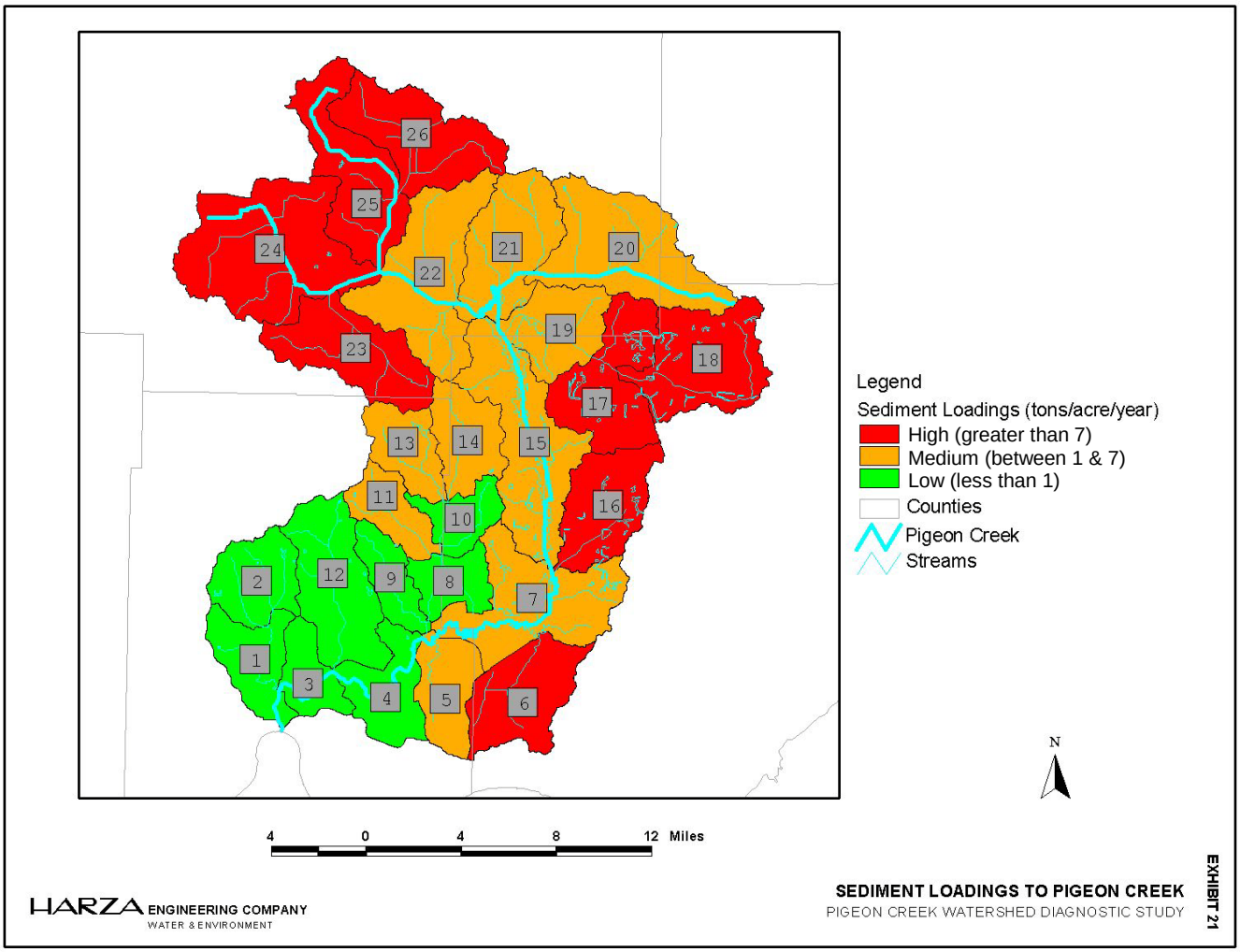
6. Identifying Critical Areas: Target areas within the watershed where the sources/stressors are causing the greatest damage, and where applying treatment measures will have the greatest effect.

Targeted areas. Areas selected for restoration efforts fall into two categories: those subwatersheds where erosion control, improved point source control, nutrient management and riparian restoration will have the greatest impact; and subwatersheds that still retain good habitat values and acceptable water quality and are thus worthy of protection and enhancement.

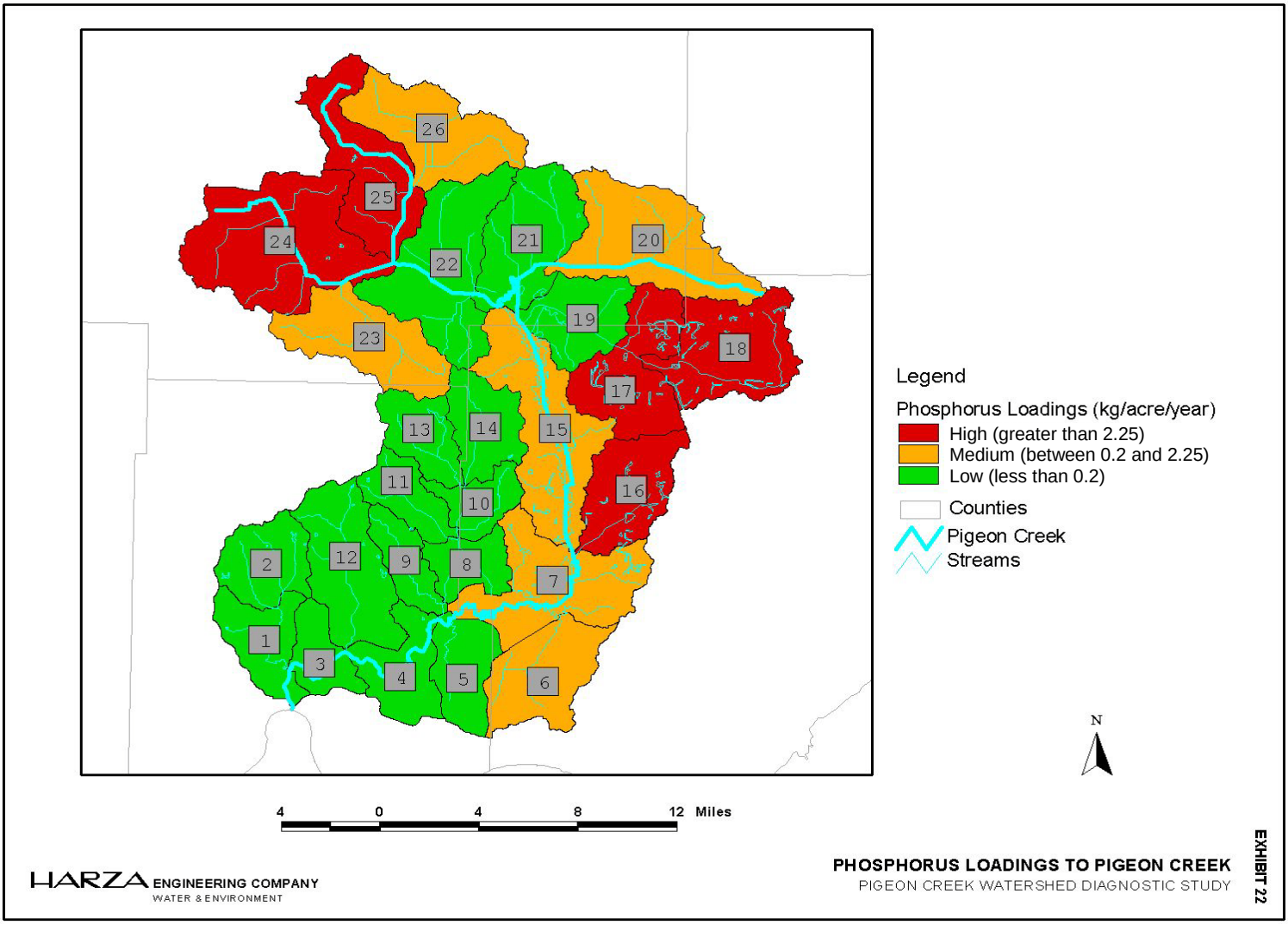
- In the Pigeon Creek basin, subwatersheds 6,16,17,18,23,24,25 and 26 exhibit the highest areal (tons/acre/yr) sediment loading and should be considered priority for erosion control best management practices.

Figure 14: sediment loading



In the Pigeon Creek basin, subwatersheds 16,17,18,24 and 25 exhibit the highest areal (kg/acre/yr) phosphorous loading and should be considered priority for applying nutrient management practices.

Figure 15: phosphorous loading



In the Pigeon Creek basin, subwatersheds 7,10,15,23 and 24 exhibited the highest nitrate concentrations and should be considered priority for applying nutrient management practices and/or further investigation into septic tank and WWTP discharges.

The surface water quality standard set by the State for nitrite and nitrate is a maximum of 10 mg/L. This is based upon human health criteria and has no wildlife basis.

Nitrate values for the August survey ranged from less than the detection limit of 0.05 mg/L as N at several sites, to a high of 6.7 mg/L at WF2 downstream of the Fort Branch wastewater treatment plant (WWTP) effluent on the West Fork Pigeon Creek. We also measured high nitrate at SD1, Stollberg Ditch at SR 62, of 5.4 mg/L as N.

Nitrate values for the May 2000 survey ranged from less than the detection limit of 0.05 mg/L as N at several sites, to a highs of 9.3 mg N/L at WF3, 8.9 at WF2 and 8.0 at WF1, all on West Fork Pigeon Creek. WF3 is upstream of all NPDES discharges and high nitrate levels there reflect agricultural nonpoint sources. We also measured high nitrate at SD1, Stollberg Ditch, of 5.7 mg N/L, and at Hurricane Creek, HC1, of 4.9 mg N/L; both SD1 and HC1 are downstream of WWTP discharges.

The surface water quality standard set by the State for ammonia nitrogen is pH and temperature dependent. Ammonia nitrogen values for the August survey ranged from less than 0.03 mg/L at PC3 (Pigeon Creek upstream of First Avenue), to a high of 2.88 mg/L at PC6, at US 41. Ammonia nitrogen values for the May survey ranged from 0.11 mg/L at PC6, to a high of 6.5 mg/L at PC9 (Stevenson Station Road). This high value at PC9 is suspect, as total Kjeldahl nitrogen (TKN) at PC9 during the May survey was 1.5 mg/L. As ammonia is operationally defined to be less than TKN, we attribute this value to laboratory error.

There is no state water quality standard for TKN. TKN values for the August 1999 survey ranged from less than the detection limit of 1.0 mg/L at several sites to 4.6 in Stollberg Ditch. TKN values for the May 2000 survey ranged from less than the detection limit of 1.0 mg/L at several sites to 10.0 in Stollberg Ditch. Other high TKN values found during May were at UN1, an unnamed tributary near Chandler, of 8.4 mg/L, and PC4, at Heidelbach Avenue of 5.0 mg/L.

- From the Harza study of McFadden Creek subwatershed, we estimated the following loadings (see map next page):

  Reach MF1
  836.4 kg/yr phosphorous, 10,418 lbs/yr nitrate,
  66.2 tons/yr sediment
  Reach MF2
  836.4 kg/yr phosphorous, 10,418 lbs/yr nitrate,
  79.2 tons/yr sediment
  Reach MF3
  114.5 kg/yr phosphorous, 1181 lbs/yr nitrate,
  6.3 tons/yr sediment
  Reach MF4
  64.4 kg/yr phosphorous, 1892.7 lbs/yr nitrate,
  1.2 tons/yr sediment
  Reach MF5
  No loading- stream flow not measured
  Reach MF6
  274.5 kg/yr phosphorous, 79.2 lbs/yr nitrate,
  65.3 tons/yr sediment
  Reach MF7
  549 kg/yr phosphorous, 125.2 lbs/yr nitrate,

- McFadden…Continued

107.1 tons/yr sediment

Reach MF8

656.2 kg/yr phosphorous, 11,676 lbs/yr nitrate,
212.6 tons/yr sediment

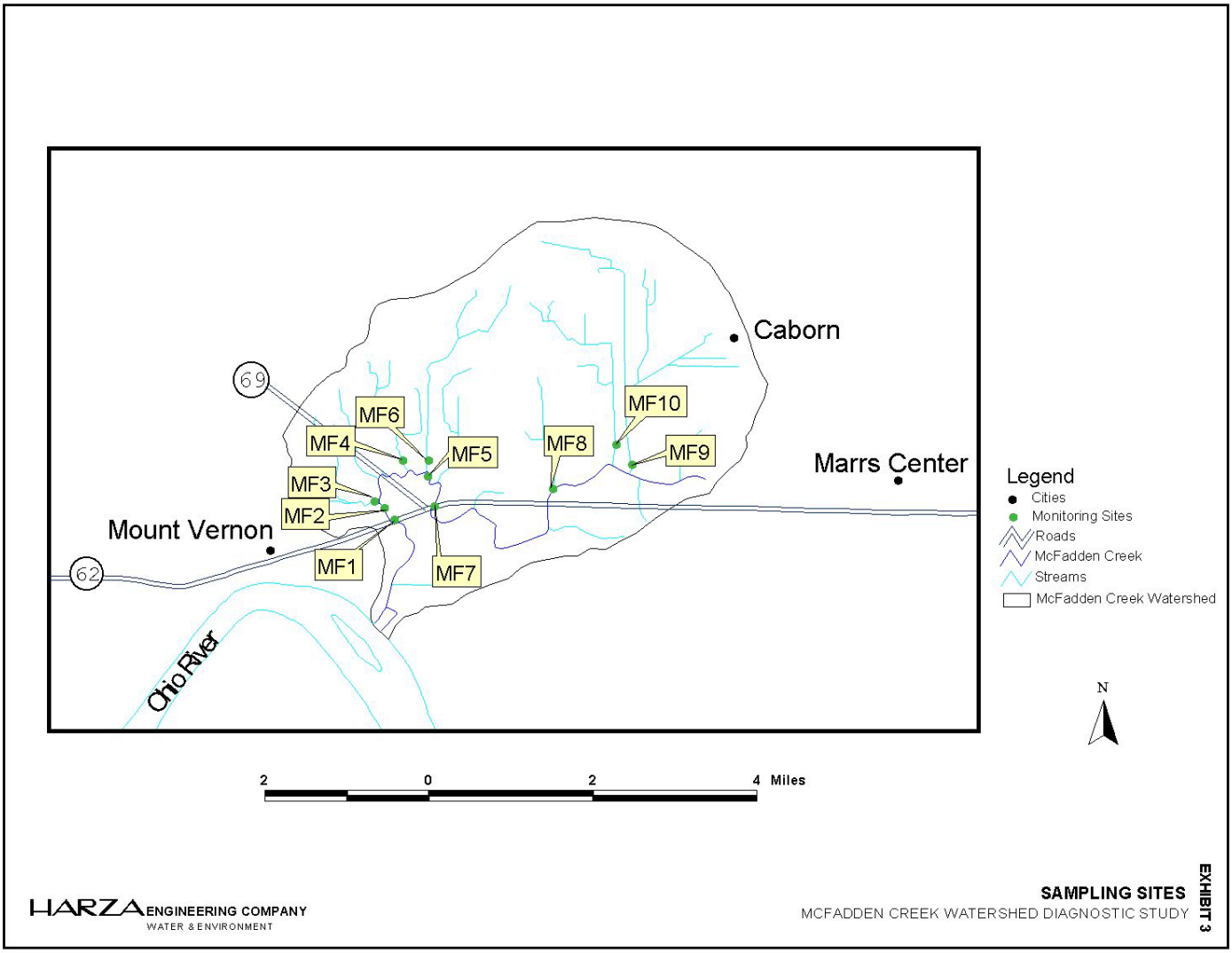
Reach MF9

210 kg/yr phosphorous, 4953 lbs/yr nitrate,
6.9 tons/yr sediment

Reach MF10

47.2 kg/yr phosphorous, 1378 lbs/yr nitrate,
0.7 tons/yr sediment

Figure 16: sampling sites in McFadden Creek subwatershed



- From Pigeon-Highland Watershed Steering Committee's quality-assured data for Carpentier Creek subwatershed:

  Phosphorous loading = 0.28 kg/yr/ac

  Nitrate loading = 0.29 lbs/yr/ac

  Sediment loading not calculated, due to no suspended solids tests done. However, given the average turbidity of 16.78 NTU, sediment loading can be assumed to be fairly low.
- No flow data was collected by IDEM Assessment Branch for the Bayou Creek subwatershed. Hoosier Riverwatch volunteers did collect flow data, unfortunately, there was no detectable flow in the channel on that particular date. Concentrations indicate phosphate enrichment and low dissolved oxygen.

- *E. coli* bacteria. *Escherichia coli* is the most widely known member of the coliform group of bacteria*. E. coli* is abundant in fecal matter and is often used as an indicator of sanitary discharges and pathogenic organisms. *E. coli* is estimated colony forming units (cfu) per 100ml of sample. Indiana's standard for recreational waters state "E. coli bacteria, using membrane filter (MF) count, shall not exceed one hundred twenty-five (125) colony forming units per one hundred (100) milliliters as a geometric mean based on not less than five (5) samples equally spaced over a thirty (30) day period nor exceed two hundred thirty-five (235) colony forming units per one hundred (100) milliliters in any one (1) sample in a thirty (30) day period" (IAC 327 2-1-6).

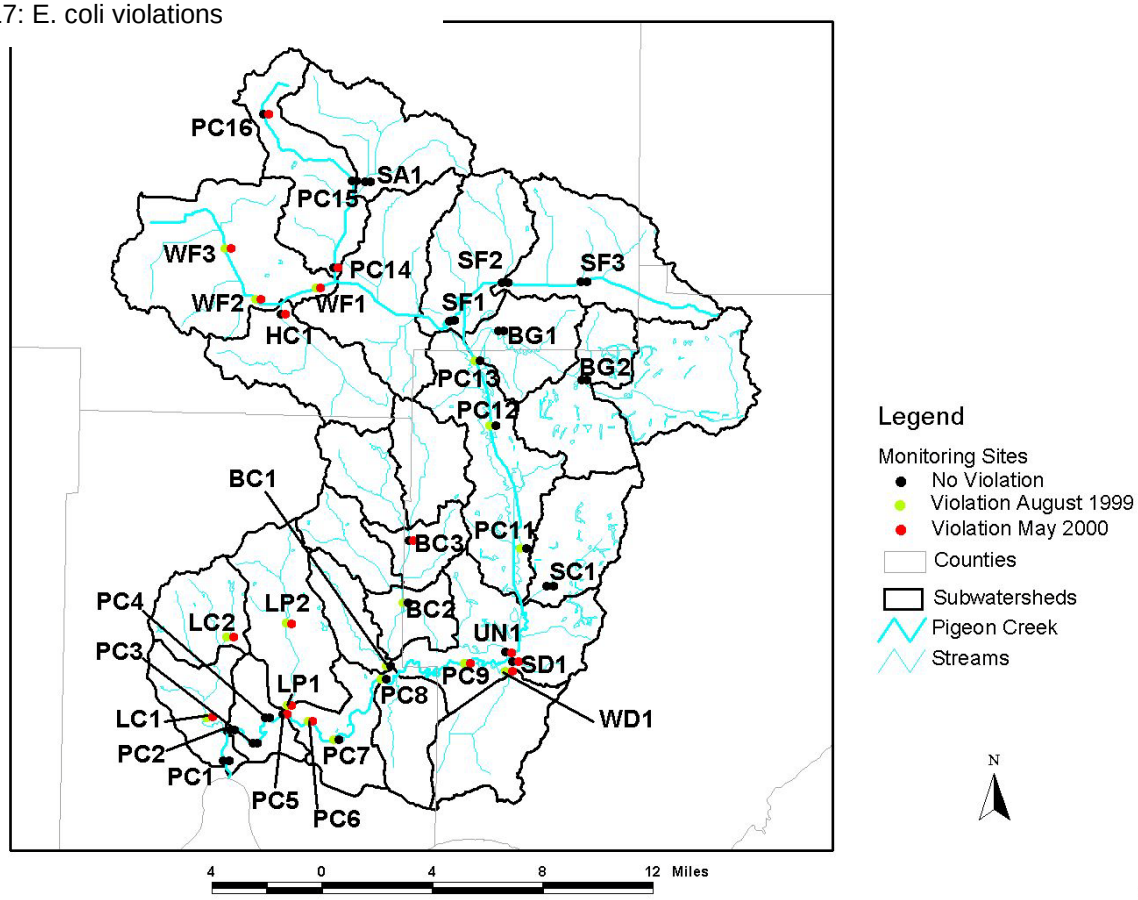
  Samples were collected for measurement of *Escherichia coli* at each site during the bioassessments of August 1999 and May 2000, as well as during CSO and wet weather sampling. The results of the latter are presented in the Stream Reach Characterization and Evaluation (Appendix C). Results from the August *E. coli* survey range from zero to 24,000 colony-forming units per 100 mL. Seventeen out of 36 sites were found to be in excess of the 235/100 mL water quality standard (Table 14) and an equal number, albeit at some different sites, exceeded the standard during the May survey. Nine sites exceeded the standard during both surveys: two locations on Pigeon Creek (PC6 and PC9), both sites on Locust Creek, both sites on Little Pigeon Creek, Weinsheimer Ditch, and all sites on West Fork Pigeon Creek (WF1, WF2, WF3).

Table 13
SITES DOCUMENTED DURING DRY WEATHER TO EXCEED THE *E. COLI* STANDARD

August 1999	**May 2000**
PC6, PC7, PC8, PC9, PC 11, PC12, PC13, LC1, LC2, LP1, LP2, BC1, BC2, WD1, WF1, WF2, WF3	PC5, PC6, PC9, PC14, PC16, LC1, LC2, LP1, LP2, BC3, WD1, SD1, UN1, WF1, WF2, WF3, HC1

In their 305(b) assessment process, IDEM does not use the water quality standard to determine recreational use support of streams. IDEM considers streams with no more than one grab sample slightly exceeding 235 colonies/100mL and the geometric mean not exceeded to support recreational use. In the August survey, 13 sites exceeded 235/100mL. During the May survey, 12 sites exceeded 235/100mL.

Figure 17: E. coli violations



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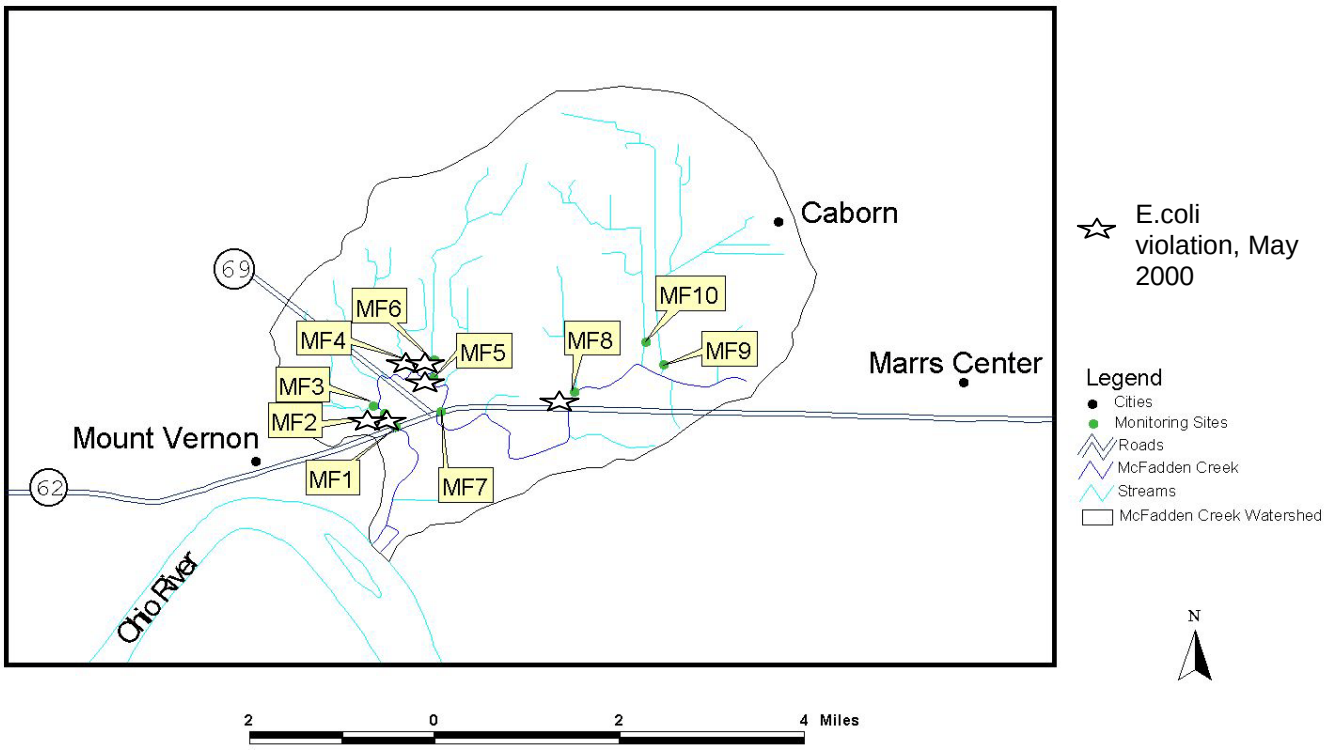
EXCEEDANCES OF COLIFORM BACTERIA STANDARD AT MONITORING SITES

PIGEON CREEK WATERSHED DIAGNOSTIC STUDY

EXHIBIT 11

In McFadden Creek subwatershed, sites MF-1, MF-2, MF-4, MF-5, MF-6, and MF-8 exceeded the state standard for *E. coli* bacteria during the May 2000 monitoring period.

Figure 18: E. coli violations, McFadden Creek



HARZA ENGINEERING COMPANY
WATER & ENVIRONMENT

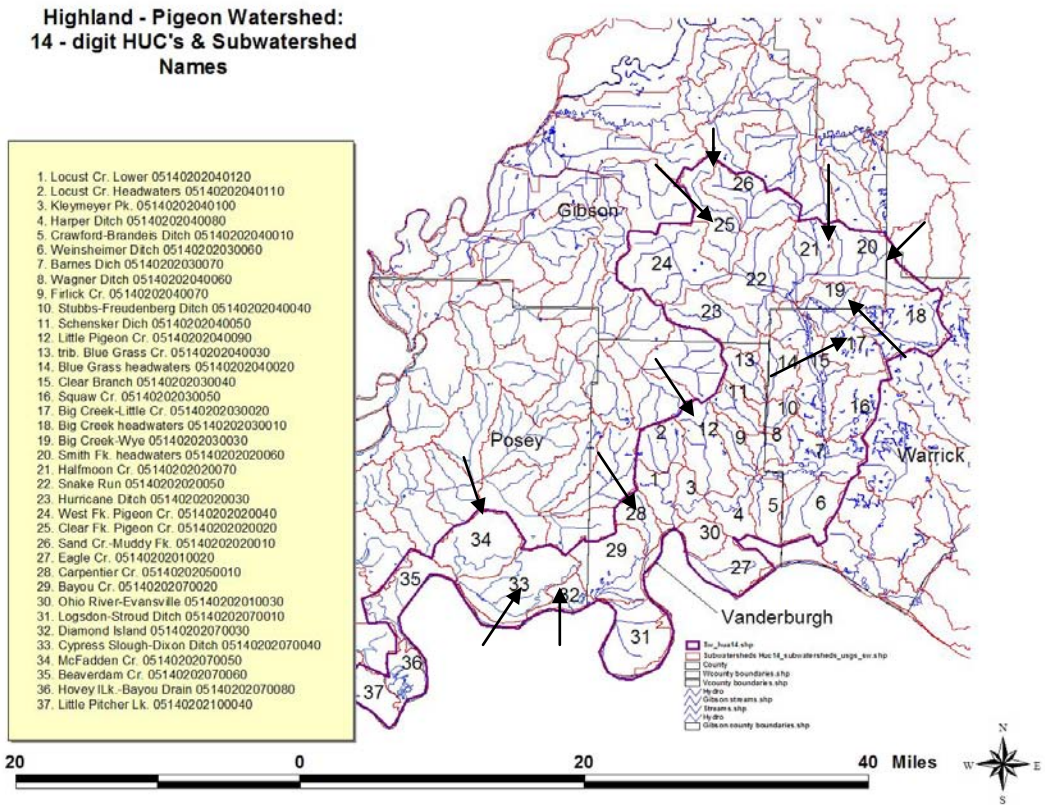
SAMPLING SITES
MCFADDEN CREEK WATERSHED DIAGNOSTIC STUDY

EXHIBIT 3

The only site not covered by both the Harza study and the PHWSC study, for which E.coli data exists, is Carpentier Creek, #28. E. coli counts ranged from 0 to 2500 colonies per 100 ml and the state standard of 235 col/100ml was exceeded in 5 of 14 sampling events.

Subwatersheds identified in the Harza study that warrant protection/conservation efforts- due to inherent habitat quality and relatively good water quality- include: 17- Big Creek/Little Creek; 19- Big Creek/Wye; 20- Smith Fork headwaters; 21- Halfmoon Ditch; and 25- Pigeon Creek/Clear Fork; 26- Sand Creek; and 12- Little Pigeon Cr.

Figure 19: Subwatersheds warranting protection



- Carpentier Creek subwatershed, #28, is slated for study by the Vanderburgh Co. Surveyor's Office-Drainage Board as the watershed is increasingly affected by urbanization.
- Subwatersheds not covered in either Harza's or PHWSC's studies, but warranting protection because of significant wetlands and cypress groves include: 32- Diamond Island/Dixon Ditch and 33- Cypress Slough. Subwatershed 36- Hovey Lake/Bayou Drain, is already protected under state and federal agencies.

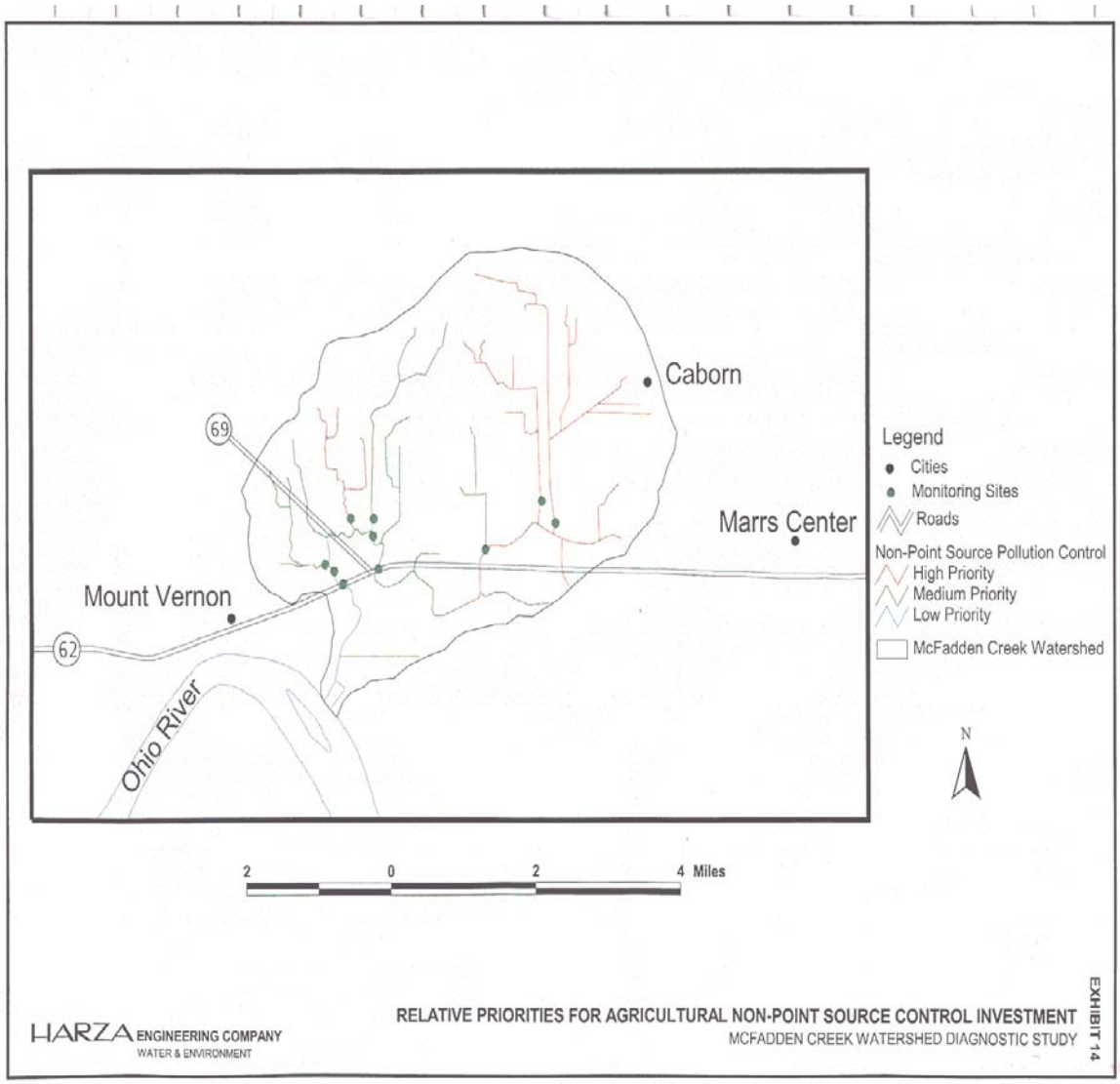
- The remainder of the subwatersheds in the Pigeon Creek basin are ranked from highest quality to worst, the very best being discussed on the previous page:

Table 14

RELATIVE TRIBUTARY BIOTIC INTEGRITY

Monitoring Site	Water Body	Points	Rank
	First Quartile		
SF3	Smith Fork	13	1
BG1	Big Creek	16	2
BG2	Big Creek	16	3
PC15	Pigeon Creek	18	4
SF1	Smith Fork	18	5
SF2	Smith Fork	18	6
PC14	Pigeon Creek	20	7
SA1	Sand Creek	22	8
LP2	Little Pigeon Creek	23	9
	Second Quartile		
PC4	Pigeon Creek	24	10
PC5	Pigeon Creek	24	11
PC12	Pigeon Creek	24	12
SC1	Squaw Creek	24	13
WF1	West Fork	25	14
PC2	Pigeon Creek	26	15
PC11	Pigeon Creek	26	16
PC16	Pigeon Creek	27	17
LC1	Locust Creek	27	18
	Third Quartile		
WF2	West Fork	27	19
WF3	West Fork	27	20
PC13	Pigeon Creek	28	21
PC1	Pigeon Creek	29	22
PC3	Pigeon Creek	29	23
BC1	Bluegrass Creek	30	24
LP1	Little Pigeon Creek	31	25
LC2	Locust Creek	33	26
UN1	Unnamed Tributary	33	27
	Fourth Quartile		
HC1	Hurricane Creek	33	28
PC8	Pigeon Creek	35	29
BC3	Bluegrass Creek	35	30
WD1	Weinsheimer Ditch	35	31
PC7	Pigeon Creek	36	32
BC2	Bluegrass Creek	37	33
PC6	Pigeon Creek	39	34
PC9	Pigeon Creek	41	35
SD1	Stollberg Ditch	41	36

- McFadden Creek, subwatershed #34, is currently the recipient of IDNR LARE (lake & river enhancement) funding for erosion control and manure management practices. McFadden Creek enters the Ohio River in close proximity to Mount Vernon's drinking water intake.
- McFadden Creek was also prioritized for agricultural nonpoint source control on a stream reach basis:

Figure 20

Prioriy	Stream reach
HIGH	MF-10,MF-4,MF-8,MF-9
MODERATE	MF-7,MF-5,MF-6,MF-3
LOW	MF-1,MF-2