Results from the IOWATER Spring 2003 Snapshot Sampling

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On May 24, 2003, IOWATER monitors across Iowa (and in southern Minnesota) tested the water quality at their stream sites as part of the IOWATER Spring 2003 Snapshot Sampling event. A snapshot sampling is when multiple sites throughout a geographic area, such as a watershed or county, are sampled within a short period of time (e.g., eight hours). A snapshot provides a picture of water quality at one point in time. The May 24 sampling event represents the second IOWATER Snapshot Sampling event. The First IOWATER Snapshot Sampling was held on October 18, 2002, in conjunction with National Water Monitoring Day. A total of 68 sites were sampled across Iowa as part of the October 2002 event.

For the May 24, 2003, snapshot sampling, IOWATER monitors were encouraged to monitor their regular sites on May 24 between 10 am and 2 pm and to complete any or all of the IOWATER field assessments. Data collected were then submitted to the IOWATER database at *www.iowater.net*. Results from the sampling were intended to provide a picture in time of water quality in Iowa. (Note: Since not all IOWATER monitors were able to sample on Saturday May 24, this summary includes data submitted to the IOWATER database for sites monitored from May 23 through May 25, however, most of the data was collected on May 24.)

As part of the spring snapshot, a total of 119 sites were monitored in 28 Iowa counties, as well as 1 site in Minnesota (Murray County) (Figure 1). Compared to the October 2002 sampling, the May 2003 sampling represented an increase in both the number of sites (68 to 119) and counties where sites are located (24 to 28). Table 1 summarizes the results from the sampling. All samples were collected using standard IOWATER methods. For 12 sites, the May 24 sampling represented the first time these stream sites were sampled. All other sites have been monitored before, with some having been monitored close to 30 times (Figure 2). A total of 35 sites were sampled during both the October 2002 and May 2003 snapshot samplings.

This report summarizes the water quality from the IOWATER Spring 2003 snapshot sampling, and includes chemical, physical, biological, and habitat results.

Table 1. Chemical/physical parameter results for the IOWATER Statewide Snapshot Sampling - May 24, 2003.

Parameter	Unit	# of samples	Min Value	Percentiles			Max Value
				25th	50th	75th	
Water Temperature	degrees F	117	47	54	56	59	70
pH	pH units	117	6	8	9	9	9
Dissolved Oxygen	mg/L	117	5	8	8	10	12
Nitrite-N	mg/L	117	0	0	0	0.15	3
Nitrate-N	mg/L	118	0	2	5	5	50
Chloride	mg/L	52	<24	<24	24	31	112
Transparency	centimeters	116	6	30	56	60	60*
Orthophosphorus	mg/L	117	0	0.1	0.2	0.3	10
E. coli Bacteria	CFU/100 ml	12	33	92	133	383	1,000

** The maximum transparency reading that can be recorded using the transparency tube is 60 centimeters.*

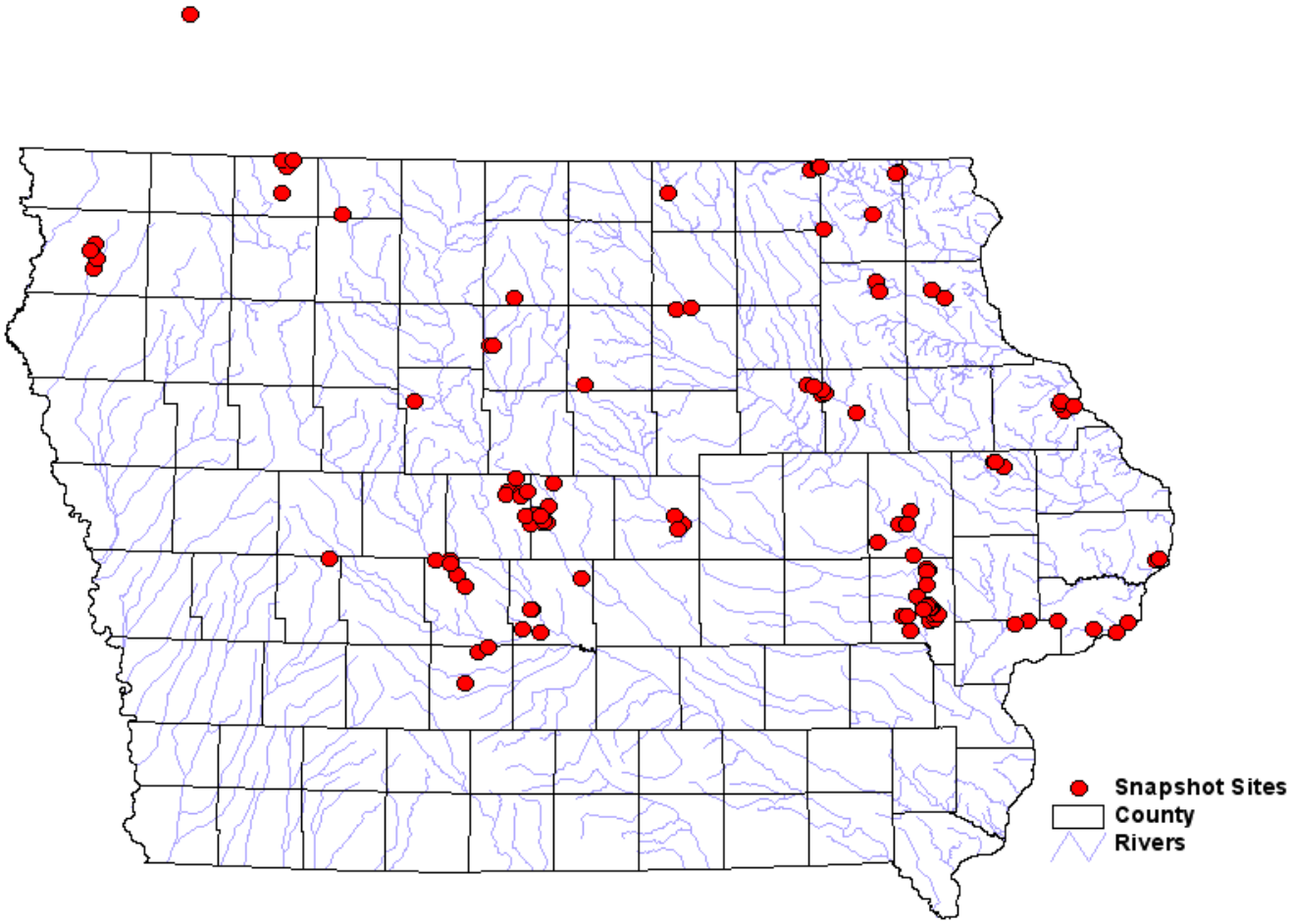

Figure 1. Location of IOWATER sites sampled as part of the Spring 2003 Snapshot. Note the one site in Murray County, Minnesota.

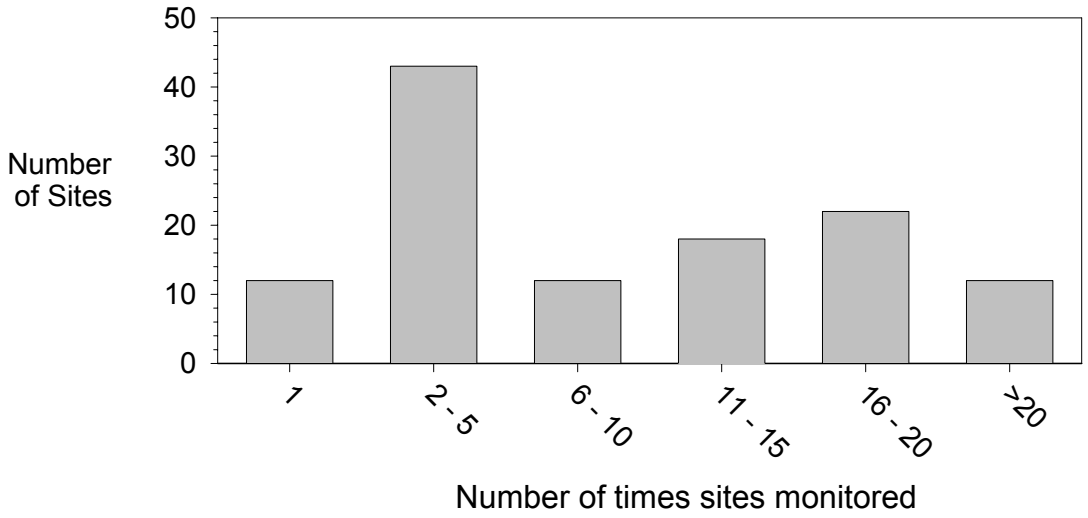

Figure 2. Frequency that IOWATER snapshot sites have been monitored, including the May 2003 snapshot.

Chemical/Physical Parameters

Water Temperature

Water temperature affects many of the biological, chemical, and physical processes in a stream, including the amount of oxygen gas that can dissolve in water, the rate of photosynthesis by algae and plants, as well as the metabolic rate of aquatic animals.

Water temperatures varied from 47 to 70 degrees Fahrenheit, with the lowest temperature reported at Reeds Run in Dickinson County and the highest at Jurdan Creek in Jones County (see Appendix 1A). For the majority of sites, water temperature was between 50 to 60 degrees Fahrenheit (Table 1; Figure 3). Temperatures were higher for the May 2003 snapshot sampling compared to the October 2002 sampling.

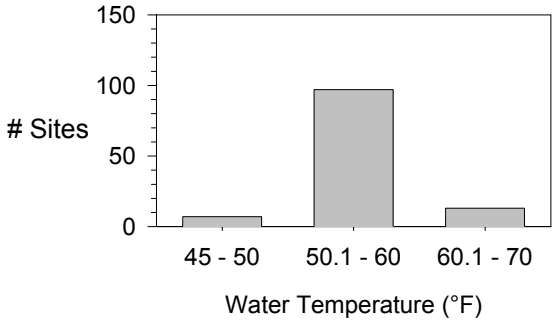

Figure 3. Histogram of water temperature.

Water temperature for streams sampled during the snapshot sampling were similar to those collected from streams statewide during May 2003. A network of 82 streams statewide are monitored monthly as part of Iowa's Ambient Water Monitoring Program. Samples from these streams are tested using field meters and lab analyses, and data from these sites will be used throughout this report to provide perspective on results from the spring 2003 IOWATER Snapshot Sampling. For the streams monitored professionally, water temperature ranged from 48 to 64 degrees Fahrenheit, with an average temperature of 55 degrees Fahrenheit. Cooler temperatures occurred in streams in the northern part of Iowa.

pH

pH is a measure of a water's acidity. Changes in pH can be caused by atmospheric deposition of acid rain, the types of soils and bedrock that the water comes in contact with, wastewater discharges, and acid mine drainage. A pH of 7 is neutral; pH values greater than 7 are alkaline or basic, while a pH less than 7 is acidic.

One-hundred and seventeen sites were tested for pH. Appendix 1B shows the pH values for sites across Iowa. The pH values are similar to what was measured as part of Iowa's Ambient Water Monitoring Program during May 2003. During the IOWATER snapshot sampling, the majority of streams had a pH of 8 or 9 (Table 1; Figure 4). Two sites in Linn County reported pH values of 6, the lowest pH reported for any sites. Prairie Creek, one of the sites, has been monitored 17 times, with pH generally in the 7 to 8 range. The four most recent times this site has been monitored, pH has been 5 or 6, the lowest values reported for this site. The other Linn County site, Hoosier Creek, has been sampled four times. The pH of 6 for this site during the snapshot sampling represents the lowest pH to date.

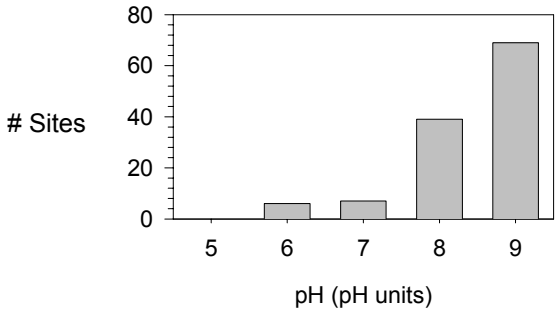

Figure 4. Histogram of pH.

Transparency

Transparency is a measure of water clarity and is affected by the amount of material suspended in water. As more material is suspended in water, less light can pass through the water, making it less transparent (or more turbid). These materials include soil, algae, plankton, and microbes.

Transparency, measured at 116 sites, ranged from 6 to 60 centimeters (Table 1; Figure 5). The median transparency was 56 centimeters, slightly lower than what it was for the October 2002 snapshot sampling (60 centimeters). Higher transparency readings were measured at streams in northeast Iowa, while 15 of the 17 sites in the Squaw Creek watershed in Boone and Story counties reported transparency >40 centimeters (see Appendix 1C).

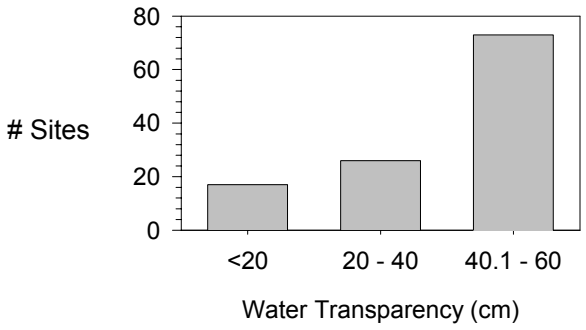

Figure 5. Histogram of water transparency.

Seventeen sites sampled in May had a transparency <20 centimeters, while three of those sites were <10 centimeters. Of those three sites, only one had been tested for transparency before, and the previous reading, measured earlier in the month, was 34 centimeters. All five sites on the North Raccoon River in Dallas County had low transparency measurements. All of the North Raccoon River sites have been sampled more than ten times previously, with the May 2003 snapshot results representing some of the lowest transparency readings for any of these sites. No rain was reported during the previous 24 hours at any of these sites.

Thirty sites were sampled for transparency during both the October 2002 and May 2003 snapshots. Fourteen of those sites had a transparency of 60 centimeters during both snapshots, while for the remaining 16 sites, transparency declined from October 2002 to May 2003 for 12 of the sites and increased for the other 4 sites.

Dissolved Oxygen

Dissolved oxygen levels in a stream can be affected by a number of variables, including water temperature, season of the year or time of day, stream flow, presence of aquatic plants, dissolved or suspended solids, and human impacts. Oxygen enters a stream through diffusion from the surrounding air and as a product of photosynthesis from aquatic plants. Oxygen in a stream can be consumed through respiration by aquatic plants and animals, and by the decomposition of organic matter.

A total of 119 sites were sampled for dissolved oxygen, with an average of 8 mg/L (Table 1; Figure 6 and Appendix 1D). No sites had a value less than 5 mg/L. Six sites did report a value of 5 mg/L, including four sites in Johnson County, and one site in both Madison and Scott counties. For four of the sites, the May 24, 2003 sampling was the first time these sites were sampled. For the other two sites, 5 mg/L was the lowest reported. The highest dissolved oxygen values (>10 mg/L) occurred at many of the streams in northeast Iowa, as well as sites in Sioux, Dickinson, Hancock, Jones, Linn, and Johnson counties, and several sites in the Story and Boone county area.

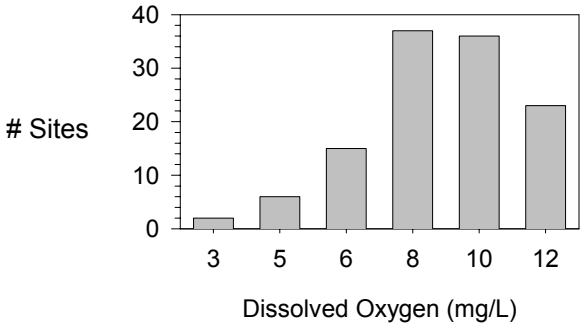

Figure 6. Histogram of dissolved oxygen.

A total of 32 sites were sampled during both snapshots for dissolved oxygen. For most sites, dissolved oxygen concentrations were very similar between the two samplings. An exception was a site on Ralston Creek in Johnson County, which had a dissolved oxygen concentration of 10 mg/L in October 2002 and only 5 mg/L in May 2003.

Nitrite-N and Nitrate-N

Nitrogen is a necessary nutrient for plant growth, and includes both nitrite- and nitrate-nitrogen. Too much nitrogen in surface waters, however, can cause nutrient enrichment, increasing aquatic plant growth and changing the types of plants and animals that

live in a stream. Sources of nitrogen include soils; human and animal wastes; decomposing plants; and fertilizer runoff from golf course, lawns, and cropland.

More than half of the sites detected no nitrite-N, while most of the remaining sites had nitrite-N of 0.15 mg/L (Table 1; Figure 7 and Appendix 1E). Six sites had nitrite-N of 1 mg/L or greater, including sites in Boone, Dickinson, Scott, Sioux, and Story counties. Several of these sites have been sampled before for nitrite-N, with the May 24 sampling reporting the highest nitrite-N. For Sandbar Slough, a site in Dickinson County, the snapshot sampling was the first time the site was sampled, but since then the site has been monitored on a weekly basis, with values of 1 mg/L nitrite-N being reported several times.

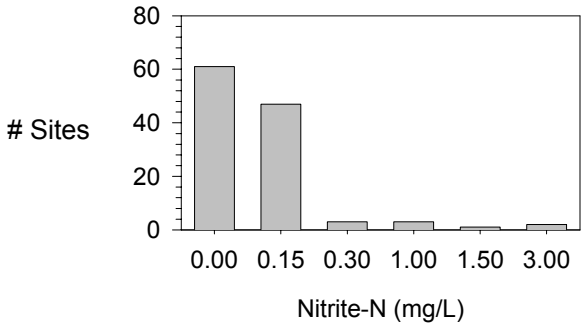

Figure 7. Histogram of nitrite-N.

A total of 118 sites were tested for nitrate-N, with the median nitrate-N concentration of 5 mg/L (Table 1; Figure 8 and Appendix 1F). Seven sites had 0 mg/L nitrate-N, including Worrell Creek (Boone Co.), Spring Run and Buffalo Run (Dickinson Co.), Catfish Creek (Dubuque Co.), Ralston Creek (Johnson Co.), Hoosier Creek (Linn Co.), and Worrell Creek (Story Co.). Several of these sites have tested low for nitrate-N before, including Catfish Creek, which had been sampled 22 times previously, with nitrate-N concentrations generally in the 0 – 2 mg/L range.

Nine sites had nitrate-N concentrations >10 mg/L, including two sites on Beaver Creek (Polk Co.), three sites on Crane Creek (Black Hawk Co.), Unnamed Creek (Sioux Co.), Clear Creek and Long Dick Creek (Story Co.), and Buttermilk Creek (Wright Co.). Five of these sites (two sites on Crane Creek, Clear Creek, Long Dick Creek, and Buttermilk Creek) have each been sampled at least 15 times previously. For these five sites, the nitrate-N concentration from the May snapshot sampling represented some of the highest levels reported for these particular sites, and based on the data collected for these sites, nitrate-N concentrations tend to be quite variable, with lower values generally occurring during the winter months.

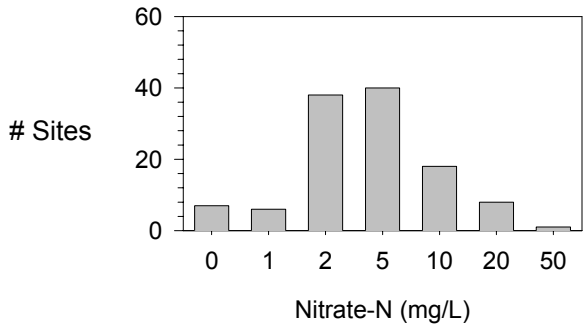

Figure 8. Histogram of nitrate-N.

Several sites sampled were clustered in watersheds. The Squaw Creek Watershed in Story and Boone counties is one example. A total of 17 sites were sampled in this watershed, with most sites having a nitrate-N concentration of 5 or 10 mg/L. Four sites in Sioux County all reported nitrate-N of 10 mg/L or higher. Two of these sites have been sampled before, and both have had elevated nitrate-N reported previously. Five sites on the North Raccoon River in Dallas County showed a downstream decline in nitrate-N concentrations, with 10 mg/L at the upstream site and 2 mg/L downstream.

Thirty sites were sampled for nitrate-N during both the October 2002 and May 2003 snapshots. For the majority of sites, higher nitrate-N occurred in May 2003 compared to October 2002. This same trend was true for streams sampled statewide as part of Iowa's Ambient Water Monitoring Program. Average nitrate-N for streams monitored professionally was 5.3 mg/L in October 2002 and 9.7 mg/L in May 2003.

Orthophosphorus

Orthophosphorus is a necessary nutrient for plant growth. Too much phosphorus in surface waters, however, can cause nutrient enrichment, increasing aquatic plant growth, and changing the types of

plants and animals that live in a stream. Sources of orthophosphorus include certain soils and bedrock; human and animal wastes; detergents; decomposing plants; and runoff from fertilized lawns and cropland.

A total of 117 sites were sampled for orthophosphorus. Concentrations ranged from 0 to 10 mg/L, with a median of 0.2 mg/L (Table 1; Figure 9 and Appendix 1G). A concentration of zero was recorded at 14 sites, all scattered throughout the state. A concentration of 10 mg/L was recorded at two sites: Prairie Creek in Linn County and an unnamed creek in Sioux County, located downstream of a city's wastewater treatment facility. The Prairie Creek site has been sampled 16 times prior to the May 2003 snapshot event, and orthophosphorus concentrations of 10 mg/L have been reported 5 of those 16 times. Orthophosphorus concentrations at Prairie Creek are highly variable, ranging from 0.1 to 10 mg/L, although higher concentrations (5 to 10 mg/L) had been reported during the 8 months prior to the May 2003 sampling. May 2003 represented the first time the unnamed creek in Sioux County was sampled. Since then, this site was sampled again and a value of 10 mg/L orthophosphorus was reported again.

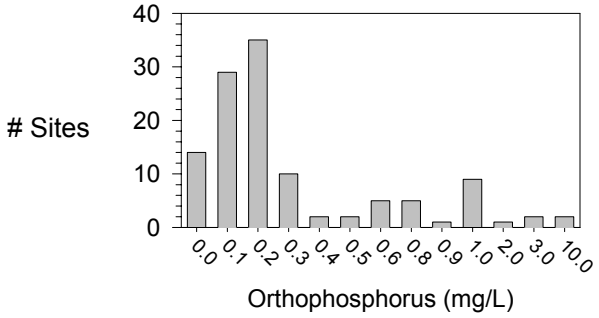

Figure 9. Histogram of orthophosphorus.

For comparison, streams monitored professionally during May 2003 reported a median concentration of 0.39 mg/L for total phosphorus and 0.08 mg/L for orthophosphorus.

Chloride

Chloride is a component of salt, and is a measure of human or animal waste inputs to a stream. Potential sources of chloride to a stream include direct input from livestock, septic system inputs, and/or discharge from municipal wastewater facilities. During winter months, elevated chloride levels in streams may occur as a result of road salt runoff to nearby streams.

Chloride concentrations in Iowa streams are typically in the 20 to 40 mg/L range. A total of 52 sites were monitored for chloride during the snapshot, with the majority of sites having a chloride concentration <40 mg/L (Table 1; Figure 10 and Appendix 1H). A cluster of ten sites were monitored for chloride in the Squaw Creek watershed (Story and Boone counties), five sites along the North Raccoon River (Dallas County), and six sites along the Wapsipinicon River (Buchanan and Black Hawk counties). All reported chloride of <40 mg/L.

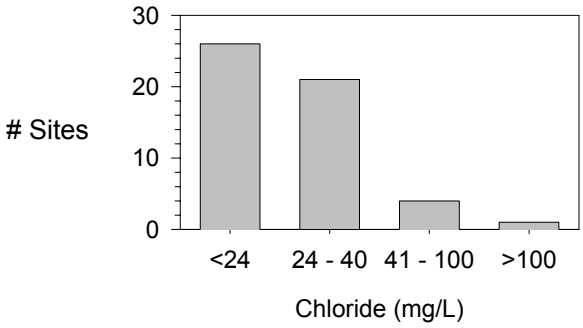

Figure 10. Histogram of chloride.

The highest chloride concentrations were reported at two sites in Polk County, one site in Linn County, and two sites in Johnson County. Chloride levels at the two Polk County streams, both located in the Des Moines area, were 82 and 92 mg/L. One site is located in Fairmeadows Park and has been sampled five times for chloride, all with elevated values ranging from 73 to 240 mg/L. The other Polk County site, a tributary stream to Grays Lake, has been sampled three times for chloride, and the 82 mg/L measured during the snapshot sampling was the highest value for this site. The Linn County site was on McLoud Run and has been sampled three times for chloride. The 71 mg/L from the snapshot sampling was the highest value to date for this site. Snyder Creek and Muddy Creek in Johnson County had chloride levels of 56 and 112 mg/L, respectively. Snyder Creek has been sampled 18 times previously, and chloride levels have ranged from 30 to 80 mg/L. The Muddy Creek site was also sampled during the October 2002 snapshot, when chloride levels were 191 mg/L.

Fifteen sites were monitored during both snapshots and chloride concentrations declined from October 2002 to May 2003 for the majority of sites.

E. coli Bacteria

E. coli bacteria are a type of coliform bacteria present in the gastrointestinal tract of warm-blooded animals. These bacteria are called "indicator bacteria" because by themselves, they do not cause illness, but their presence suggests that disease-causing organisms or pathogens, may be present. As the number of indicator bacteria rises in water, so does the likelihood that pathogens are present. The most frequent sources of pathogens are sewage overflows, malfunctioning septic systems, animal waste, polluted stormwater runoff, and boating wastes. The presence of *E. coli* bacteria suggests that a pathway exists for a relatively fresh source of human or animal waste to enter the stream. *E. coli* bacteria is reported in Colony Forming Units per 100 milliliters (CFU/100 ml).

Iowa's water quality standard for *E. coli* bacteria applies to Class A swimmable waterbodies. The one-time maximum value is 235 CFU/100 ml or the geometric mean, a measure of 5 samples collected in a 30-day period, is 126 CFU/100 ml.

IOWATER monitors tested 12 sites for *E. coli* bacteria, with bacteria counts ranging from 33 to 1,000 CFU/100 ml (Table 1; Appendix 1I). Training for *E. coli* bacteria monitoring is done at Level 2 IOWATER workshops. Samples need to be incubated for 48 hours, and more time is involved in testing for this parameter, hence not as many samples were collected. Six of the twelve sites tested for *E. coli* bacteria were in Black Hawk and Buchanan counties. These sites were tested by one IOWATER monitor. Three other IOWATER monitors each tested two of the remaining six sites.

All 12 sites had been previously tested for *E. coli* bacteria. *E. coli* results from the May 2003 snapshot sampling were similar to results reported previously for each site or represented the lowest value to date for that particular site. The highest *E. coli* of 1,000 CFU/100 ml occurred at Montgomery Creek in Boone County, and this result was typical for this site, with previous samples reporting either much higher or much lower levels.

Water Odor

Water odor was recorded at 113 sites. All but five sites reported no odor to the water (Figure 11).

Figure 11. Histogram of water odor. (Note: more than one odor category can be indicated for a site.)

Water Color

Water color was recorded at 115 sites. Water was clear at 72 sites and brown at 58 (Figure 12). Green was the only other color noted, and that was identified at 5 sites.

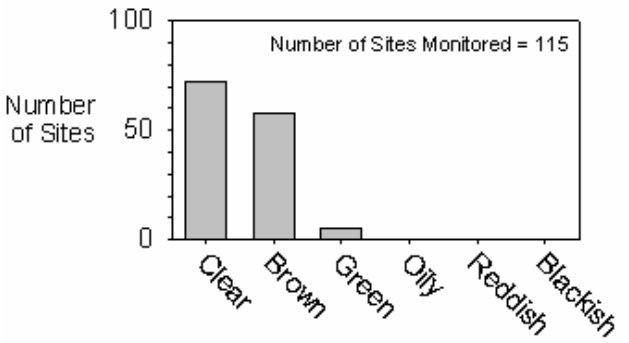

Figure 12. Histogram of water color. (Note: more than one category can be indicated for a site.)

Biological Parameters

The most common method for assessing the biological health of a stream is to use benthic macroinvertebrates. Benthic macroinvertebrates are aquatic insects, clams, crustaceans, leeches, snails, and worms. Tolerances of these organisms to

pollution have been established, therefore, the types of bugs present can be used an an indicator of stream health. For the snapshot sampling, the IOWATER Level 1 benthic macroinvertebrate key was used to identify bugs.

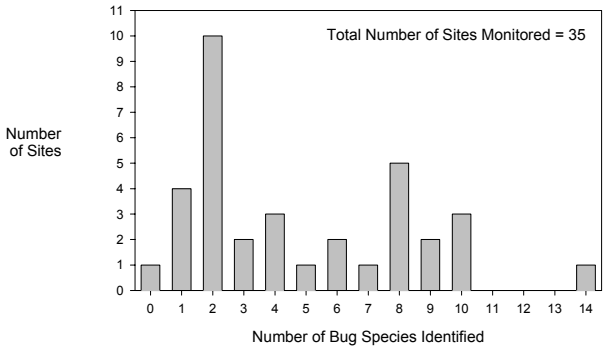

Figure 13. Number of bug species identified.

A total of 35 sites were monitored for benthic macroinvertebrates. The number of bug species identified at these sites ranged from 0 to 14 (Figure 13; Appendix 2A). One site on Duck Creek in Scott County reported no bugs present. This site has been monitored before for bugs. The site was sampled two months prior to the snapshot sampling, at which time only flatworms and leeches were present. Both of these bugs are low quality organisms. One site, Catfish Creek in Dubuque County, had 14 bug species identified. This site has been sampled for bugs twice previously, and both times 11 bug species were present. This site generally has 4 high, 6 medium, and 2 low quality bug species present.

Figure 14 shows the quality of bugs collected from the 35 sites. The bar graph shows the percentages of high quality, medium quality, and low quality bugs present. For 11 sites, the bug population was comprised of an equal percentage of high, medium, and low quality bugs. For 12 sites, the bug population was dominated by medium quality bugs. For one site, Farmers Creek near Fulton in Jackson County, only high quality bugs were present. This particular site has been sampled for bugs twice previously. In the past, this site has had, in addition to the high quality bugs, a few medium quality bugs present also.

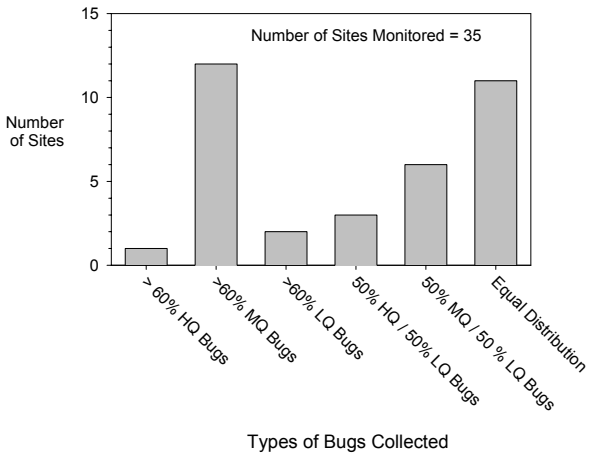

Figure 14. Quality of bugs collected. HQ = High Quality; MQ = Medium Quality; LQ = Low Quality.

Of the bugs identified at all sites, more than 50% are classified as medium quality bugs (Figure 15). Only 20% of the bugs were high quality bugs.

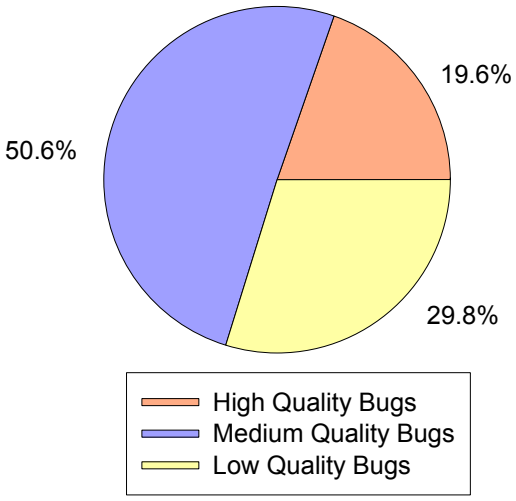

Figure 15. Pollution tolerance of bugs identified.

Habitat Parameters

Stream habitat is the space occupied by living organisms. With the IOWATER habitat assessment, observations are made on the vegetation that occurs in and around the stream, as well as the types of rocks and sediments on the stream bottom. These habitat characteristics can affect the biological communities in the stream, as well as affect chemical measurements made at a stream.

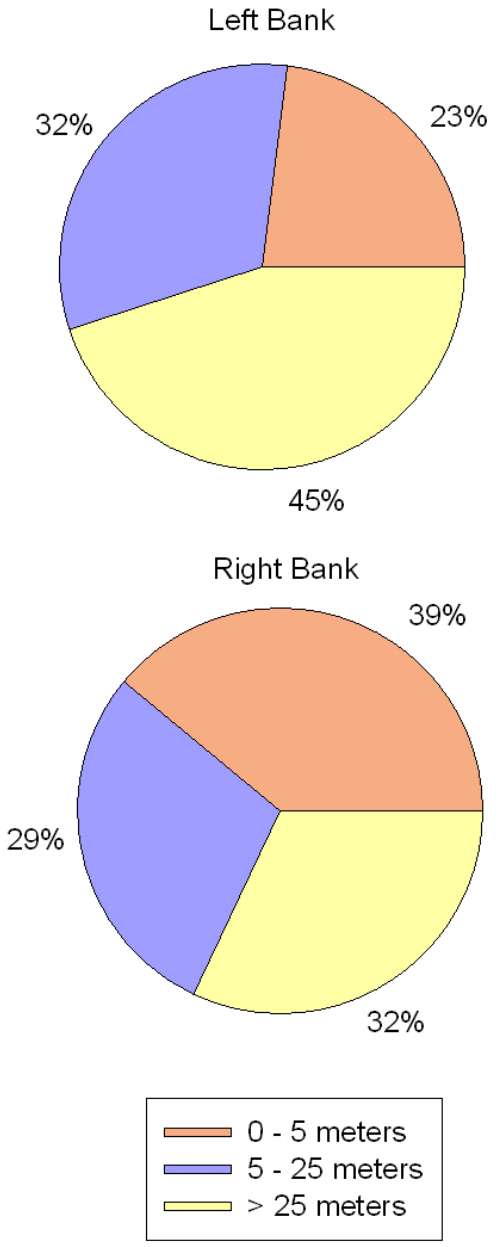

Figure 16. Riparian zone width at 31 stream sites.

The stream's riparian zone is the area of land directly connected to the stream. This zone is important to the health and protection of the stream. The riparian zone width is distinguished by left versus right bank while looking upstream. Figure 16 shows the riparian zone width for 31 sites monitored. For 45% of the sites, the left bank riparian zone width was greater than 25 meters, while for 32% of the sites, the right bank was greater than 25 meters wide. Nine sites had >25 meters riparian zone width on both sides of the stream, while six sites had <5 meters on both sides.

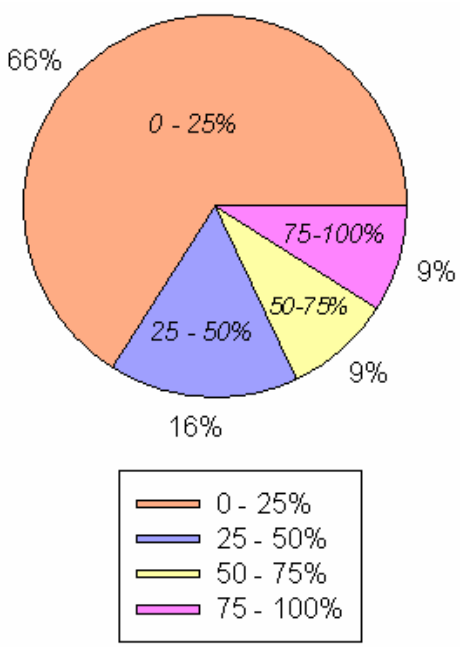

Figure 17. Canopy cover at 32 stream sites.

Canopy cover controls the amount of light that filters through overhead tree branches and leaves to a stream. Canopy cover is estimated as the percentage of the area above the stream that is covered by tree branches, leaves and/or grasses. For 66% of the 32 sites monitored, canopy cover ranged from 0-25% (Figure 17).

Aquatic plant cover includes all plants that grow in the water or wet soils. These plants provide habitat and stabilize substrate during high flow conditions, produce oxygen, and take contaminants out of the sediment via root absorption. Aquatic plant cover is calculated at the stream transect as the percent of streambed covered by aquatic plants. This is recorded in increments of 25%. Of the 31 sites where aquatic plant cover was estimated, all had less than 50% aquatic plant cover (Figure 18).

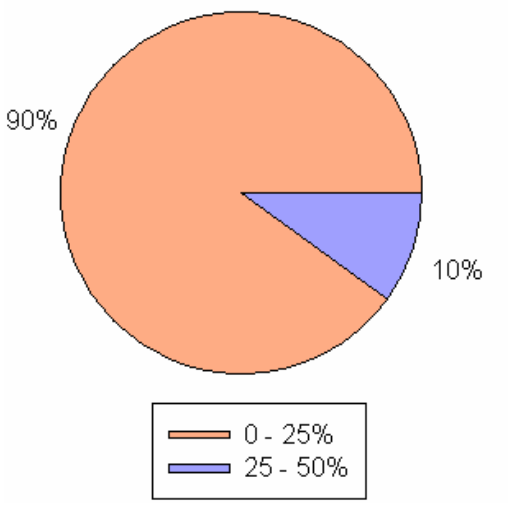

Figure 18. Aquatic plant cover in the stream at 31 sites.

Algae are commonly found in slower moving waters attached to rocks or other streambed substrates. Excess algae can be caused by too many nutrients in the stream and can lead to oxygen depletion. Algae cover, estimated at the stream transect, is quantified as the percentage of stream or streambed covered with algae in increments of 25%. The majority of sites sampled (74%) had very little algae cover present, with IOWATER monitors reporting 0 – 25% algae cover at most of their sites (Figure 19).

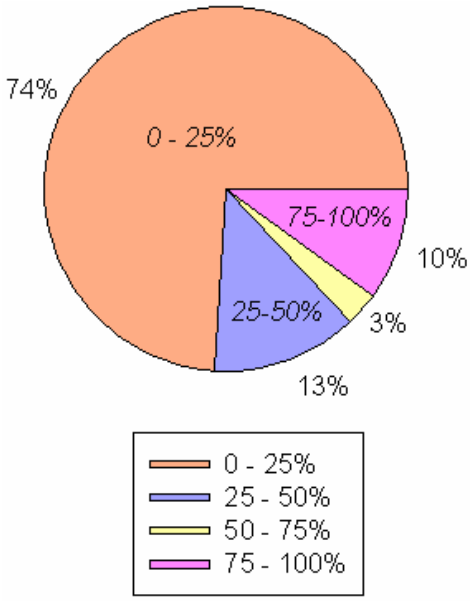

Figure 19. Algae cover in the stream at 31 sites.

The characteristics of the stream bottom are very important to habitat quality and the type of aquatic life you may find. What a streambed is made up of is called the substrate. At the stream transect, the percent area covered by the different substrate categories was estimated. The categories include bedrock, boulder, cobble, gravel, sand, mud/silt, and other (organic material). Figure 20 shows the type of streambed substrate present at the 33 sites monitored for substrate. The streambed substrate at the majority of sites was comprised of sand, mud/silt, or other.

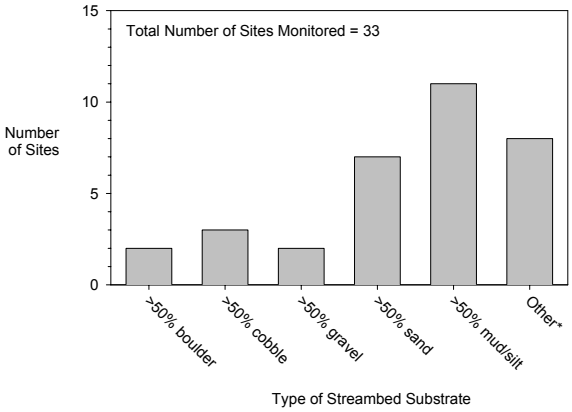

Figure 20. Type of streambed substrate present at each site. (Note: Other represents three or more substrate categories, relatively equally represented.)

Future Statewide Snapshots

The IOWATER program would like to thank all IOWATER monitors who sampled their sites as part of the spring 2003 IOWATER Snapshot Sampling. Your continued commitment to monitoring Iowa's water resources is greatly appreciated. This biannual snapshot event will continue, with the next sampling scheduled for Saturday October 18, 2003, which also happens to be International Monitoring Day. Additional copies of this report can be obtained by contacting Lynette Seigley or by accessing the summary on the IOWATER website (*www.iowater.net*).

Acknowledgements

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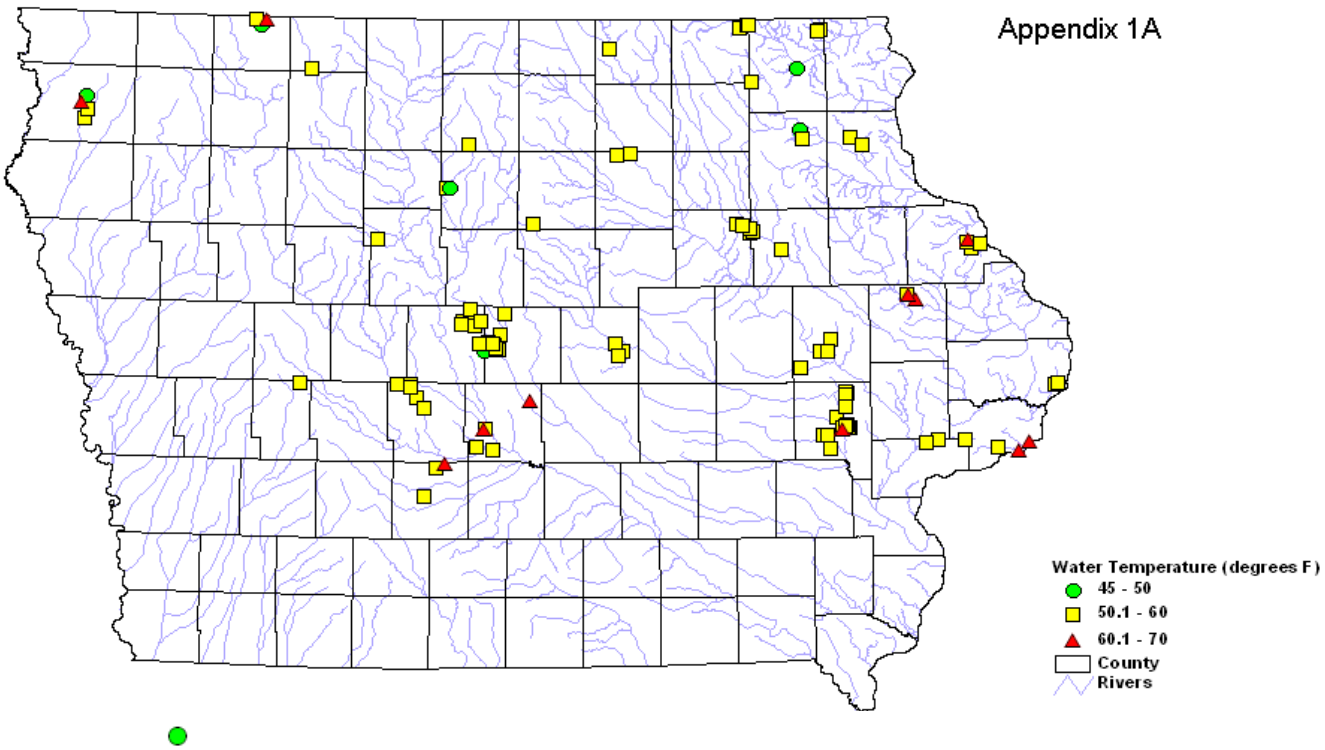
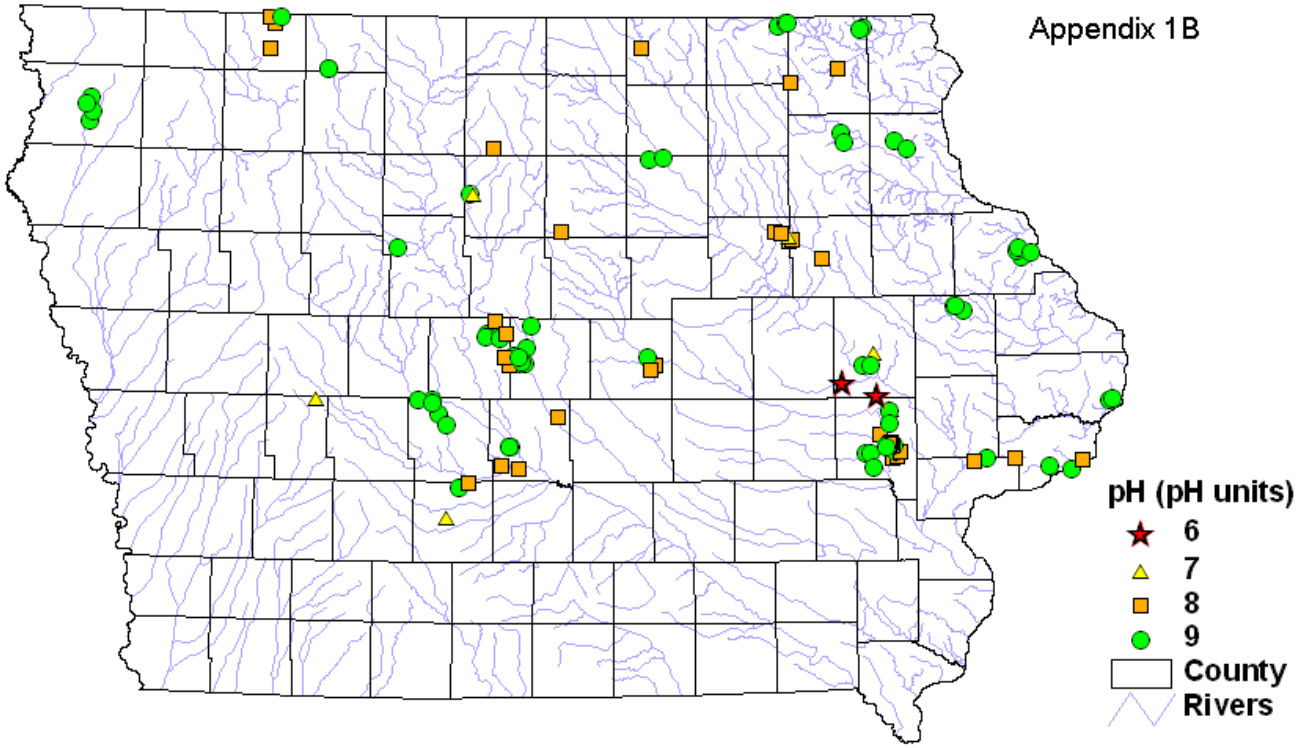
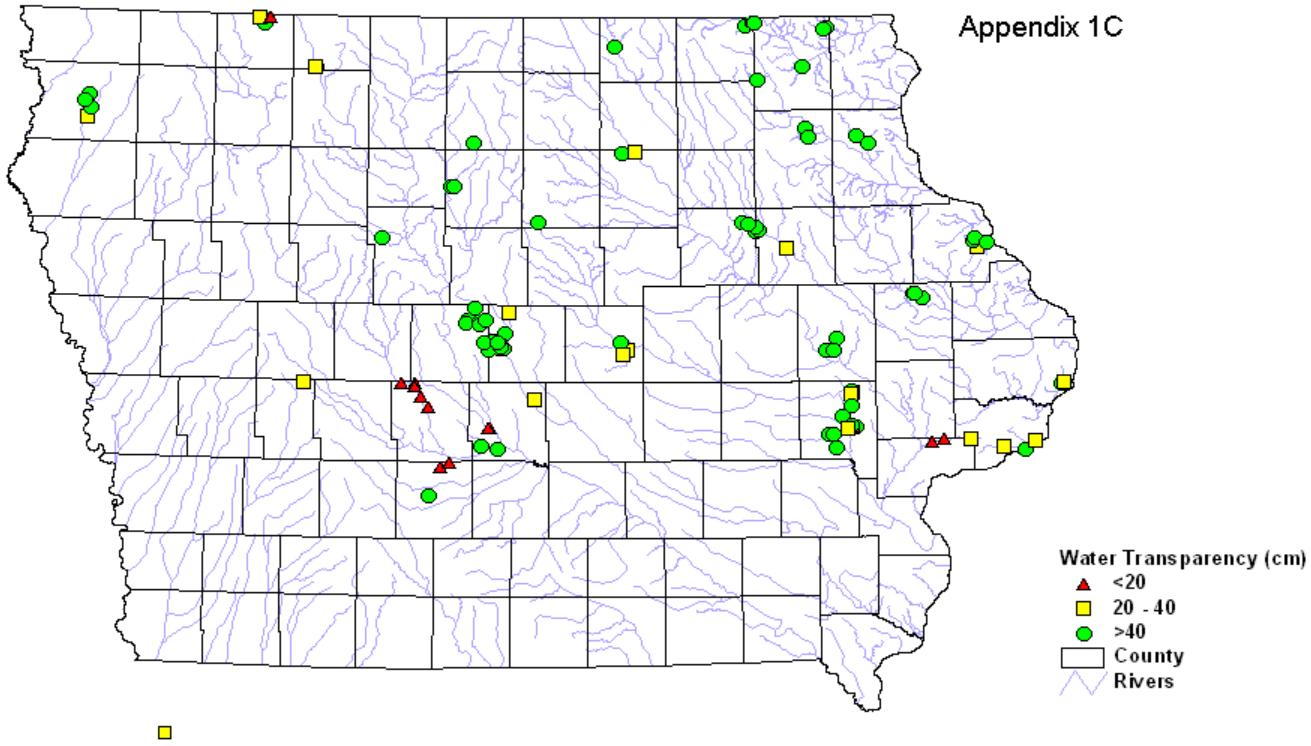
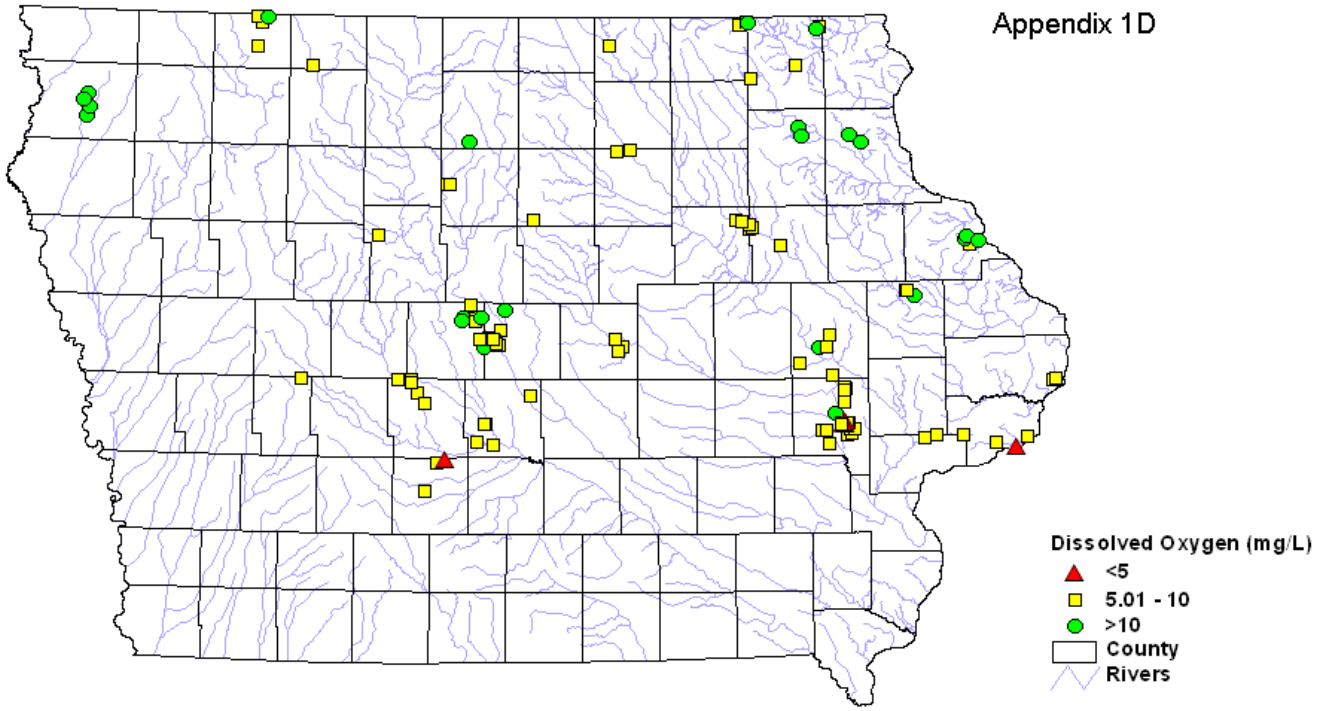
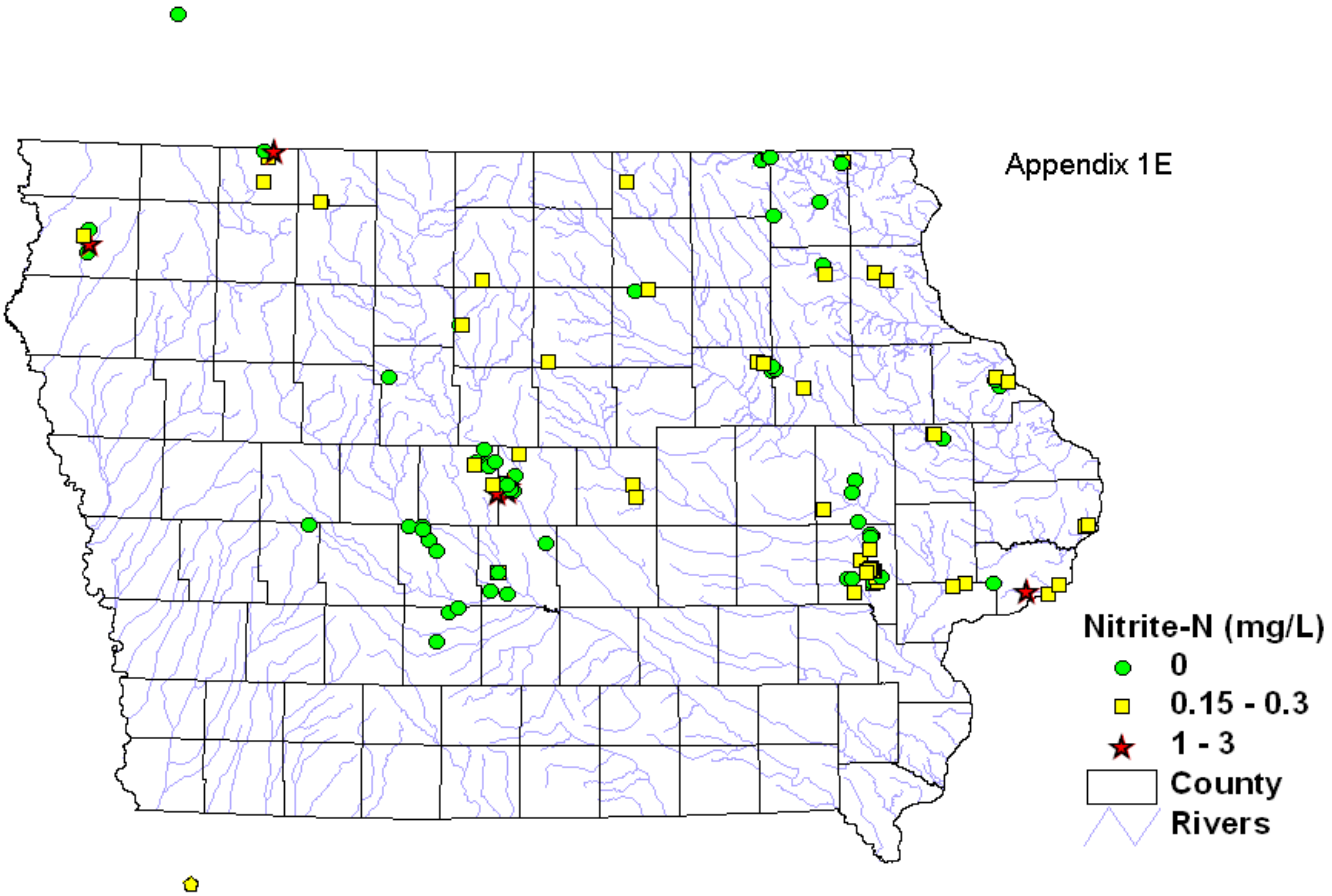
Written: September 2003

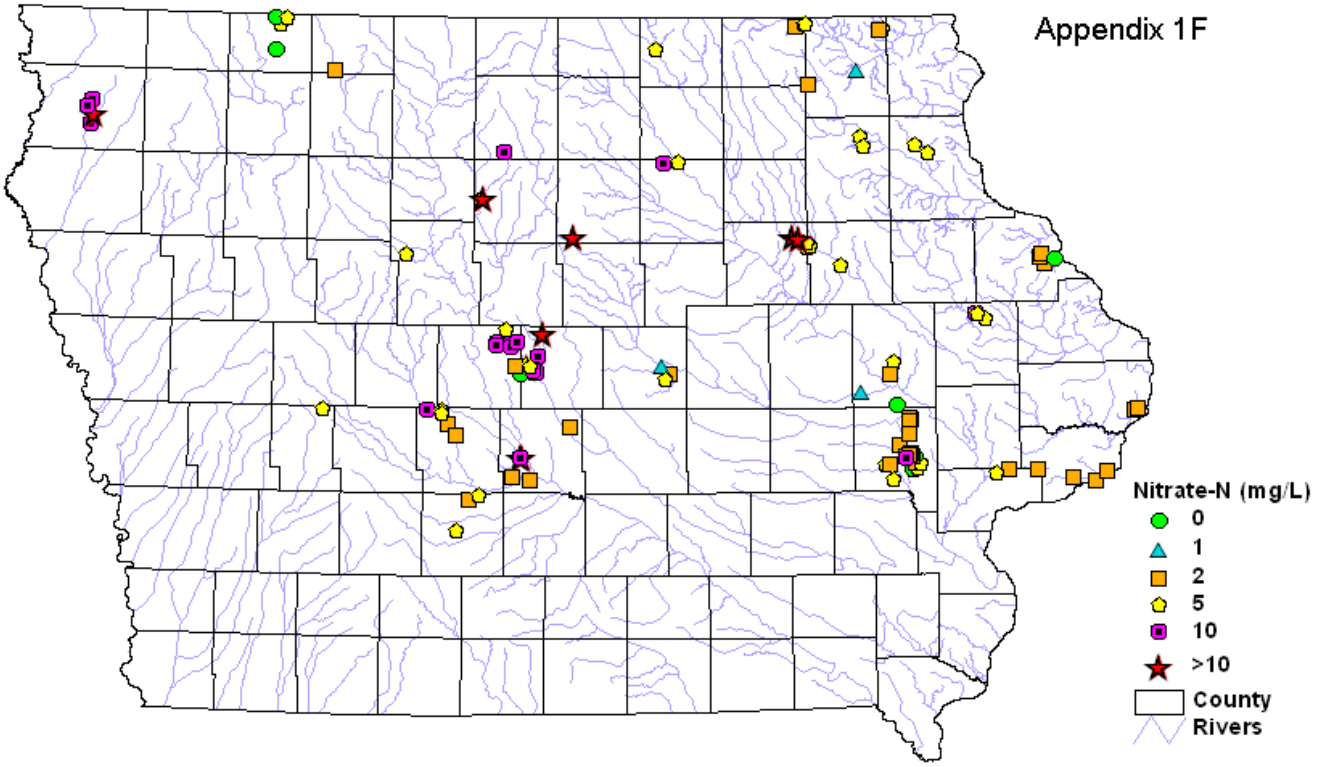

Appendix 1A
Water Temperature (degrees F)
45 - 50
50.1 - 60
60.1 - 70
County
Rivers

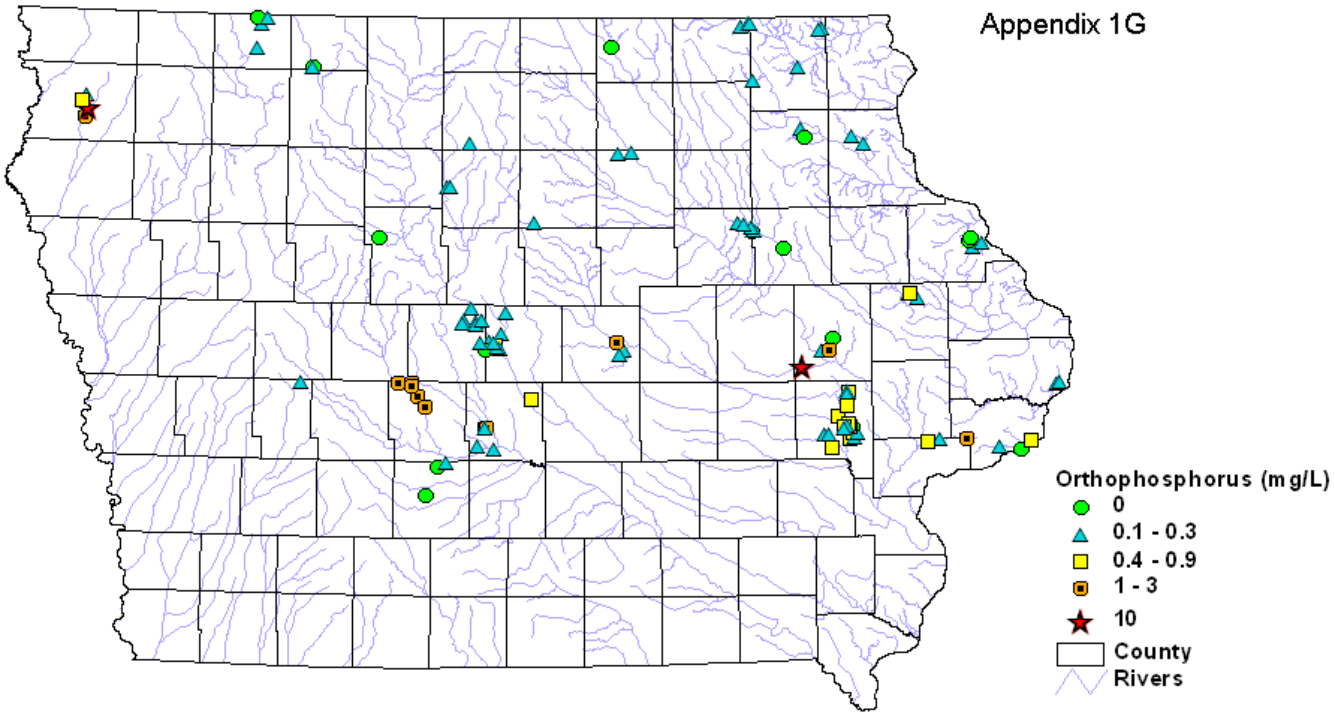

Appendix 1B
pH (pH units)
6
7
8
9
County
Rivers

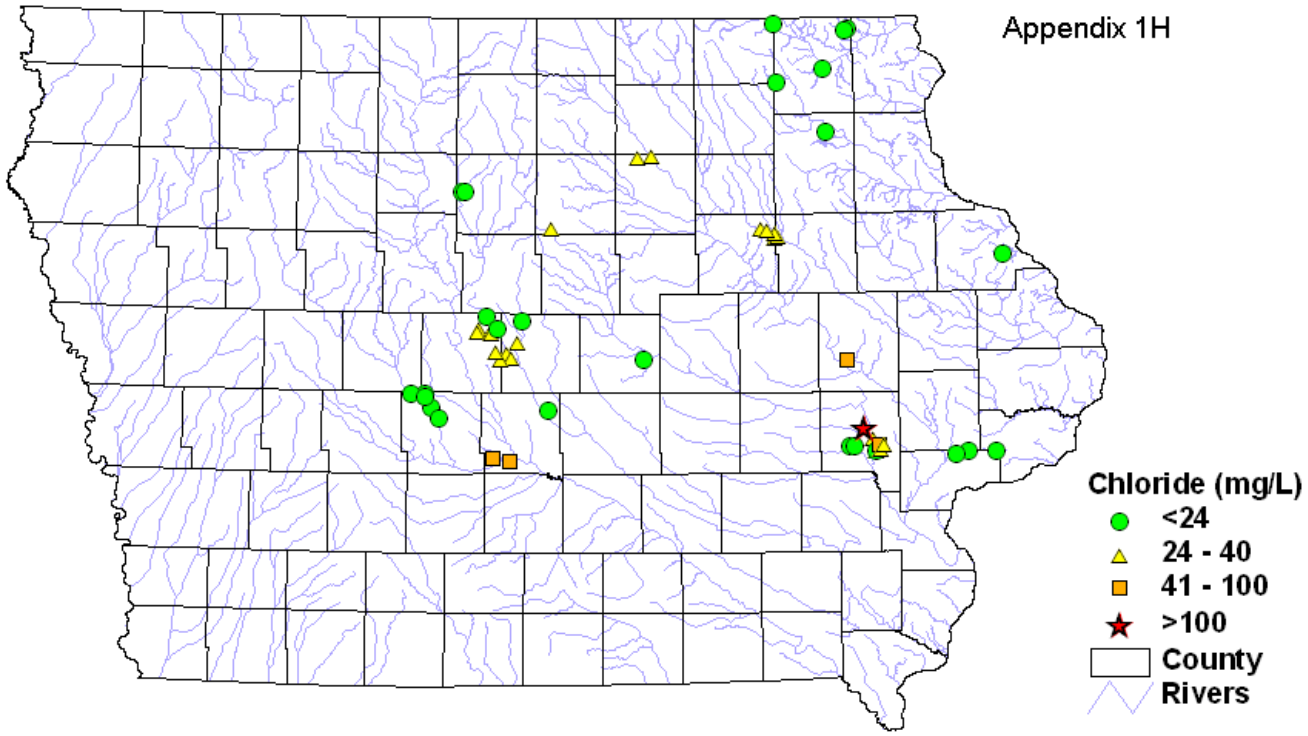

Appendix 1C
Water Transparency (cm)
<20
20 - 40
>40
County
Rivers

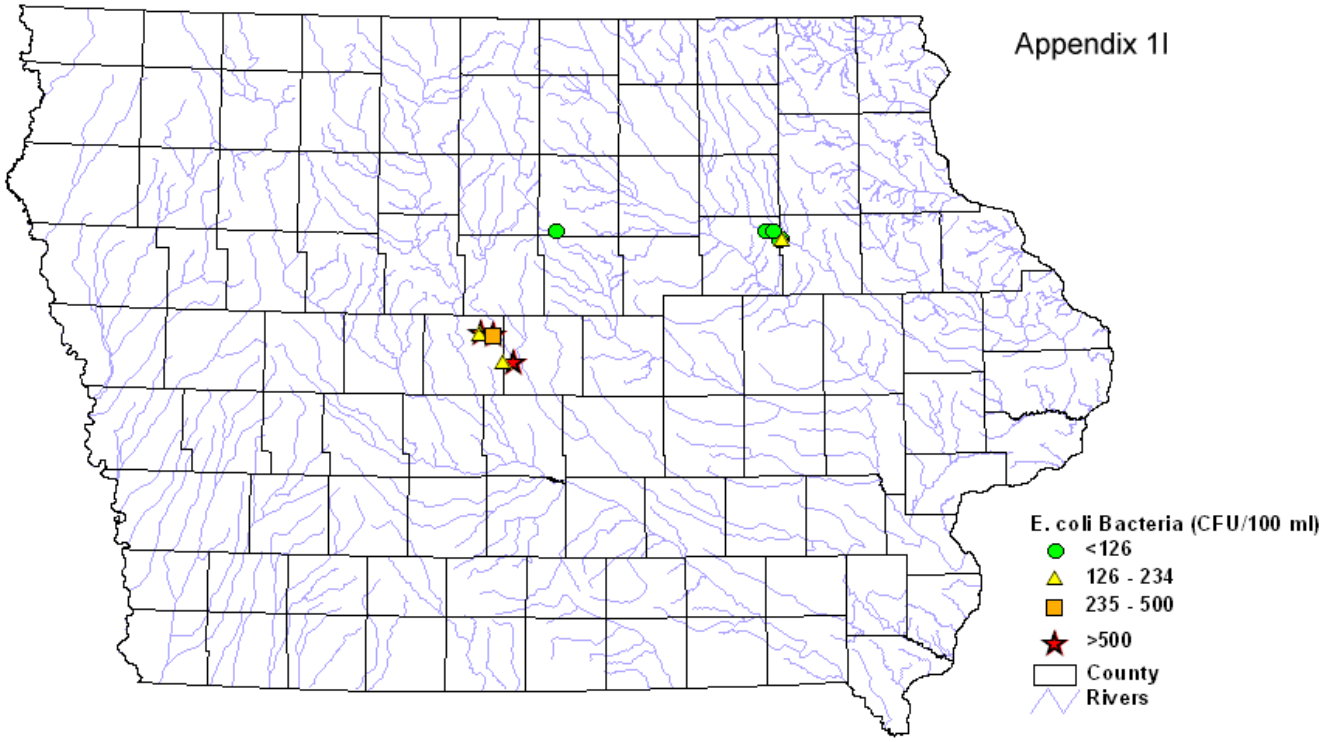

Appendix 1D
Dissolved Oxygen (mg/L)
<5
5.01 - 10
>10
County
Rivers


Appendix 1E
Nitrite-N (mg/L)
0
0.15 - 0.3
1 - 3
County
Rivers


Appendix 1F
Nitrate-N (mg/L)
0
1
2
5
10
>10
County
Rivers


Appendix 1G
Orthophosphorus (mg/L)
0
0.1 - 0.3
0.4 - 0.9
1 - 3
10
County
Rivers


Appendix 1H
Chloride (mg/L)
<24
24 - 40
41 - 100
>100
County
Rivers


Appendix 1l
E. coli Bacteria (CFU/100 ml)
<126
126 - 234
235 - 500
>500
County
Rivers

Appendix 2A