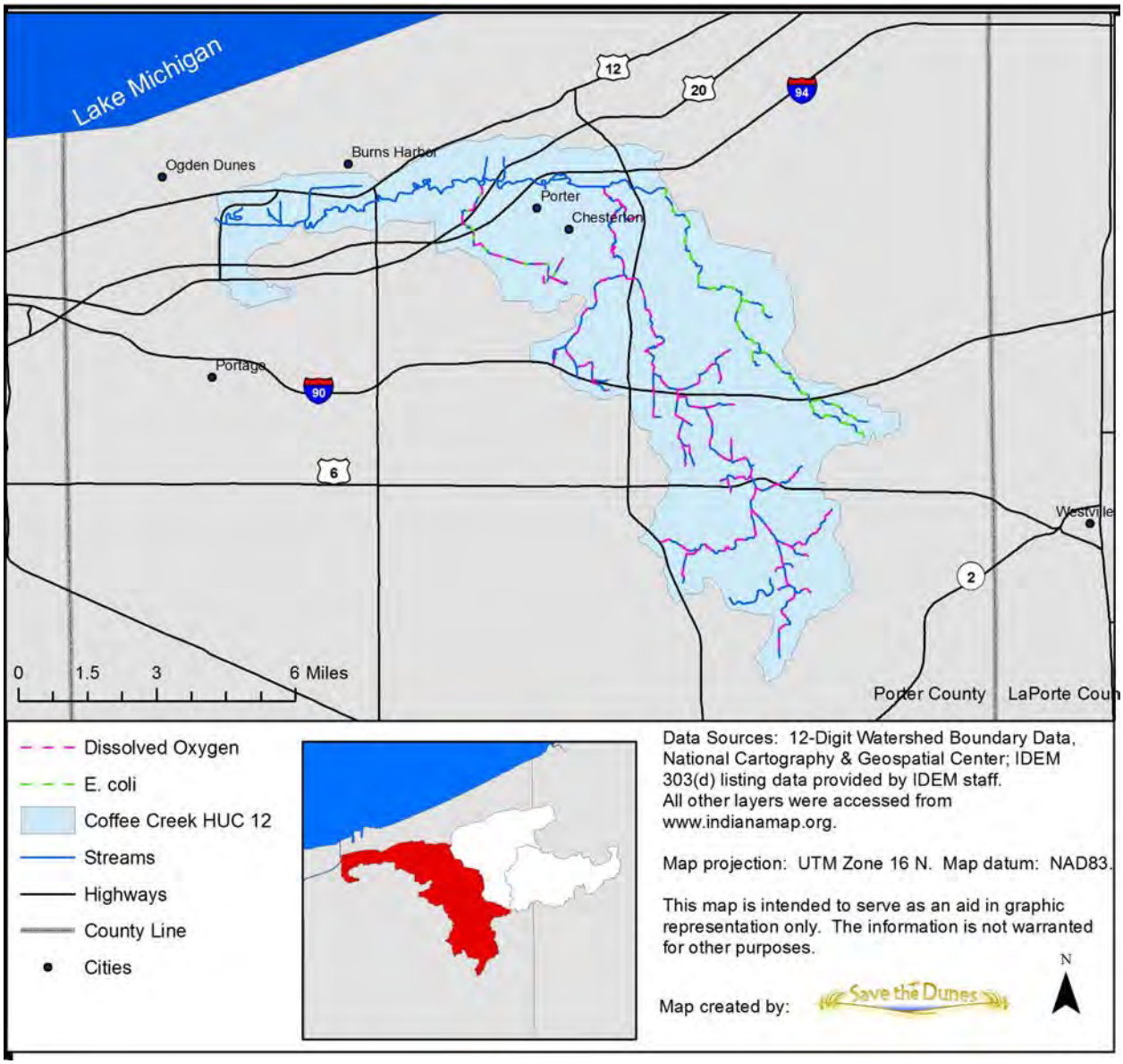

Figure 56. Coffee Creek subwatershed 2014 draft 303(d) listings for *E. coli* and dissolved oxygen

Current Studies

All stream segments within the Coffee Creek subwatershed are included on the 2014 (draft) 303(d) listing. For impaired biotic communities (Figure 54), the entire subwatershed is listed. The entire length of the Pope O'Connor Ditch (sites 14 and 15) is impaired for excessive nutrients (Figure 55). The entire length of Sand Creek (sites 22, 23, and 24) is impaired for chloride and *E. coli*. Peterson Ditch (sites 7 and 8) is impaired for *E. coli* and dissolved oxygen (Figure 56). The entire Coffee Creek (sites 12, 13, 16, 18, 20, and 21) and its tributaries, Johnson Ditch and Shooter Ditch (sites 17 and 19, respectively), are also listed for dissolved oxygen (Figure 56) on the 2014 (draft) 303(d) listing.

For the purpose of this data summary, Sites 1 and 2 were not included for data analysis. Site 2 is at the base of the Salt Creek watershed, which is entirely out of the LCEB watershed. Site 1 includes discharge from the Salt Creek watershed in addition to discharge from the entire LCEB watershed. Consequently, site 1 is not an appropriate comparison for the rest of the LCEB stream sites.

Temperatures in the Coffee Creek subwatershed were highest at the base of the watershed and lower in the tributaries. Most sites had few samples exceed the designated target temperature (21.1° C) during baseline sampling in 2012. Four sites had zero temperature violations (site 8, Peterson Ditch Upstream; site 15, Pope O'Connor Ditch Upstream; site 23, Middle Sand Creek; and site 24, Upper Sand Creek). Overall, 28% of samples in the Coffee Creek subwatershed exceeded the temperature target. The highest measurement was 27.9° C at site 14 (Pope O'Connor Ditch Downstream). The highest mean was 23.6° C at site 4 (Samuelson Ditch Downstream). Sites 4, 3, and 48 had the three highest temperature means in the LCEB watershed (23.6° C, 22.1° C, and 20.9° C, respectively). Site 24 had the lowest mean in the LCEB watershed (and the Coffee Creek subwatershed), however this upstream part of Sand Creek was not flowing during much of the recreational period in 2012, so temperature data for this site likely underestimates normal average temperatures for a given year.

There were relatively few dissolved oxygen (DO) violations for the Coffee Creek subwatershed, except for three sites that frequently exceeded the target concentration (6 mg/l). Sites 8, 19, and 22 had 6, 6, and 8 violations, respectively. The highest mean was 17.2 mg/l at site 15 (Pope O'Connor Ditch Upstream), but the high DO readings always corresponded with extremely low water temperatures during the winter months, which allowed the water in Coffee Creek to hold more oxygen than it would under warmer temperatures. Because of this, the samples were not labeled as oversaturated, even though some values were as high as 19.9 mg/l (corresponding with 13.5° C water temperature). At Site 15 the lowest concentration was 3.1 mg/l, which corresponded to a very warm water temperature (27.9° C). The lowest mean in the Coffee Creek subwatershed was 9.4 mg/l at site 22 (Lower Sand Creek), which is still well above the target concentration of 6 mg/l. Overall, only 8% of samples collected in the Coffee Creek subwatershed exceeded the target concentration. There were no pH violations in the Coffee Creek subwatershed in 2012: all samples fell within the six to nine pH units range from the IAC.

Nitrate and nitrite concentrations in the Coffee Creek subwatershed were generally low in 2012. Only 15% of samples collected exceeded the target concentration of 1.0 mg/l and 25% of samples were below the analytical detection limit. Sites 5 (mainstem), 9 (mainstem), and 10 (mainstem) had the highest percentage of samples exceed the target concentration (83%, 75% and 82%, respectively). Site 10 (mainstem) also had the highest mean (1.8 mg/l). The lowest mean of 0.1 mg/l was at site 17 (Johnson Ditch). This site was also the second lowest nitrate mean in the LCEB watershed. Seven sites in the Coffee Creek subwatershed had enough data to calculate annual loads: sites 3 (mainstem), 7 (Peterson Ditch Downstream), 9 (mainstem), 11 (mainstem), 12 (Coffee Creek), 20 (Coffee Creek) and 22 (Lower Sand Creek). The Purdue load tool requires at least 12 uncensored data points with associated flow to generate loads, and several sites in this subwatershed had too little

data to calculate loads and areal loads. Site 9 (mainstem) had the highest annual nitrate-loading rate (138,394 lb/yr) and site 3 (mainstem) within the National Lakeshore had the second highest annual load (100,015 lb/yr) for nitrate in the LCEB watershed in 2012. It is important to note that due to the historic 2012 drought, the baseline data that has been reported for nitrate may underestimate normal pollution levels for this watershed.

Phosphorus in the Coffee Creek subwatershed was somewhat high. Thirty-seven percent of samples collected exceeded the target concentration of 0.08 mg/l and 36% of samples were below the analytical detection limit. Every site, except sites 4 and 48 (Samuelson Ditch) had exceedances for phosphorus. Sites 10 (mainstem) and 19 (Shooter Ditch) had the highest percentage of samples exceed the phosphorus target. Ten sites had enough data to calculate annual loads: sites 3, 7, 9, 11, 12, 13, 17, 18, 20, and 22. Site 9 (mainstem) had the highest phosphorus load of any site in the LCEB watershed (10,160 lb/yr), while site 17 (Johnson Ditch) had the smallest phosphorus load (154 lb/yr) in the Coffee Creek subwatershed. The smallest phosphorus means were 0.03 and 0.05 mg/l at sites 48 and 4, respectively. It is important to note that Samuelson Ditch (sites 4 and 48) is comprised only of treated steel mill effluent, and is therefore not a true river like the rest of the sites in the LCEB watershed. The largest mean in this subwatershed was 0.14 mg/l at site 22 (Lower Sand Creek).

Total suspended solids (TSS) were relatively low in the Coffee Creek subwatershed. Overall, only 5% of samples collected exceeded the target concentration (30 mg/l) and 40% of samples were below the analytical detection limit. Fourteen sites had no TSS violations (sites 3, 4, 6, 7, 8 10, 11, 13, 14, 15, 16, 18, 20 and 24), while six more had only one violation (sites 9, 17, 19, 21, 23, and 48). Site 12 (Coffee Creek) had the largest percentage of exceedances (24%). The lowest mean for TSS was 4 mg/l at site 14 (Pope O'Connor Ditch downstream). This was the second lowest mean in the LCEB watershed in 2012. The lowest annual TSS load (36,965 lb/yr) was site 7(Peterson Ditch Upstream). However, site 9 had the highest annual load of those calculated for the LCEB watershed at 1,548,644 lb/yr.

Concentrations of *E. coli* in the Coffee Creek Outlet showed a wide range of bacterial levels. Over 47% of samples collected exceeded the target concentration of 235 CFU/100 ml. Only two sites (4 and 48) had zero *E. coli* violations. Sites 4 and 48 (Samuelson Ditch Downstream and Upstream) had the lowest *E. coli* means in the entire LCEB watershed (12 and 18 CFU/100 ml, respectively). This waterway was created to drain and cool treated steel mill effluent and is not a natural waterway. It is important to note that several of the smaller tributary sites were not flowing or totally dry during the growing season, so some of the baseline values at these sites may underestimate normal conditions in these streams. Site 7 (Peterson Ditch Downstream) had the largest mean (2,277 CFU/100 ml). The largest percentage of samples exceeding the target concentration was at Site 12 (Coffee Creek, 81%). Sites 7 (Peterson Ditch), 9 (mainstem), and 22 (Lower Sand Creek) also had large percentages of exceedances (75%, 70%, and 70%, respectively).

4.3.b Habitat/Biological Information

The 1990 macroinvertebrate study sampled site 16 in the Coffee Creek subwatershed. This site rated a QHEI score of 65 (good) and a mIBI score of 3.6 (moderately impaired). The 2000 Corvallis study examined a mainstem site near site 9. A QHEI score of 35 (non-supporting) and an IBI score of 34 (poor) were reported.

The Coffee Creek Watershed Management Plan (2003) evaluated macroinvertebrates in the spring and fall at the 7 sampling sites. The fall sampling reported higher mIBI scores (5 sites supporting, 2 sites not supporting) than the spring sample (3 sites supporting and 4 sites not supporting). Only one site received a supporting score for the QHEI (habitat).

IDEM utilized two biotic indices during the recreational period in 2012 to analyze two main aquatic communities. Benthic macroinvertebrates were analyzed using the mIBI methodology, and fish communities were assessed using the IBI methodology. Both communities were assessed at all the Coffee Creek subwatershed sites except for site 15 (Pope O'Connor Ditch Upstream) where IDEM assessed neither of the biotic communities in 2012 and site 24 (Upper Sand Creek) where the fish community was not assessed due to drought conditions.

Two sites received supporting scores (>36) for macroinvertebrates (mIBI): sites 5 (mainstem) and 23 (Middle Sand Creek). Sites 5 (mainstem), 6 (mainstem), 9 (mainstem), 13 (Coffee Creek), and 16 (Coffee Creek) received supporting scores for fish communities (>36). To evaluate the cause of failing biotic communities, in-stream habitat is assessed using the QHEI. Habitat was found to be not supporting at sites 8 (Peterson Ditch Upstream), 14 (Pope O'Connor Ditch Downstream), 19 (Shooter Ditch), 21 (Coffee Creek), 22 (Lower Sand Creek), and 48 (Samuelson Ditch Upstream). It is important to note that 2012 was a historic drought year, and many of these sites showed habitat ratings that were potentially lower than what may be considered normal conditions for these sites, due to low water levels that could have put root wads, overhanging vegetation, and other fish and macroinvertebrate habitats above the waterline.

4.3.c Land Use Information

Land cover in the subwatershed is predominantly developed land/urban (31%) followed by forest (30%) and agriculture (16%) (Figure 39 and Figure 57). With 31% developed land, the Coffee Creek subwatershed is by far the most urban in the LCEB watershed. Developed land is primarily in and around the incorporated areas along the mainstem and near the confluence of Coffee Creek with the mainstem. The rural areas in the Coffee Creek subwatershed have abundant low-density rural residential homes combined with agriculture. The headwaters of Coffee Creek are largely forested and protected within the Moraine Nature Preserve, which provides a large amount of open space. Much of the LCEB mainstem, downstream of Coffee Creek, is protected within INDU. Sections of Shooter Ditch, Pope O'Connor Ditch, Johnson Ditch, Peterson Ditch, and some reaches of the LCEB mainstem are regulated drains within the Coffee Creek subwatershed.

Chesterton is likely to expand to the south and southwest, in areas that are currently agriculture or low-density rural residential homes. Large industry, such as ArcelorMittal, is not anticipated to expand in to this watershed. There are no fairgrounds located in the Coffee Creek subwatershed at this time. There are only two small animal kennels located in Chesterton and Porter: Ark of the Dunes Animal Hospital in Chesterton and Dog Kennels Runs and More in Porter. Two small hobby farms are located in the Coffee Creek subwatershed (Figure 58). The acreage of these farms is approximately 18 acres with 6 horses and 10 cattle.

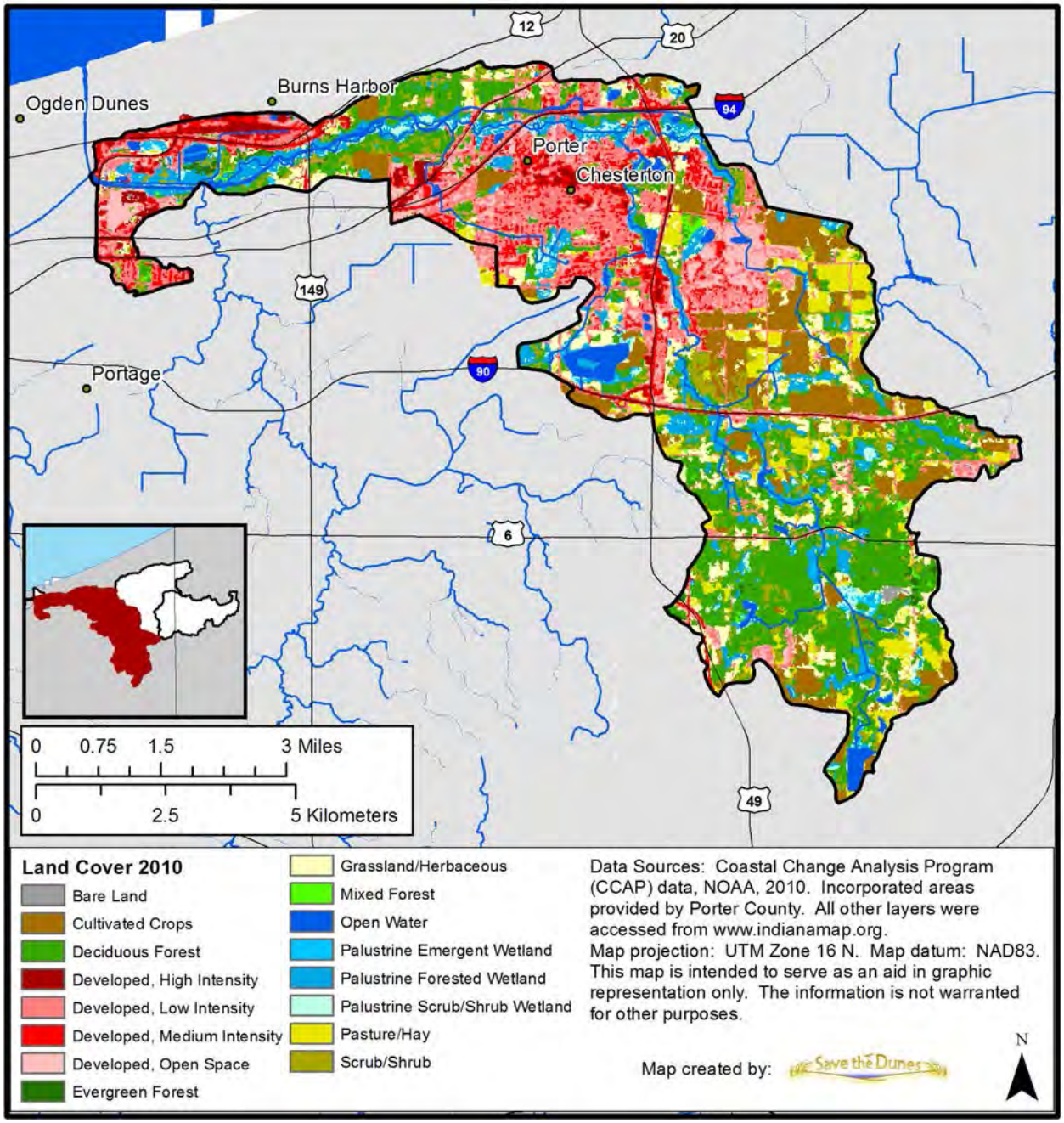

Figure 57. Land cover in the Coffee Creek subwatershed

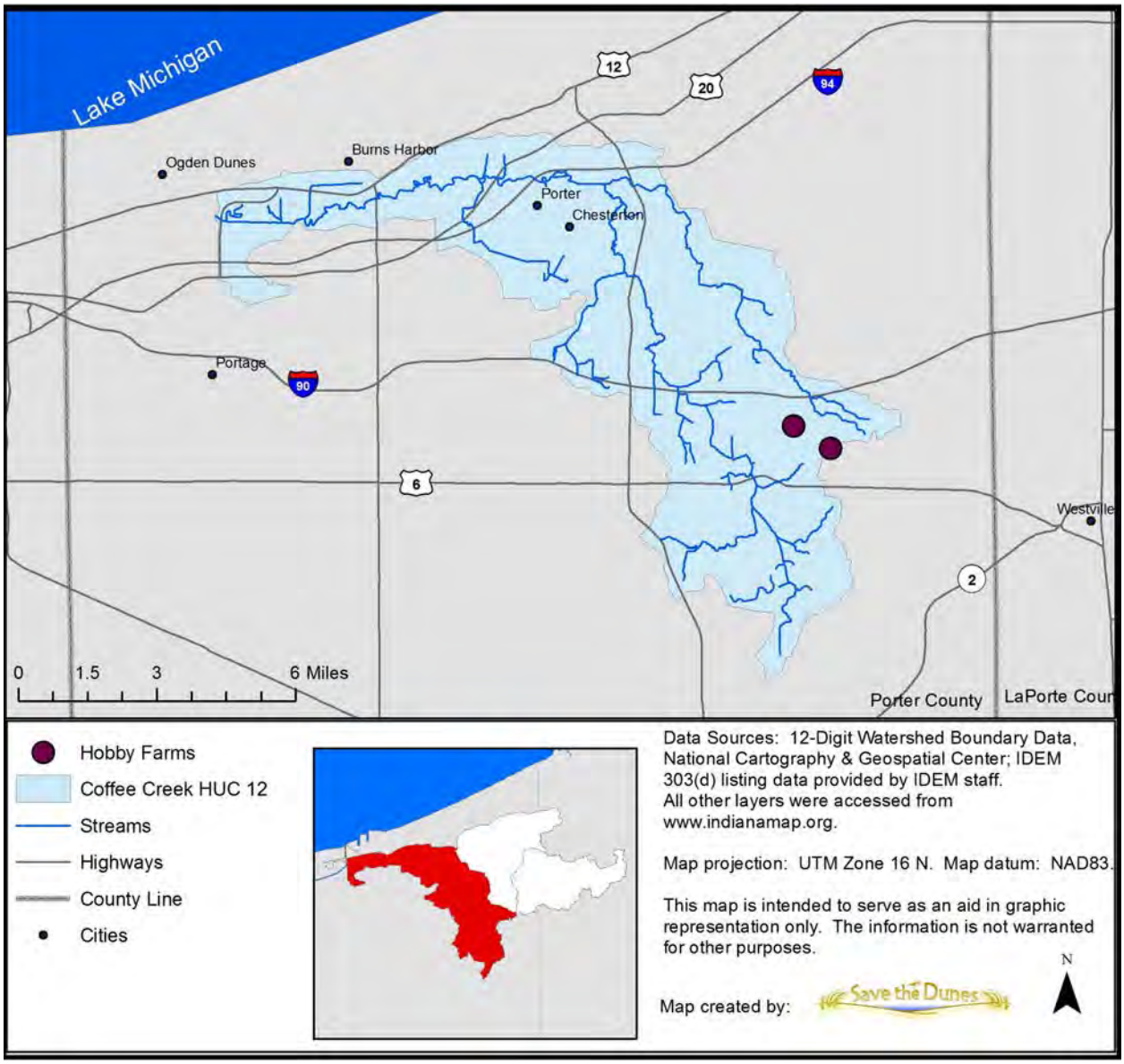

Figure 58. Hobby farms in the Coffee Creek subwatershed

Windshield surveys in the Coffee Creek subwatershed highlighted land uses due to their potential effect on water quality. Beneficial land uses noted by the surveyors included INDU forest preserves, a fen, many wetlands, ponds and lakes, two stormwater detention basins, a classified forest, and three preservation areas. Other land uses reported by surveyors included: severe bank erosion associated with the Praxair dam, an armored streambank near the confluence with Deep River, 4 sites with steep streambanks, industrial effluent at one site on the mainstem, dense residential areas within Chesterton, 4 large impervious

surfaces/parking lots, large strip mall development, several large lawn turf areas up to stream edges, 4 yard waste dump sites, 2 sites where trash has been dumped near the stream, green and grey color of the LCEB mainstem at two different sites, exposed pipes at two sites, Canadian geese and other water fowl in ponds, rusty discoloration of curbs and trees in a neighborhood with sprinkler systems, a road salt storage facility, disturbed soils at two locations, two sites with loose fill material, a large neighborhoods' ditches draining to nearby creek, a channelized river at one site, a sand mine, and numerous log jams. Over 3.4 miles of absent or insufficient riparian buffers were identified from the windshield survey combined with desktop analysis (Figure 59). Utilizing both the QHEI (habitat) analysis and the windshield survey, approximately 1,206 ft. of stream bank are eroding throughout in the Coffee Creek subwatershed (Figure 59). Moderate to heavy siltation was also reported for over 1,775 ft. of streambed.

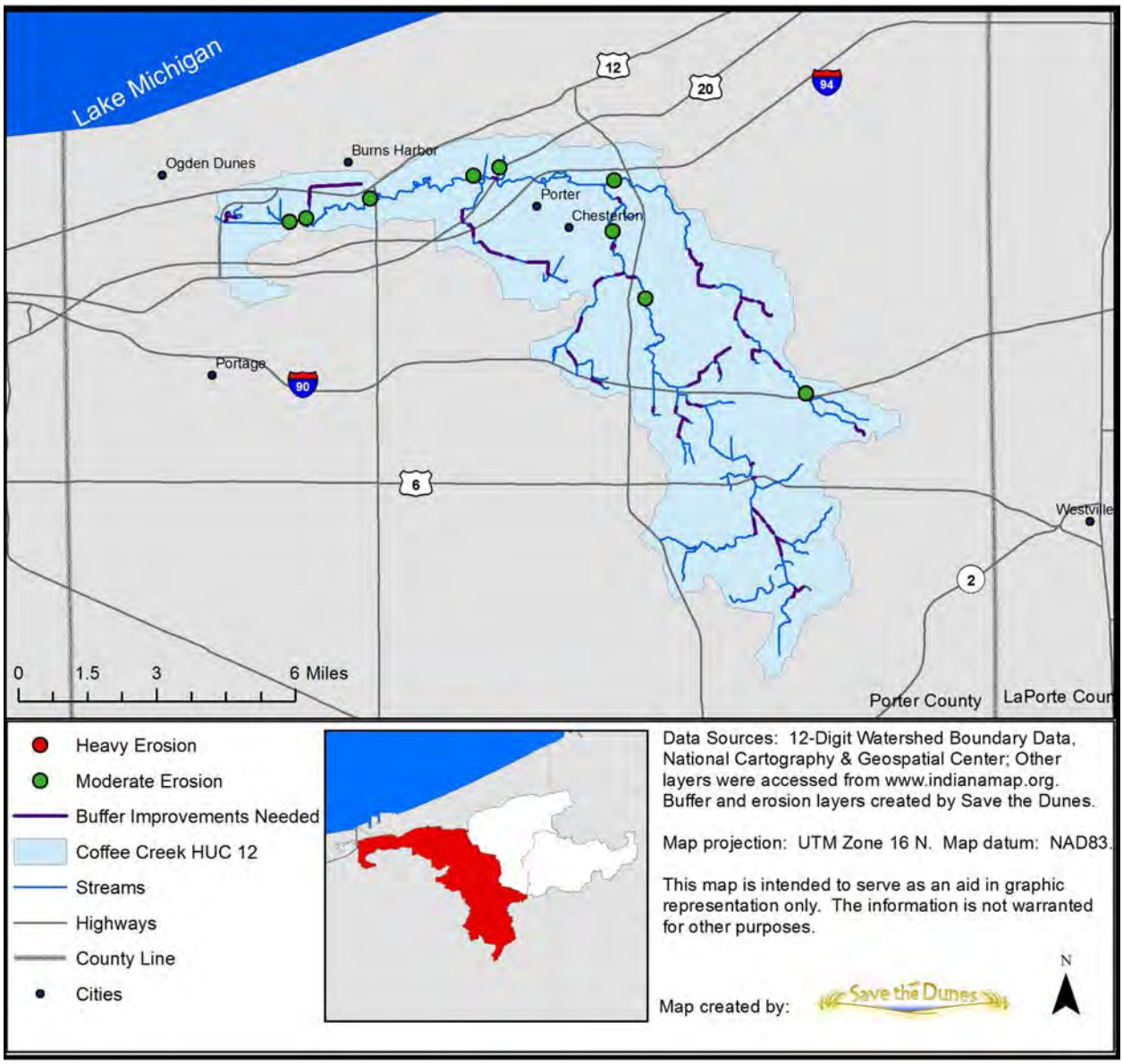

Figure 59. Streambank erosion and buffers needed in the Coffee Creek subwatershed

4.3.d Summary

The Coffee Creek subwatershed has the largest amount of urban land use in the LCEB. Impervious surfaces in urban landscapes tend to degrade water quality and scour stream banks. Commercial development areas in the Coffee Creek subwatershed generally lack green infrastructure to reduce impacts of large impervious surfaces. However, this urban area is also the only part of the LCEB serviced by sanitary sewers. The southern and eastern portion of the Coffee Creek subwatershed is not serviced by sewers and may be contributing *E. coli* from malfunctioning onsite septic systems. The rural areas of this watershed contain many large residential homes on wooded lots or in agricultural settings. Approximately 16% of the Coffee Creek subwatershed is agricultural. Therefore, sediment and nutrients are likely exported to local streams and rivers. This subwatershed also contains a large portion of forested protected lands, such as the Moraine Nature Preserve and the Coffee Creek Watershed Preserve. All streams in this subwatershed are 303(d) listed for biotic communities, while others are listed for nutrients, dissolved oxygen, chloride, and *E. coli*. Due to the drought, the 2012 baseline study may underestimate water quality parameters such as nutrients and sediment. However, the impairment of the biological communities may demonstrate established water quality problems in this subwatershed.

4.4. Watershed Inventory Summary

The LCEB watershed is a diverse landscape containing high quality natural lands, conventional agriculture, and urban areas with extensive impervious surfaces. Soils in this watershed are also diverse; ranging from very poorly draining and nutrient rich to quickly draining and nutrient poor sandy soils. Historic water quality sampling shows that water quality impairments and impaired biological communities are increasing throughout the watershed. The 2012 baseline study was affected by a historic multi-year drought. Pollutant loads could not be calculated for many sampling sites due to data restrictions. However, the 2014 (draft) 303(d) impairment listings clearly demonstrate the current level of water quality impairments in the LCEB. Numerous sampling sites exceeded the IAC target for over 50% of samples collected for nitrogen (nitrate+nitrite), phosphorus (total phosphorus), *E. coli*, and sediment (total suspended solids) (Figure 60). Only 11 sites (4, 15, 16, 20, 24, 39, 40, 42, 45, 46, and 47) are not represented in Figure 60. This means only 11 sites consistently had fairly good water quality.

The widespread impairment of biological communities demonstrates a well-established condition of impairment throughout the watershed. The health of stream biological communities helps to interpret long-term conditions, while a grab sample for water chemistry can only assess current conditions. Nearly every stream in the LCEB has been listed for impaired biological communities. Figure 61 depicts the sampling sites that rated unsupporting for fish (IBI) and macroinvertebrates (mIBI), or poor for habitat (QHEI). Site

5 was the only sampling site evaluated that rated satisfactory scores for biology and habitat.

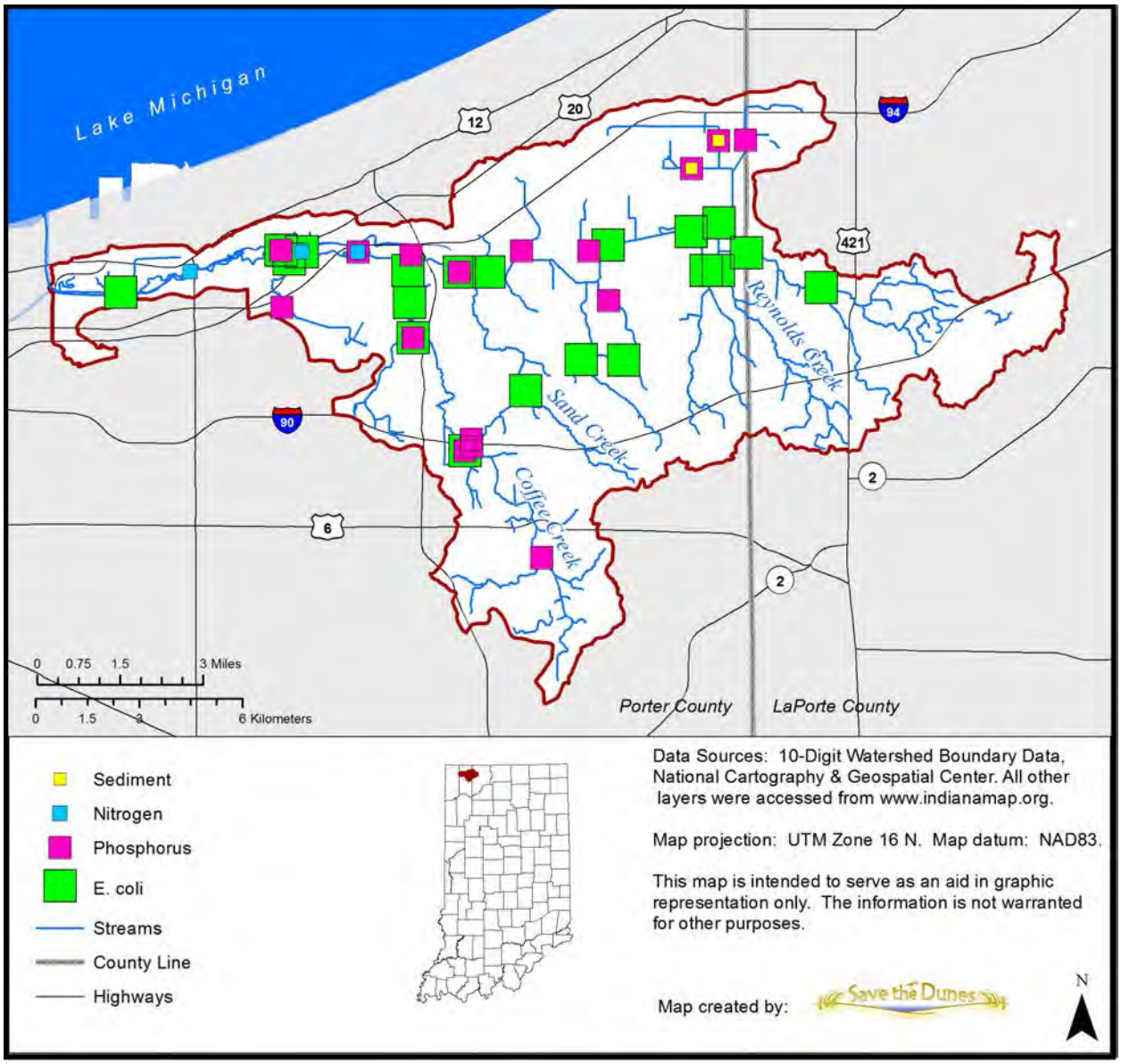

Figure 60. LCEB sampling sites that exceeded IAC targets for over 50% of samples collected in 2012 Baseline Study.

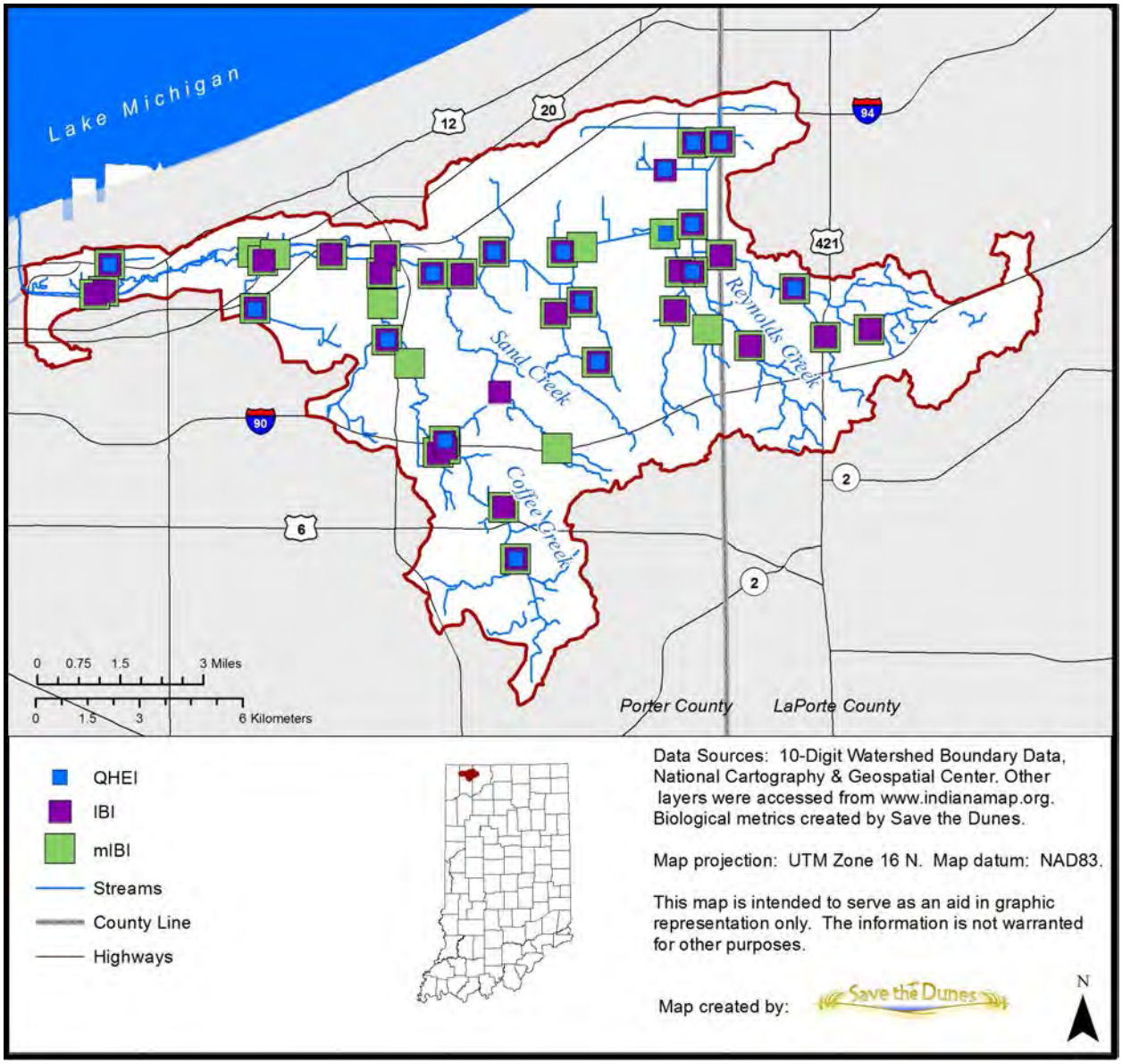

Figure 61.LCEB sampling sites that did not meet targets for 2012 Baseline Study

5.0 Review of Watershed Problems and Causes

5.1 Stakeholder Concerns

The following stakeholder concerns were developed from stakeholder input and the watershed inventory analysis. The LCEB steering committee evaluated the concerns and available data to determine the group's focus.