Project A.W.A.R.E. 2006 Water Quality Results for the Iowa and English Rivers

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Abstract: From June 17-24, 2006, approximately 175 volunteers removed trash from the Iowa and English rivers in Johnson, Louisa, and Washington counties in southeast Iowa as part of Project AWARE 2006 (A Watershed Awareness River Expedition). In addition to trash removal, 27 stream sites along the canoe route were monitored for various water quality parameters. This report summarizes those results and, for perspective, those results are compared to a network of 85 streams sampled statewide during June 2006 as part of Iowa’s Ambient Water Monitoring Program. Results from the monitoring indicated that dissolved oxygen levels in the English River were lower than levels in streams statewide, while dissolved oxygen concentrations in the Iowa River were similar to those sampled statewide. Specific conductivity and \textit{E. coli} bacteria levels were slightly higher than streams sampled statewide. The lower dissolved oxygen levels are of concern given some of the values were near the warm water aquatic life standard of 5 mg/L.

Introduction

From June 17-24, 2006, approximately 175 Project AWARE volunteers removed trash from the Iowa and English rivers in southeast Iowa. Project AWARE is a 7-day, 7-night canoe trip down an Iowa river where volunteers remove trash and take part in evening educational programs. The trip began at Sturgis Ferry Access in Johnson County, just south of Iowa City, and traveled 79 miles southward over the next week to the final destination, Ferry Landing Public Use Area near Oakville, Louisa County. Water quality measurements were made at starting, half-way, and take-out points for each day, as well as at tributary locations and other locations of interest. A total of 27 sites were sampled throughout Johnson, Louisa, and Washington counties (Figure 1). The data points for each day provide a picture of water quality at that point in time.

For all sites sampled on the Iowa and English rivers during Project AWARE 2006, volunteers collected data using IOWATER field methods. In addition, field meters were also used to collect dissolved oxygen, pH, water temperature, specific conductivity, and turbidity data. Water samples for \textit{E. coli} bacteria analysis were processed in the field using the IDEXX Colilert method. Data collected are intended to provide a picture of water quality at various locations along both rivers. This report summarizes the water quality from the Project AWARE 2006 sampling of 27 sites along the Iowa River (18 sites) and English River (9 sites) at main stem, tile line, and tributary locations (Figure 1), and includes chemical and physical results (Table 1).
Table 1. Water quality results from the Iowa River and English River during Project AWARE 2006.

### Project AWARE Sampling Results – June 17 - 24, 2006 on the Iowa River.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Method</th>
<th># of samples</th>
<th>Min Value</th>
<th>Percentiles</th>
<th>Max Value</th>
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<tbody>
<tr>
<td>Water Temperature</td>
<td>degrees F</td>
<td>18</td>
<td>57.2</td>
<td>71.6 75.2 77.0</td>
<td>84.2</td>
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<td>Field Kit</td>
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<td>0</td>
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<tr>
<td>Nitrate-N</td>
<td>IOWATER Test Strip</td>
<td>18</td>
<td>0</td>
<td>2 5 5 10</td>
<td>0</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>IOWATER Field Kit</td>
<td>18</td>
<td>6</td>
<td>6 8 8 10</td>
<td>0</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>Field Meter</td>
<td>18</td>
<td>5.0</td>
<td>7.7 8.5 9.7</td>
<td>10.8</td>
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<tr>
<td>Chloride</td>
<td>IOWATER Test Strip</td>
<td>18</td>
<td>&lt;33</td>
<td>&lt;33 &lt;33 33</td>
<td>581</td>
</tr>
<tr>
<td>Phosphate as P</td>
<td>mg/L</td>
<td>18</td>
<td>0</td>
<td>0 0 0 0</td>
<td>10</td>
</tr>
<tr>
<td>pH</td>
<td>pH units</td>
<td>18</td>
<td>7</td>
<td>8 9 9 9</td>
<td>9</td>
</tr>
<tr>
<td>E. coli Bacteria (100 ml Sample)</td>
<td>IDEXX Colilert</td>
<td>18</td>
<td>&lt;10</td>
<td>&lt;10 &lt;20 &lt;219</td>
<td>10,760</td>
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<tr>
<td>Specific Conductivity</td>
<td>µmhos/cm</td>
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<td>219</td>
<td>484 544 561</td>
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<td>NTU</td>
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<td>centimeters</td>
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<td>11</td>
<td>16 19 58</td>
<td>60</td>
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</table>

### Project AWARE Sampling Results – June 17 - 24, 2006 on the English River

<table>
<thead>
<tr>
<th>Unit</th>
<th>Method</th>
<th># of samples</th>
<th>Min Value</th>
<th>Percentiles</th>
<th>Max Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Temperature</td>
<td>degrees F</td>
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<td>64.4</td>
<td>68.0 71.6 73.4</td>
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<td>Field Kit</td>
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<td>0 0 0 0</td>
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<tr>
<td>Nitrate-N</td>
<td>IOWATER Test Strip</td>
<td>9</td>
<td>0</td>
<td>2 2 2 2</td>
<td>10</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>IOWATER Field Kit</td>
<td>9</td>
<td>5</td>
<td>6 6 6 8</td>
<td>8</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>Field Meter</td>
<td>9</td>
<td>6.2</td>
<td>6.7 7.8 8.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Chloride</td>
<td>IOWATER Test Strip</td>
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<td>&lt;33</td>
<td>&lt;33 &lt;33 &lt;33</td>
<td>282</td>
</tr>
<tr>
<td>Phosphate as P</td>
<td>mg/L</td>
<td>9</td>
<td>0</td>
<td>0 0 0 0</td>
<td>10</td>
</tr>
<tr>
<td>pH</td>
<td>pH units</td>
<td>9</td>
<td>7.7</td>
<td>8 8 9 9</td>
<td>9</td>
</tr>
<tr>
<td>E. coli Bacteria (100 ml Sample)</td>
<td>IDEXX Colilert</td>
<td>9</td>
<td>147</td>
<td>163 240 378</td>
<td>1,300</td>
</tr>
<tr>
<td>Specific Conductivity</td>
<td>µmhos/cm</td>
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<td>265</td>
<td>467 494 571</td>
<td>1,865</td>
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<tr>
<td>Turbidity</td>
<td>NTU</td>
<td>9</td>
<td>9.0</td>
<td>12 20 29</td>
<td>118</td>
</tr>
<tr>
<td>Transparency</td>
<td>centimeters</td>
<td>9</td>
<td>2</td>
<td>22 33 41</td>
<td>55</td>
</tr>
</tbody>
</table>

mg/L = milligrams per liter (or parts per million - ppm)
MPN = Most Probable Number
NTU = Nephelometric Turbidity Units
µmhos/cm = micromhos per centimeter
Figure 1. Location of sites sampled (red circles) as part of Project AWARE 2006 on the Iowa and English rivers.
Chemical and 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 temperature was measured at 27 sites during Project AWARE 2006 and varied from 57 to 84 degrees Fahrenheit, with the lowest and highest temperatures occurring on the Iowa River (Table 1; Figure 2). Iowa River sites averaged 75.2 degrees Fahrenheit, while English River sites averaged 71.6 degrees Fahrenheit (Table 1).

![Water temperature graph](image)

*Figure 2. Water temperature for sites sampled as part of Project AWARE 2006.*

Water temperature for the Iowa and English River sites sampled during June 2006 were similar to temperatures for streams sampled statewide during June 2006 (Figure 3). A network of 85 streams statewide is 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 Iowa and English rivers collected during Project AWARE 2006.

![Water temperature box plot](image)

*Figure 3. Box plot of water temperature values collected from Project AWARE 2006 and Ambient Water Monitoring sites.*
**pH**

pH is a measure of water’s acid/base content. 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.

pH was measured at 27 sites during Project AWARE 2006. The majority of sites had a pH between 8 and 9, with the exception of several sites on the Iowa and English rivers, which had a pH value of less than 8 (Table 1; Figure 4). pH values collected on AWARE were similar to pH levels in streams statewide for June 2006 (Figure 5).

![Figure 4. pH (top graph-IOWATER test kit; bottom graph-field meter) for sites sampled as part of Project AWARE 2006.](image)

![Figure 5. Box plot of pH values collected using a field meter from Project AWARE 2006 and Ambient Water Monitoring Program sites.](image)
**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 was measured at 27 sites and ranged from 11 to 60 centimeters with a median of 19 centimeters on the Iowa River, while transparency ranged from 2 to 55 with a median of 33 on the English River (Table 1; Figure 6). The lowest transparency reading was measured near Riverside, IA, where monitors observed a brown water color. The low transparency occurred the day after an overnight rain event.

![Figure 6. Transparency for sites sampled during Project AWARE 2006.](image)

**Dissolved Oxygen**

Dissolved oxygen levels in a stream can be affected by a number of variables, including water temperature, season of the year, 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 27 sites were sampled for dissolved oxygen during Project AWARE. The Iowa River had a median of 8.5 mg/L and a range of 5.0 to 10.8 mg/L using a field meter, and a median of 8.0 mg/L and a range of 6.0 to 10.0 mg/L using the IOWATER field kit method (Table 1; Figure 7). The English River had a median of 7.8 mg/L and a range of 6.2 to 10.0 mg/L using a field meter, and a median of 6.0 mg/L and a range of 5.0 to 8.0 mg/L using the IOWATER field kit method (Table 1; Figure 7). All sites met the warm water dissolved oxygen standard of 5 mg/L. Dissolved oxygen levels in the English River were lower while those in the Iowa River were similar to streams statewide in June 2006 (Figure 8).

![Figure 7. Dissolved oxygen data (top graph-field meter data; bottom graph-IOWATER test kit data) from sites sampled as part of Project AWARE 2006.](image)
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.

A total of 27 sites were tested for nitrate-N using IOWATER test strips. Nitrate-N values concentrations averaged 5.0 mg/L on the Iowa River and 2.0 mg/L on the English River, and ranged from 0-10 mg/L for both the Iowa and English rivers. Both rivers had one reading of 10 mg/L, but neither had a nitrate-N value greater than 10 mg/L (Figure 9).

Figure 8. Box plot of dissolved oxygen values collected using field meters for Project AWARE 2006 and streams statewide as part of the Ambient Water Monitoring Program.

Figure 9. Nitrate-N concentrations for the Iowa and English River sites sampled during Project AWARE 2006.
**Phosphorus**

Phosphorus 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 phosphorus include certain soils and bedrock; human and animal wastes; detergents; decomposing plants; and runoff from fertilized lawns and cropland.

A total of 27 sites were sampled for phosphate during Project AWARE 2006. Concentrations ranged from 0 to 10 mg/L, with a median of 0 mg/L on both the Iowa and English rivers (Figure 10). Phosphate concentrations were 10 mg/L at two sites on the Iowa River; both sites were located immediately downstream of point source outfalls.

![Figure 10. Phosphate data from Iowa and English River sites during Project AWARE 2006.](image)

**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. During Project AWARE 2006, 27 sites were monitored for chloride using IOWATER test strips. The majority of sites had a chloride concentration less than 50 mg/L (Figure 11). However, the Iowa River just south of Iowa City had a chloride reading of 581 mg/L. The highest reading (282 mg/L) on the English River was near Riverside close to the mouth of the English River. The higher reading near Iowa City may be due to contributions from a point source outfall, specifically a municipal wastewater facility.

![Figure 13. Chloride data for Iowa and English River sites sampled during Project AWARE 2006.](image)
**Specific Conductivity**

Specific conductivity is a measure of how well water can conduct an electrical current. Conductivity increases with the increasing amount and mobility of ions. These ions, which come from the breakdown of compounds, conduct electricity because they are negatively or positively charged when dissolved in water. Therefore, specific conductance is an indirect measure of the presence of dissolved solids such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron, and can be used as an indicator of water pollution.

Specific conductivity values ranged from 219 to 2,252 umhos/cm with a median value of 544 umhos/cm on the Iowa River. The English River had conductivity values ranging from 265 to 1,865 umhos/cm with a median value of 494 umhos/cm. The highest conductivity reading in both the Iowa and English rivers were at the same sites where the highest chloride levels occurred. These specific conductivity values were higher than concentrations in streams statewide for June 2006 (Figure 14 and 15).

**Turbidity**

Turbidity refers to how turbid or dirty the water is. The greater the amount of total suspended solids (TSS) in the water, the murkier it appears and the higher the measured turbidity. The major source of turbidity in rivers is typically from overland runoff flows, stream bank erosion, re-suspension of bottom sediments, and organic detritus from stream and/or wastewater discharges. Dredging operations, channelization, increased flow rates, floods, or even too many bottom-feeding fish (such as carp) may stir up bottom sediments and increase the cloudiness of the water.

Turbidity values on the Iowa River ranged from 0 (a tile line value) to 83 NTUs (Nephelometric Turbidity Units) with a median turbidity value of 37 NTUs. The English River had a median value of 20 NTUs with a range of 9.0 to 118 NTUs.

![Figure 14. Specific conductivity data for Iowa and English River sites sampled during Project AWARE 2006.](image-url)

![Figure 15. Box plot of specific conductivity values collected using a field meter for Project AWARE 2006 and the Ambient Water Monitoring Program.](image-url)
Figure 16. Turbidity data from Iowa and English River sites during Project AWARE.

Figure 17. Box plot of turbidity values collected using a field meter for Project AWARE 2006 and the Ambient Water Monitoring Program sites.

**Escherichia coli Bacteria**

*E. coli* bacteria are a type of 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 storm-water runoff, and boating wastes. The presence of these bacteria suggests that a pathway exists for a relatively fresh source of human or animal waste to enter the stream. Bacteria levels are reported as Most Probable Number per 100 milliliters (MPN/100 ml).

Iowa’s water quality standard for *E. coli* bacteria applies to Class A waterbodies. The stretch of the Iowa River that was canoed as part of Project AWARE 2006 is designated Class A1, primary contact recreational use, while the English River is designated Class A2, secondary contact recreational use. The one-time maximum *E. coli* bacteria standard is 235 CFU/100 ml for Class A1 waterbodies and 2,880 CFU/100 ml for Class A2 waterbodies (CFU = Colony Forming Units per 100 milliliters of water). MPN is a statistical calculation of the number of colonies of bacteria whereas CFU is a direct count of the number of colonies.
*E. coli* levels in the Iowa River ranged from <10 to 10,760 MPN/100 ml with a median value of 20 MPN/100 ml. The English River had a range of 147 to 1,300 MPN/100 ml with a median value of 240 MPN/100 ml (Figure 18). None of the water samples from the English River violated the 2,880 *E. coli* standard for Class A2 waterbodies, whereas three of the samples from the Iowa River violated the 235 CFU/100 ml *E. coli* standard for Class A1 waterbodies. *E. coli* levels in both rivers were similar to those collected statewide (Figure 19).

![Figure 18. *E. coli* bacteria data from Iowa and English River sites during Project AWARE.](image)

![Figure 19. Box plot of *E. coli* values collected using field methods from Project AWARE 2006 and the Ambient Water Monitoring Program. Iowa River and English River data are reported as MPN; Ambient Water Monitoring Program data as CFU.](image)

**Summary**

Of the eleven parameters sampled during Project AWARE 2006 on the Iowa and English rivers, concentrations for most were within the range of values collected for streams statewide for Iowa’s Ambient Water Monitoring Program. Exceptions to this were dissolved oxygen, specific conductivity, and *E. coli* bacteria. The English River had slightly lower dissolved oxygen levels than those collected during the same time period by Iowa’s Ambient
Water Monitoring Program. The lower dissolved oxygen levels are of concern given some of the values are near
the warm water aquatic life standard of 5 mg/L. The lower values may be attributed to the extremely low water
levels and elevated and prolonged higher water temperatures. The monthly mean discharge (flow rate) for the
English River for June 2006 was 68.1 cfs (cubic feet/second), while the monthly mean discharge for June for 1940
through 2006 was 579 cfs. Iowa River water temperatures were similar to those sampled statewide, but flows were
below normal at 1,619 cfs compared to the monthly mean discharge of 4,690 cfs for 1959 through 2006.

Some specific conductivity values were elevated when compared to streams sampled statewide. Elevated
conductivity values occurred at sites that also had elevated levels of chloride and phosphorus. An E. coli level of
10,760 MPN/100 ml occurred at one of the Iowa River sites. This site had the highest level of the 27 sites sampled
as part of Project AWARE 2006, as well as any of the streams sampled statewide during June 2006. The site with
the elevated E. coli bacteria was located directly downstream of a municipal wastewater facility. Field observations
at this site did not note any unusual water odor or color.

For future Project AWARE events, it would be beneficial to include a tow-behind type data logger for a canoe or
boat to continuously collect data on the stretch of river as the event is being held. In addition, we recommend that
sites be monitored prior to each Project AWARE event to gather baseline data, followed by collection of data
during the trip, as well as sampling subsequent to the event. Sampling prior to the event would also allow for the
evaluation and identification of appropriate sites to be monitored.

Acknowledgements

A special thanks to Project AWARE participants, Project AWARE staff, Project AWARE sponsors, and the Project
AWARE Planning Committee for making the 4th Annual Project AWARE a successful event.

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