SECOND ANNUAL REPORT ON OPERATIONS OF RUSSELL COUNTY REGIONAL TREATMENT PLANT AND ASSOCIATED ENVIRONMENTAL MONITORING

Natural Resources and Environmental Protection Cabinet
Division of Water

September 1995
Second Annual Report on Operations of Russell County Regional Wastewater Treatment Plant and Associated Environmental Monitoring

Kentucky Department for Environmental Protection
Division of Water
Water Quality Branch

This report has been approved for release:

[Signature]
Jack A. Wilson, Director
Division of Water

9-20-1995
Date
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EXECUTIVE SUMMARY

At the conclusion of the Russell County Regional Wastewater Treatment Plant's second year of discharging to the main body of Lake Cumberland, the plant had met all regulatory requirements, and no detrimental impacts to the environment had been detected. Intensive water quality, sediment quality, and biological monitoring were conducted by both Jamestown and the Division of Water. Operations at the treatment plant were rated satisfactory by the Division in several compliance inspections, and discharge monitoring data submitted by Jamestown to the Division showed that permitted constituents, including copper, chloride, and whole effluent toxicity, were always less than permit limits. This is significant because of the large number of samples taken of the final effluent at the plant: Jamestown sampled daily for chloride, weekly for copper, quarterly (with two additional monthly samples) for whole effluent toxicity, and at least weekly for all other permitted constituents, and the Division conducted semiannual compliance sampling inspections.

Sampling of the thermally stratified lake by Jamestown and the Division in late summer and early fall of 1994 indicated low pollutant concentrations and that the effluent remains well below the surface. These plume surveys detected increased conductivity and chloride in a thin vertical layer at distances of almost 5000 feet from the diffuser, but chloride concentrations were less than 15 mg/l. Near-field samples were taken for the first time by means of divers from both the Division and Jamestown. Samples were collected directly out of the pipe and at the edge of the zone of initial dilution (7 feet) to compare field results to earlier modeling predictions from which several permit limits were derived. Chloride concentrations in the 7-foot samples were highly variable, ranging from 6 to 180 mg/l, probably because of the turbulent nature of the plume at close proximity to the discharge ports. Kentucky’s acute aquatic life criterion for chloride, applicable at the edge of the zone of initial dilution, is 1200 mg/l. Chloride samples taken from the edge of the mixing zone (70 feet) ranged from 9 to 34 mg/l. This compares to upstream control station concentrations of 1 to 4 mg/l and a chronic aquatic life water quality criterion applicable at the edge of the mixing zone of 600 mg/l. Total recoverable copper concentrations never exceeded 0.006 mg/l at any of the water quality monitoring sites outside the zone of initial dilution or 0.007 mg/l at the edge of the zone of initial dilution. These levels compare to background concentrations that were very low (0.001 to 0.003 mg/l) or undetectable, a chronic aquatic life criterion of about 0.008 to 0.010 mg/l, and an acute criterion of about 0.011 to 0.014 mg/l (copper criteria are dependent on water hardness).

Samples collected during unstratified conditions of February 1995 did not detect any increase in chlorides outside the mixing zone. Concentrations within the mixing zone were also much lower than during stratified conditions. These results were not unexpected because the lack of density differences in the receiving water allows more complete mixing of the effluent.

Studies by the Division did not detect any appreciable differences in nutrient levels or phytoplankton biomass downstream of the diffuser compared to an upstream control station. Fish tissue and sediment samples did not indicate any significant differences between samples collected upstream and downstream of the diffuser. Zooplankton densities downstream of the diffuser did show significant reduction in the fall 1994 samples, but species richness was not affected. Further decreases of nutrients and biomass in the Lily Creek embayment, which previously received the effluent via Lily Creek, were also found in the 1994 growing season. Division biologists surveyed Lily Creek upstream of the lake in June 1995 to assess changes since the discharge was relocated to the lake. While quantitative results are not yet available, it was evident that a greater diversity of macroinvertebrates was present.
INTRODUCTION

The Russell County Regional Wastewater Treatment Plant (RCRWWTP), operated by the City of Jamestown, was issued a Kentucky Pollutant Discharge Elimination System (KPDES) permit in October 1989 by the Kentucky Department for Environmental Protection (DEP), Division of Water (Division). The permit contained limits for typical components of sanitary wastewater and several constituents found in the large contribution from Union Underwear (Table 1). The limits applied to a discharge from a submerged multiport diffuser in the main body of Lake Cumberland. Final permit limits were to have taken effect on June 1, 1992. This date was required by Section 304(l) of the Clean Water Act following the Division’s decision to place Lily Creek on the list of streams not meeting a water quality standard for a priority pollutant (copper) because of a point source discharge (RCRWWTP). Until June 1, 1992, the plant was to continue discharging to Lily Creek about three miles above the lake, the same location at which it had discharged since 1981 (Figure 1).

The change in location of the discharge was necessary because water quality criteria for chloride, copper, and several other constituents became effective after Jamestown’s previous permit was issued in 1982. The RCRWWT could not meet the revised chronic aquatic life criteria for chloride, copper, or whole effluent toxicity because no dilution was available in Lily Creek during low-flow conditions. Because of the cost and technical difficulty of removing salt from the wastewater, the RCRWWT applied for a permit to discharge into the main body of Lake Cumberland, taking advantage of the large volume of dilution water available.

The Lake Cumberland Trust, a coalition of environmental organizations, appealed the permit, and the issue was placed before a Natural Resources and Environmental Protection Cabinet hearing officer in 1991. After lengthy testimony, the hearing officer recommended to the cabinet, Secretary that the copper limit be reevaluated by the Division. The hearing officer’s final opinion also stated that no significant testimony was presented indicating that the chloride allowed in the final permit would in any way degrade the water quality of the lake. An Agreed Order was signed in January 1992 that placed the issue in the hands of a Technical Advisory Committee (TAC) made up of two members of the Lake Cumberland Trust, one member each from the Town of Jamestown and Union Underwear, and the Assistant Director of the Division. After a year of extensive work, the TAC concluded that the final permit as initially issued by the Division was the proper course of action. This decision was based on evaluations of alternative treatment technologies, engineering reliability, costs, pollution prevention measures, and environmental considerations. It was noted that progress had been made toward improving effluent quality, especially copper and color. Other recommendations were that the Division prepare at least three annual reports and that Union Underwear continue waste minimization efforts. The TAC report was accepted by the Division, and the Secretary, issued an order in February 1993 that the permit become effective with conditions as recommended by the TAC. Because of the time involved for the assessment by the TAC, the effective date of the final permit was delayed one year until June 1, 1993.
Discharge through the pipeline began on April 2, 1993, and the system operated without problems until a break in the pipeline occurred on October 22, 1993. Evidence indicated that air was drawn into the pipeline, causing the pipe to flex and eventually break. The submerged portion of the pipeline was refitted with additional weights and an air trap and 8-inch vent line to ensure that any air in the pipe would be vacated. Treated wastewater was discharged at the former discharge location on the free-flowing reaches of Lily Creek for nearly four months. Union Underwear reduced dyeing operations during this time period to minimize impact to Lily Creek. The plant resumed discharge to the main lake through the diffuser on February 15, 1994, and it has operated without problems since that time.

Environmental monitoring and plant operations from March 1993 through May 1994 were presented in the first annual report (Kentucky Division of Water, 1994a). The present report covers the second year of operation following the plant upgrade and relocation of the discharge to the main lake.
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<th>Constituent</th>
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<th>Weekly Average</th>
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<td>Weekly</td>
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<tr>
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<td>6&lt;sup&gt;c&lt;/sup&gt;/16.5&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>Monthly&lt;sup&gt;f&lt;/sup&gt;</td>
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<sup>a</sup> mg/l unless noted otherwise
<sup>b</sup> Five-day carbonaceous biochemical oxygen demand
<sup>c</sup> May - October
<sup>d</sup> November - April
<sup>e</sup> Daily maximum
<sup>f</sup> First year; quarterly in subsequent years
RUSSELL COUNTY REGIONAL WASTEWATER TREATMENT PLANT

Description of Treatment Facilities and Pipeline

The RCRWWTP upgrade and expansion was completed in the summer of 1992, well before the effective date of the final permit and relocation of the discharge to the main lake. A decolorization/dechlorination basin (where chlorine is added to remove color and sulfur dioxide is then added to remove excess chlorine), a new chemical feed building, additional aeration equipment in the biological treatment (carrousel) units, floating aerators to increase dissolved oxygen in the effluent, an effluent pump station, two belt filter presses for sludge dewatering, a backup power generator, and a new operations and laboratory building were constructed (Figure 2). The new basins allowed one of the four existing biological treatment units that had been used for chlorination and decolorization to be returned to biological treatment. The effect of this construction was to increase the hydraulic capacity from 2.5 to 3.6 million gallons per day (mgd) and the retention time from 30 to 38 hours when all basins are in use.

The 24-inch pipeline was completed in the spring of 1991 but was not put into operation for two years. It follows road right-of-ways for much of its length before entering the lake near the mouth of the Lily Creek embayment (Figure 1). The pipeline then crosses the embayment and terminates in a 300-foot multiport diffuser in the main lake. The diffuser lies on the steeply sloping lake bottom and angles out slightly into the lake at an elevation of 650 feet above mean sea level (MSL) on the upstream end and 620 feet MSL on the downstream end. At normal pool elevation of 723 feet MSL, the diffuser is 73 to 103 feet deep and lies less than 100 feet horizontally from the shoreline. During the late summer and fall, the depth is usually reduced by 30 to 40 feet as the lake is gradually drawn to generate hydro-electricity. Sixteen two-inch ports spaced at 20-foot intervals distribute the wastewater in both horizontal and vertical dimensions. Following repair of the pipeline in the winter of 1994, an 8-inch vent line was added where the pipeline enters the lake to release any accumulated air (Figure 3). The underwater position of the pipeline was inspected by divers late in 1994 and found to be in excellent condition (Appendix A).

Influent from Industrial Sources

Jamestown is required to have a pretreatment program approved by the Division because industrial wastewaters are discharged into the sanitary sewer system. Union Underwear, a subsidiary of Fruit of the Loom, has a textile facility in Russell County with manufacturing, bleaching, dyeing, and sewing operations. The facility employs more than 3000 persons and supplies other Fruit of the Loom plants in the state with colored fabric. The plant has been in operation since 1981, when the RCRWWTP was constructed at its present location to handle the large volume of wastewater from Union Underwear. As in similar facilities worldwide, the dyeing operations use large amounts of salt (sodium chloride) to fix dyes in fabric. The salt then becomes a component of the wastewater, from which it is difficult and costly to remove. Copper, a component of several of the azo-dyes, is also found in the wastewater in moderately high amounts.
Figure 2. Schematic of Wastewater Flow (1993)
Russell County Regional Wastewater Treatment Plant
Jamestown, Kentucky
(Prepared by Kenvirons, Inc.)
Figure 3. Jamestown Effluent Force Main Modifications
Air Vent Manhole and Pipeline Prepared by:
Kenvirons, Inc.

NOTE: Additional concrete weights as used on Ext. 24" Line to be spaced between Submerged EBF and both sa-thal spacing is about 5'-0".
Expansion of the Union Underwear facility took place in 1987-88. Influent to the RCRWWTP increased from 1.5 to 2.0 mgd. Average salt use was expected to increase to about 35 tons per day, but the installation of several high-pressure dye pads and careful selection and use of dyes that require lower amounts of salt has currently lowered average salt use to less than 20 tons per day. The first annual report (Kentucky Division of Water, 1994a) noted that average salt use for the period from April 1993 to May 1994 was 20 to 25 tons per day, so less salt was used and discharged for the period covered by this report. Union Underwear continues to explore alternative dyes and dyeing methods to further reduce the use of salt in the dyeing process and to maximize the use of the latest generation of reduced metal dyes. Also, the addition of a cationic polymer to Union Underwear's wastewater beginning early in 1993 resulted in much lower levels of total copper and suspended solids passed on to the RCRWWTP.

Monitoring and Inspections

The RCRWWTP is required to conduct regular sampling of constituents listed in Table 1. Results are submitted monthly to the Division in discharge monitoring reports (DMRs) and entered into the permit compliance system (PCS) database. Semiannual compliance sampling inspections (CSIs) and periodic compliance evaluation inspections (CEIs) are also performed by Division regional office personnel. Biomonitoring results are obtained by personnel of the Division's Bioassay Section in conjunction with the CSIs.

Pretreatment audits or inspections are performed by Division personnel on an annual basis to determine compliance with the program. Pretreatment reports are also submitted semiannually to the Division's Pretreatment Section by the permittee. Results of extensive annual influent and effluent sample analyses are reported by the permittee in one of the semiannual reports.

Results. The DMR data from May 1994 through April 1995 are shown in Table 2. In no instances were permit limits exceeded. Monthly average concentrations ranged from 1173 to 1612 mg/l for chloride and 57 to 89 ADMI units for color. Daily maximum copper concentrations ranged from 0.029 to 0.063 mg/l. Whole effluent toxicity was always less than 4.8 acute toxicity units, and total residual chlorine was always less than 0.010 mg/l. As was noted above, both chloride and copper concentrations were generally lower for the twelve-month period covered by this report compared to the previous twelve-month period.

Inspections by Division personnel have found the plant to be operating satisfactorily. CSIs were performed in November 1994 and May 1995 (Appendix B). Biomonitoring results obtained in conjunction with the latter November 1994 CSI showed toxicity well below the permit limit (Appendix B). Less detailed CEIs conducted in September 1994 and February and March 1995 also gave satisfactory ratings.

A pretreatment audit was performed in July 1993 which indicated that Jamestown was implementing its pretreatment program efficiently and effectively. At the time of the audit, it was noted that Union Underwear had begun adding polymer to its process discharge in an effort
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* Data submitted by Town of Jamestown
to reduce the levels of copper being discharged to the RCRWWTP. The positive effect of this polymer can be seen by comparing the copper results from sampling conducted before and after polymer addition began. Influent and effluent samples taken on December 31, 1991, before polymer addition had begun, showed copper concentrations of 0.28 and 0.0466 mg/l, respectively. Influent and effluent samples taken on June 30, 1993, after polymer addition had begun, showed copper concentrations of 0.22 and 0.028 mg/l, respectively. The decrease in copper concentration in the final effluent demonstrates that the polymer is having a noticeable effect on copper removal after reaching the RCRWWTP. During the past year, Jamestown has continued its practice of adding the polymer to remove copper and copper has continued to show a gradual decline in the final effluent of the RCRWWTP. A Pretreatment Compliance Inspection conducted in November 1994 (Appendix B) and pretreatment semi-annual reports submitted to the Division in September 1994 and March 1995 have shown that Jamestown has continued to meet the requirements of all federal and state pretreatment requirements over the past year. The city performs annual inspections and semi-annual compliance monitoring of Union Underwear. The industrial user permit requires Union Underwear to perform daily self-monitoring of its effluent. Union Underwear has maintained consistent compliance with all pretreatment program requirements. This was confirmed during the most recent Pretreatment Compliance Inspection and semi-annual pretreatment reports. Currently, Jamestown and the Pretreatment Section of the Division are involved in a review of the city’s local discharge limitations. This is a routine re-evaluation which must be performed at or near the time of KPDES permit reissuance. Some of the local discharge limitations may be revised as a result of this re-evaluation.

Garment Finishers, Jamestown’s other industrial contributor, has also been in compliance with all pretreatment requirements. The 0.03 mgd of wastewater generated by the jean washing facility has had few problems with solids and color typical of this type of facility because of the recent innovation of using enzyme solution instead of stone washing to fade jeans.

ENVIRONMENTAL MONITORING

Lily Creek

The free-flowing portion of Lily Creek was sampled in March 1993 just before relocation of the outfall. Severe impacts to the creek were observed and discussed in the first annual report (Kentucky Division of Water, 1994a). Another survey was to have taken place in the spring of 1994 to document anticipated recovery of the creek after the outfall was relocated to the main body of the lake, but the pipeline break and discharge to Lily Creek at the old discharge location from October 1993 to February 1994 caused a postponement of that survey. The survey finally was made in June 1995 by Division biologists after two attempts were cancelled earlier in the spring because of heavy rains. Quantitative results are not yet available, but it was evident to the field investigators that a greater diversity of macroinvertebrates was present compared to the March 1993 survey. Complete results of the Lily Creek survey will be discussed in the third annual report.
Lake Cumberland

Water Quality. Monitoring of the lake environment was a condition of the final permit. A study plan was submitted by Jamestown and approved by the Division prior to relocation of the outfall. The study plan was revised in September 1994 based on the experience and findings of the first year of sampling. The original study plan called for quarterly water, sediment, and fish tissue samples to be collected by Jamestown at an upstream control station and several downstream stations and for the biological community to be assessed in the vicinity of the discharge. Background conditions prior to the discharge relocation to the lake were also assessed. The revised study plan reduced fish tissue and sediment sampling to semiannually, phytoplankton sampling was deleted because the first year’s sampling turned up mostly dead cells descending from the photic zone, and water quality sampling in the near- and far-field areas was re-evaluated. It was agreed that the samples at the edge of the zone of initial dilution (ZID) can be accurately collected only by SCUBA diving and that diving is practical only in the late summer to fall when the most favorable lake conditions are present (i.e., lower lake levels and better visibility). Also, far-field plume work was to be performed quarterly by Jamestown during the second year of sampling.

The Division continued its independent assessment of environmental conditions and also obtained edge-of-ZID and far-field plume dispersion samples in late summer and early fall to determine the accuracy of the plume dispersion model that was used to derive the permit limits.

Model Verification. A preliminary diving trip was made by Division personnel in August 1994. Edge-of-ZID samples were collected at two ports on August 10, and effluent, edge-of-ZID, and edge-of-mixing-zone (MZ) samples were collected at one upstream port on August 11. Effluent samples were not collected from the diffuser ports in the August sampling, but chloride analyses from daily composites of the final effluent at the RCRWWTP were available from the city.

The first (upstream), middle, and last (downstream) ports of the 300-foot long diffuser were sampled by Jamestown in September and October and by the Division in October. Different sampling methods were employed by the Division and Jamestown. Jamestown used a water hose held in the sampling locations by a diver and pumped samples to the surface; the Division filled rigid plastic bottles underwater. Samples were obtained by the Division at the 7-ft and 70-ft locations at or near the same time as the port samples. Jamestown sampled at the 70-ft location on the day or second day following the port sampling in both September and October and at the 7-ft site at the middle port in October. Data from in-lake samples not taken on the same day as the port samples should be compared with effluent concentrations found on that day at the plant. Again, daily composite chloride sample results were obtained from the city for comparison purposes.

Results of the near-field sampling are presented in Table 3. The most interesting results are from the 7-ft (edge-of-ZID) samples. Even though samples were taken at seven feet directly out from the ports, the results are highly variable, probably because of the turbulent nature of the plume this close to the ports. The variable nature of these data complicate efforts to
<table>
<thead>
<tr>
<th>Date</th>
<th>Port</th>
<th>Constituent</th>
<th>Effluent</th>
<th>7-ft</th>
<th>70-ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/10/94 (Division)</td>
<td>Upper</td>
<td>Chloride</td>
<td>1000&lt;sup&gt;b&lt;/sup&gt;</td>
<td>38</td>
<td>38&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Copper</td>
<td>0.011</td>
<td></td>
<td>0.011&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Middle</td>
<td>Chloride</td>
<td>14</td>
<td>14&lt;sup&gt;a&lt;/sup&gt;</td>
<td>14&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Copper</td>
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<td>0.003&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.003&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>8/11/94 (Division)</td>
<td>Upper</td>
<td>Chloride</td>
<td>926&lt;sup&gt;b&lt;/sup&gt;</td>
<td>11</td>
<td>29</td>
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<tr>
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<td></td>
<td>Copper</td>
<td>0.024</td>
<td>0.002</td>
<td>0.002</td>
</tr>
<tr>
<td>9/12/94 (Jamestown)</td>
<td>Upper</td>
<td>Chloride</td>
<td>970&lt;sup&gt;b&lt;/sup&gt;</td>
<td>37</td>
<td>14&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Copper</td>
<td>&lt;0.006</td>
<td>&lt;0.006&lt;sup&gt;c&lt;/sup&gt;</td>
<td>&lt;0.006&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Middle</td>
<td>Chloride</td>
<td>942</td>
<td>25</td>
<td>20&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Copper</td>
<td>&lt;0.006</td>
<td>&lt;0.006&lt;sup&gt;c&lt;/sup&gt;</td>
<td>&lt;0.006&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Lower</td>
<td>Chloride</td>
<td>940</td>
<td>85</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Copper</td>
<td>0.007</td>
<td>0.007&lt;sup&gt;c&lt;/sup&gt;</td>
<td>&lt;0.006&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>10/10/94 (Jamestown)</td>
<td>Upper</td>
<td>Chloride</td>
<td>1374&lt;sup&gt;b&lt;/sup&gt;</td>
<td>180&lt;sup&gt;d&lt;/sup&gt;</td>
<td>9&lt;sup&gt;e&lt;/sup&gt;</td>
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<tr>
<td></td>
<td></td>
<td>Copper</td>
<td>&lt;0.006&lt;sup&gt;d&lt;/sup&gt;</td>
<td>&lt;0.006&lt;sup&gt;e&lt;/sup&gt;</td>
<td>&lt;0.006&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Middle</td>
<td>Chloride</td>
<td>1408</td>
<td>17&lt;sup&gt;e&lt;/sup&gt;</td>
<td>9&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Copper</td>
<td>&lt;0.006&lt;sup&gt;c&lt;/sup&gt;</td>
<td>&lt;0.006&lt;sup&gt;c&lt;/sup&gt;</td>
<td>&lt;0.006&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Lower</td>
<td>Chloride</td>
<td>1461&lt;sup&gt;d&lt;/sup&gt;</td>
<td>155&lt;sup&gt;d&lt;/sup&gt;</td>
<td>13&lt;sup&gt;e&lt;/sup&gt;</td>
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<tr>
<td></td>
<td></td>
<td>Copper</td>
<td>&lt;0.006&lt;sup&gt;d&lt;/sup&gt;</td>
<td>&lt;0.006&lt;sup&gt;e&lt;/sup&gt;</td>
<td>&lt;0.006&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>10/11/94 (Division)</td>
<td>Upper</td>
<td>Chloride</td>
<td>1220&lt;sup&gt;b&lt;/sup&gt;</td>
<td>31</td>
<td>21</td>
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<td></td>
<td></td>
<td>Copper</td>
<td>0.015</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Middle</td>
<td>Chloride</td>
<td>1080</td>
<td>125</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Copper</td>
<td>0.016</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Lower</td>
<td>Chloride</td>
<td>6</td>
<td>6</td>
<td>6&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Copper</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
</tr>
</tbody>
</table>

<sup>a</sup> Sample not collected
<sup>b</sup> 24-hr composite effluent sample by Town of Jamestown at RCRWWTP
<sup>c</sup> Sample collected on 9/13/94; 1300 mg/l Cl<sup>-</sup> in RCRWWTP effluent
<sup>d</sup> Average of triplicate samples on 10/10/94
<sup>e</sup> Average of triplicate samples on 10/12/94; 1400 mg/l Cl<sup>-</sup> in RCRWWTP effluent
<sup>f</sup> Sample collected but dropped and lost
calibrate the model. The samples taken directly from the ports have little variability and were usually in fairly good agreement with (although always lower than) composite samples taken by the city at the RCRWWTP. The samples taken at the edge of the mixing zone (70 ft) ranged from 9 to 34 mg/l and had moderate variability. In 1995, some samples will also be taken 15 to 20 feet from the ports in order to decrease the effects of near-field turbulence and provide more consistent data for model calibration well within the mixing zone. The number of dilutions at the edge of the mixing zone ranged from 35 to 267, corresponding to chloride concentrations at 70 feet of 34 and 9 mg/l, respectively. Model predictions used by the Division to derive certain permit limits estimated 64 dilutions at the edge of the mixing zone. However, the model estimates dilution along the center line of the effluent plume, which results in a very conservative prediction of dilution when applied to the plume as a whole. The variability of the sampling results makes comparisons to model predictions difficult, but model predictions generally appear to be consistent with the data collected in 1994 and 1995.

**Plume Surveys.** During the past year, Jamestown performed plume surveys in September (late summer period), October (fall), and February (winter). Complete data are presented in Appendix C. Spring 1995 sampling will be reported in the next annual report.

In September, lake elevation during the study was about 703 to 705 feet MSL (U.S. Army Corps of Engineers, 1995a), placing the diffuser at a depth of about 54 to 84 feet. Effluent chloride concentrations determined from 24-hour composite samples at the RCRWWTP were 1150 to 1450 mg/l for that period. Chloride concentrations of 20 and 22 mg/l were detected at 70 feet and 1000 feet respectively from the diffuser at depths of 53 to 61 feet (Figure 4 and Table 4). All other sampling locations at greater distances from the diffuser had chloride concentrations no greater than 15 mg/l. Trihalomethanes were not detected at any of the sites, including the 7-ft edge-of-ZID location. Except in one 7-ft sample where 0.007 mg/l was found, copper was always less than the detection limit of 0.006 mg/l (Appendix C). Trihalomethanes were always less than the detection limit of 0.005 mg/l. Mercury was always less than the detection limit of 0.001 mg/l, including samples of 100 percent effluent taken from the end of the pipe.

Besides a 34 mg/l reading from the edge of the mixing zone, the highest chloride level found in the October plume survey was 23 mg/l at the transect 400 feet downstream of the diffuser (Figure 5 and Table 4). Concentrations remained somewhat elevated at the transect located 2000 feet downstream, but the plume did not extend laterally across the lake. As in other surveys, concentrations of copper were low at all sampling locations. The lake level was about 698 feet MSL (U.S. Army Corps of Engineers, 1995a), placing the diffuser at a depth of about 48-78 feet.

Only 4 mg/l of chloride was found at the edge of the mixing zone (70 ft) during non-stratified lake conditions of February 1995 (Table 3). All other samples were at the background level of 3 mg/l (Figure 6 and Table 4). This winter study is noteworthy because it shows that the wastewater mixes even more thoroughly in non-stratified lake conditions that exist for roughly half the year.
Figure 4. Chloride Concentrations (mg/l) in Lake Cumberland at Depth of Effluent Plume (44-69 ft), Town of Jamestown Survey, September 1994
Table 4. Chloride Concentrations (mg/l) at Depth of Effluent Plume, Town of Jamestown Surveys, September 1994, October 1994, and February, 1995

<table>
<thead>
<tr>
<th>Distance from Shoreline</th>
<th>Upstream Control Site</th>
<th>At Diffuser</th>
<th>400 ft Downstream of Diffuser</th>
<th>2000 ft Downstream of Diffuser</th>
<th>4000 ft Downstream of Diffuser</th>
<th>Near Mouth of Greasy Creek</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 ft.</td>
<td>2 3 3</td>
<td>16 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500 ft.</td>
<td>17 15 3</td>
<td>15 23 3</td>
<td>9 12 3</td>
<td>5 4 3</td>
<td>4 ND^b 3</td>
<td></td>
</tr>
<tr>
<td>1000 ft.</td>
<td>22 8</td>
<td>7 10 3</td>
<td>5 5 3</td>
<td>4 4 3</td>
<td>4 3 3</td>
<td></td>
</tr>
<tr>
<td>1500 ft.</td>
<td>6 4</td>
<td>13 5 3</td>
<td>6 6 3</td>
<td>3 4 3</td>
<td>4 6 3</td>
<td></td>
</tr>
<tr>
<td>2000 ft.</td>
<td>4</td>
<td>6 4</td>
<td>4 4</td>
<td>4 4</td>
<td>3 4</td>
<td></td>
</tr>
<tr>
<td>2500 ft.</td>
<td></td>
<td>7</td>
<td>4</td>
<td>4</td>
<td>3 3</td>
<td></td>
</tr>
<tr>
<td>3000 ft.</td>
<td></td>
<td>5</td>
<td>11</td>
<td>5</td>
<td>3 3</td>
<td></td>
</tr>
<tr>
<td>3500 ft.</td>
<td></td>
<td>5</td>
<td>11</td>
<td>5</td>
<td>4 4</td>
<td></td>
</tr>
<tr>
<td>4000 ft.</td>
<td></td>
<td>3</td>
<td>6</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4500 ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5000 ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5500 ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5800 ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{a}\) = See also Figures 4, 5 and 6

\(^{b}\) = Plume not detected
Figure 6. Chloride Concentrations (mg/l) in Lake Cumberland at Depth of Effluent Plume (50-71 ft), Town of Jamestown Survey, February 1995
The Division performed limited plume work on August 10-11, 1994. The plume was detected by specific conductivity measurements, and samples were taken for chloride and copper. The lake level during the survey was about 714 feet MSL (U.S. Army Corps of Engineers, 1995a), placing the diffuser at a depth of 64 to 94 feet. Chloride concentrations taken from 24-hour composite samples of the effluent from August 10-11 were 1000 to 1055 mg/l, and flow was in the range of 2.5 to 3.0 mgd (Town of Jamestown, 1995). Because of the large overall capacity of the treatment units, these concentrations should be relatively unchanged at any one period throughout the day.

At the upstream control station near the north shore, the chloride concentration was 10 mg/l at a depth of 69 feet, suggesting that the plume extended a short distance upstream. Evidence of the plume was not found at stations farther south along the upstream control transect (Table 5). Copper was 0.003 mg/l or less (Table 5). At a distance of 70 feet from the diffuser, at the edge of the defined mixing zone where chronic aquatic life criteria apply, the plume was found at a depth of 57 to 67 feet. The highest specific conductance measurement was 280 umhos/cm at a depth of 59 feet, with a corresponding chloride concentration of 29 mg/l and copper concentration of 0.001 mg/l. Outside the mixing zone, the highest chloride concentration was 12 mg/l at a depth of 66 feet. Copper never exceeded 0.003 mg/l at any of the stations. As was found in the previous year, there was not always a gradual decrease in chloride with increasing distance from the diffuser. While only 1 to 2 mg/l of chloride was found at distances of 500 and 1000 feet from the diffuser, about 10 mg/l was detected at a distance of 2000 feet.

Another data source confirms that the chloride plume has no overall impact to Lake Cumberland and that there is no buildup of chloride in the lake. The U.S. Army Corps of Engineers (COE) performs vertical profile surveys at several sites on the lake. From downstream to upstream, these sites are: 14 miles downstream near the Wolf Creek Dam, 5.8 miles downstream of the diffuser, 11.5 miles upstream of the diffuser, and further upstream near Somerset. Conductivity measurements taken at 5-foot intervals have revealed no discernible differences at the sites up- and downstream of the diffuser. Appendix D presents the August 1994 and June 1995 field data provided by the COE (1995b) for the lower three sites.

Sediment. Results from sediment sampling by Jamestown at three sites are presented for May and September 1994 (Tables 6 and 7). In May, Site 2 at the diffuser exhibited slightly elevated copper compared to the upstream control (Site 1). The average copper concentration of three replicates was 32.9 mg/kg at Site 2 at the diffuser, and 25.1 mg/kg at control Site 1. Nickel was also slightly elevated at Site 2 compared to the upstream sites, and mercury was slightly higher at Site 3. Other constituents including lead showed no differences between sites. In September, there was no elevated copper, nickel, mercury, or any other constituent at Site 2.

The sediment data also do not indicate a significant increase in metals in the area of the diffuser when compared to data collected the previous year or even before the discharge was moved to the main lake. In March 1993 (prior to diffuser operation), average copper concentrations were 24.5 mg/kg, while the most recent data from the spring and fall of 1994 averaged 26.9 mg/kg. Other metals also exhibited insignificant differences.
Table 5. Chloride and Copper Concentrations (mg/l) at Depth of Effluent Plume, Division of Water Survey, August 1994

<table>
<thead>
<tr>
<th>Distance from Shoreline (ft)</th>
<th>Upstream Control</th>
<th>At Diffuser</th>
<th>4000 Feet Downstream of Diffuser</th>
<th>Near Mouth of Greasy Creek</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chloride</td>
<td>Copper</td>
<td>Chloride</td>
<td>Copper</td>
</tr>
<tr>
<td>350</td>
<td>10</td>
<td>0.003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>1</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>2</td>
<td>0.002</td>
<td>4</td>
<td>0.001</td>
</tr>
<tr>
<td>1500</td>
<td></td>
<td></td>
<td>2</td>
<td>0.002</td>
</tr>
<tr>
<td>2000</td>
<td>10</td>
<td>0.001</td>
<td>4</td>
<td>0.002</td>
</tr>
<tr>
<td>2600</td>
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<td>3500</td>
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Table 6. Sediment Quality Data, May 1994

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<th>Site #2</th>
<th>Site #3</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>Sample 1 SO</td>
<td>Sample 2 SO</td>
<td>Sample 3 SO</td>
</tr>
<tr>
<td></td>
<td>#40943</td>
<td>#40945</td>
<td>#40947</td>
</tr>
<tr>
<td>Arsenic (Total) (mg/kg)</td>
<td>16.4</td>
<td>15.7</td>
<td>11.2</td>
</tr>
<tr>
<td>Copper (Total) (mg/kg)</td>
<td>26.6</td>
<td>25.4</td>
<td>23.1</td>
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<td>Lead (mg/kg)</td>
<td>28.1</td>
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<tr>
<td>Mercury (mg/kg)</td>
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<td>0.097</td>
<td>0.112</td>
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<td>Aroclor - 1016 (mg/kg)</td>
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<td>ND&lt;</td>
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<tr>
<td>Aroclor - 1221 (mg/kg)</td>
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<td>1</td>
<td>ND&lt;</td>
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<td>Aroclor - 1232 (mg/kg)</td>
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<td>ND&lt;</td>
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<td>Aroclor - 1242 (mg/kg)</td>
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<td>Aroclor - 1260 (mg/kg)</td>
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<td>ND&lt;</td>
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<td>Chlordane (Technical) (mg/kg)</td>
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<td>0.3</td>
<td>ND&lt;</td>
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<tr>
<td>Nickel (mg/kg)</td>
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<td>41.3</td>
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<td>Solids (%) (mg/kg)</td>
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<td>44</td>
</tr>
<tr>
<td>Total Organic Carbon (mg/kg)</td>
<td>DRY 181</td>
<td>DRY 193</td>
<td>DRY 287</td>
</tr>
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</table>

Site 1 located approximately one mile upstream of diffuser
Site 2 located in area of diffuser
Site 3 located approximately 4,000 ft downstream of diffuser
Table 7.  Sediment Quality Data, September 1994

<table>
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<tr>
<th>PARAMETER</th>
<th>Above Wolf Creek</th>
<th>Diffuser Area</th>
<th>Below Diffuser 4000'</th>
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<tbody>
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<td></td>
<td>Site #1</td>
<td>Site #2</td>
<td>Site #3</td>
</tr>
<tr>
<td></td>
<td>Sample 1 SO #42393</td>
<td>Sample 2 SO #42395</td>
<td>Sample 3 SO #42397</td>
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<tr>
<td></td>
<td>9/16/94</td>
<td>9/16/94</td>
<td>9/16/94</td>
</tr>
<tr>
<td>Amanita (mg/kg)</td>
<td>0.37</td>
<td>2.02</td>
<td>3.33</td>
</tr>
<tr>
<td>Copper - Total (mg/kg)</td>
<td>25.1</td>
<td>22.9</td>
<td>22.7</td>
</tr>
<tr>
<td>Lead (mg/kg)</td>
<td>23.3</td>
<td>20.3</td>
<td>19.9</td>
</tr>
<tr>
<td>Mercury (mg/kg)</td>
<td>&lt; 0.029</td>
<td>&lt; 0.029</td>
<td>&lt; 0.029</td>
</tr>
<tr>
<td>Aroclor - 1016 (mg/kg)</td>
<td>ND&lt;</td>
<td>1</td>
<td>ND&lt;</td>
</tr>
<tr>
<td>Aroclor - 1221 (mg/kg)</td>
<td>ND&lt;</td>
<td>1</td>
<td>ND&lt;</td>
</tr>
<tr>
<td>Aroclor - 1232 (mg/kg)</td>
<td>ND&lt;</td>
<td>1</td>
<td>ND&lt;</td>
</tr>
<tr>
<td>Aroclor - 1242 (mg/kg)</td>
<td>ND&lt;</td>
<td>1</td>
<td>ND&lt;</td>
</tr>
<tr>
<td>Aroclor - 1248 (mg/kg)</td>
<td>ND&lt;</td>
<td>1</td>
<td>ND&lt;</td>
</tr>
<tr>
<td>Aroclor - 1254 (mg/kg)</td>
<td>ND&lt;</td>
<td>1</td>
<td>ND&lt;</td>
</tr>
<tr>
<td>Aroclor - 1260 (mg/kg)</td>
<td>ND&lt;</td>
<td>1</td>
<td>ND&lt;</td>
</tr>
<tr>
<td>Chlordane (Technical) (mg/kg)</td>
<td>ND&lt;</td>
<td>0.3</td>
<td>ND&lt;</td>
</tr>
<tr>
<td>Nickel (mg/kg)</td>
<td>43.3</td>
<td>49.9</td>
<td>40.8</td>
</tr>
<tr>
<td>pH (S.U.)</td>
<td>6.78</td>
<td>6.87</td>
<td>6.77</td>
</tr>
<tr>
<td>Solids (%) (mg/kg)</td>
<td>44.4</td>
<td>37.8</td>
<td>46.5</td>
</tr>
<tr>
<td>Total Organic Carbon (mg/kg)</td>
<td>DRY = 427</td>
<td>DRY = 342</td>
<td>DRY = 607</td>
</tr>
</tbody>
</table>

Site 1 located approximately one mile upstream of diffuser
Site 2 located in area of diffuser
Site 3 located approximately 4,000 ft downstream of diffuser
Fish Tissue. Fish tissue samples were collected by Jamestown in May and October 1994 by gill nets placed at the depth of the diffuser and at a depth mid-way between the diffuser and the surface. The upstream control station (Station 4) was located nearly five miles up the lake near the mouth of Harmon Creek. Samples were also collected on both dates from fish taken in the area of the diffuser (Station 2) and at a site located about 4000 feet downstream of the diffuser (Station 3). Whole body samples were used for forage fish such as alewives and shad, and several of these fish were composited into a single sample when the fish were of small size. Right side fillets were taken from predator fish such as bass, gar, and walleye, and the remaining portion of the fish was used for whole body sample if the fish was of adequate size.

The sites were fished until samples were obtained, but not for more than three nights. Because some types of fish were not caught on all sample dates, the number of samples is not equal between sites and dates. Low numbers of fish, including forage fish such as shad, were taken from the lower nets on all sampling dates. (Also, very few fish were observed by divers in the vicinity of the diffuser.) This information indicates that the diffuser does not attract fish.

A total of 46 samples were analyzed. Nine samples (eight forage and one small predator) were taken from Station 2 in May, and five samples (two predators with both fillet and whole body samples off each fish, and one forage fish) were taken in October. Twelve samples (six forage fish and three predators with both whole body and fillet each) came from Station 4 in May, while 13 samples came from predators in October (fillets not could be obtained from gar). Two samples were obtained from forage fish at Station 3 in May, and five samples (two from forage fish and three from predators) were obtained in October.

There were there no apparent differences in tissue concentrations in fish from the up- and downstream sites (Appendix E). The city’s data show mercury was present in high concentrations (between 0.5 and 1.0 mg/kg) in several fish, and one composite sample of two alewives exceeded the FDA action level of 1.0 mg/kg. However, all tissue samples of sport fish were well below the FDA action level. Relatively high levels of mercury in fish have been detected in previous sampling in several areas of the lake (Kentucky Division of Water, 1994, 1992a), but data have shown that the RCRWWTP discharge is not the source of the mercury. The various isomers of PCBs and chlordane were usually at nondetectable levels, but low levels of chlordane were detected in several fish at concentrations well below the FDA action level of 0.3 ppm. A PCB isomer was detected occasionally, but levels were well below the FDA action level of 2 ppm.

Plankton. Phytoplankton sampling was deleted from the monitoring program beginning in the summer of 1994 based on the first year’s results. There was no indication of any effects of the discharge of effluent on the algal community, and sampling at depth resulted mostly in dead cells descending from the photic zone. May 1994 results showed no difference in dominant species between the three sites, and mean cell density was low (<10 cells/ml) at all three sites.
Zooplankton data from four quarterly collections from spring of 1994 through winter of 1995 at three stations are presented in Appendix F. Station 1 is the upstream control station, Station 2 is in the vicinity of the diffuser, and Station 3 is about 4000 feet downstream of the diffuser. The data indicate that there has been no detrimental influence on the zooplankton community from diffuser operation. Data from the September sampling showed no significant difference between stations in the density of organisms per cubic meter but did show a difference at the 0.01 level between the taxa. A mean number of 9.6 taxa were present at Station 3, while stations 1 and 2 had means of 17 and 17.7, respectively. The difference occurred primarily in the rotifers, which showed a decrease in mean numbers from 11 at Station 1 to 4.3 at Station 3. One possible explanation is that Station 3 was sampled late in the day and underwater light levels may have triggered some vertical movement in this group of organisms. Another possible explanation is the general patchiness of zooplankton distribution. The lack of significant difference in the density data was largely because of greater variability between replicates.

October data showed a significant difference at the 0.05 level between stations in the density of organisms. Station 1 had more than three times as many individuals as either Station 2 or 3. There was very close agreement between all stations in species richness, however. The mean number of taxa per station was 7.0, 7.0, and 6.7 for stations 1, 2, and 3, respectively. The reduction in species richness from September to October is very likely a natural seasonal decline since it occurred at all stations.

Trophic State. The Division's Water Quality Branch has monitored the Lily Creek embayment of Lake Cumberland since 1985. Monitoring was initiated to assess trophic state and the impacts to water quality from the RCRWWTP.

A comparison of chemical, physical, and biological data collected in the two years prior to the construction of the pipeline to data collected in 1993 and 1994, after the discharge had been relocated to the main lake, indicates a trend of improved water quality and overall aesthetics associated with the removal of the discharge from Lily Creek. For the past several years, the Division (1994, 1992b, 1990, 1988, 1986) has classified the Lily Creek embayment as eutrophic, and the Kentucky Department of Fish and Wildlife Resources (KDFWR) has recognized the embayment as supporting one of the better fisheries on Lake Cumberland. However, once the nutrient input ceased, chlorophyll-a, total phosphorus, and soluble reactive phosphorus decreased in 1993 and 1994 when compared to 1991 and 1992 (Table 8). Secchi disk transparency and euphotic zone depths also increased, indicating that the embayment is less eutrophic.

In May, August, and October 1994, three stations below the diffuser and a control station above the diffuser were sampled to monitor the effects on phytoplankton biomass of the diffuser discharge. These stations were located at River Mile (RM) 475.9 (control), RM 475.6 (600 feet below the diffuser), RM 475.0, and RM 474.4 of Lake Cumberland.

No significant differences were found in chlorophyll-a concentrations in seasonal samples collected in May, August, and October at three stations downstream of the diffuser when
TABLE 8. Growing Season (April - October) Averages of Chemical, Physical and Biological Parameters at Milepoint 3.8 of the Lily Creek Embayment

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Chlorophyll-a (ug/l)</td>
<td>19.8</td>
<td>25.8</td>
<td>13.5</td>
<td>10.4</td>
</tr>
<tr>
<td>Total Phosphorus (mg/l)</td>
<td>0.17</td>
<td>0.08</td>
<td>0.05</td>
<td>&lt;0.041</td>
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<tr>
<td>Soluble Reactive</td>
<td>0.117</td>
<td>0.021</td>
<td>&lt;.005</td>
<td>&lt;0.021</td>
</tr>
<tr>
<td>Phosphorus (mg/l)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Euphotic Zone (feet)</td>
<td>13.1</td>
<td>13.5</td>
<td>16.4</td>
<td>15.1</td>
</tr>
<tr>
<td>Secchi Disk Transparency</td>
<td>3.0</td>
<td>3.1</td>
<td>4.2</td>
<td>4.3</td>
</tr>
</tbody>
</table>

*Discharge relocated to main lake prior to 1993 growing season.

compared to the control station (RM 475.9). Little or no difference in 1993 and 1994 was found in the concentrations of nutrients and other selected parameters sampled below the diffuser when compared to the control station. Thus, after two years of trophic state and physical-chemical monitoring, there appears to be very little effect on the biomass in the main lake as a result of the discharge. This is because the concentrations of nutrients are rapidly diluted and remain below the photic zone. This was also demonstrated by higher conductivity measurements downstream of the diffuser at the depth of the diffuser throughout the growing season, indicating that the effluent remains mostly below the photic zone.

Creel Survey. The Kentucky Department of Fish and Wildlife Resources (KDFWR) conducts creel surveys in the Lily Creek area of the lake in even-numbered years. At the request of the Division of Water, data from the Lily Creek embayment were separated from other survey areas in 1994 and submitted to the Division (KDFWR, 1995). The purpose of the request was to monitor the impact on the sport fishery of the Lily Creek embayment once the discharge was relocated to the main body of the lake. The embayment had once been one of the better fisheries on Lake Cumberland, but it is expected that the loss of nutrient input from the RCRWWTP discharge will decrease productivity (see discussion above on trophic state) and eventually adversely affect the sport fishery. The information presented below is a baseline against which future data will be compared.

Lily Creek anglers fished a total of 15,249 man-hours (105.9 hours per acre) and made 5083 trips (Table 9). Anglers caught 10,489 fish, of which 1878 fish totalling 1757 pounds were harvested. The overall catch rate for all fish species was about one fish per 1.4 hours of fishing (0.69 fish per hour). The overall harvest rate was about one fish per 8.3 hours of fishing (0.12 fish per hour). Striped bass comprised more than 93 percent of the weight harvested (1643 pounds), followed by black bass (5 percent) and panfish (2 percent). Panfish, mostly bluegill and longear sunfish, accounted for more than one half of the numbers harvested, followed by striped bass and black bass.
Table 9. Fish harvest statistics for the Lily Creek embayment (144 acres) derived from a creel survey in Lake Cumberland from 8 February - 31 December 1994.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Value</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Fishing trips</td>
<td>Number of fishing trips (per acre)</td>
<td>5,083</td>
<td>35.3</td>
</tr>
<tr>
<td>Fishing pressure</td>
<td>Total man-hours (R.S.E.)</td>
<td>15,249</td>
<td>11.3</td>
</tr>
<tr>
<td></td>
<td>Man hours/acre</td>
<td>105.9</td>
<td></td>
</tr>
<tr>
<td>Catch/harvest</td>
<td>Number of fish caught (S.E.)</td>
<td>10,489</td>
<td>3,873</td>
</tr>
<tr>
<td></td>
<td>Number of fish harvested (S.E.)</td>
<td>1,878</td>
<td>965</td>
</tr>
<tr>
<td></td>
<td>Pounds of fish harvested</td>
<td>1,757</td>
<td></td>
</tr>
<tr>
<td>Harvest rates</td>
<td>Fish/hour</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pounds/hour</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fish/acre</td>
<td>13.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pounds/acre</td>
<td>12.2</td>
<td></td>
</tr>
<tr>
<td>Catch rates</td>
<td>Fish/hour</td>
<td>0.69</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fish/acre</td>
<td>72.8</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous characteristics (%)</td>
<td>Male</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Resident</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-resident</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Method (%)</td>
<td>Still fishing</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Casting</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trolling</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Live bait (Striped bass fishermen)</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

Source: Kentucky Department of Fish and Wildlife Resources (1995)
CONCLUSIONS

The second year of operation at the Russell County Regional Wastewater Treatment Plant following an expansion and upgrade of treatment facilities and relocation of the discharge to Lake Cumberland in April 1993 was marked by compliance with all regulatory requirements and no demonstrable impacts to Lake Cumberland as observed through environmental monitoring by both Jamestown and the Division of Water. Data submitted by Jamestown and inspections conducted by the Division indicated that the facility operated satisfactorily. Monitoring in the lake of water quality, fish tissue, sediment quality, and plankton indicated no environmental problems associated with the discharge. Studies conducted by Jamestown and the Division of Water showed chloride concentrations in the lake were less than 200 mg/l at the edge of the zone of initial dilution (7 feet from the end of the nozzles) and less than 40 mg/l at the edge of the mixing zone (70 feet from the nozzles). Other constituents of the wastewater, including metals and trihalomethanes, were again found in very low or undetectable concentrations in the lake. As has been found in all previous environmental monitoring, the highest concentrations were found in a thin vertical layer during stratified lake conditions. During winter when the waters of the lake are not stratified by temperature and density differences, the plume was barely detectable outside the mixing zone.
REFERENCES


APPENDIX A
PIPELINE INSPECTION
December 28, 1994

Kenvirons, Inc.
Attn: Harold Snodgrass
452 Versailles Rd.
Frankfort, KY. 40601

Re: Report/Inspection of 24 Inch Pipeline.

Diver enters water at flange between pipe and diffuser; diver inspects bolts at flange, bolts in satisfactory condition. Diver reports pipeline has not moved.

Throughout the total of all dives, this pipeline is in satisfactory condition and also pipeline has not moved since the installation of the weights. Diver took pneumo shots every (5) five feet on top of the vent pipe. The vent pipe has a positive flow from the 54 inch to surface. The 54 inch pipe has not moved.

Overall, the pipeline is in excellent condition.

Reported By:

Derek D. Bivins

DB/db
APPENDIX B

DIVISION OF WATER COMPLIANCE

SAMPLING INSPECTIONS AND BIOMONITORING RESULTS
January 23, 1995

Honorable Donnie Wilkerson
Mayor City of Jamestown
Monument Square Box 587
Jamestown, Kentucky 42629

RE: Russell County Regional WWTP
KY0062995

Dear Mayor Wilkerson:

Please find enclosed your copy of the Compliance Sampling Inspection Report (including appropriate laboratory reports) conducted by James S. Woody of the Kentucky Division of Water at the Russell County Regional Wastewater Treatment Plant in Russell County, Kentucky on November 30, 1995. At the time of inspection your facility received a rating of Satisfactory. The analytical data from this inspection indicates compliance with your facility's KPDES permit.

If you have any questions regarding this report, please feel free to contact this office.

Sincerely,

Sara E. Gold, Supervisor
Division of Water
Columbia Regional Office
P. O. Box 335
Columbia, Kentucky 42728
Phone: (502) 384-4734

Enclosure

cc: KPDES Branch, Division of Water
Frankfort Central Office files
Columbia Regional Office files
Division of Environmental Services  
Report Number: A02-15240  
Sample Number: 9404755

TO: Division of Water  
   Frankfort Office Park  
   Frankfort, Kentucky 40601

ATTN: Sam Lester  
County: Russell

RE: Russell County Regional WWTP
Facility: KY0062995
Date: 11/30/94  Time: 0915
Date: 11/30/94  Time: 1300
Date: 11/30/94  Time: 1300
Collection Method: Composite

Sample Identification: J11 Influent

REPORT OF ANALYSIS

<table>
<thead>
<tr>
<th>TOTAL CONSTITUENTS</th>
<th>CONCENTRATION</th>
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</thead>
<tbody>
<tr>
<td>BOD-5</td>
<td>278 mg/L</td>
</tr>
<tr>
<td>Chloride</td>
<td>1,210 mg/L</td>
</tr>
<tr>
<td>Color, Filtered @ ambient pH</td>
<td>996 ADH1 Color Units</td>
</tr>
<tr>
<td>Color, Filtered @ pH = 7.6</td>
<td>1,110 ADH1 Color Units</td>
</tr>
<tr>
<td>pH</td>
<td>7.4 S.U.</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>320 mg/L</td>
</tr>
<tr>
<td>Ammonia-Nitrogen</td>
<td>4.7 mg/L</td>
</tr>
<tr>
<td>Copper</td>
<td>0.113 mg/L</td>
</tr>
</tbody>
</table>

This report has been prepared and reviewed by personnel within the Division of Environmental Services. It has been approved for release.

[Signature]
William E. Davis, Director  
Division of Environmental Services
TO: Division of Water  
Frankfort Office Park  
Frankfort, Kentucky 40601  

ATTN: Sam Lester  
County: Russell  
Collected by: James S. Woody  
Delivered by: James S. Woody  
Received by: Polly Baker  
Sample Matrix: Water  

RE: Russell County Regional WWTP  
Facility: KY0062995  
Date: 11/30/94 Time: 0920  
Date: 11/30/94 Time: 1300  
Date: 11/30/94 Time: 1300  
Collection Method: Composite  

Sample Identification: J1 Effluent to pipeline  

REPORT OF ANALYSIS  

<table>
<thead>
<tr>
<th>TOTAL CONSTITUENTS</th>
<th>CONCENTRATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD-5</td>
<td>8.3 mg/L</td>
</tr>
<tr>
<td>Chloride</td>
<td>622 mg/L</td>
</tr>
<tr>
<td>Color, Filtered &amp; ambient pH</td>
<td>37.9 ADHI Color Units</td>
</tr>
<tr>
<td>Color, Filtered @ pH = 7.6</td>
<td>27.9 ADHI Color Units</td>
</tr>
<tr>
<td>pH</td>
<td>7.0 S.U.</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>22 mg/L</td>
</tr>
<tr>
<td>Ammonia-Nitrogen</td>
<td>0.2 mg/L</td>
</tr>
<tr>
<td>Copper</td>
<td>0.018 mg/L</td>
</tr>
</tbody>
</table>

This report has been prepared and reviewed by personnel within the Division of Environmental Services. It has been approved for release.

William E. Davis, Director  
Division of Environmental Services
January 19, 1995

Division of Environmental Services
Report Number: A02-15239
Sample Number: 9404754

TO: Division of Water
Frankfort Office Park
Frankfort, Kentucky 40601

ATTN: Sam Lester
County: Russell
Collected by: James S. Woody
Delivered by: James S. Woody
Received by: Polly Baker
Sample Matrix: Water

RE: Russell County Regional WWTP
Facility: KY0062995
Date: 11/30/94  Time: 0920
Date: 11/30/94  Time: 1300
Date: 11/30/94  Time: 1300
Collection Method: Composite

Sample Identification: JE1 Effluent to pipeline

REPORT OF ANALYSIS

<table>
<thead>
<tr>
<th>TOTAL CONSTITUENTS</th>
<th>CONCENTRATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>8.3 mg/L</td>
</tr>
<tr>
<td>Chloride</td>
<td>822 mg/L</td>
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<tr>
<td>Color, Filtered @ ambient pH</td>
<td>37.9 ADHI Color Units</td>
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<td>Color, Filtered @ pH = 7.6</td>
<td>27.9 ADHI Color Units</td>
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<tr>
<td>pH</td>
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<tr>
<td>Total Suspended Solids</td>
<td>22 mg/L</td>
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<tr>
<td>Ammonia-Nitrogen</td>
<td>0.2 mg/L</td>
</tr>
<tr>
<td>Copper</td>
<td>0.018 mg/L</td>
</tr>
</tbody>
</table>

This report has been prepared and reviewed by personnel within the Division of Environmental Services. It has been approved for release.

William E. Davis, Director
Division of Environmental Services
February 10, 1995

Honorable Donnie Wilkerson
Mayor, City of Jamestown
Monument Square Box 587
Jamestown, Kentucky 42629

RE: Russell County Regional STP
KPDES NO. KY0062995
Russell County

Dear Mayor Wilkerson:

Please find enclosed your copy of a Compliance Evaluation Inspection conducted by James S. Woody of the Kentucky Division of Water at the above referenced treatment plant on February 1, 1995. At the time of inspection your facility received a rating of Satisfactory.

If you have any questions regarding this report, please feel free to contact this office.

Sincerely,

Sara E. Gold, Supervisor
Division of Water
P. O. Box 335
Columbia, Kentucky 42728
Phone: (502) 384-4734

SEG: bjb

Enclosure

cc: KPDES Branch, Division of Water
Frankfort Central Office files
Columbia Regional Office files
Honorable Donnie Wilkerson
Mayor, City of Jamestown
Monument Square Box 587
Jamestown, Kentucky 42629

RE: Russell County Regional WWTP
KPDES NO. KY0062995
Russell County

Dear Mayor Wilkerson:

Please find enclosed your copy of a Compliance Evaluation Inspection conducted by James S. Woody of the Kentucky Division of Water at the above referenced treatment plant on March 10, 1995. At the time of inspection your facility received a rating of Satisfactory.

If you have any questions regarding this report, please feel free to contact this office.

Sincerely,

[Signature]
Sara E. Gold, Supervisor
Division of Water
P. O. Box 335
Columbia, Kentucky 42728
Phone: (502) 384-4734

SEG: bjb

Enclosure

cc: KPDES Branch, Division of Water
Frankfort Central Office files
Columbia Regional Office files
Mr. Terry Lawless, Supervisor  
Public Works  
City of Jamestown  
P. O. Box 99  
Jamestown, KY 42629  

RE: Jamestown/Russell County WWTP (KY 0062995) Biomonitoring Tests  
Performed by the Kentucky Division of Water, Bioassay Section  

Dear Mr. Lawless:  

Enclosed please find biomonitoring data for your facility, as determined by the Kentucky Division of Water, Bioassay Section.  

The enclosed data is the summary of the acute toxicity tests completed on May 26, 1995 using the fathead minnow (Pimephales promelas) and the Daphnid (Ceriodaphnia dubia). Samples were four grabs collected on May 23 and 24, 1995. The results indicate no acute toxicity in any grab sample with both test species, LC₅ₐ >21% (TU₅ < 4.8). Samples were also tested at 100% effluent which again showed no toxicity to either species.  

Please call if you have any questions regarding this report.  

Sincerely,  

Charles A. Roth, Supervisor  
Bioassay Section  
Water Quality Branch  

Enclosure  

CAR: dh  
c: Sara Gold, Columbia Regional Office  
Bob Rogers, Pretreatment Section  
Walter, Water Quality Branch  
DOW Files
### Acute 96 Hour Toxicity Test

<table>
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<th>Start Date</th>
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<td>KY0062995</td>
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<tr>
<td>End Date</td>
<td>Protocol ID</td>
<td>Sample Type</td>
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<td>26 May-95 14:00</td>
<td>EPAF 91</td>
<td>EFF1 POTW</td>
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<tr>
<td>Sample Date</td>
<td>Analyst Name</td>
<td>Test Species</td>
</tr>
<tr>
<td>24 May-95</td>
<td>CAR, LAC, SLC, BI</td>
<td>CD Ceriodaphnia dubia</td>
</tr>
<tr>
<td>Comments</td>
<td>Response</td>
<td></td>
</tr>
<tr>
<td>JAMESTOWN/RUSSELL CO. STP</td>
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#### Group ID

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**End Date:** 26 May-95 14:00  
**Protocol ID:** EPAF 91  
**Sample Type:** EFF1 POTW  
**Sample Date:** 24 May-95  
**Analyst Name:** CAR LAC SLC BK  
**Species:** PP Pimephales promelas  
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</table>
Honoroble Donnie Wilkerson
Mayor City of Jamestown
Monument Square Box 587
Jamestown, Kentucky 42629

RE: Russell County Regional WWTP
KY0062995

Dear Mayor Wilkerson:

Please find enclosed your copy of the Compliance Sampling Inspection Report (including appropriate laboratory reports) conducted by James S. Woody of the Kentucky Division of Water at the Russell County Regional Wastewater Treatment Plant in Russell County, Kentucky on May 24, 1995. At the time of inspection your facility received a rating of Satisfactory. The analytical data from this inspection indicates compliance with your facility’s KPDES permit.

If you have any questions regarding this report, please feel free to contact this office.

Sincerely,

Sara E. Gold, Supervisor
Division of Water
Columbia Regional Office
P. O. Box 335
Columbia, Kentucky 42728
Phone: (502) 384-4734

SEG/bjb

Enclosure

cc: KPDES Branch, Division of Water
    Frankfort Central Office files
    Columbia Regional Office files
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DIVISION OF WATER

WASTEWATER TREATMENT PLANT INSPECTION REPORT

Facility Name: Russell Lo Be WTP
County: Russell

TRAN CODE KPD# 1 2 3 4 X# MD QA TYPE INSPECTOR FACT TYPE
N 5 KY 0 D 6 2 9 1 5 1 9 5 0 5 2 4 5 5 1

RATING: 5

REMARKS

RATING CODES: S = Satisfactory; U = Unsatisfactory; M = Marginal; OUT = Out of Operation

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<th>CONDITION / APPEARANCE</th>
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<td>Sludge Removal / return</td>
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<td>Aeration Tank(s)</td>
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<td>Lagoon(s)</td>
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<td>Filter(s)</td>
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<td>Digesters</td>
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<td>Stream</td>
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SUMMARY OF FINDINGS / GENERAL COMMENTS

24 Hr CS1 & Bio monitoring
Effluent to pipeline
pH 7.6 D.O. 75 temp 25°
Fecal coliform <2/100 ml
See attached results

IDENTIFICATION SECTION

On-Site Representative Name: Otis Stagg, Calvin Johnson
Owner or Responsible Party Title: City of Jamestown
Person(s) Contacted: Same
Inspector's Signature: James S. Groody
COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF ENVIRONMENTAL SERVICES
100 SOWER BOULEVARD
SUITE 104
FRANKFORT, KY 40601

June 27, 1995

Division of Environmental Services
Report Number: A02-15520
Sample Number: 9501652

To: Division of Water
Frankfort Office Park
Frankfort, Kentucky 40601

Re: Russell County Regional WWTP

Attn: Sam Lester
County: Russell
Collected by: James Woody
Delivered by: Betty Beshoar
Received by: Polly Baker
Sample Matrix: Water

Sample Identification: Jamestown 24 hour composite effluent to pipeline

REPORT OF ANALYSIS

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<th>TOTAL CONSTITUENTS</th>
<th>CONCENTRATION</th>
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<td>BOD-5</td>
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<td>856 mg/L</td>
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<td>Color, Filtered @ ambient pH</td>
<td>31.1 ADMI Color Units</td>
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<td>34.7 ADMI Color Units</td>
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<tr>
<td>Copper</td>
<td>0.014 mg/L</td>
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</tbody>
</table>

ND = Not Detected

This report has been prepared and reviewed by personnel within the Division of Environmental Services. It has been approved for release.

William E. Davis, Director
Division of Environmental Services
To: Division of Water
Frankfort Office Park
Frankfort, Kentucky 40601

Attn: Sam Lester

County: Russell

Collected by: James Woody
Delivered by: Betty Beshoar
Received by: Polly Baker
Sample Matrix: Water

Sample Identification: Jamestown Influent 24 Hour Composite CSI

REPORT OF ANALYSIS

<table>
<thead>
<tr>
<th>TOTAL CONSTITUENTS</th>
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<td>BOD-5</td>
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<td>Color, Filtered @ ambient pH</td>
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<td>Copper</td>
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Re: Russell County Regional WWTP

Facility: KY0062995

Date: 05/24/95 Time: 0930

Date: 05/24/95 Time: 1340

Date: 05/24/95 Time: 1340

Collection Method: Composite

This report has been prepared and reviewed by personnel within the Division of Environmental Services. It has been approved for release.

William E. Davis, Director
Division of Environmental Services
November 17, 1994

Terry Lawless, Public Works Director
City of Jamestown
P.O. Box 99
Jamestown, Kentucky 42629

Re: Pretreatment Compliance Inspection (PCI)
City of Jamestown
KPDES No.: KY0062995
Russell County

Dear Mr. Lawless:

This is to inform you of the findings of the PCI conducted in Jamestown on November 15, 1994. The inspection indicated that your Pretreatment Program is being implemented efficiently. Both significant industrial users (SIUs) are operating under adequate permits, and have been sampled and inspected. Also, the Enforcement Response Plan (ERP) is being implemented when necessary.

I commend you and the city of Jamestown for your diligence in implementing an exemplary pretreatment program. Your thorough monitoring program has resulted in effective pretreatment on the part of your industries.

Attached is a general summary describing the findings of the PCI. Thank you for your cooperation and patience during this inspection and should you have any questions regarding this matter, please contact me at (502) 564-2225, extension 459.

Sincerely,

Sandra Grzesky, P.E.
Environmental Engineer
Pretreatment Section
KPDES Branch
Division of Water

SG:mm

Attachment

c: Cynthia Brumfield, Hall & Associates, Inc.
Columbia Regional Office
Municipal Compliance Section
Division of Water Files
APPENDIX C
WATER QUALITY DATA
## CITY OF JAMESTOWN
### SAMPLING RESULTS

#### WATER

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>UNITS</th>
<th>Above Wolf Creek</th>
<th>Out of Nozzle</th>
<th>7' From End of Nozzle</th>
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<tr>
<td></td>
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<td>Site #1</td>
<td>Site #2</td>
<td>Site #2</td>
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<td></td>
<td>Background #42391 Sample 1 SW #42392 Sample 2 SW Sample 3 SW</td>
<td>D-1 SW #42385 D-2 SW #42386 D-3 SW #42387</td>
<td>D-1 SW #42388 D-2 SW #42389 D-3 SW #42390</td>
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<tr>
<td>Arsenic</td>
<td>mg/l</td>
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<td>&lt; 0.006 &lt; 0.006 0.007</td>
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<td>0.01 &lt; 0.006 &lt; 0.006</td>
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<td>ND &lt; 5</td>
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<td>ND &lt; 5</td>
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<td>Chlorodibromomethane</td>
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**FIELD**

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<tr>
<th>PARAMETER</th>
<th>UNITS</th>
<th>Above Wolf Creek</th>
<th>Out of Nozzle</th>
<th>7' From End of Nozzle</th>
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<td></td>
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<td>Site #1</td>
<td>Site #2</td>
<td>Site #2</td>
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<tr>
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<td>Background #42391 Sample 1 SW #42392 Sample 2 SW Sample 3 SW</td>
<td>D-1 SW #42385 D-2 SW #42386 D-3 SW #42387</td>
<td>D-1 SW #42388 D-2 SW #42389 D-3 SW #42390</td>
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<td>7.31 7.36 7.47</td>
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<td>UMHO/cm</td>
<td>153 175 146</td>
<td>169 151 179</td>
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<tr>
<td>Bromodichloromethane</td>
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<td>ND&lt; 5 ND&lt; 5 ND&lt; 5</td>
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<tr>
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<td>ND&lt; 5 ND&lt; 5 ND&lt; 5</td>
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</tr>
</tbody>
</table>

**FIELD**

| pH                | S.U.  | 7.7 7.53 6.98 | 7.19 | 7.55 7.88 7.88 | 7.82 |              |
| Temp.             | Deg. C | 17.6 17.5 14  | 15.2 | 14.2 20 19.8 | 20.3 |              |
| O.                | mg/l  | 0.84 1.04 2.8 | 2.18 | 1.84 0.82 0.78 | 0.51 |              |
| Cond.             | MHOM/cm | 0.242 0.274 0.248 | 0.258 | 0.19 0.182 0.184 | 0.184 |              |
| Chlorides         | mg/l  | 45 65 53 | 40 | 12.5 2.5 4 | 6 |              |
| Depth             | ft.   | 50 53 67.6 | 61 | 68 49 60 | 50 |              |
# CITY OF JAMESTOWN
## SAMPLING RESULTS
### WATER

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>UNITS</th>
<th>Site #3</th>
<th>Site #3</th>
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<td>&lt; 0.006</td>
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<td>su</td>
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<td>6.85</td>
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<tr>
<td>Specific Conductivity</td>
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<td>119</td>
<td>130</td>
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<td>Bromodichloromethane</td>
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<tr>
<td>Bromoform</td>
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<td>Chlorodibromomethane</td>
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<tr>
<td>Chloroform</td>
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<td>mg/l</td>
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<tr>
<td>Cond.</td>
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# CITY OF JAMESTOWN
## SAMPLING RESULTS
### WATER

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## CITY OF JAMESTOWN
### SAMPLING RESULTS

### WATER

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<td>Sample 2</td>
<td>Sample 3</td>
<td>Sample 1</td>
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<td>#42686</td>
<td>#42687</td>
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<td>140</td>
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<td>&lt; 0.01</td>
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<td>15.9</td>
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<td>DO (mg/L)</td>
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<td>0.80</td>
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<td>Cond. (MHO/cm)</td>
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<td>196</td>
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<td>9.5</td>
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<td>Depth (ft.)</td>
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## CITY OF JAMESTOWN
### SAMPLING RESULTS

### WATER

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<th>1000' Lake C</th>
<th>500' 60' Deep</th>
<th>500' Site #3</th>
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<tr>
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<td>Transect 3</td>
<td>Transect 4</td>
<td>Transect 5</td>
<td>Sample 1</td>
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<td>#42970</td>
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<td>&lt; 0.005</td>
<td>&lt; 0.005</td>
<td>&lt; 0.005</td>
<td>&lt; 0.005</td>
<td>&lt; 0.025</td>
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<td>Chloride (mg/L)</td>
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<td>&lt; 0.006</td>
<td>&lt; 0.006</td>
<td>&lt; 0.006</td>
<td>&lt; 0.006</td>
<td>&lt; 0.006</td>
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<td>&lt; 0.001</td>
<td>&lt; 0.001</td>
<td>&lt; 0.001</td>
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<td>&lt; 0.01</td>
<td>&lt; 0.01</td>
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<td>1.1</td>
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<td>23</td>
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## CITY OF JAMESTOWN
### SAMPLING RESULTS

### WATER

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<tr>
<th>PARAMETER</th>
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<th>Above Wolf Creek</th>
<th>7' From End of Nozzle</th>
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<td>Site #1</td>
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<td>Arsenic - Total</td>
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<td>&lt; 0.005</td>
<td>&lt; 0.005</td>
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<tr>
<td>Copper - Total</td>
<td>mg/l</td>
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<td>&lt; 0.006</td>
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<tr>
<td>Lead - Total</td>
<td>mg/l</td>
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<td>&lt; 0.001</td>
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<tr>
<td>Nickel - Total</td>
<td>mg/l</td>
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<td>Temp.</td>
<td>Deg. C</td>
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<td>Cond.</td>
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<tr>
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<td>Depth</td>
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### CITY OF JAMESTOWN
### SAMPLING RESULTS
### WATER

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<tr>
<td>Copper - Total</td>
<td>mg/l</td>
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<td>5.7 Deg C</td>
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Note: All values are below the detection limit (B.D.L.).
CITY OF JAMESTOWN
SAMPLING RESULTS

WATER

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<tr>
<td>Copper - Total</td>
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<td>Mercury - Total</td>
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<td>&lt; 0.001</td>
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APPENDIX D

VERTICAL PROFILE DATA FROM THE
U.S. ARMY CORPS OF ENGINEERS AT
THREE SITES IN LAKE CUMBERLAND
August 1994
June 1995
Site at River Mile 487.0, approximately 11 miles upstream of RCRWWTP discharge, 8/30/94

CUMBERLAND RIVER BASIN  LAKE CUMBERLAND  052000  CUMBERLAND RIVER, MILLE 487.0  KENTUCKY  STAT 3WOL20004

DATE: 30 AUG 94  TIME: 1330NOMINAL  00078 SECCHI: 3.7  72020 ELEV  AB.MSL: 708.1

272002 MAX  DEPTH: 141

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<td>00415 P.Alk</td>
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<td>00500 T.Solids</td>
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<td>00505 V.Solids</td>
<td>18</td>
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<td>00515 D.Solids</td>
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Site at River Mile 461.4 at dam, 14 miles downstream of RCRWWTP discharge, 6/20/95

SUM AURAS WATER QUALITY DATA
NASHVILLE DISTRICT CORPS OF ENGINEERS
CUMBERLAND RIVER BASIN LAKE CUMBERLAND 052000 CUMBERLAND RIVER, MILE 461.4 KENTUCKY STAT 3WOL20002

DATE: 20 JUN 95 TIME: 1300 NOMINAL
72025 MAX DEPTH: 182
72020 SECCHI ELEV: 5.4 72020 ELEV: AB.MSL: 723.1

RESULTS OF LABORATORY ANALYSES

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APPENDIX E
FISH TISSUE DATA
## FISH TISSUE ANALYSIS - SAMPLING PERIOD
### STATION 2

**May 17 - 19, 1994**

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<th>Station 2 20 Alewives Avg. 9 cm</th>
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<tr>
<td><strong>Total Nickel (ICP)</strong></td>
<td>mg/kg</td>
<td>&lt;2.000</td>
<td>&lt;2.000</td>
<td>&lt;2.000</td>
<td>&lt;2.000</td>
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<td>&lt;2.000</td>
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<tr>
<td><strong>Total Lead (ICP)</strong></td>
<td>mg/kg</td>
<td>&lt;10.000</td>
<td>&lt;10.000</td>
<td>&lt;10.000</td>
<td>&lt;10.000</td>
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</table>
# FISH TISSUE ANALYSIS - SAMPLING PERIOD
## STATION 4

<table>
<thead>
<tr>
<th></th>
<th>Station 4 20 Alewives Avg 9.5 cm</th>
<th>Station 4 20 Alewives Avg 9.5 cm</th>
<th>Station 4 3 Alewives 18 cm</th>
<th>Station 4 20 Alewives 9 cm</th>
<th>Station 4 18, 19.5 cm</th>
<th>Station 4 Walleye Fillet</th>
<th>Station 4 Walleye, Whole Body, 3 lb</th>
<th>Station 4 Catfish Fillet, 3.75 lb</th>
<th>Station 4 Catfish, Whole Body, 3.75 lb</th>
<th>Station 4 Catfish, Whole Body, 3 lb</th>
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<tbody>
<tr>
<td>Chloride</td>
<td>mg/kg</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
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<td>&lt;0.050</td>
<td>&lt;0.050</td>
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<tr>
<td>Oxychloride</td>
<td>mg/kg</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
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</tr>
<tr>
<td>Trans-chloride</td>
<td>mg/kg</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
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<td>&lt;0.050</td>
<td>&lt;0.050</td>
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<tr>
<td>Cis-chloride</td>
<td>mg/kg</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
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<td>Trans-nonachlor</td>
<td>mg/kg</td>
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<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
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<tr>
<td>Alpha-chloride</td>
<td>mg/kg</td>
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<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
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<tr>
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<td>&lt;0.050</td>
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<td>Gamma-chloride</td>
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<td>&lt;0.050</td>
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<td>&lt;0.050</td>
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<td>&lt;0.050</td>
<td>&lt;0.050</td>
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<tr>
<td>PCB, Aroclor-1016/1242</td>
<td>mg/kg</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
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<tr>
<td>PCB, Aroclor-1232</td>
<td>mg/kg</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
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<tr>
<td>PCB, Aroclor-1248</td>
<td>mg/kg</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
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<td>&lt;0.250</td>
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<tr>
<td>PCB, Aroclor-1254</td>
<td>mg/kg</td>
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<td>&lt;0.250</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
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<td>&lt;0.250</td>
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<tr>
<td>PCB, Aroclor-1260</td>
<td>mg/kg</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
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<tr>
<td>Lipids, Total</td>
<td>% Total Wt.</td>
<td>8.000</td>
<td>8.000</td>
<td>5.000</td>
<td>8.000</td>
<td>3.000</td>
<td>3.000</td>
<td>3.000</td>
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<tr>
<td>Total Arsenic</td>
<td>mg/kg</td>
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<td>&lt;0.100</td>
<td>&lt;0.100</td>
<td>&lt;0.100</td>
<td>&lt;0.100</td>
<td>&lt;0.100</td>
<td>&lt;0.100</td>
<td>&lt;0.100</td>
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<tr>
<td>Total Copper</td>
<td>mg/kg</td>
<td>&lt;1.000</td>
<td>&lt;1.000</td>
<td>&lt;1.000</td>
<td>&lt;1.000</td>
<td>&lt;1.000</td>
<td>&lt;1.000</td>
<td>&lt;1.000</td>
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<tr>
<td>Total Mercury</td>
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<td>0.210</td>
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<td>Total Lead</td>
<td>mg/kg</td>
<td>&lt;10.000</td>
<td>&lt;10.000</td>
<td>&lt;10.000</td>
<td>&lt;10.000</td>
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<td></td>
<td>October 19 - 20, 1994</td>
<td>Station 2 3 lb Catfish Fillet</td>
<td>Station 2 3 lb Catfish Whole Body</td>
<td>Station 2 3 lb 12 oz. Catfish Whole Body</td>
<td>Station 2 3 lb 12 oz. Catfish Fillet</td>
<td>Station 2 30 cm Shad Whole Body</td>
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<td>&lt;0.050</td>
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<td>Oxychlordane</td>
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<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
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<tr>
<td>Trans-chlordane</td>
<td>mg/kg</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
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<tr>
<td>Cis-chlordane</td>
<td>mg/kg</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
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<td>Trans-nonachlor</td>
<td>mg/kg</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
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<td>Alpha-chlordene</td>
<td>mg/kg</td>
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<td>&lt;0.050</td>
<td>&lt;0.050</td>
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<tr>
<td>Chlordene</td>
<td>mg/kg</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
<td>&lt;0.050</td>
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<td>&lt;0.050</td>
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<td>&lt;0.050</td>
<td>&lt;0.050</td>
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<td>&lt;0.050</td>
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<tr>
<td>PCB, Aroclor-1016/1242</td>
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<td>&lt;0.500</td>
<td>&lt;0.750</td>
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<td>&lt;0.250</td>
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<td>PCB, Aroclor</td>
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<td>&lt;0.500</td>
<td>&lt;0.750</td>
<td>&lt;0.250</td>
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<td>PCB, Aroclor-1232</td>
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<td>&lt;0.500</td>
<td>&lt;0.500</td>
<td>&lt;0.750</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
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<td>PCB, Aroclor-1248</td>
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<td>&lt;0.750</td>
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<td>&lt;0.250</td>
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<tr>
<td>PCB, Aroclor-1254</td>
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<td>&lt;0.500</td>
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<td>&lt;0.750</td>
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<td>&lt;0.250</td>
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<tr>
<td>PCB, Aroclor-1260</td>
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<td>&lt;0.750</td>
<td>&lt;0.250</td>
<td>&lt;0.250</td>
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<tr>
<td>Lipids, Total</td>
<td>% Total Wt.</td>
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<td>16.000</td>
<td>14.000</td>
<td>12.000</td>
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<tr>
<td>Total Arsenic (Furnace)</td>
<td>mg/kg</td>
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<td>&lt;0.100</td>
<td>&lt;0.100</td>
<td>&lt;0.100</td>
<td>&lt;0.100</td>
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</tr>
<tr>
<td>Total Copper (ICP)</td>
<td>mg/kg</td>
<td>&lt;1.000</td>
<td>&lt;1.000</td>
<td>&lt;0.850</td>
<td>&lt;1.000</td>
<td>&lt;1.000</td>
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<tr>
<td>Total Mercury (Cold Vapor)</td>
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<td>0.030</td>
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<tr>
<td>Total Nickel (ICP)</td>
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<td>&lt;2.000</td>
<td>&lt;2.000</td>
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<tr>
<td>Total Lead (ICP)</td>
<td>mg/kg</td>
<td>&lt;5.000</td>
<td>&lt;3.000</td>
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# FISH TISSUE ANALYSIS - SAMPLING PERIOD
## STATION 3

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<tr>
<td></td>
<td>Station 3</td>
<td>Station 3</td>
</tr>
<tr>
<td></td>
<td>3 Alewives</td>
<td>20 Alewives</td>
</tr>
<tr>
<td></td>
<td>Avg. 9 cm</td>
<td>Whole Body</td>
</tr>
<tr>
<td>Chlordane</td>
<td>mg/kg</td>
<td>&lt;0.050</td>
</tr>
<tr>
<td>Oxychlordane</td>
<td>mg/kg</td>
<td>&lt;0.050</td>
</tr>
<tr>
<td>Trans-chlordane</td>
<td>mg/kg</td>
<td>&lt;0.050</td>
</tr>
<tr>
<td>Cis-chlordane</td>
<td>mg/kg</td>
<td>&lt;0.050</td>
</tr>
<tr>
<td>Trans-nonachlor</td>
<td>mg/kg</td>
<td>&lt;0.050</td>
</tr>
<tr>
<td>Alpha-chlordene</td>
<td>mg/kg</td>
<td>&lt;0.050</td>
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<tr>
<td>Chlordene</td>
<td>mg/kg</td>
<td>&lt;0.050</td>
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<tr>
<td>Gamma-chlordene</td>
<td>mg/kg</td>
<td>&lt;0.050</td>
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<tr>
<td>Cis-nonachlor</td>
<td>mg/kg</td>
<td>&lt;0.050</td>
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<tr>
<td>PCB, Aroclor-1016/1242</td>
<td>mg/kg</td>
<td>&lt;0.250</td>
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<tr>
<td>PCB, Aroclor-1232</td>
<td>mg/kg</td>
<td>&lt;0.250</td>
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<tr>
<td>PCB, Aroclor-1248</td>
<td>mg/kg</td>
<td>&lt;0.250</td>
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<td>PCB, Aroclor-1254</td>
<td>mg/kg</td>
<td>&lt;0.380</td>
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<td>mg/kg</td>
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<td>Lipids, Total</td>
<td>% Total Wt.</td>
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<td>Total Arsenic (Furnace)</td>
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<tr>
<td>Total Copper (ICP)</td>
<td>mg/kg</td>
<td>1.000</td>
</tr>
<tr>
<td>Total Mercury (Cold Vapor)</td>
<td>mg/kg</td>
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</tr>
<tr>
<td>Total Nickel (ICP)</td>
<td>mg/kg</td>
<td>&lt;2.000</td>
</tr>
<tr>
<td>Total Lead (ICP)</td>
<td>mg/kg</td>
<td>&lt;10.000</td>
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## FISH TISSUE ANALYSIS - SAMPLING PERIOD
### STATION 4

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<tbody>
<tr>
<td></td>
<td>2 lbs. 12 oz.</td>
<td>2 lbs. 12 oz.</td>
<td>41 cm Gage</td>
<td>3 lb Walleye</td>
<td>Fillet</td>
<td>Whole Body</td>
<td>3 lb Walleye</td>
<td>Whole Body</td>
<td>56 cm Gage</td>
<td>57 cm Gage</td>
<td>1 lb 12 oz.</td>
</tr>
<tr>
<td>Chlorothen</td>
<td>0.100</td>
<td>0.107</td>
<td>0.105</td>
<td>0.105</td>
<td>0.105</td>
<td>0.105</td>
<td>0.105</td>
<td>0.105</td>
<td>0.105</td>
<td>0.105</td>
<td>0.105</td>
</tr>
<tr>
<td>Oxachlorine</td>
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<td>0.050</td>
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Date: October 19 - 20, 1994
APPENDIX F
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KENVIRON LAKE CUMBERLAND PHYTOPLANKTON SAMPLES FOR 17 MAY
VALUES EXPRESSED IN CELLS PER LITER

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TAXONOMIC LISTING FOR LAKE CUMBERLAND PHYTOPLANKTON SAMPLES FOR 17 MAY 1994

CLASS CODE
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E = EUGLENOPSIS (EUGLENOPHYCEAE)    C = CHRYSTOPHYTES (CHLOROPHYCEAE)
D = DIATOMS (BACILLARIOPHYCEAE)

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### SPECIES LIST FOR LAKE CUMBERLAND ZOOPLANKTON SAMPLES

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- **R** = ROTIFERS
- **CL** = CLADOCERN
- **CO** = COPEPODS

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September, 1994

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**October, 1994**

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