Sampling Results

According to the modified QAPP plan, found in Appendix 13: Quality Assurance Project Plan, there were seven (7) sampling sites that were sampled twice, once for storm flow and once for base flow, for the full suite of chemical and physical parameters. The water quality sampling found concentrations of NH_3, NO_3, TP, Ortho-P, TSS, and *E.coli*. The DO and pH levels were also found for each sampling site during both storm and base flow conditions. The sampling results for NH_3, NO_3, TP, Ortho-P, and TSS were converted to yearly loading rates to allow for a direct comparison to the expected yearly loading rates found using the WTM. The results of these water quality samplings, converted to yearly loading rate from concentrations, can be found in Tables 4.3 and 4.4. There were also 42 sampling locations that had four (4) separate grab samples performed to find *E.coli* concentrations in the Little Calumet River and its tributaries. Two grab samples were taken during what was considered to be base flow and two during storm flow to analyze the *E.coli* concentrations. The sampling results for these grab samples can be found in Table 4.5. The sampling sites and location can be seen in Figures 4.34 to 4.38. Fourteen of the 42 sampling locations were on the Little Calumet River itself, while the others were on tributaries including drainage ditches.

One sampling location at the uppermost end of the Little Calumet River (Indianapolis Blvd.) had 100% of its samples exceed the recreational standard for *E.coli*. Since contamination at this upstream site has the potential to negatively affect the entire river, finding and reducing sources of bacteria at this site are of the highest priority.

Other high priority sites include Willow Creek (67% of its samples exceeded the criteria for impairment by *E.coli*), the Little Calumet River at Grant Street (87% of the samples indicated impaired conditions), and a tributary of Deep River at Lake Park Avenue (75% of its samples showed impairment).

Two locations (one site on the lowermost end of the Little Calumet River at the Lake/Porter County Line and a tributary of the Little Calumet River at Three Rivers Park) fully supported their recreational uses. *E.coli* at these locations had a mean of less than 235 cfu/100 ml and no values higher than 576 cfu/100 ml.

Nitrate and phosphorus concentrations on the Little Calumet River were relatively low. A notable exception was at sampling site #1, Indianapolis Boulevard, during base flow conditions. This site had elevated nitrate and extremely high phosphorus values.

Dissolved oxygen levels fell below the state water quality standard (4 mg/l) at four sites during base flow and at two sites during storm flow. The lowest value occurred at Indianapolis Boulevard, indicating again the importance of finding and reducing pollutant sources in this area.

Sampling Site	Base Flow Pollutant Loads from Water Quality Sampling							
	DO (mg/L)	NH_3 (lbs/yr)	NO_3 (lbs/yr)	TP (lbs/yr)	Ortho-P (lbs/yr)	TSS (lbs/yr)	E.coli (cfu/100mL)	pH SU
1*	6.7	2,042	34,708	19,600	11,025	44,916	3,150	7.4
2	3.4	4,900	15,244	708	653	506,325	255	7.6
3**	5.1	17,014	40,833	8,167	5,104	748,598	501	7.9
4	3.3	20,586	37,056	10,705	5,352	1,070,496	61	7.5
5	3.1	14,004	56,014	6,068	4,201	606,821	118	7.5
6	7.6	2,144	3,335	429	357	14,291	927	7.7
7	6.2	24,500	146,998	11,760	10,780	440,993	125	7.5

* Water quality data entering into watershed on Little Calumet River

** Water quality data entering into watershed on Deep River

Table 4.3: Base flow pollutant loads for the seven sampling sites.

Sampling Site	Storm Flow Pollutant Loads from Water Quality Sampling							
	DO (mg/L)	NH_3 (lbs/yr)	NO_3 (lbs/yr)	TP (lbs/yr)	Ortho-P (lbs/yr)	TSS (lbs/yr)	E.coli (cfu/100mL)	pH SU
1*	0.3	104,484	156,725	18,807	15,673	2,455,363	1,820	7.1
2	2.9	125,380	195,036	13,931	12,538	2,228,982	1,320	7.3
3**	6.1	696,557	957,766	121,897	113,190	25,250,184	2,380	7.3
4	4.8	2,107,084	1,158,896	200,173	158,031	20,544,072	1,240	7.4
5	6.0	1,552,747	1,074,979	71,665	59,721	33,443,782	1,760	7.4
6	7.1	115,803	73,138	7,314	6,704	1,432,295	2,900	7.4
7	6.0	1,629,943	1,253,802	275,836	225,684	45,136,881	2,600	7.3

* Water quality data entering into watershed on Little Calumet River

** Water quality data entering into watershed on Deep River

Table 4.4: Storm flow pollutant loads for the seven sampling sites.

Sampling Location	E. coli (cfu/100ml)			
	Dry Weather (7/24/2007)	Wet Weather (8/21/2007)	Wet Weather (9/26/2007)	Dry Weather (10/30/2007)
1		695	2	225
2	1804	3890	0	341
3	448	465	4	190
4	25	1620	0	218
5	396	2570	6	174
6	94	220	2	52
7	2	200	0	3
8	3	1385	2	5
9	1	2775	0	32
10	228	910	6	15
11	207	11130	0	144
12	108	340	2	15
13	56	215	6	1
14	353	415	14	20
15	270	3760	0	46
16	692	2765	0	75
17	119	1010	982	78
18	345	695	0	58
19	1	345	0	428
20	88	310	0	113
21	51	720	0	79
22	111	130	6400	7
23	374	945	8	40
24	505	685	2	77
25	275	565	2540	48
26	68	2285	114	16
27	937	2145	182	445
28	375	1220	56	260
29	158	4120	170	5
30	168	735	6	18
31	5	2310	1030	72
32	72	1610	792	102
33	50	405	882	8
34	71	1065	110	19
35	129	1100	358	27
36	51	755	4	2
37	4	1600	654	92
38	3	4580	2700	79
39	36	4515	62	67
40	9	2375	292	2
41	86	105	2440	44
42	913	2040	3100	586

Table 4.5: E.coli concentrations of grab sample location during both storm and base flow.

Baseline Conclusions

E.coli Bacteria

E.coli bacteria is the major pollutant of concern in this watershed. Significant contributions enter the watershed on the west end where flow from Hart Ditch has been sampled as high as 10,000 cfu/100mL. (HNTB, 2003). These elevated levels can be seen in Figure 4.39 where the x-axis is based on a distance measurement and the point represents the sampling location position along the Little Calumet River. The distance represents how far away from the first sample location, located at Indianapolis Boulevard, each of the 13 subsequent locations is along the Little Calumet River. The sample location immediately downstream of Hart Ditch, distance is zero meters, was the only location to exceed the state standard of 235 cfu/100mL in all four grab samples taken. A horse farm rep0rtedly exists in this western area just south of the Borman Expressway and may be contributing to this reading.

There is a second peak that indicates a possible hotspot around the 18,000 meter mark. This location is downstream of the convergence of Deep River with the Little Calumet River. Figure 4.40 shows the CDM data collected for the Gary Sanitary District in which there are elevated levels of *E.coli* at the same location. The x-axis is based on the same zero point of distance as Figure 4.39, showing the peak happens in the same physical location. A horse farm reportedly exists in this area as well and may be contributing to this reading.

Contributions from the watershed itself, even without CSO discharges, cause the river to exceed the state water quality standards for *E.coli* bacteria. Figure 4.41 visually summarizes the results of the *E.coli* sampling exceedance locations. Of

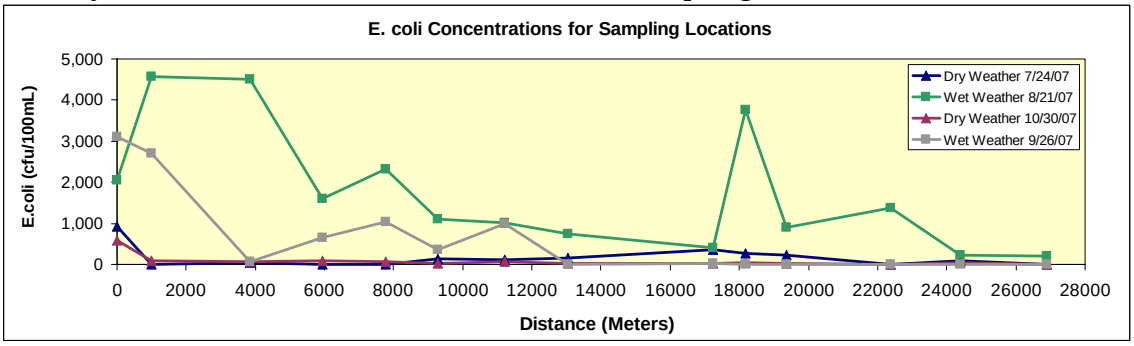

Figure 4.39: E.coli concentrations of sample locations along the Little Calumet River.

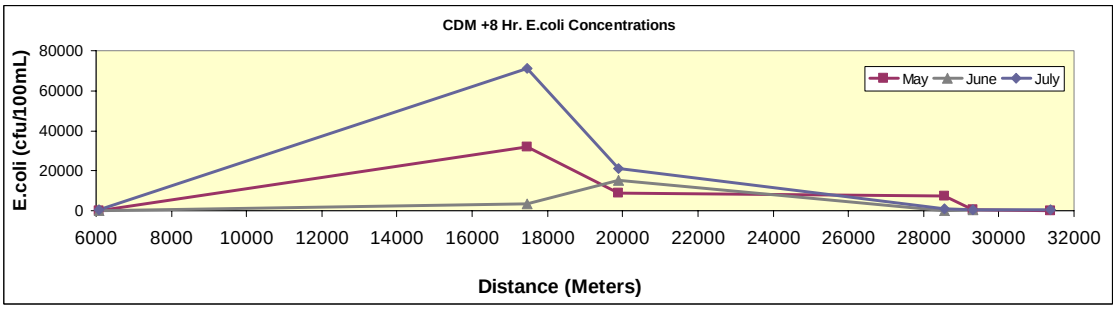

Figure 4.40: E.coli concentrations according to data reported in the 2003 CDM report to GSD.

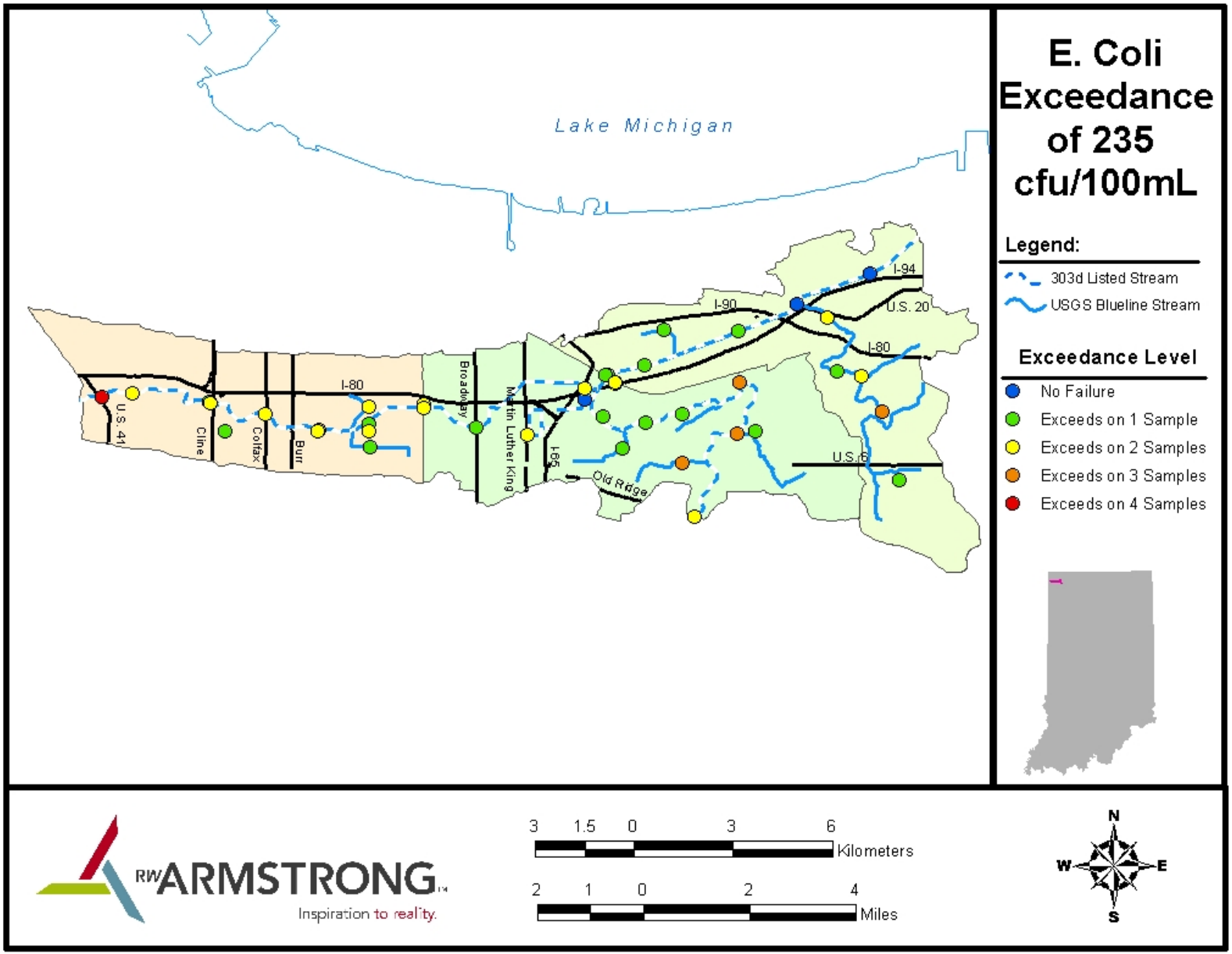

Figure 4.41: Sampling locations E.coli exceedance frequency and location.

the 42 sampling locations, only two never exceeded the 235 cfu/100mL standard. Thirty-nine of the locations met the standard at least once in the four samples and one was consistently above the 235 cfu/100mL mark.

As Figure 4.41 shows, all of the sampling sites that exceeded the 235 cfu/100mL standard more than three times were on tributaries to the Little Calumet River, or just downstream from their confluence with the Little Calumet River. The highest concentration of points exceeding the state standard at two of the four grab samples was located in the western most watershed immediately downstream from Hart Ditch.

Total Nitrogen (TN)

The calculated yearly loading rates for Total Nitrogen at each sampling site found using the Watershed Treatment Model (WTM) were greatly exceeded by the measured loads found during the water quality sampling conducted for this plan. Tables 4.2 to 4.4 show the calculated pollutant loads, measured base flow pollutant loads, and measured storm flow pollutant loads, respectively. When looking at these numbers it can be seen that sample site #7, at the eastern edge of the watershed study area, had the highest values compared to the calculated. The non-storm, or base flow, loads were more than 25 times the calculated while the calculated storm load was exceeded by nearly a factor of 100. This comparison indicates that the sample data may not be reliable. More sampling events are needed to ensure a representative measured load has been found.

High TN loads can be problematic for the aquatic life of the Little Calumet River and its tributaries. TN is very soluble and therefore does not evaporate. Without evaporation being a possibility the only way for nitrates and nitrites to leave surface water is through consumption by plants and animals. The increased consumption of nitrates by aquatic life can potentially lead to the death of the local fish life. The increased presence of nitrates can also lead to a growth in the number of algae blooms along the river and its tributaries. The presence of increases algae blooms can lead to eutrophication which can create significant changes to the ecosystem.

Total Phosphorus (TP)

Total Phosphorus in the measured water quality sample results conducted for this plan exceeded the calculated pollutant loads that were expected when looking at the land use. Sample sites # 2 and 6 were close in yearly loading rates: exceeding the calculated loads by less than a factor of two (2). Sample site #7 was once again the worst site exceeding the calculated loads (Table 4.2) by a factor of 23 for the non-storm or base flow (Table 4.3) and a factor of 66 for the storm flow (Table 4.4).

The presence of TP in surface water is essential for plant life. The water measured quality sampling results exceeding the calculated WTM pollutant loadings can possibly mean that the current loading rate is too high. When phosphorus concentrations are too great in surface water the eutrophication, or

reduction in Dissolve Oxygen (DO) is sped up due in an increase in mineral and organic nutrients. One way to visually measure if the TP level is too great is through excess algae bloom.

Total Suspended Solids (TSS)

The measured water quality sample results of the Total Suspended Solids compared to the calculated loads found using the WTM followed the same pattern as the total nitrogen and total phosphorus. Sample site #7 exceeded the calculated storm flow by the greatest factor (over 40). The non-storm or base flow had the greatest exceedance factor at sample site #4, at over 20. The calculated total suspended solids yearly loads, the measured base flow pollutant loads and the measured storm flow pollutant loads can be found in Tables 4.2 to 4.4, respectively.

The presence of increased levels of TSS in a water body has similar effects on the aquatic life that elevated concentrations of TN and TP have. As the concentration of TSS raises a decrease in macroinvertebrate density happens creating a poor environment for fishing. The resulting poor aquatic habitat makes keeping the TSS concentration relatively low important so that the Little Calumet River and its tributaries can maintain recreational features.

Overview

Figures 4.42 and 4.43 show the sites that had the worst base flow and storm flow nutrient loads, respectively. Sites that present problems both in base flow and storm flow are Sites one (1) and four (4). Site 4 is sampling the Deep River and while there do not seem to be *E.coli* bacteria problems, other nutrients are affecting the water quality here. Sampling Site 1 has a number of problems that differentiate between base flow and storm flow.

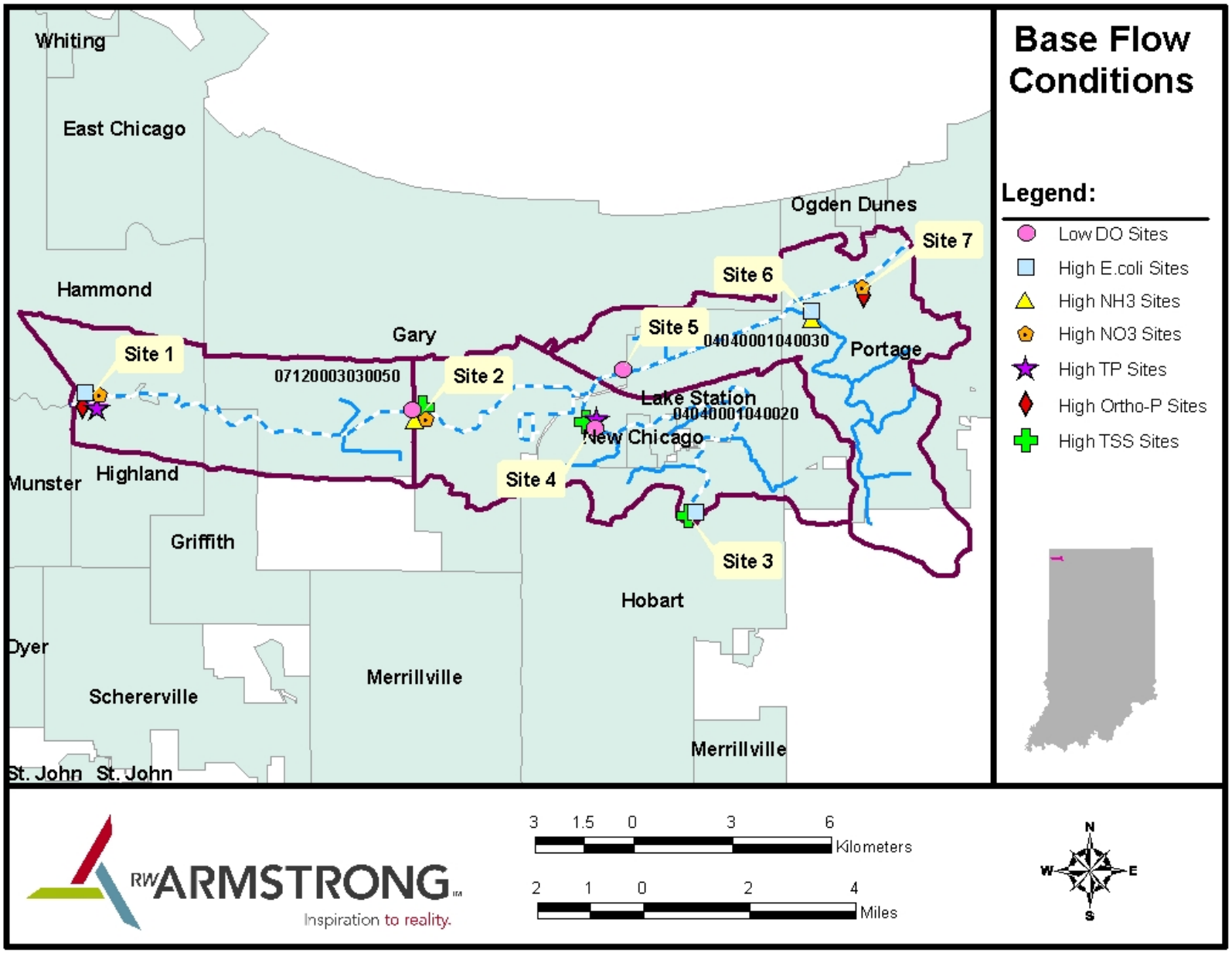

Figure 4.42: Base flow nutrient problems for the Little Calumet River Watershed Management Plan sampling sites.

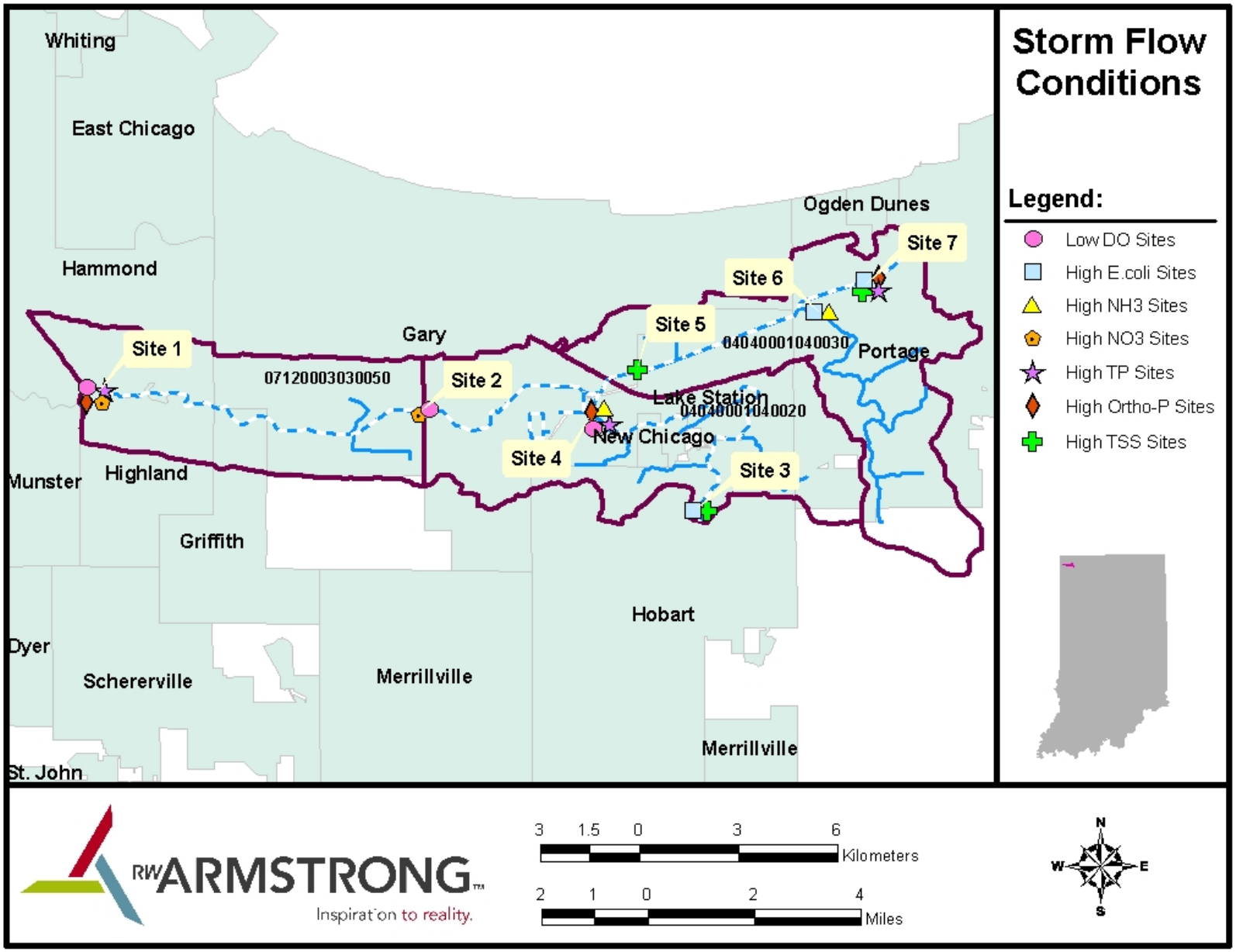

Figure 4.43: Storm flow nutrient loads for the Little Calumet River Watershed Management Plan sampling sites.