9 Watershed Critical Areas

IDEM identifies "Critical Areas" as areas where watershed management plan implementation can remediate nonpoint pollution sources in order to improve water quality and/or can mitigate the impact of future sources in order to protect water quality. Because storm water delivers additional pollutants and flow to streams, and excess flow has been shown to destabilize stream banks and add to pollutant loads, the reduction of flow may be designated as a critical activity if that reduction will reduce a nonpoint source pollutant in a critical area. IDEM requires the use of inventoried data, current pollutant loads, and potential sources to identify critical areas.

9.1 Identification Process

Site catchment drainage areas were used as the geographical extent in evaluating critical areas. The decision to use catchment areas over the larger HUC-12 subwatersheds was based on the fact that there are 35 sites in the watershed with water chemistry, biological, and habitat monitoring data available from IDEM's baseline assessment in 2013. A two-step process was used in the evaluation:

1. The first step was to consider data that was shown to be statistically significant in describing the reasons behind existing stream impairments.
2. The second step was to consider data that represented stakeholder concerns.

A "weight of evidence" approach was used to prioritize which catchments would be deemed the most critical for implementation actions. Water quality data was prioritized over data that represented stakeholder concerns since that data captured real conditions.

9.1.1 Loads & Stressors

The first step of the critical area identification process was to consider data from the stressor linkage analysis completed in Section 5: Watershed Inventory- Part III and STEPL pollutant loading data from Section 7.2: Current Pollutant Loads. Based on this review, eighteen different indicators were chosen for consideration (Table 110).

Site data for each indicator were sorted and ranked from worst to best. The top nine worst sites (upper 25%) were recorded. In the instance of a tie, site selection was inclusive of all tie values. These data were combined to come up with a cumulative score which was used to rank sites based on number of occurrences documented.

STEPL Loads (adjusted for catchment area)
• Nitrogen load • Phosphorus load • Biological oxygen demand load • Sediment load • Runoff volume
Water Chemistry (% observations exceeding target value or water quality standard)
• Dissolved oxygen • Ammonia • Nitrate • Total Kjeldahl nitrogen • Total phosphorus • Total suspended solids • Turbidity • E. coli
Habitat Quality
• Qualitative Habitat Evaluation Index scores

Fish & Macroinvertebrate Community Health
• Index of biotic integrity scores • Macroinvertebrate Index of Biotic Integrity scores
Land Cover (% of land cover in catchment area)
• Forest • Agriculture

Table 110 Pollutant load and stressor indicators used in critical area identification process

9.1.2 Stakeholder Concerns

The second step considered stakeholder concerns identified in Section 6: Problems and Causes that could be measured and were not captured by the previous step. Based on this review, seven different indicators were chosen for consideration (Table 111).

Stakeholder Concerns
• Percent wetland loss • Percent Green Infrastructure Vision lands not protected • Recreational sites located on or adjacent to impaired waterways • Approximate percentage of impaired streams that are regulated drains • Percent human land cover • Percent riparian human land cover • Percent impervious cover

Table 111 Stakeholder concern indicators used in critical area identification process

Data for each indicator was evaluated and the top 25% worst values for each indicator were identified. In the instance of a tie, the data was inclusive of all tie values.

Site	% Exceedance DO	% Exceedance Ammonia	% Exceedace Nitrate	% Exceedance TKN	% Exceedance TP	% Exceedance TSS	% Exceedance Turbidity	% Exceedance E coli	QHEI Score	IBI Score	mIBI Score	STEPL N Load	STEPL P Load	STEPL BOD Load	STEPL Sed Load	STEPL Runoff Volume	% Ag Land Cover	% Forest Cover
1	7	50	30	90	100	10	67	67	48	16	36	3.00	0.60	10.25	135.71	0.45	29	9
2	0	14	57	29	29	0	17	89	58	12	22	0.57	0.09	2.16	26.24	0.47	29	6
3	0	57	57	17	43	14	25	78	40	30	26	2.91	0.74	6.91	87.08	0.80	47	2
5	8	14	0	14	100	0	50	22	48	34	38	0.02	0.00	0.08	0.93	0.33	30	10
6	0	22	22	89	89	0	43	11	52	36	30	1.13	0.20	4.22	49.26	0.42	30	10
7	8	14	14	100	100	14	100	78	74	18	30	1.46	0.31	4.59	52.78	0.81	17	9
8	17	29	0	33	71	0	25	89	44	32	28	2.26	0.51	6.65	78.27	0.64	30	10
9	7	22	22	67	89	0	14	33	52	30	30	2.95	0.74	6.91	73.57	0.48	50	10
10	0	0	14	29	100	0	17	33	41	12	28	1.49	0.35	4.06	46.07	0.70	56	8
11	33	14	57	86	86	14	67	78	49	24	30	3.44	0.97	6.65	81.62	0.49	69	7
12	0	22	89	56	100	11	64	67	56	42	28	0.57	0.12	1.39	9.27	0.34	39	10
13	0	14	14	43	43	14	58	78	66	30	42	0.61	0.13	1.59	13.35	0.43	30	6
14	0	10	100	60	100	10	13	44	75	36	40	1.40	0.33	3.81	40.42	0.67	40	10
15	0	0	0	14	14	0	50	89	64	30	28	6.12	1.51	15.35	184.58	0.76	33	32
16	0	0	0	29	57	29	75	78	52	40	30	2.76	0.71	6.46	74.08	0.64	34	20
17	0	0	0	0	14	0	17	78	51	34	38	1.47	0.41	2.84	33.11	0.54	34	9
18	0	40	100	60	100	10	20	78	57	36	40	3.94	1.11	7.41	91.12	0.55	38	8
19	8	71	0	86	86	29	45	56	36	32	28	0.85	0.15	3.18	34.82	0.79	45	8
20	75	71	14	100	100	0	33	67	44	38	38	1.94	0.37	6.84	76.16	0.76	67	9
21	77	100	14	100	100	14	42	40	33	12	20	0.88	0.14	3.43	37.63	0.88	67	9
22	17	29	0	71	100	71	100	80	25	38	38	1.49	0.42	2.90	37.55	0.62	5	14
23	0	70	100	90	100	0	6	33	58	36	26	1.50	0.39	3.50	37.60	0.46	25	11
24	85	100	100	100	100	0	25	80	26	14	24	1.30	0.34	3.16	39.32	0.81	2	6
25	62	71	38	100	100	0	62	40	37	28	26	2.27	0.43	7.90	91.15	0.80	43	13
26	85	29	0	100	100	14	77	30	40	12	26	3.11	0.71	8.88	104.30	0.70	33	23
27	46	14	0	100	86	29	92	50	27	40	28	0.82	0.14	2.93	30.59	0.73	44	0
28	56	29	0	86	86	14	22	29	37	12	0	0.69	0.11	2.68	29.25	0.73	4	16
29	0	29	0	67	43	0	8	80	49	36	26	0.27	0.05	1.02	11.17	0.31	8	13
30	15	14	0	29	0	0	0	20	36	28	34	0.90	0.17	2.99	34.55	0.81	1	22
31	8	14	0	29	86	0	69	60	41	12	28	0.96	0.22	2.77	33.60	0.84	13	8
32	0	40	0	40	30	10	31	20	51	44	30	1.70	0.30	6.30	71.67	0.82	16	11
33	38	14	0	86	71	14	54	80	41	30	28	1.47	0.28	4.89	57.33	0.87	25	6
34	77	100	0	100	100	14	69	40	31	12	30	2.26	0.53	6.08	69.43	0.65	4	7
35	0	86	0	57	14	14	85	100	43	20	30	1.96	0.52	3.96	41.74	0.73	14	3
36	0	50	0	40	40	10	88	100	40	16	30	4.50	1.21	8.65	89.63	0.71	13	9

Table 112 Top 25% worst values for each water quality indicator highlighted in red

Site	% Wetland Loss	Ratio Managed Lands / GIV	Recreational Sites on 303d Stream	% 303d Streams Regulated Drains	% Human Land Cover	% Impervious Cover	% Human Riparian Land Cover
1	85	100	0	0	76	39	82
2	93	100	1	75	86	23	80
3	89	100	0	100	71	17	70
5	81	84	0	75	71	5	65
6	86	100	0	100	82	5	63
7	92	60	0	0	76	6	57
8	82	99	0	25	50	28	56
9	93	88	1	0	87	24	56
10	87	96	2	75	79	24	55
11	90	67	0	50	93	31	55
12	83	100	1	50	77	20	54
13	83	100	0	100	75	15	53
14	64	61	0	100	48	21	53
15	78	61	0	100	76	10	50
16	93	72	0	0	74	16	49
17	91	98	3	100	79	21	47
18	80	100	0	50	68	25	46
19	72	98	0	50	49	17	45
20	95	100	1	100	92	19	45
21	95	93	1	100	75	13	45
22	75	83	3	100	62	17	44
23	75	100	0	75	79	18	44
24	78	85	0	0	72	12	44
25	61	99	4	0	70	17	43
26	0	100	4	0	51	17	43
27	76	94	0	0	36	13	43
28	71	97	0	25	63	5	42
29	63	98	0	0	60	9	41
30	85	100	0	25	82	23	37
31	50	99	0	0	75	22	36
32	82	76	1	100	65	22	31
33	81	100	1	100	73	7	28
34	85	94	0	0	76	7	26
35	92	65	0	0	87	5	25
36	97	91	0	0	80	24	25

Table 113 Top 25% worst values for each stakeholder concern indicator highlighted in red

In order to better understand where the worst problems existed throughout the watershed, the number of times a site was identified as having a value in the top 25% worst was recorded (Table 114). Thirty-two out of the thirty-five

sites had at least one data record in the top 25% worst values for water quality, loads, and stressors. Twenty-eight out of the thirty-five sites had at least one data record in the top 25% worst values relating to stakeholder concerns.

Site	Pollutant Load & Stressor Indicators # of Times Site Identified	Stakeholder Concern Indicator # of Times Site Identified	Site	Pollutant Load & Stressor Indicators # of Times Site Identified	Stakeholder Concern Indicators # of Times Site Identified
1	7	2	**20**	6	1
2	5	0	**21**	10	4
3	11	5	**22**	4	3
5	0	2	**23**	5	0
6	0	1	**24**	11	3
7	5	3	**25**	11	1
8	2	2	**26**	11	3
9	4	0	**27**	7	3
10	2	2	**28**	5	2
11	7	0	**29**	2	1
12	1	0	**30**	2	3
13	2	2	**31**	3	5
14	1	3	**32**	1	2
15	5	2	**33**	5	6
16	4	0	**34**	9	2
17	0	1	**35**	5	3
18	5	2	**36**	7	3
19	4	0			

Table 114 Number of times site identified

The information on number of times a site was identified (Table 114) was used to populate an attribute table in GIS so that the data could be expressed spatially. GIS shapefile layers were created to display the Pollutant Load & Stressor Indicators data and Stakeholder Concern Indicators data (Figure 220). An "equal interval" classification scheme with four classes was chosen to classify the dataset for priority ranking. Equal interval classification divides the range of attribute values into equal-sized subranges. This allows the user to specify the number of intervals, four in this case, and ArcGIS automatically determines the class breaks based on the value range (Table 115). Equal interval is best applied to familiar data ranges, such as percentages. This method emphasizes the amount of an attribute value relative to other values. Additionally, the data was linear in distribution and had no outliers that would skew the results, thereby making equal interval classification an appropriate method.

Load & Stressor Indicators	Rank	Stakeholder Indicators	Rank
0 - 2.750000	4 - Low Priority	0 – 1.500000	4 - Low Priority
2.750001 – 5.500000	3 – Moderately Low Priority	1.500001 – 3.00000	3 – Moderately Low Priority
5.500001 – 8.250000	2 – Moderately High Priority	3.00001 – 4.500000	2 – Moderately High Priority

8.250001 - 11	1 – High Priority	4.500001 - 6	1 – High Priority

Table 115 Classification scoring breaks

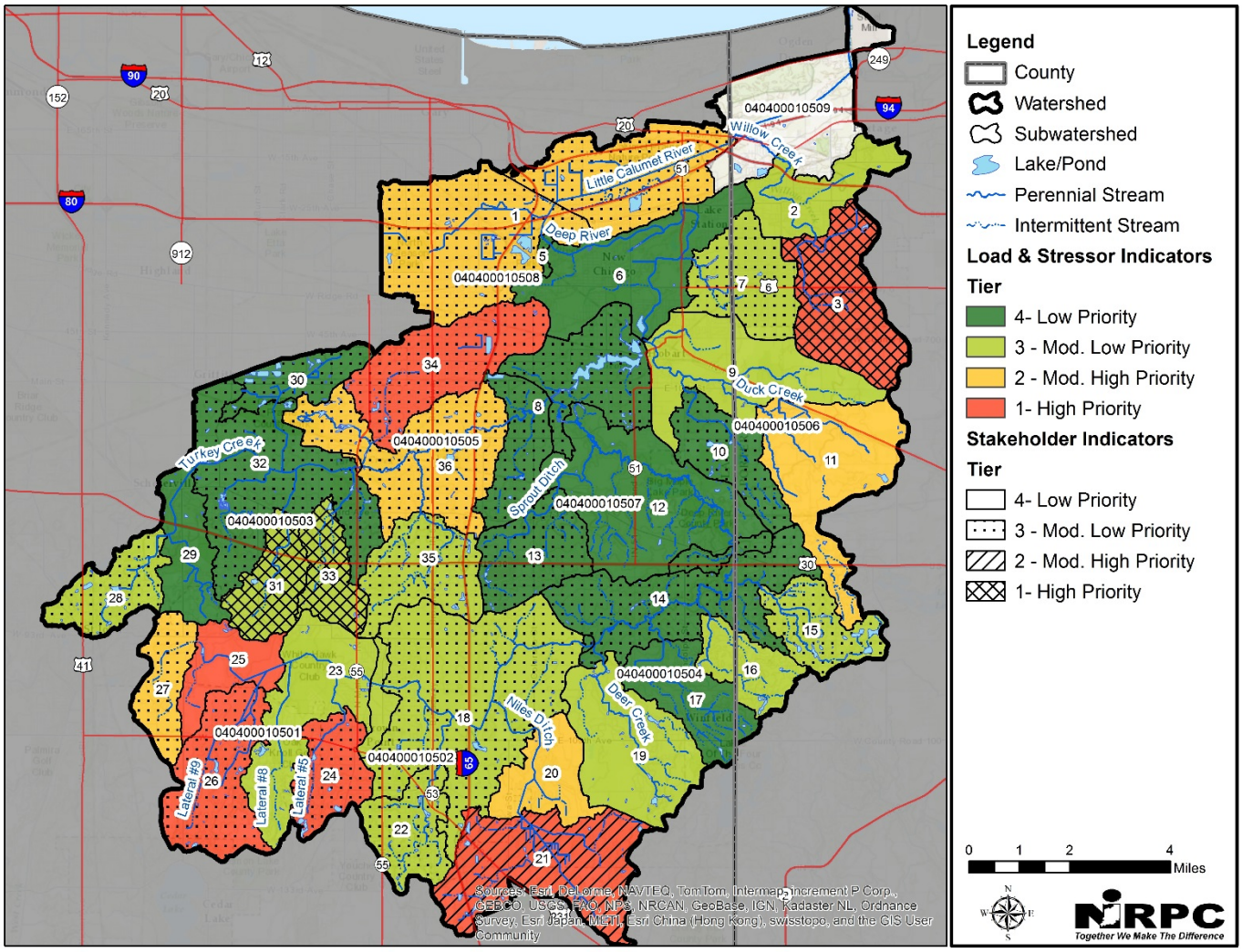

Figure 220 Pollutant load and stressor indicators with stakeholder indicators overlay

Since further prioritization is necessary, we counted the number of times each site had at least one data record in the top 25% worst values for the water quality, loads, and stressors and at least one data record in the top 25% worst values related to stakeholder concerns.

9.1.3 Final Determination

As previously stated, water quality data was prioritized over data that represented stakeholder concerns since that data captured real conditions. However, one last step was taken to further prioritize critical areas. Any site that had an occurrence of five or more stakeholder concerns received a higher priority ranking. In Table 116, below, note that both sites 33 and 31 are considered moderately low priority for water quality. However, since the data shows that there are a lot of stakeholder concerns that need to be addressed in these areas, they are moved from moderately low priority to moderately high priority critical areas.

Site	Water Quality Indicator # of Times Site Identified	Stakeholder Concern Indicator # of Times Site Identified	Site	Water Quality Indicator # of Time Site Identified	Stakeholder Concern Indicator # of Times Site Identified
3	11	5	23	5	0
24	11	3	22	4	3
26	11	3	9	4	0
25	11	1	16	4	0
21	10	4	19	4	0
34	9	2	31	3	5
27	7	3	30	2	3
36	7	3	8	2	2
1	7	2	10	2	2
11	7	0	13	2	2
20	6	1	29	2	1
33	5	6	14	1	3
7	5	3	32	1	2
35	5	3	12	1	0
15	5	2	5	0	2
18	5	2	6	0	1
28	5	2	17	0	1
2	5	0			

Table 116 Final step in critical area determination

The results of this last step are a shown in Figure 221 . Catchments identified as Tier 1 critical areas will be a priority for 319 grant cost-share program implementation at this time. This includes catchments areas 3, 21, 24, 25, 26, 27 and 36.

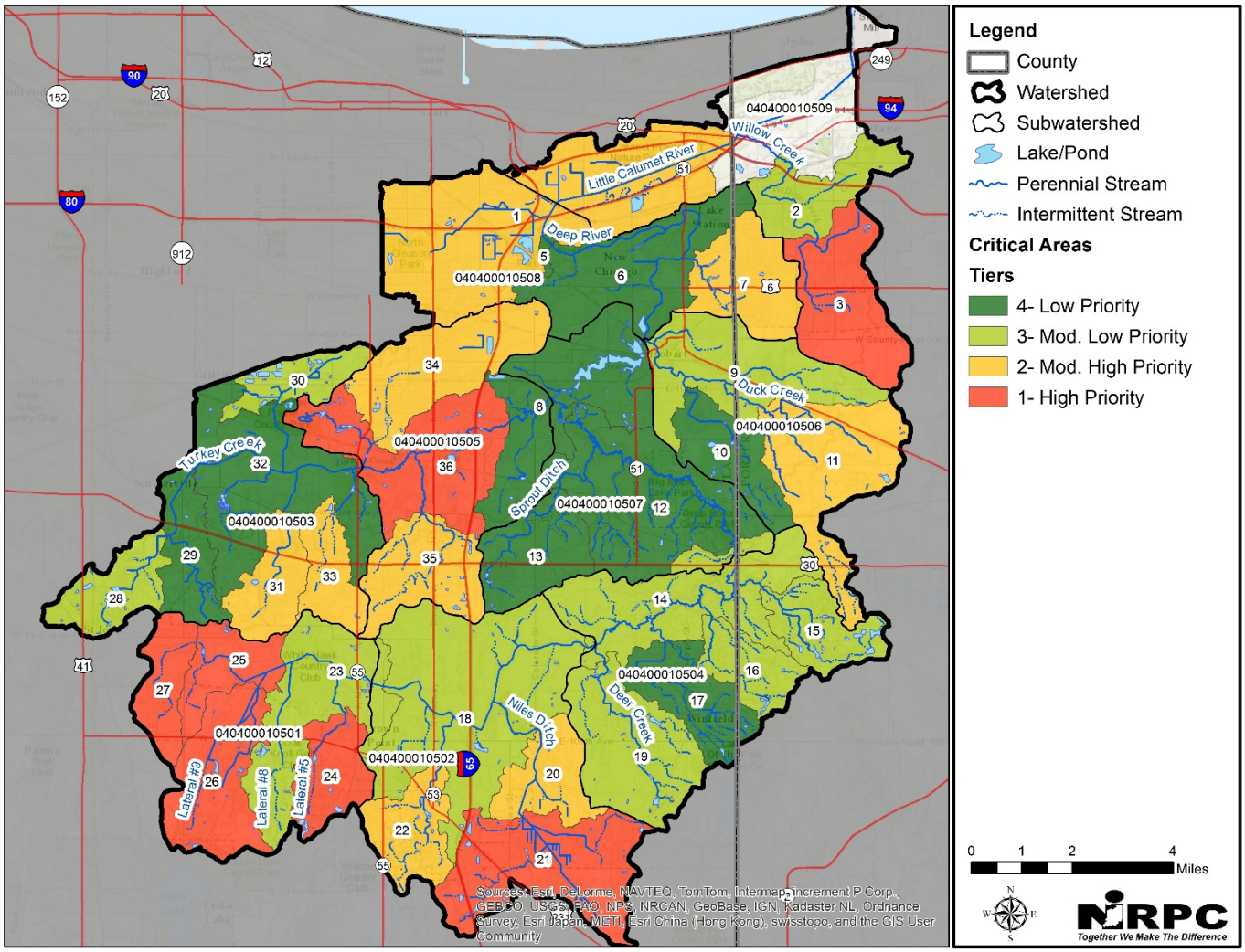

Figure 221 Critical areas

9.2 Critical Area Summary of Potential Problems & Sources

Table 117 lists the water quality, physical habitat, and aquatic life problems documented for the Tier 1 critical areas. These are the issues that will need to be addressed through implementation actions.

Tier 1- High Priority Critical Areas							
Catchment Area	*E. coli*	Dissolved Oxygen	Nutrients	Sediment	Ammonia Toxicity	Physical Habitat	Aquatic Life
3	X		X	X		X	X
21	X	X	X	X	X	X	X
24	X	X	X	X	X	X	X
25	X	X	X	X	X	X	X
26	X	X	X	X		X	X
27	X	X	X	X		X	X
36	X		X	X		X	X

Table 117 Tier 1 critical area problems

The following four tables are based on the conceptual diagrams presented earlier in Section 3.2. They outline the casual pathways, from sources to the observed biotic impairments. Multiple stressors exist in each critical area and contribute to the observed impairment in most of the catchments. Each table includes information on the human activities, sources, and site evidence contributing to the biotic impairment. Human activity and source information included in the tables was gathered from a desktop GIS assessment using data such as aerial imagery, land cover, and NPDES facility (point source) outfalls. Information on site evidence was gathered from IDEM's field notes, data sheets and site pictures.

	Human Activity			Source						Site Evidence					
Site	Agriculture	Urbanization	Channel Alteration	Impoundments	Septic Systems	Point Sources	Agricultural & Urban Runoff	Devegetated Riparian Areas	Channel Alteration	High Plant Abundance	Slow Moving Water	Reduced Water Volume	Organic Wastes	Turbidity	Color	Embedded Substrate
21	X		X		X		X	X	X	X	X		X	X	X	X
24		X	X	X		X	X		X	X	X			X	X	X
25	X	X	X		X		X	X	X	X	X			X	X	X
26	X	X	X		X		X		X	X	X			X	X	X
27	X	X	X		X		X	X	X	X	X			X	X	X

Table 118 Human activities, sources and site evidence tied to dissolved oxygen problems in tier 1 critical areas

	Human Activity			Source						Site Evidence		
Site	Agriculture	Urbanization	Channel Alteration	Waste Water Treatment Plants/CSO/SSO	Landfills & Waste Disposal Sites	Confined Animal Feeding Operations	Agricultural & Urban Runoff	Pasture Runoff	Septic Systems	Proliferation of Filamentous or Algae Mats	Phytoplankton Blooms (Green Water)	High Plant Abundance
3	X	X	X				X		X	X		
21	X		X			X	X	X	X	X	X	X
24	X	X	X	X			X	X	X	X	X	X
25	X	X	X				X	X	X	X	X	X
26	X	X	X		X		X	X	X	X	X	X
27		X	X				X	X	X	X		X
36	X	X	X	X			X		X			X

Table 119 Human activities, sources and site evidence tied to nutrient problems in tier 1 critical areas

	Human Activity	Source	Site Evidence

Site	Land Cover Alteration	Riparian Alteration	Channel Alteration	Autumn Plowing	Road Maintenance	Channel Modification	Eroding Streambanks	Impoundments	Impervious Surfaces	Turbid Water	Deposited or Embedded Substrate	Slow Moving Water
3	X	X	X		X	X	X		X	X		X
21	X	X	X	X	X	X	X			X	X	X
24	X	X	X		X	X	X		X	X	X	X
25	X	X	X	X	X	X				X	X	X
26	X	X	X	X	X	X				X	X	X
27	X	X	X	X	X	X				X	X	X
36	X	X	X	X	X	X			X	X	X	X

Table 120 Human activities, sources and site evidence tied to sediment problems in tier 1 critical areas

	Human Activity			Source								Site Evidence			
Site	Agriculture	Urbanization	Channel Alteration	Impoundments	Septic Systems	Point Sources	Agricultural & Urban Runoff (Fertilizer)	Manure Application	Concentrated Animal Feeding Operations	Piped/Buried Streams	Devegetated Riparian Areas	High Plant Production	Slow Moving or Stagnant Water	Organic Wastes	Suspended Solids	Alkaline, Anoxic, or Warm Water
21	X		X		X		X	X	X		X	X	X	X	X	X
24		X	X	X		X	X					X	X			X
25	X	X	X		X		X				X	X	X			X

Table 121 Human activities, sources and site evidence tied to ammonia toxicity problems in tier 1 critical areas

	Human Activity		Source							Site Evidence						
Site	Agriculture	Urbanization	Channelization	Impervious Surfaces	Levees or Walls	Agricultural Drainage	Devegetated Riparian Areas	Dredging	Burried/ Piped Stream	Concrete or Rip-Rap	Embedded Substrates	Bridge or Culvert	Channelization	Predominance of Runs, Glides, or Pools	Eroded Streambanks	Lack or Alteration of Riparian Vegetation	Lack of Habitat Features

3	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X
21	X	X	X			X	X	X			X	X	X	X	X	X	X
24		X	X	X			X	X		X	X	X	X	X		X	X
25	X	X	X			X	X	X			X	X	X	X	X	X	
26	X	X	X			X	X	X			X	X	X	X	X	X	
27	X	X	X	X		X	X	X			X	X	X	X	X	X	X
36	X	X	X	X		X	X	X			X	X	X	X	X	X	X

Table 122 Human activities, sources and site evidence tied to physical habitat problems in tier 1 critical areas