# Toxics Substances Control Program

## *Cincinnati to Louisville Field Survey*

ORSANCO

OHIO RIVER VALLEY WATER SANITATION COMMISSION
AN INTERSTATE AGENCY
ESTABLISHED JUNE 30, 1948

**Ohio River Valley Water Sanitation Commission**

# RESULTS OF OCTOBER 1989 FIELD SURVEY
# CINCINNATI - LOUISVILLE SEGMENT
# OHIO RIVER

**TOXIC SUBSTANCES CONTROL PROGRAM**

**Ohio River Valley Water Sanitation Commission**
**(513) 421-1151**

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## I. BACKGROUND

The Ohio River Valley Water Sanitation Commission, ORSANCO, is conducting investigations of segments of the Ohio River as part of its Toxic Substances Control Program. The segment investigations involve the following activities:

- Analysis of historic data
- Recommendation for field survey
- Analysis of field survey data
- Recommendation of follow-up work
- Analysis of follow-up data
- Determine needs for additional work/recommend control program

The segment of the Ohio River from Cincinnati, Ohio to Louisville, Kentucky is the scope of this report. A report evaluating historic data and recommending a field survey was completed in January 1989. The field survey took place in October 1989. This report presents an analysis of those data and recommends additional data collection.

Analyses of historic data showed long-term water quality problems. These problems potentially impact aquatic life (copper and lead), human health (arsenic, chloroform and nickel) and contaminate fish tissue (chlordane, mercury, phenolics, and polychlorinated biphenyls). Contributions of these pollutants come from both point and nonpoint sources. Recommendations from the January 1989 reports included: (1) collection of water column samples for analysis of volatile organic chemicals, phenolics and metals at low flow conditions; (2) collection of sediment samples for analysis of metals, PCBs and chlordane: (3) collection of fish tissue samples for analysis of chlordane and PCBs, and; (4) routine monitoring of Mill Creek in Cincinnati. Collection of water column and sediment samples occurred in October 1989. The fish tissue sampling was not completed due to resource problems.

**Parameters of Concern**

Table 1 shows the parameters of concern for the Cincinnati-Louisville segment of the Ohio River. The table shows those pollutants identified in three separate reports. All three reports used similar methods for analysis. Application of the Seasonal Kendall Test for trends shows copper, lead and phenolics significantly decreasing for the 1977-1987 period. Arsenic, mercury and nickel were not evaluated for trends due to an insufficient number of samples.

**TABLE I**

**CINCINNATI - LOUISVILLE SEGMENT**
**TOXIC SUBSTANCES CONTROL PROGRAM**

**Parameters of Concern**

| | | |
|---|---|---|
| *The Presence of Toxic Substances in the Ohio River* | | *Published Date* 1986 |
| Metals | Organics | |
| * Copper | @ Chlordane | |
| Mercury | * Phenolics | |
| | @ Polychlorinated Biphenyls (PCBs) | |
| | 1,1,1-Trichloroethane | |
| | Methylene Chloride | |
| *Cincinnati - Louisville Recommendation Report* | | *Published Data* 1989 |
| Metals | Organics | |
| Arsenic | Chloroform | |
| * Copper | @ Chlordane | |
| * Lead | Methylene Chloride | |
| Mercury | @ Polychlorinated Biphenyls (PCBs) | |
| Nickel | * Phenolics | |
| *Assessment of Water Quality Conditions: Water Years 1988-1989* | | *Published Date* 1990 |
| Metals | Organics | |
| * Copper | @ Chlordane | |
| * Lead | @ Polychlorinated Biphenyls (PCBs) | |
| Nickel | | |

* *These parameters have a significant decreasing trend for 1977-1987*
@ *Parameter of Concern due to Presence of Fish Tissue*

Table 1 indicates changing concerns since the publication of The Presence of Toxic Substances in the Ohio River. Arsenic and nickel have emerged as pollutants of concern due to a lower detection level. Mercury was not included as a pollutant of concern in the Assessment of Water Quality Conditions - Water Years 1988-1989 because mercury is not found at levels of concern in fish tissue. The change in concern for the volatile organics is due to a change in analysis. The more recent analysis considers overall exposure to carcinogenic pollutants rather than individual criteria violations.

## Inventory of Facilities

Ninety seven facilities discharge to the Ohio River in the study segment. These include 58 industrial facilities and 20 municipal waste water treatment plants (WWTPs). Table 2 is a summary of those discharges. Twelve of the facilities are in Ohio, 63 are in Kentucky, and 22 are in Indiana. Appendix 1 contains a complete listing of these facilities.

**TABLE 2**

**SUMMARY OF DISCHARGES TO THE OHIO RIVER**
**MILE POINT 0 - 85**

| | |
|---|---|
| Municipal WWTPs flow > 5.0 MGD | 7 |
| Municipal WWTPs flow < 5.0 MGD | 13 |
| Private WWTP | 10 |
| Water Treatment Plants | 9 |
| Chemical Manufacturing Facilities | 12 |
| River Terminals | 19 |
| Power Stations | 10 |
| Other | 17 |
| **Total Permitted Facilities** | **97** |

Six of the communities along the study segment have combined sewer systems transporting both waste water and storm water runoff. These systems overload during periods of heavy rainfall. This results in inadequate treatment of waste water and direct discharge of untreated sewage into the Ohio River. Table 3 lists those communities with combined sewer systems.

**TABLE 3**

**COMMUNITIES WITH**
**COMBINED SEWER SYSTEMS**

| Mile Point | Municipality |
|---|---|
| 470.0 | Newport, Kentucky |
| 472.5 | Cincinnati, Ohio |
| 545.0 | Carrollton, Kentucky |
| 601.1 | Jeffersonville, Indiana |
| 605.0 | Louisville, Kentucky |
| 609.5 | New Albany, Indiana |

Urban runoff has been identified as contributing metals, PCBs and chlordane to the Ohio River. Urban runoff is delivered to the Ohio River by storm water discharges and combined sewer overflows.

A concern of the Commission is the transport of toxic substances from contaminated ground water to the surface water. The Commission inventoried sites that potentially have contaminated the ground water and several areas along the study segment have been identified. For the study segment there are 45 sites with the potential to impact ground water, with 8 sites evaluated to have severe contamination. The types of contaminants identified include metals, organics and other inorganics. There is a need to obtain additional data to characterize this problem.

There are 29 public water supplies along the Ohio River in the Cincinnati-Louisville segment. Five of these facilities (serving over 1.8 million people) use the Ohio River as their raw water source. Twenty-four of these utilities (serving over 125,000 people) use ground water pumped from the alluvial aquifer adjacent to the Ohio River. Appendix 1 contains a complete listing of all the public water supplies in the study area.

## II. SURVEY DESIGN

### Objective

The objective of the October 1989 field survey was to: characterize the distribution of PCBs and chlordane in the sediments and fish of the Ohio River and to delineate sources of metals and certain organics present in the Ohio River under low flow conditions. The specific recommendations from the January 1989 report are: (1) collection of water column sampling for analysis of volatile organic contaminants, phenolics and metals at low flow conditions; (2) collection of sediment samples for analysis of metals, PCBs and chlordane; (3) collection of fish tissue samples for analysis of chlordane and PCBs; (4) routine monitoring of Mill Creek in Cincinnati, Ohio.

### Sampling Locations

Sampling locations were selected to isolate the effects of urban and industrial areas on the Ohio River. Five stations provided data on inputs of toxic substances from the tributaries. Six months of monitoring of Mill Creek in Cincinnati was done to better understand its contribution of toxic substances at different flow conditions. Numerous combined sewer overflows discharge into Mill Creek discharging untreated domestic and industrial wastes. Table 4 lists the sampling stations, the types of samples collected and shows the number of discharges between stations on the Ohio River. Rubbertown is an industrial area primarily producing plastics in southern Louisville. Appendix 1 includes sampling stations with the discharge list.

# TABLE 4
## In Stream Sampling Locations

| River Mile | River | Location | Sample Matrix | Discharges@ IW | DW |
|---|---|---|---|---|---|
| 462.8 | Ohio | ***Cincinnati Water Works*** | Water | | |
| 464.1* | Little Miami | Kellogg Ave. Bridge | Sediment | | |
| 470.2* | Licking | Downstream of Banklick Creek | Sediment | | |
| 472.0 | Ohio | Upstream of Mill Creek | Sediment | 0 | 3 |
| 472.5* | Mill Creek | Downstream of Barrier Dam | Sediment | | |
| 474.0 | Ohio | Downstream of Mill Creek | Sediment | 1 | 1 |
| 491.1* | Great Miami | Mile Point 1.0 | Sediment | | |
| 492.0 | Ohio | Downstream of Great Miami | Sediment | 10 | 3 |
| 545.8* | Kentucky | Lock and Dam1 | Water/Sediment | | |
| 559.0 | Ohio | Upstream of Madison, IN | Water | 12 | 13 |
| 563.0 | Ohio | Downstream of Madison, IN | Water | 1 | 1 |
| 593.0 | Ohio | Upstream of Louisville | Sediment | 4 | 2 |
| 606.9 | Ohio | Downstream of McAlpine Locks | Sediment | 13 | 6 |
| 611.0 | Ohio | ***Upstream of Rubbertown*** | Water/Sediment | 2 | 1 |
| 615.0 | Ohio | ***Downstream of Rubbertown*** | Water/Sediment | 13 | 1 |
| 625.9 | Ohio | West Point, KY | Water/Sediment | 5 | 5 |
| | | Total Number of Discharges: | | 61 | 36 |

@ – Number of discharges between sampling points
IW – Industrial Wastewater Discharges
DW – Domestic Wastewater Discharges, including water treatment plants
* – Mile point of confluence with the Ohio River
Samples collected from Stations shown in Bold Italics were analyzed for volatiles

## Analytes

Water samples were analyzed for arsenic, copper, mercury, nickel, lead, phenolics, and volatile organic chemicals, as well as several field and conventional water quality parameters. These included dissolved oxygen, conductivity, hardness, pH, temperature, and total suspended solids. The field parameters indicate any lateral or vertical variability of water quality at the sampling stations. Sediments were analyzed for arsenic, chlordane, lead, mercury, nickel, and PCBs. Table 5 lists all the parameters analyzed.

**TABLE 5**

**PARAMETERS FOR ANALYSIS**

| Analytes/Sample | Water | Sediment |
|---|---|---|
| Temperature | X | |
| pH | X | |
| Dissolved Oxygen | X | |
| Conductivity | X | |
| Hardness | X | |
| Total Suspended Solids | X | |
| Arsenic | X | X |
| Copper | X | X |
| Lead | X | X |
| Mercury | X | X |
| Nickel | X | X |
| Phenolics | X | X |
| Volatile Organics (Method 601) | X* | |
| Pesticides | | X |
| PCBs | | X |

**Only at selected stations, see Table 4*

## Participants

The field work was accomplished thanks to many different organizations. One federal agency, three state agencies and a public utility participated in the field work. These agencies provided personnel, equipment and valuable information on the middle Ohio River. Table 6 lists the agencies which participated.

| TABLE 6<br><br>AGENCIES PARTICIPATING IN THE OCTOBER 1989<br>CINCINNATI-LOUISVILLE FIELD SURVEY |
|---|
| **State Participants** |
| Ohio Environmental Protection Agency<br>Kentucky Division of Water<br>Indiana Department of Environmental Management |
| **Federal Participants** |
| United States Army Corps of Engineers |
| **Public Utilities** |
| Louisville Water Company |

### Quality Assurance/Quality Control

The Quality Assurance/Quality Control (QA/QC) plan developed for the survey is included as Appendix 2. Each participating agency reviewed and approved the QA/QC plan before the field work. NET Midwest, Inc. of Dayton performed all the laboratory analyses, except for the monthly samples from Mill Creek which were analyzed by the West Virginia Department of Natural Resources laboratory.

## III. SURVEY RESULTS

### Overall

The data collected show water quality conditions under stable flow conditions and a characterization of metals in bottom sediments. PCBs and chlordane were not detected in the bottom sediments. The only toxic substance detected in the water column was copper.

The water temperature ranged from 17°C to 18°C. Dissolved oxygen levels were near saturation at all stations except Mill Creek (3.4 mg/L). Conductivity ranged from 740 µmhos/cm in the Little Miami River to 270 µmhos/cm in the Ohio River and pH ranged from 7.0 - 8.0 standard units.

#### Metals (Water Column)

Copper was the only metal present above the detection level in any of the water column samples collected. Copper was detected in all water column samples except those from the Cincinnati Water Works (M.P. 462.8) and Madison, Indiana (M.P. 559.0). All detections exceeded the acute aquatic life criterion.

Volatile Organic Chemicals (Water Column)

No volatile organic chemicals were present above the detection level in any of the samples.

Metals (Sediments)

All of the metals analyzed (arsenic, copper, mercury, nickel, and lead) except mercury, were present in all of the sediment samples analyzed. Table 7 presents the range of values for each of the analyzed metals.

TABLE 7

RANGE OF METALS CONCENTRATIONS IN SEDIMENT SAMPLES

| Metals | Max. mg/kg | Min. mg/kg | Location of Max |
|---|---|---|---|
| Arsenic | 10 | 2 | Great Miami River |
| Copper | 112 | 11 | Mill Creek |
| Mercury | 0.4 | <0.1 | Ohio River (left bank) @ M.P. 492 |
| Nickel | 58 | 10 | Ohio River (left bank) @ M.P. 492 |
| Lead | 102 | 11 | Mill Creek |

Organics (Sediment)

Sediment samples were analyzed for the presence of PCBs and pesticides. All results were below the detection limit. The detection limit varied with each sample, but was approximately 2.2 mg/kg for both PCBs and pesticides.

Assessment by Objective

The objective of the field study was to (1) characterize the distribution of PCBs and chlordane in the Ohio River system: (2) show the distribution of metals in the Ohio River under stable flow conditions; (3) determine what contribution, if any, the Rubbertown industries have on levels of organic compounds in the Ohio River, and; (4) characterize the loadings of metals from Mill Creek in Cincinnati over time.

Table 8 shows the flow conditions on October 11, 1989 along with long-term average flows and minimum monthly flows on record. It is clear flow conditions were normal during October 1989. The exception is the Licking River which had flow above (200% greater) the long-term monthly average.

| TABLE 8<br><br>FLOW CONDITIONS | | | |
|---|---|---|---|
| **Flow Station** | **Flow 10/11/89** | **LTA Flow** | **Min. Avg. Flow** |
| Cincinnati, Ohio | 45.2 | 41.7 | 7.1 |
| Licking River | 3.4 | 1.6 | 0.2 |
| Markland Dam | 52.1 | 19.3 | 19.3 |
| McAlpine Dam | 58.6 | 45.6 | 7.9 |

*All values in 1000 cubic feet per second*
*LTA = Long-term Average flow for October (1953-1986)*
*Min. Avg. Flow = Minimum average monthly (October for the period of record)*

Table 9 displays sampling locations and key parameters identified in the data from the survey.

Field data were analyzed to determine variability in the water column by depth and by lateral position. A blocked, one factor analysis of variance was done for each field parameter at each station. A blocked, one factor analysis of variance allows evaluation of variability by location (factor) and by depth (block). A summary of the analysis is shown in Table 10.

Table 10 shows the significant variation ($p<0.05$) at each station for each parameter. The analyses indicate lateral position is more likely to show variation than depth.

Lateral variation suggests an input to the river that has not completely mixed. Temperature variation indicates a thermal load, conductivity indicates dissolved solids loads (i.e., metals), pH indicates an acid/caustic load, and dissolved oxygen variation indicates a load with an oxygen demand. Overall the following conclusions can be made:

- There are significant temperature differences at all stations except upstream of Louisville (M.P. 600.6).
- Significant variations in conductivity are observed at three stations in the study segment. This suggests incomplete mixing at the flow conditions of October 11, 1989.
- There are significant variations in dissolved oxygen concentrations at all but one station (Cincinnati Water Works, M.P. 462.8).

The lack of detections (detection level 2 mg/kg) of PCBs and chlordane in sediment prevents characterization of the distribution of these parameters in the system. Fish tissue samples were not collected due to resource problems.

## TABLE 9
## In Stream Sampling Locations and Parameters of Concern

| River Mile | River | Location | Sample Matrix | Discharges@ IW | DW | Parameters of Concern |
|---|---|---|---|---|---|---|
| 462.8 | Ohio | Cincinnati Water Works | Water | | | |
| 464.1* | Little Miami | Kellogg Ave. Bridge | Sediment | | | Mercury |
| 470.2* | Licking | Downstream of Banklick Creek | Sediment | | | Arsenic, Copper |
| 472.0 | Ohio | Upstream of Mill Creek | Sediment | 0 | 3 | Copper, Lead |
| 472.5* | Mill Creek | Downstream of Barrier Dam | Sediment | | | Copper, Lead, Nickel |
| 474.0 | Ohio | Downstream of Mill Creek | Sediment | 1 | 1 | Copper, Lead, Nickel |
| 491.1* | Great Miami | Mile Point 1.0 | Sediment | | | Arsenic, Copper, Nickel |
| 492.0 | Ohio | Downstream of Great Miami | Sediment | 10 | 3 | Arsenic, Copper, Lead, Nickel |
| 545.8* | Kentucky | Lock and Dam1 | Water/Sediment | | | |
| 559.0 | Ohio | Upstream of Madison, IN | Water | 12 | 13 | Copper |
| 563.0 | Ohio | Downstream of Madison, IN | Water | 1 | 1 | Copper |
| 593.0 | Ohio | Upstream of Louisville | Sediment | 4 | 2 | |
| 606.9 | Ohio | Downstream of McAlpine L&D | Sediment | 13 | 6 | Arsenic, Copper, Nickel |
| 611.0 | Ohio | Upstream of Rubbertown | Water | 2 | 1 | Copper |
| 615.0 | Ohio | Downstream of Rubbertown | Water | 13 | 1 | Copper |
| 625.9 | Ohio | West Point, KY | Water | 5 | 5 | Copper |
| | | Total Number of Discharges: | | 61 | 36 | |

@ – Number of discharges between sampling points
IW – Industrial Wastewater Discharges
DW – Domestic Wastewater Discharges, including water treatment plants
* – Mile point of confluence with the Ohio River

## TABLE 10
## Variation of Field Data

| River Mile | River | Location | Sample Matrix | Discharges@ IW | DW | Field Parameters Temp | pH | Cond | D.O. |
|---|---|---|---|---|---|---|---|---|---|
| 462.8 | Ohio | Cincinnati Water Works | Water | | | Y-d | N | N | N |
| 559.0 | Ohio | Upstream of Madison, IN | Water | 23 | 20 | Y | N | Y | Y |
| 563.0 | Ohio | Downstream of Madison, IN | Water | 1 | 1 | Y | N | Y | Y |
| 600.0 | Ohio | Upstream of Louisville | Sediment | 4 | 2 | N | N | N | Y |
| 611.0 | Ohio | Upstream of Rubbertown | Water | 15 | 7 | Y | N | N | Y |
| 616.0 | Ohio | Downstream of Rubbertown | Water | 13 | 1 | Y | N | N | Y |
| 626.9 | Ohio | West Point, KY | Water | 5 | 5 | Y | N | Y | Y |
| | | Total Number of Discharges: | | 61 | 36 | | | | |

@ – Number of discharges between sampling points
IW – Industrial Wastewater Discharges
DW – Domestic Wastewater Discharges, including water treatment plants
Y-d – Significant Variation with Depth ($p<0.05$)
Y – Significant Lateral Variation ($p<0.05$)
N – Variation not Significant ($p>0.05$)

Metals were detected in the sediment samples but organics were not. At this time there are no established criteria for levels of contamination in sediments. The sediment data can be evaluated relative to each other and to historic data.

Figures 2 through 6 show the results of the laboratory analyses. The figures show the difference between the sediments from the left and right descending bank of the Ohio River. Tributary data are displayed with the data shown as left or right to show the side of the Ohio River on which the tributary enters.

Figure 2 shows the concentration of arsenic in bottom sediments. The sediments from the Great Miami River have the highest level of arsenic and the Kentucky River sediments have the lowest level. There appears to be a large difference between the left and right bank of the Ohio at M.P. 492.0 (Station ORS3).

Figure 3 shows the concentration of copper in bottom sediments. Tributary sediments have higher levels of copper than Ohio River sediments. It appears that the tributary contribution is diluted by sediments from upstream in the Ohio River.

Mill Creek and the Kentucky River have the highest levels of copper of the tributaries samples. This is of note as the drainage basins of these two tributaries are very different. Mill Creek has an urban watershed while the Kentucky River watershed is dominated by forest lands, with some resource extraction activities.

Figure 4 shows the concentration of nickel in bottom sediments. The highest level observed was the sample taken at M.P. 492.0, left descending bank, and the lowest level was from the Little Miami River. There is a marked difference between the levels found on the left descending bank and the right descending bank at M.P. 492.0. There is also a difference, though not as large, between the left and right banks at M.P. 472.0.

Figure 5 shows the concentration of mercury in bottom sediments. Figure 6 demonstrates that Mill Creek sediments have the highest level of lead of all the samples collected. Once again, the left descending bank sample at M.P. 492.0 is markedly greater than the right descending bank sample.

The concentration of metals in bottom sediments provides insight into the relative levels of metals carried by the Ohio River and tributaries during period of high flow. Overall the relative levels of the metals analyzed are similar in both the tributaries and the Ohio River. Mill Creek is the exception to this. For all metals analyzed, except arsenic, the sediments from Mill Creek are greater than that found in the Ohio River.

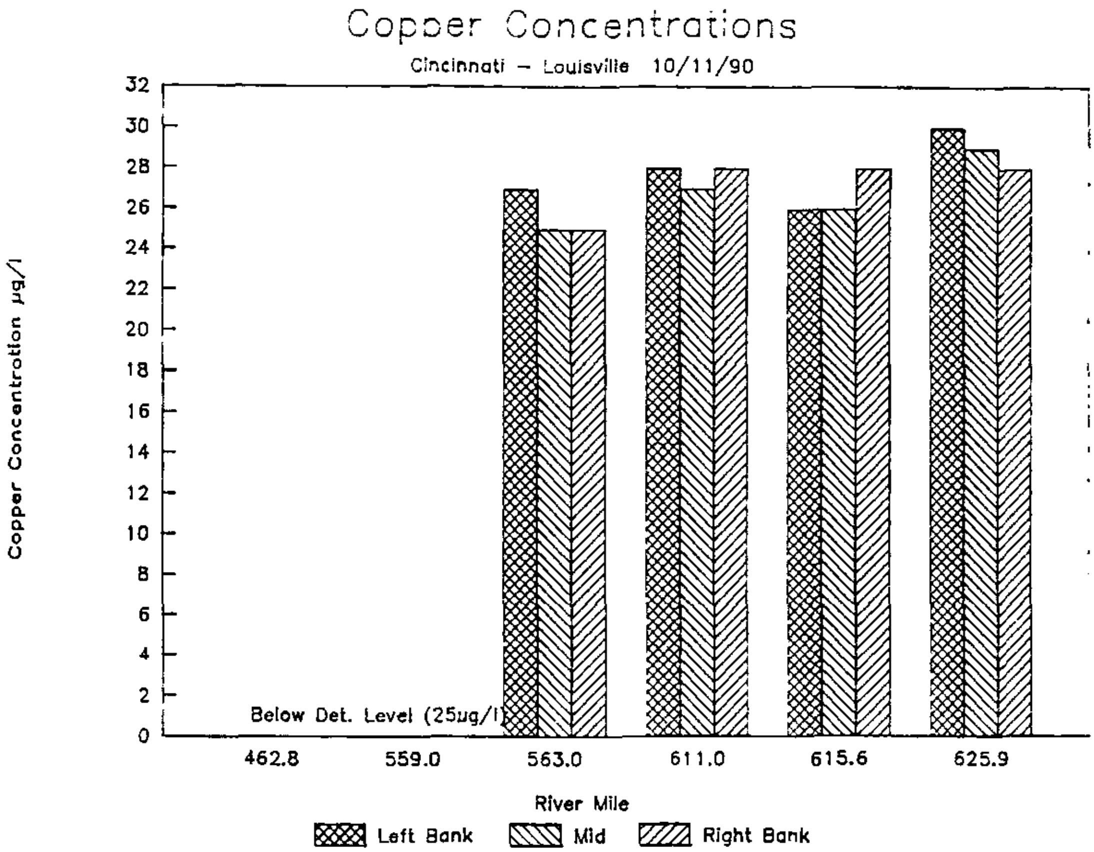



FIGURE 1

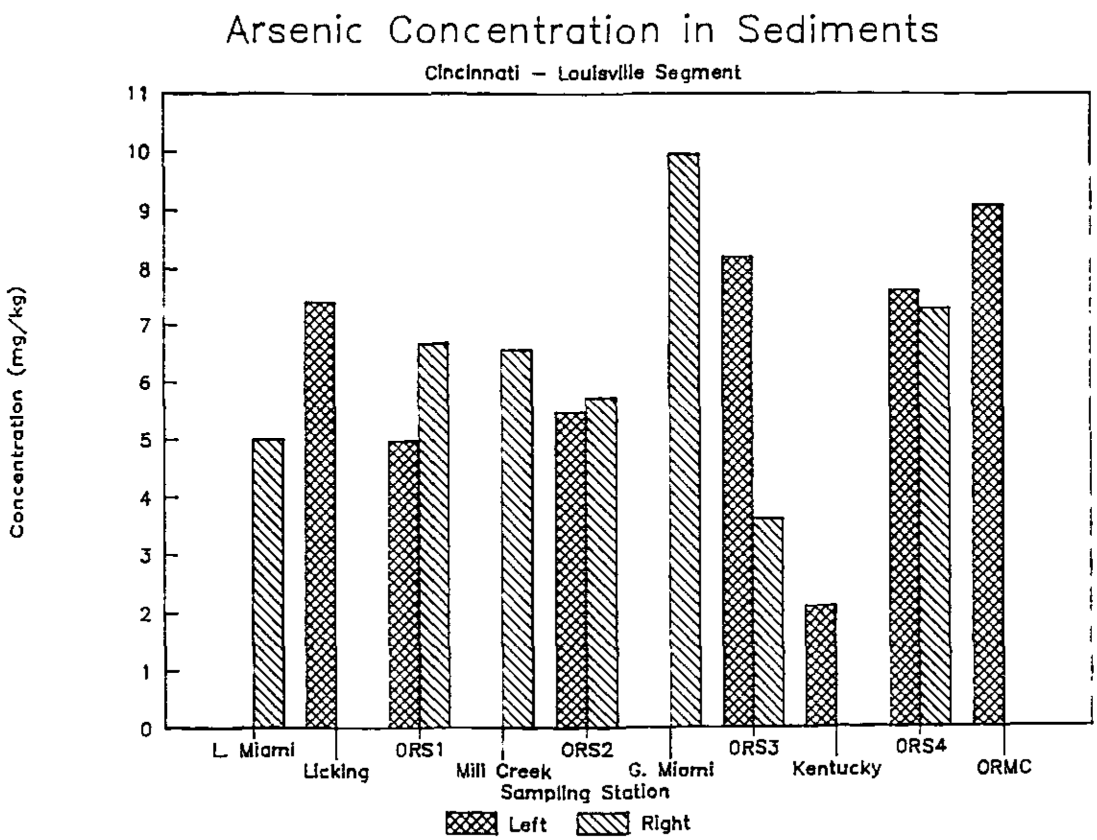



FIGURE 2

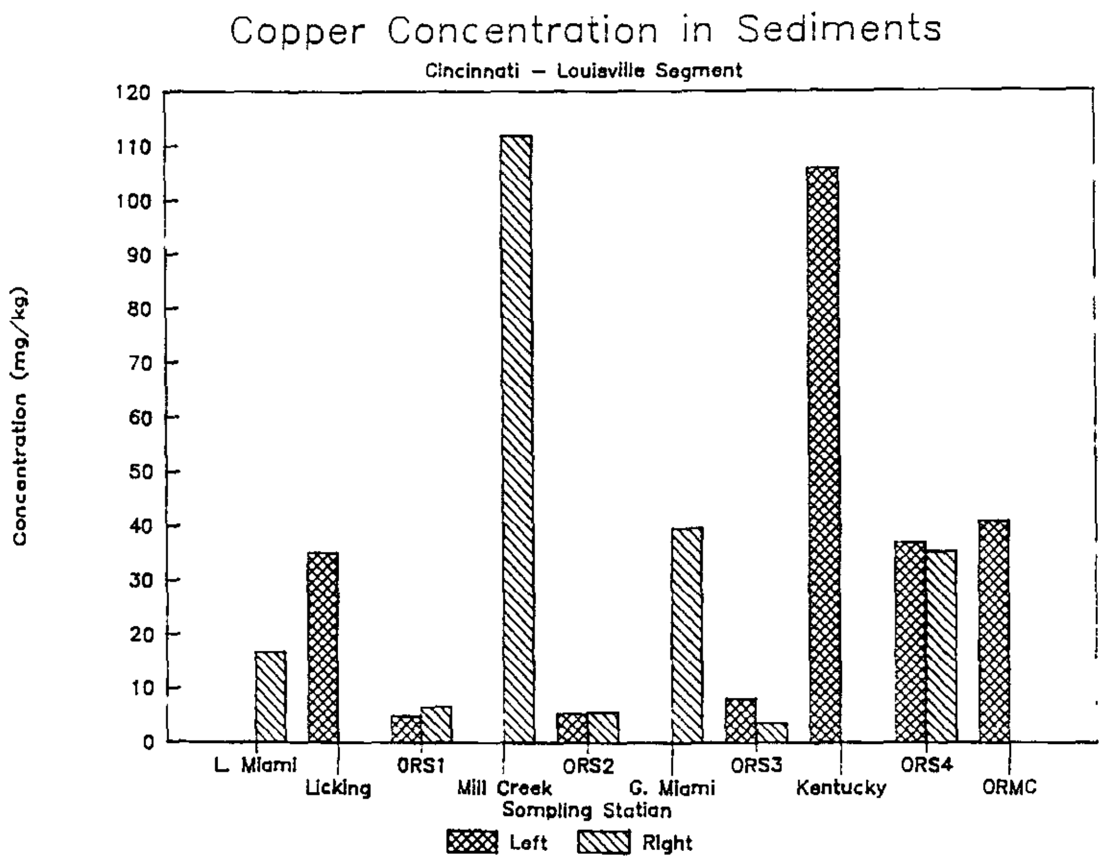



FIGURE 3

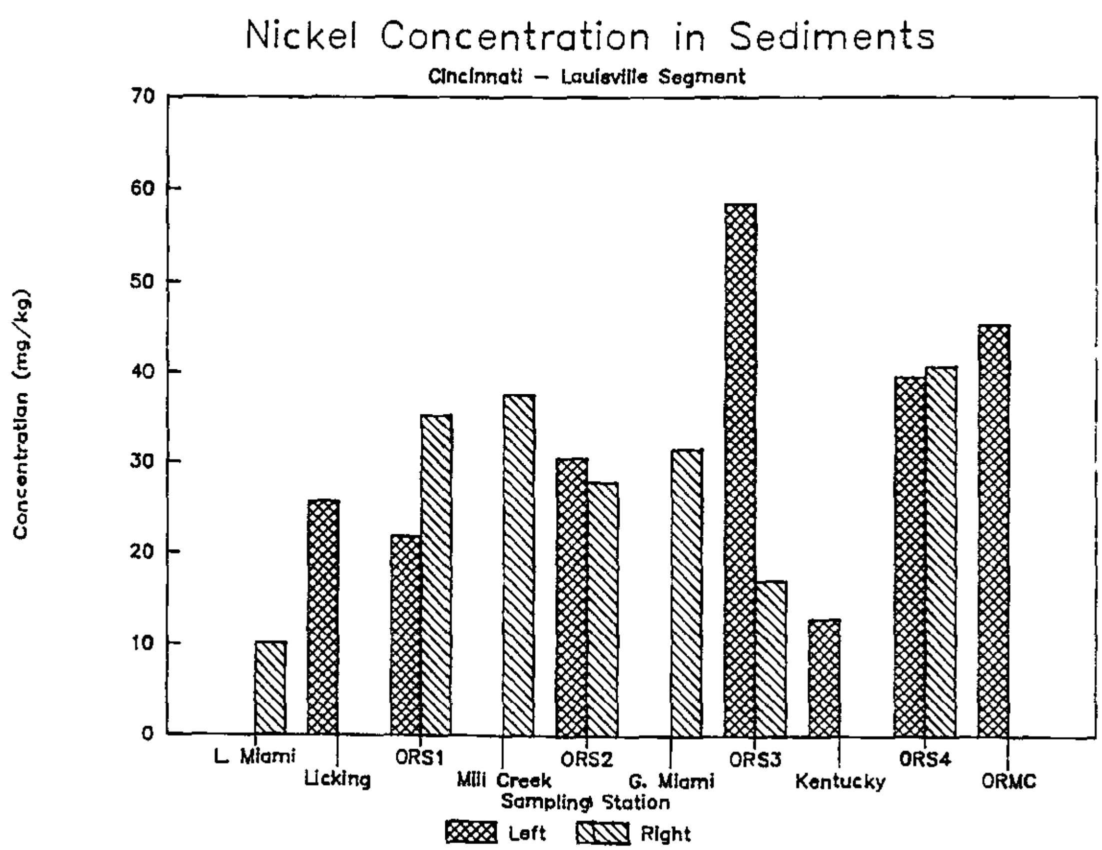



FIGURE 4

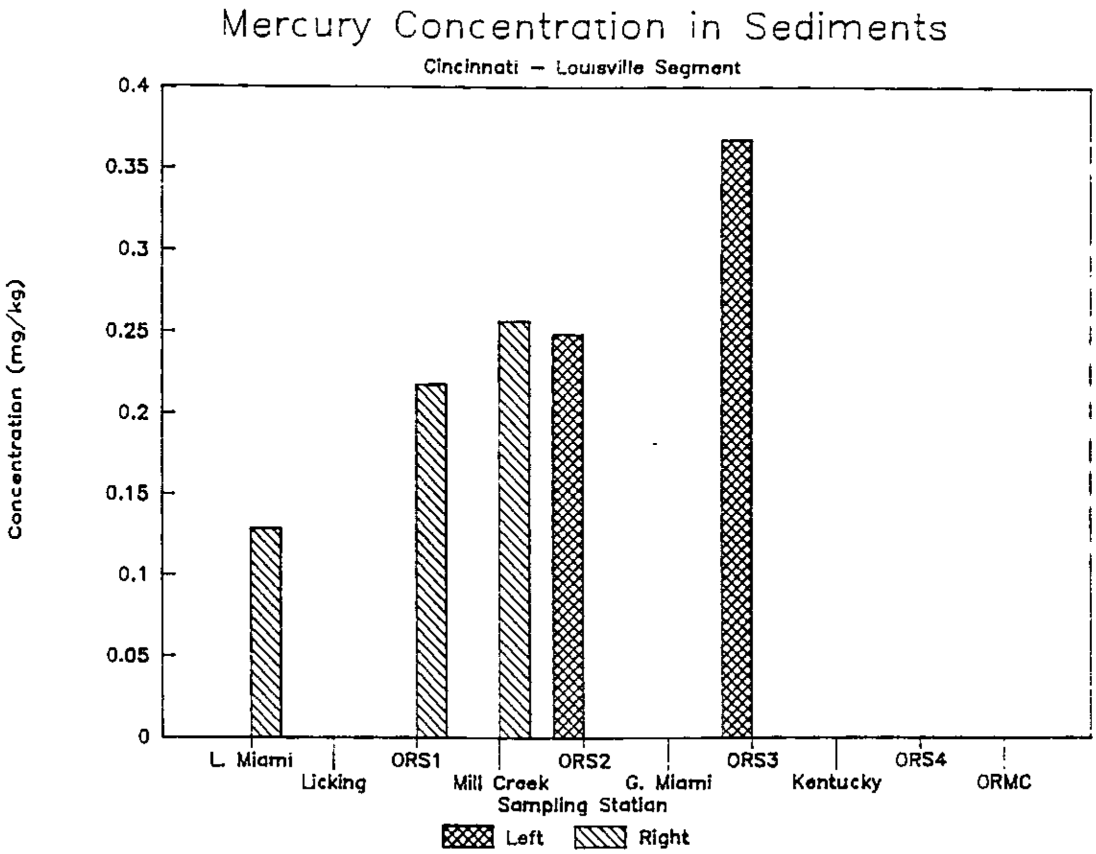



FIGURE 5

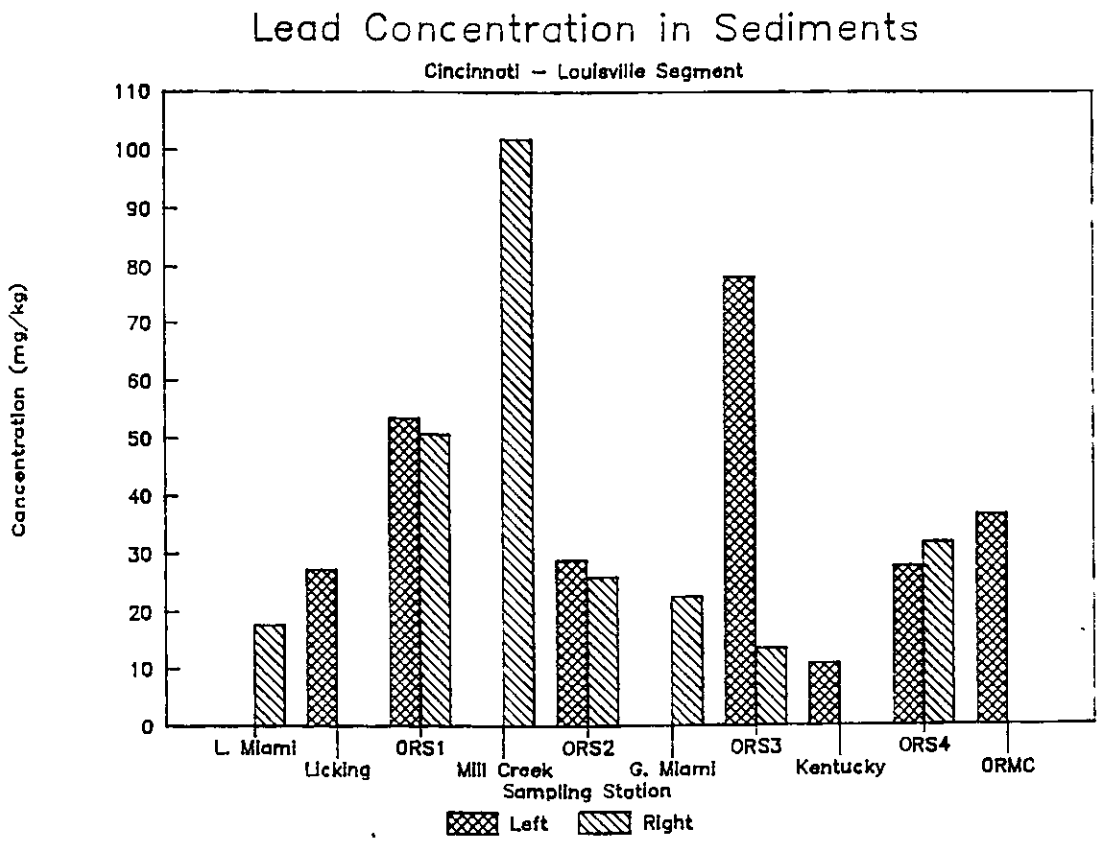



FIGURE 6

A comparison of sediment data collected during the October field study with those sediment data available on the U.S. EPA STORET system shows that levels of arsenic, copper, lead, nickel, and mercury measured in October 1989, are similar to levels measured in the past. The exception is Mill Creek, which appears to have improving conditions since these type of data were last collected. Table 11 is a summary of these data.

TABLE 11

COMPARISON OF OCTOBER 1989 DATA WITH HISTORIC DATA

| Station | Sample Date | Mile Point | Arsenic mg/kg | Copper mg/kg | Nickel mg/kg | Lead mg/kg |
|---|---|---|---|---|---|---|
| Mill Creek | 10/11/89 | 472.5 | 6.6 | 112.0 | 37.6 | 102.0 |
| Mill Creek | 07/00/73 | 472.5 | 33.0 | 236.0 | 123.0 | 783.0 |
| G. Miami | 10/11/89 | 491.1 | 10.0 | 39.8 | 31.6 | 22.7 |
| G. Miami | 09/00/80 | 491.1 | 3-7 | 10-29 | 6-17 | 19-72 |
| ORS4L | 10/11/89 | 593.0 | 7.6 | 37.1 | 39.6 | 27.8 |
| ORS4R | 10/11/89 | 593.0 | 7.3 | 35.5 | 40.9 | 31.9 |
| Ohio R. | 09/00/81 | 594.5 | <8 | 11-20 | 36-40 | 15.0 |
| Ohio R. | 09/00/81 | 596.5 | 16 | 38.0 | 49.0 | 37.0 |
| ORMC | 10/11/89 | 606.9 | 9.1 | 41.1 | 45.5 | 36.8 |
| Ohio R. | 07/00/80 | 606.9 | NA | <10 | NA | 20.0 |

Sample locations up and down stream of the Rubbertown area (southwest Louisville) were chosen to characterize the effects of the Rubbertown industries on Ohio River water quality. Water column data (organic and inorganic) did not indicate any effects. Attempts to collect sediment at these locations yielded only sand and gravel.

Monthly samples (April-November) were collected from Mill Creek in Cincinnati and analyzed for selected water quality parameters. These data provide an overview of water quality conditions in the Mill Creek under different flow conditions. Table 12 displays these data. Those samples which exceed Ohio River stream criteria are shaded.

It is apparent that dissolved oxygen in Mill Creek is depressed and phenolics occasionally exceed criterion. Comparing Mill Creek data to samples taken from the Ohio River at M.P. 462.8 and M.P. 490.0 (up and down stream of the confluence of Mill Creek with the Ohio River) shows that except for conductivity, dissolved oxygen and phenolics, Mill Creek is of similar quality. The water column data do not support the sediment data which showed relatively high levels of metals.

## TABLE 12
## Mill Creek Monitoring Data

| | 04/11/89 | 05/17/89 | 06/29/89 | 07/27/89 | 08/22/89 | 09/28/89 | 10/24/89 | 11/30/89 |
|---|---|---|---|---|---|---|---|---|
| Flow | | | | | | | | |
| Temperature deg C | 8.7 | 19.5 | 22.0 | 27.8 | 25.1 | 16.2 | 12.5 | 5.7 |
| Conductivity | 480 | 440 | 860 | 730 | 410 | 330 | 420 | 390 |
| pH | 7.1 | 6.4 | 7.0 | 7.4 | 7.5 | 7.8 | 7.5 | 8 |
| Dissolved Oxygen mg/l | 2.3 | 3.3 | 3.0 | 3.2 | 5.5 | 7.5 | 5.4 | 11.8 |
| TSS mg/l | 40 | 17 | 15 | 5 | 13 | 29 | 24 | 10 |
| Sulfate mg/l | 51 | | 85 | | 87 | 73 | 70 | 65 |
| Hardness mg/l | 218 | 210 | 252 | 308 | 130 | 156 | 204 | 160 |
| Phenolics ug/l | 9 | 3 | 13 | 5 | 3 | 2 | 10 | 2 |
| Cyanide ug/l | | 6 | 4 | 2 | 1 | <1 | 2 | 1 |
| Copper ug/l | 19 | 14 | 20 | <10 | <10 | 10 | <10 | <10 |
| Lead ug/l | 20 | <10 | <50 | <50 | <50 | <50 | <50 | <50 |
| Mercury ug/l | <0.1 | <0.1 | 0.4 | <0.1 | 0.1 | <0.1 | 0.4 | <0.2 |
| Zinc ug/l | 23 | | | | 10 | | | 5 |
| Arsenic ug/l | 2.0 | 1.3 | | 3.5 | <0.5 | <0.5 | 2.6 | 2.3 |
| Nickel ug/l | <2 | <10 | | <20 | | | <20 | |

## IV. CONCLUSIONS

Data collected on October 11, 1989 at 15 locations in the middle Ohio River (M.P. 462 - M.P. 626) and selected tributaries provides an overview of metals concentrations in bottom sediments. The data show that sediment loads from several tributaries in the study area are contributing metals to the Ohio River. There are several locations on the Ohio River where there is an apparent different between left and right banks in metals concentrations in the sediment.

Specific conclusions are as follows:

- Sediment from the Great Miami River had the highest level of arsenic of the samples collected.
- Sediment from Mill Creek had the highest copper and lead levels of the samples collected. This is of particular interest as monthly water column samples collected from Mill Creek showed little difference from the Ohio River.
- Sediment from the left descending bank of the Ohio River at M.P. 492.0 had the highest level of nickel of the samples collected.
- There was a market difference between levels of arsenic, lead and nickel detected in sediment samples taken from opposite banks on the Ohio River at M.P. 492.0. The left descending bank had the higher level.

## V. FOLLOW-UP ACTIONS

### Action Underway

The primary concern in this segment of the Ohio River was levels of PCBs and chlordane in fish tissue. The issue is not isolated to this segment of the Ohio River. The Commission will carry out a significantly expanded fish tissue sampling program in fiscal year 1991. This will provide more data from more locations and species.

The U.S. Army Corps of Engineers, Louisville District, has intensified efforts in sediment sampling and analysis. Commission staff is in communication with the Corps' personnel regarding these efforts.

### Remaining Actions

In January 1989, it was recommended that extensive fish tissue analyses be performed to accompany the sediment data collected. These samples were not collected due to resource constraints. There is a need for additional work in this area. The Commission's FY91 Program Plan partly addresses this issue with a fourfold increase in fish tissue analyses.

The emphasis of the fish tissue program is to determine what levels of contamination are present in different species of fish. These data will then be used by the Ohio River states to address the need for consumption advisories. There is a need for site specific fish and sediment sampling to assess the impacts of urban runoff on levels of contamination in fish tissue.

This could be accomplished through additional fish and sediment collection up and down stream of urban areas on the Ohio River as well as from tributaries. Another method needing investigation is to use hexane filled dialysis bags. The bags are used as receptors of PCBs and organochlorine pesticides. This method is being investigated by the Commonwealth of Pennsylvania for monitoring of lipophilic compounds.

Additional sediments needs to be collected and analyzed for PCBs and pesticides. The analyses must be performed by a laboratory capable of reporting at levels as low as 10 ug/kg. These samples should also be analyzed for total organic carbon (TOC). Proposed U.S. EPA sediment criteria for PCBs and organochlorine pesticides are based on TOC concentration.

# APPENDIX 1

Ohio River Discharges
Cincinnati, OH - Louisville, KY
Mile Point 462 - 626

| River Mile | Corporation | Plant Name | State | Permit Number |
|---|---|---|---|---|
| | | | | Water Sample |
| 462.8 | CINCINNATI WATERWORKS | CINCINNATI WTP | OH | OH0009083 |
| 462.9 | NEWPORT WATER FILTRATION PLANT | NEWPORT WTP | KY | KY0002828 |
| 464.5 | HAMILTON COUNTY COMMISSIONERS | LITTLE MIAMI WWTP | OH | OH0025453 |
| | | | | Sediment Sample |
| 472.5 | HAMILTON COUNTY COMMISSIONERS | MILL CREEK WWTP | OH | OH0025461 |
| 473.0 | HVC/M.J. DALY COMPANY | | KY | KY0093009 |
| | | | | Sediment Sample |
| 474.3 | UNOCAL CORPORATION | CINCINNATI TERMINAL | OH | OH0010120 |
| 474.5 | BORON OIL COMPANY | BROMLEY TERMINAL | KY | KY0001406 |
| 475.4 | CHEVRON U.S.A., INC. | COVINGTON TERMINAL | KY | KY0063274 |
| 475.8 | ASHLAND OIL COMPANY | VALVOLINE OIL COMPANY DIVISION | OH | OH0047457 |
| 476.8 | TRESLER OIL COMPANY | | OH | OH0009598 |
| 477.4 | SANITATION DISTRICT NO. 1 OF CAMPBELL AND KENTON COUNTIES | DRY CREEK WWTP | KY | KY0021466 |
| 480.0 | HILLTOP BASIC RESOURCES, INC. | RIVER TERMINAL PLANT | OH | OH0010031 |
| 480.4 | TAYLORSPORT SAND COMPANY, INC. | | KY | KY0089061 |
| 482.0 | HAMILTON COUNTY COMMISSIONERS | MUDDY CREEK WWTP | OH | OH0025470 |
| 484.0 | MONSANTO PLASTICS AND RESIN COMPANY | PORT PLASTICS PLANT | OH | OH0009946 |
| 486.0 | HAMILTON COUNTY COMMISSIONERS | INDIAN CREEK WWTP | OH | OH0024678 |
| 489.5 | KAISER ALUMINUM AND CHEMICAL COMPANY | KAISER AGRICULTURAL CHEMICAL DIVISION | OH | OH0009571 |
| 490.0 | CINCINNATI GAS AND ELECTRIC COMPANY | MIAMI FORT STATION | OH | OH0009873 |
| | | | | Sediment Sample |
| 493.0 | SOUTH DEARBORN REGIONAL SEWER DISTRICT | SOUTH DEARBORN REGIONAL WWTP | IN | IN0024538 |
| 495.0 | JOSEPH E. SEAGRAM AND SONS, INC. | | IN | IN0003131 |
| 495.0 | SCHENLEY DISTILLERS, INC. | | IN | IN0001694 |
| 495.5 | INDIANA AND MICHIGAN ELECTRIC COMPANY | TANNER'S CREEK GENERATING STATION | IN | IN0002160 |
| 502.5 | BOONE COUNTY BOARD OF EDUCATION | CHARLES H. KELLY ELEMENTARY SCHOOL | KY | KY0080691 |
| 502.9 | TOM ARLINGHAUS | ARLINGHAUS PROPERTIES WWTP | KY | KY0077917 |
| 503.9 | RIVER RIDGE PARKS, INC. | RIVER RIDGE PARKS WWTP | KY | KY0075639 |
| 506.0 | TOWN OF RISING SUN | RISING SUN WWTP | IN | IN0024431 |
| 511.0 | CINCINNATI GAS AND ELECTRIC COMPANY | EAST BEND STATION | KY | KY0040444 |
| 516.5 | U.S. ARMY CORPS OF ENGINEERS | BIG BONE CREEK RAMP WTP | KY | KY0027642 |
| 516.6 | KENTUCKY DEPARTMENT OF PARKS | BIG BONE LICK STATE PARK WTP | KY | KY0004243 |
| 529.9 | CRAIG'S CREEK CAMPGROUND | CRAIG'S CREEK CAMPGROUND WWTP | KY | KY0075825 |
| 530.0 | CITY OF WARSAW | WARSAW WWTP | KY | KY0028118 |
| 535.0 | CLEANCOAL TERMINAL COMPANY | | KY | KY0082686 |
| 536.0 | SPANGLER APARTMENTS | WWTP | KY | KY0090603 |
| 536.0 | KENTUCKY UTILITIES COMPANY | GHENT GENERATING STATION | KY | KY0002038 |
| 537.5 | TOWN OF VEVAY | VEVAY WWTP | IN | IN0020231 |
| 540.8 | DOW CORNING CORPORATION | | KY | KY0001279 |
| 543.7 | BOBBY L. HARPER DISTRIBUTING COMPANY, INC. | | KY | KY0071757 |

Ohio River Discharges
Cincinnati, OH - Louisville, KY
Mile Point 462 - 626

| River Mile | Corporation | Plant Name | State | Permit Number |
|---|---|---|---|---|
| 544.0 | CHEVRON U.S.A., INC. | CARROLLTON BULK PLANT | KY | KY0071757 |
| 544.5 | M & T CHEMICALS INC. | | KY | KY0001431 |
| 553.5 | MILTON SAND AND GRAVEL COMPANY, INC. | | KY | KY0079014 |
| 554.7 | KAWNEER COMPANY, INC. | | KY | KY0001732 |
| 556.6 | CITY OF MILTON | MILTON WWTP | KY | KY0088625 |
| 558.6 | CITY OF MADISON | MADISON WWTP | IN | IN0024210 |
| | Water Sample | | | |
| 560.0 | INDIANA - KENTUCKY ELECTRIC CORPORATION | CLIFTY CREEK STATION | IN | IN0001759 |
| 562.5 | TOWN OF HANOVER | HANOVER WWTP | IN | IN0020702 |
| | Water Sample | | | |
| 571.1 | BOBBY L. HARPER OISTRIBUTING COMPANY | BULK PETROLEUM TERMINAL | KY | KY0091359 |
| 572.0 | LOUISVILLE GAS AND ELECTRIC COMPANY | TRIMBLE COUNTY GENERATING STATION | KY | KY0041971 |
| 586.0 | MARTIN MARIETTA BASIC PRODUCTS | LANE QUARRY | IN | IN0053571 |
| 589.5 | GOSHEN UTILITIES, INC. | GOSHEN WWTP | KY | KY0038580 |
| 590.0 | HEIL COMPANY | | KY | KY0072389 |
| 592.0 | CITY OF CHARLESTOWN | CHARLESTOWN WWTP | IN | IN0020508 |
| | Sediment Sample | | | |
| 593.5 | INDIANA ARMY AMMUNITION PLANT | | IN | IN0001163 |
| 600.7 | LOUISVILLE WATER COMPANY | B.E. PAYNE WTP | KY | KY0003123 |
| 600.8 | LOUISVILLE WATER COMPANY | ZORN AVENUE WTP | KY | KY0001830 |
| 601.0 | LOUISVILLE AND JEFFERSON COUNTY MUNICIPAL SEWER DISTRICT | NEW MARKET SUBDIVISION WWTP | KY | KY0031801 |
| 601.5 | CONVENIENT ENERGY, INC. | | KY | KY0072745 |
| 602.0 | CONSERVANCY DISTRICT OF OAK PARK | CONSERVANCY DISTRICT OF OAK PARK WWTP | IN | IN0023965 |
| 602.6 | ASHLAND PETROLEUM COMPANY | LOUISVILLE PLANT | KY | KY0054771 |
| 603.0 | MARTIN MARIETTA AGGREGATES | UTICA SAND AND GRAVEL | IN | IN0048801 |
| 603.0 | CHEVRON U.S.A., INC. | LOUISVILLE ASPHALT PLANT | KY | KY0061395 |
| 603.3 | JEFFERSON COUNTY MEDICAL CENTER | STEAM AND CHILLED WATER PLANT | KY | KY0053783 |
| 603.5 | GALT HOUSE EAST | | KY | KY0080675 |
| 603.8 | LOUISVILLE GAS AND ELECTRIC COMPANY | WATERSIDE STATION | KY | KY0002101 |
| 604.0 | HUMANA, INC. | | KY | KY0069809 |
| 604.1 | CITY OF JEFFERSONVILLE | JEFFERSONVILLE WWTP | IN | IN0023302 |
| 604.5 | ASHLAND PETROLEUM COMPANY | | IN | IN0025313 |
| 605.0 | COLGATE - PALMOLIVE COMPANY | | IN | IN0003638 |
| 605.2 | TOWN OF CLARKSVILLE | CLARKSVILLE WWTP | IN | IN0020621 |
| 605.9 | LOUISVILLE GAS AND ELECTRIC COMPANY | OHIO FALLS STATION | KY | KY0002089 |
| 606.3 | U.S. ARMY CORPS OF ENGINEERS | McALPINE LOCK AND DAM | KY | KY0020320 |
| 606.4 | MOSER LEATHER COMPANY, INC. | | IN | IN0002666 |
| | Sediment Sample | | | |
| 609.5 | CITY OF NEW ALBANY | NEW ALBANY WWTP | IN | IN0023884 |
| 610.0 | PUBLIC SERVICE COMPANY OF INDIANA | GALLAGHER GENERATING STATION | IN | IN0002798 |
| | Water Sample | | | |
| 611.6 | ASHLAND PETROLEUM COMPANY | | KY | KY0002291 |

Ohio River Discharges
Cincinnati, OH - Louisville, KY
Mile Point 462 - 626

| River Mile | Corporation | Plant Name | State | Permit Number |
|---|---|---|---|---|
| 612.0 | LOUISVILLE AND JEFFERSON COUNTY METROPOLITAN SEWER DISTRICT | MORRIS FORMAN WWTP | KY | KY0022411 |
| 612.1 | BP OIL COMPANY | LOUISVILLE TERMINAL | KY | KY0089711 |
| 612.5 | CHEVRON U.S.A., INC. | LOUISVILLE TERMINAL | KY | KY0063002 |
| 612.6 | TEXACO, INC. | TERMINALS AND BULK STORAGE | KY | KY0021717 |
| 613.0 | ASHLAND CHEMICAL COMPANY | | KY | KY0021610 |
| 613.1 | B.F. GOODRICH CHEMICAL COMPANY | | KY | KY0001457 |
| 613.3 | ROHM AND HAAS KENTUCKY, INC. | | KY | KY0002305 |
| 613.5 | AMERICAN SYNTHETIC RUBBER CORPORATION | | KY | KY0001589 |
| 613.6 | LOUISVILLE GAS AND ELECTRIC COMPANY | PADDY'S RUN STATION | KY | KY0002071 |
| 613.8 | E.I. DU PONT DE NUMOURS AND COMPANY | | KY | KY0001350 |
| 614.0 | ASHLAND SERVICE STATION | NO.14-O WWTP | KY | KY0027839 |
| 614.1 | MARATHON OIL COMPANY | | KY | KY0064629 |
| 614.9 | STAUFFER CHEMICAL COMPANY | | KY | KY0002780 |
| Water Sample | | | | |
| 615.2 | BORDEN CHEMICAL A&C | LOUISVILLE SITE | KY | KY0001112 |
| 615.7 | WELLINGTON ELEMENTARY SCHOOL | WELLINGTON ELEMENTARY SCHOOL WWTP | KY | KY0027103 |
| 616.2 | LOUISVILLE GAS AND ELECTRIC COMPANY | CANE RUN STATION | KY | KY0002062 |
| 616.3 | EDWARDSVILLE WATER CORPORATION | EDWARDSVILLE WTP | IN | IN0004731 |
| 617.4 | INTERPOLYMER CORPORATION | | KY | KY0086665 |
| 619.2 | LOUISVILLE AND JEFFERSON COUNTY RIVERPORT AUTHORITY | | KY | KY0090875 |
| 620.0 | SHACKLETTE ELEMENTARY SCHOOL | SHACKLETTE ELEMENTARY SCHOOL WWTP | KY | KY0027014 |
| 620.5 | EXXON COMPANY, U.S.A | EXXON TERMINAL NO. 5277 | KY | KY0021881 |
| 621.0 | JOHNSONTOWN ROAD ELEMENTARY SCHOOL | JOHNSONTOWN ROAD ELEMENTARY SCHOOL WWTP | KY | KY0026310 |
| 623.3 | LOUISVILLE AND JEFFERSON COUNTY METROPOLITAN SEWER DISTRICT | WEST COUNTY WWTP | KY | KY0078956 |
| Water Sample | | | | |

# APPENDIX 2

1. Project Name: Cincinnati to Louisville Toxics Survey

2. Project Initiation: October 1989

3. Project Objective:

   To provide data on certain chemical and physical parameters for water quality assessments under the Commission's Toxics Substances Control Program for the Ohio River from Mile 462.8 to 625.9 (Cincinnati, Ohio to West Point, Kentucky).

4. Project Description:

   This sampling project is designed to further characterize levels of metals, organic compounds, PCBs, and pesticides in the sediments, water column and the fishes of the Ohio River and its tributaries.

5. Sampling Design and Rationale:

   Review of Commission monitoring data indicate that the greatest water quality concerns in the reach of Ohio River from Mile 462.8 to 625.9 are with the contribution of PCBs and chlordane and the subsequent bioaccumulation in fish tissue. A fish sampling program is proposed in conjunction with a sediment sampling program to characterize the general distribution of these parameters.

   Of additional concern are instream levels of metals which exceed criteria established for the protection of aquatic life. Analysis has indicated that many of these parameters are runoff related, therefore sediment analysis will provide an understanding of the relative contribution from tributaries and of instream loads in the Ohio River.

   Water column samples are proposed at selected locations to provide background data on the study segment and to characterize the input from ash ponds and ground water contribution from industrial areas in the study area.

   Tables 1, 2, and 3 show the sampling locations for water column sediment and fish tissue samples.

TABLE 1

**PROPOSED WATER COLUMN SAMPLING LOCATIONS**
**CINCINNATI - LOUISVILLE SEGMENT**

| Site ID | | River Mile | Parameters | Rationale |
|---|---|---|---|---|
| Cincinnati Water Works | ORWC1 | 462.8 | Metals, conventionals, VOCs | Upstream end of study segment<br>Questions regarding monitoring station data |
| Kentucky River | KRWC1 | *4.0 | Metals, conventionals | Characterization of contribution to Ohio River |
| Madison, Indiana | ORWC2 | 559.0 | Metals, conventionals | Background sample for Hanover Beach sample |
| Hanover Beach, Indiana | ORWC3 | 563.0 | Metals, conventionals | Characterize the impact of ash ponds to Ohio River |
| Louisville, Kentucky | ORWC4 | 611.0 | Metals, conventionals, VOCs | Background sample for RM 615.5 sample |
| Louisville, Kentucky | ORWC5 | 615.6 | Metals, conventionals, VOCs | Characterize the impact of Louisville industry on Ohio River |
| West Point, Kentucky | ORWC6 | 625.9 | Metals, conventionals | Downstream of the study segment |

*River miles from the confluence with the Ohio River - Upstream of Lock #1

Three depth integrated samples to be collected at each site          21 samples for each parameter set

Metals include: Arsenic, Copper, Lead, Mercury, Nickel
Volatile Organics by EPA Method 502.2
Conventionals to include field parameters (temperature, pH, conductivity, and dissolved oxygen) + total suspended solids and hardness

**TABLE 2**

**PROPOSED SEDIMENT SAMPLING LOCATIONS**
**CINCINNATI - LOUISVILLE SEGMENT**

| Site ID | | River Mila | Parameters | Rationale |
|---|---|---|---|---|
| Little Miami River | LMS1 | ***** | Metals, pesticides, PCBs | Characterization of contribution from Little Miami River |
| Licking River | LRS1 | *4.5 | Metals, pesticides, PCBs | Characterization of contribution from Licking River |
| Ohio River | ORS1 | 472.0 | Metals, pesticides, PCBs | Downstream of Mill Creek and Mill Creek WWTP |
| Mill Creek | MCS1 | @@@@@ | Metals, pesticides, PCBs | Characterization of contribution from Mill Creek |
| Ohio River | ORS2 | 474.0 | Metals, pesticides, PCBs | Downstream of Mill Creek and Mill Creek WWTP |
| Great Miami | GMS1 | *5.5 | Metals, pesticides, PCBs | Characterization of contribution from Great Miami River |
| Ohio River | ORS3 | 491.0 | Metals, pesticides, PCBs | Downstream of confluence of Great Miami River |
| Kentucky River | KRS1 | *4.0 | Metals, pesticides, PCBs | Characterization of contribution from Kentucky River |
| Ohio River | ORS4 | 611.0 | Metals, pesticides, PCBs | Upstream of Louisville industrial area |
| Ohio River | ORS5 | 615.6 | Metals, pesticides, PCBs | Downstream of Louisville industrial area |

***** To be determined in the field
@@@@@ Upstream of the barrier dam
Metals include: Arsenic, Copper, Lead, Mercury, Nickel

For Ohio River samples - discreet samples are to be collected from each side of the river.

**TABLE 3**

**PROPOSED FISH SAMPLING LOCATIONS**
**CINCINNATI - LOUISVILLE SEGMENT**

| Site ID | | River Mile | Parameters | Rationale |
|---|---|---|---|---|
| Ohio River | ORF1 | 460.0 | Pesticides, PCBs | Upstream of Cincinnati |
| Ohio River | ORF2 | 480.0 | Pesticides, PCBs | Upstream of the confluence of the Great Miami |
| Great Miami | GMF1 | ***** | Pesticides, PCBs | Characterization of fish inhabiting the Great Miami |
| Great Miami | GMF2 | +++++ | Pesticides, PCBs | Characterization of fish inhabiting the Great Miami and the Ohio River |
| Ohio River | ORF3 | 492.0 | Pesticides, PCBs | Downstream of the confluence with the Great Miami |
| Ohio River | ORF4 | 593.0 | Pesticides, PCBs | Upstream of Louisville |
| Ohio River | ORF5 | 625.9 | Pesticides, PCBs | Downstream of Louisville metropolitan area |

***** Determined in field
+++++ Determined in field

Two species to be collected at each station. Samples to be ten, one sided fillet composites.
1 - Channel Catfish
1 - Game Fish

6. Monitoring Parameters and Frequency:

6.1 Water Column Samples

Vertically composited grab samples will be collected at stream quarter points. All water samples will be analyzed for hardness, total suspended solids, arsenic, copper, lead, and phenolics. Field parameters (temperature, pH, dissolved oxygen, and conductivity) will be measured at all collections points (i.e. at bottom, mid-depth, center depth) at stream quarter points.

Mid-depth samples will be collected at stream quarter points at three stations, see Table 1, for volatile organic chemical analysis.

TABLE 4

PARAMETER TABLE FOR WATER COLUMN SAMPLES

| Compound | Number of Samples | Analytical Method Reference | Sample Preservation | Holding Time |
|---|---|---|---|---|
| Temperature | 63 | Std. Method 212 | None | Field Test |
| pH | 63 | EPA 150.1 | None | Field Test |
| Specific Conductance | 63 | EPA 120.1 | None | Field Test |
| Dissolved Oxygen | 63 | | None | Field Test |
| Total Suspended Solids | 21 | EPA 160.1 | Cool 4°C | 7 Days |
| Hardness | 21 | EPA 130.1, 130.2 | $HNO_3$ to pH<2 | 6 Mos. |
| Arsenic | 21 | EPA 206.3, 206.2 | $HNO_3$ to pH<2 | 6 Mos. |
| Copper | 21 | EPA 220.1, 220.2 | $HNO_3$ to pH<2 | 6 Mos. |
| Lead | 21 | EPA 239.1, 239.2 | $HNO_3$ to pH<2 | 6 Mos. |
| Mercury | 21 | EPA 245.1 | $HNO_3$ to pH<2 | 28 Days |
| Nickel | 21 | EPA 249.1, 249.2 | $HNO_3$ to pH<2 | 6 Mos. |
| Phenolics | 21 | EPA 420.1 | $H_2SO_4$ to pH<2 | 28 Days |
| Bromochloromethane | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| Bromodichloromethane | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| Bromoform | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| Carbon Tetrachloride | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| Chloroform | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| Dibromochloromethane | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| 1,1-Dichloroethane | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| 1,2-Dichloroethane | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| 1,1-Dichloroethylene | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| 1,2-Dichloropropane | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| Methylene Chloride | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| Tetrachloroethylene | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| 1,1,1-Trichloroethane | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| Trichloroethylene | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| Trichlorofluoromethane | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| Benzene | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| Chlorobenzene | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| Ethylbenzene | 11 | EPA 502.2 | Cool 4°C | 7 Days |

TABLE 4

PARAMETER TABLE FOR WATER COLUMN SAMPLES (Continued)

| Compound | Number of Samples | Analytical Method Reference | Sample Preservation | Holding Time |
|---|---|---|---|---|
| 1,2-Dichlorobenzene | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| 1,3-Dichlorobenzene | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| 1,4-Dichlorobenzene | 11 | EPA 502.2 | Cool 4°C | 7 Days |
| Toluene | 11 | EPA 502.2 | Cool 4°C | 7 Days |

EPA Method 502.2 - Volatile Organic Compounds in water by Purge and Trap Capillary Column Gas Chromatography with Photoionization and Electrolytic Conductivity Detector in Series (Sept. 1986); OEPA Method 003A

## 6.2 Sediment Samples

Sediment samples will be collected at stations described in Table 2 for analysis of arsenic, copper, lead, phenolics, PCBs, and pesticides. It is recognized that sediment sample collection is dependent on the availability of sediments. The locations provided are a guide and exact locations will be determined in the field. The goal is to determine the influence of certain upstream influences (see Table 2).

TABLE 5

PARAMETER TABLE FOR SEDIMENT SAMPLING

| Compound | Number of Samples | Analytical Method Reference | Sample Preservation | Holding Time |
|---|---|---|---|---|
| Arsenic | 17 | EPA 200 | Cool 4°C | |
| Copper | 17 | EPA 200 | Cool 4°C | |
| Lead | 17 | EPA 200 | Cool 4°C | |
| Mercury | 17 | EPA 200 | Cool 4°C | |
| Nickel | 17 | EPA 200 | Cool 4°C | |
| Phenolics | 17 | | | |
| PCBs/Pesticides | 17 | EPA 608 | Cool 4°C | |

## 6.3 Fish Tissue Samples

Fish tissue samples will be collected at stations described in Table 3. Each sample will consist of fillets from five adult fish of the same species. Two samples (channel catfish and game fish) are to be collected at each site and analyzed for PCBs and pesticides. The locations provided are a guide to the area where the fish samples have to be collected.

TABLE 6

| Compound | Number of Samples | Analytical Method Reference | Sample Preservation | Holding Time |
|---|---|---|---|---|
| PCBs/Pesticides<br>% Fat (lipid content) | 14 | EPA 608 | Freeze | 1 Year |

7. Project Organization and Responsibility

The field survey is a cooperative effort between the Indiana Department of Environmental Management (IDEM), the Kentucky Division of Water (KDOW), and the Ohio River Valley Water Sanitation Commission (ORSANCO). ORSANCO will provide field personnel, all sample containers, preservatives, shipping materials, field data sheets and a sampling boat. Participating agencies will provide field personnel, appropriate sampling gear and necessary sampling boats to complement existing resources.

8. Quality Assurance Objectives

Data quality requirements are parameter specific and shall confirm to those stated in U.S. EPA approved analytical methods. Method 502.2 GC (VOCs), and Methods for Chemical Analysis of Water and Wastes, EPA 600/4-74-020 (inorganics). All sampling and analysis procedures will be performed as representativeness and minimize sample loss and contamination problems. Twenty-two volatile organics will be analyzed in grab samples of river water, and river sediments using purge and trap gas chromatography with photoionization and electrolytic conductivity detectors. The analytical method employed is approved by U.S. EPA for analysis of treated drinking water and raw source water (Method 502.2). The compounds include halogenated methanes, ethanes, laboratory detection limits for these parameters range from 0.2 μg/l to 0.3 μg/l.

| Parameter | Target Detection Limit* |
|---|---|
| Temperature | 1°C |
| pH | 0.1 s.u. |
| Specific Conductance | 10μ |
| Suspended Solids | 5 mg/l |
| Hardness | 1 mg/l |
| Cyanide | 5 mg/l |
| Phenolics | 2 mg/l |

METHOD DETECTION LIMIT, µg/L*

| PARAMETER | HECD/PID |
|---|---|
| Bromochloromethane | Not Established |
| Bromodichloromethane | 0.1 |
| Bromoform | 0.1 |
| Carbon Tetrachloride | Not Established |
| Chloroform | 0.1 |
| Dibromochloromethane | 0.1 |
| 1,1-Dichloroethane | 0.2 |
| 1,2-Dichloroethane | 0.1 |
| 1,1-Dichloroethylene | 0.1 |
| 1,2-Dichloropropane | 0.1 |
| Methylene Chloride | 0.8 |
| Tetrachloroethylene | 0.1 |
| 1,1,1-Trichloroethane | 0.1 |
| Trichloroethylene | 0.1 |
| Trichlorofluoromethane | Not Established |
| Benzene | 0.1 |
| Chlorobenzene | 0.1 |
| Ethylbenzene | 0.1 |
| 1,2-Dichlorobenzene | 0.3 |
| 1,3-Dichlorobenzene | 0.2 |
| 1,4-Dichlorobenzene | 0.2 |
| Toluene | 0.1 |

HECD = Hall Electrolytic Conductivity Detector
PID = Photoionization Detector

*OEPA QA Manual

9. Internal Quality Control Checks and Frequency

Quality control checks in the field will consist of field blanks, split samples and duplicate samples. All VOC samples will be collected in duplicate and analyzed at a frequency of 10%. One field blank and one duplicate per inorganic parameter will be analyzed for every 16 samples collected. Sampling sites for collection of blanks and duplicates will be selected randomly in the field and sample bottles labeled "field blanks" or "duplicate." Single lot reagent grade water will be provided for preparing all field blanks.

Laboratories providing analysis in this project have an approved quality assurance program in place and are certified in water/wastewater analysis. Routine quality control in the laboratory should include the following:

1) daily reagent blank analysis;
2) daily calibration standard analysis;
3) analysis of field blanks and duplicates; and
4) weekly low level spike analysis.

## 10. Sampling Procedures

### 10.1 Water Column Samples

Water column samples are to be collected at each designated location at each quarter point (right quarter point, mid-stream and left quarter point) along a line perpendicular to the river bank. Depth composite samples collected for the inorganic parameters will consist of a composite of samples collected at depths of one meter from the surface, mid-depth and one meter from the bottom. Samples collected for volatile organic analysis shall be taken at mid-depth only. Appropriate preservatives will be added to each sample container. Samples will be collected using stainless steel or teflon Kemmerer samplers.

Cleaned, labeled sample bottles will be provided as follows:

| | |
|---|---|
| Volatile Organics | 40 ml glass-teflon septum |
| Phenolics | 8 oz glass |
| Suspended Solids | 1 qt plastic |
| Hardness | 1 qt plastic |
| Metals | 1 qt plastic |

Bottle labels will specify analyte, date, time, location description, sample ID, preservative, and collector's name and agency. A field sample report will also be prepared for each sampling point.

Field Parameters: ORSANCO and each participating agency will provide their own field instruments for field tests. Field measurements for temperature, conductivity and pH will be recorded at each quarter point at each sample interval. The completed field report will be returned with the results to ORSANCO.

Volatile Organics: Samples must be collected in 40 ml septum (teflon septums) vials from the mid-depth at each quarter point at the sampling locations so designated. The sample vials are to be filled such that a meniscus forms on the top rim of vial. The tops are to be put on such that there are no air bubbles present in the vials. The hermetic seal is to be maintained on the sample vial until the time of analysis. Duplicates will be collected and submitted at all times and field blank samples will be submitted at a frequency of 10%. All samples are iced or refrigerated at 4°C from the time of collection to the time of analysis.

Phenolics: Samples must be collected in 8 oz. glass containers with polyethylene caps. Samples will be vertically composited in the field. Samples are preserved in the field by adding 1 ml 1:1 $H_2SO_4$. Samples will be stored at 4°C and submitted to the laboratory as soon as possible.

Metals: Samples will be collected in 1 qt. plastic containers. Samples will be vertically composited in the field. Samples are preserved in the field by adding 2 ml $HNO_3$. Samples will be stored at 4°C and submitted to the laboratory as soon as possible.

Total Suspended Solids: Samples will be collected in 1 qt. polyethylene cubitainers. Samples will be vertically composited in the field. Samples will be stored at 4°C from the time of collection to the time of analysis.

Total Hardness: Samples will be collected in 1 qt. polyethylene cubitainers. Samples will be vertically composited in the field and preserved by adding 2 ml of 1:1 $H_2SO_4$. Samples will be stored at 4°C from the time of collection to the time of analysis.

10.2 Sediment Samples

Sediment samples are to be collected in the vicinity of the locations designated in Table 2 and indicated on the maps in Appendix A. Actual location for collection will be determined in the field based on availability of sediment. In the case of the Ohio River locations, two discreet samples are to be collected, one from each side of the River.

Samplers shall attempt to collect samples of small particle size and no samples with particle size greater than sand (2.0 mm) shall be collected.

The samples shall be collected with either a ponar type sampler or a corer type sampler. Sediments shall be collected from the top layer of bottom sediments. The samples will be placed in 1 qt. glass jars.

Bottle labels will specify analyte, date, time, location description, sample ID, and collector's name and agency. A field sample report, which will include a river chart showing sampling collection location, shall be prepared for each sample.

10.3 Fish Tissue Sampling

Fish are to be collected for fish tissue samples at the locations indicated on Table 3. The locations are provided as a guide for the collection area, actual collection location will be determined in the field. The following procedures will be used to collect and preserve the fish tissue samples. Each sample is to be a composite consisting of ten one sided fillets. Two composite samples are to be collected at each site.

1 - Composite Catfish
1 - Composite Game Fish (preferably white bass)

10.3.1. Field Equipment

The following equipment is needed in the collection of fish fillets:

Fish measuring board
Fish weigh scale
Fillet board
Scaling tool
Stainless steel knife
Aluminum foil
Acetone or Hexane (reagent grade)
Plastic bags
Dry ice
Coolers
Data sheets
Label tags

10.3.2 Fish Collection Procedures

a. Collect the fish species to be filleted for tissue analysis.

i. Methods of Collection

Several methods of collection are acceptable. The methods most commonly used are:

1. Rotenone
2. Electrofishing
3. Hoop netting

Any method of collection is acceptable which provides live fish to be collected from the water, in good condition, without contamination from analyte compounds or substances which interfere with analyte compound identification or analysis.

b. Field Data Collection

Record on an ORSANCO field data sheet the location, date, time, collection method, and collectors of the fish to be filleted for analysis, etc. (see Attachment A). A copy of this data sheet should accompany the fish to be ORSANCO offices and be delivered to the Coordinator of Field Operations.

c. Fish Data Collection

Field data is collected on the fish to be filleted for analysis. This data should include:

a. Species identification
b. Total length
c. Total weight
d. Notation of anomalous characteristics

10.3.3 Filleting Procedures

a. Fillet Equipment Preparation

i. Rinse all equipment that will come in contact with the fish fillets (foil, scalers, knives, etc.) with reagent grade acetone or hexane.

ii. Rinse the equipment between species or composites, which are being submitted for analysis. It is not necessary to rinse equipment between individuals of the same species or individuals of the same composite.

iii. Cover all work surfaces which will come in contact with the fish or fillet (table surface, scaling board, filleting board) with hexane or acetone rinsed aluminum foil. Use the foil with dull side up, or in contact with the fish and the fillet. Replace foil as often as necessary, especially between species or between composites of the same species.

b. Fish Preparation

i. All fish, with the exception of catfish, are scaled prior to filleting. Catfish, having no scales, are skinned prior to filleting. Fish are scaled carefully as not to abrade the underlying tissue thus permitting unnecessary contamination.

ii. After scaling or skinning has been completed, cut dorso-ventrally behind the opercular flap from the nape to the rib cage, cutting deep enough to reach the spinal vertebrae. Do not cut into the abdominal cavity. If organs or viscera are cut during the filleting process, the fillet and equipment are automatically considered contaminated. The fish is discarded, the equipment rinsed with solvent, the foil replaced, and a new fish is started.

iii. Cut posteriorly from the opercular cut to the caudal peduncle. Cut deep enough to reach the vertebrae on the anterior portion of the fish. Once passed the anus, the knife blade can extend ventrally through the fish, and the posterior portion of the fillet is cut following the vertebrae to the caudal peduncle.

iv. Returning to the anterior portion of the fillet, carefully cut along the rib cage, extracting the bulk of the muscle tissue covering this area. As the muscle tissue thins appreciably, cut through the muscle wall to the exterior, resulting in the ventral extent of the anterior portion of the fillet. Continue this cut to just behind the anus (see Attachment B, 1-2 fish species and fillet locations).

v. Place fillet on rinsed aluminum foil, dull side up, and composite with other fillets.

vi. Once the composite is complete, wrap the fillets in two layers of solvent rinsed aluminum foil, shiny side out. One the outside of the aluminum foil, write the species, location and date of collection. Place each composite in a resealable plastic bag and again write the species, location and date on the outside of the bag. Place the samples in a cooler with dry ice and present the cooler to the ORSANCO representative or ship overnight to the ORSANCO offices in care of the Coordinator of Field Operations.

11. <u>Sample Custody</u>

All pertinent information will be documented on field sample reports and sample bottle labels at the time of collection. The sample collector attests to the validity of the sample by signature on the bottle and log sheet. The log sheets are submitted with the samples to the laboratory and can be used to report the test results to ORSANCO. ORSANCO will be responsible for transporting the water samples to the laboratory.

12. <u>Calibration Procedures and Preventive Maintenance</u>

Field instrumentation to measure pH, temperature, and conductivity should be calibrated prior to sampling according to the manufacturer's directions. A copy of the calibration procedures will be submitted to ORSANCO. Calibration of laboratory instruments should conform to U.S. EPA protocol for the specific method used. Field personnel will record field calibration results and submit a copy of this log to ORSANCO.

Documentation of equipment maintenance, calibration and repairs is an integral part of a laboratory's quality assurance program. Each laboratory participating in this study is responsible for this element.

13. <u>Analytical Procedures</u>

See Section 6, Monitoring Parameters and Frequency.

14. Data Reduction, Validation and Reporting

Documentation of test results, review of calculations, and data reporting will be conducted by each laboratory according to standard operating procedures. The data will be reviewed for completeness and consistency and entered into ORSANCO's toxics data base which has been established to manage all data collected on this Ohio River segment. Copies of the data on either floppy disk and/or paper will be made available to all participants.

15. Data Usage

The physical/chemical data generated by this sampling project is used to:

- assess general water quality conditions and identify problem areas,
- evaluate point, nonpoint and tributary impacts to the Ohio River,
- identify specific sources of toxic substances in the study area, and
- support water quality management decisions

Basic statistical tests and simple conservative water quality modeling will be performed on the data to characterize water quality. These values will be compared to the Commission's stream criteria and combined with other monitoring data for Toxic Substances Control Program assessments.

16. Corrective Action

In the field, spare sampling containers will be available in case of sample loss or contamination. State personnel are responsible for sample collection devices and test equipment supplies. In the event of unfavorable weather conditions or major conflicts with personnel scheduling, an alternative sampling data will be established.

Corrective action in the laboratory should follow established analytical operating procedures and any action taken reported to ORSANCO's project coordinator.

17. Quality Assurance Reports

A status report will be prepared by ORSANCO to review progress and discuss any quality assurance problems following the field sampling effort. An estimation of analytical precision and accuracy should be included in the test results reported by the laboratory. The final project report will include a summary of quality control objectives achieved during the project.

Attachment A

# ORSANCO FISH CONTAMINANTS PROGRAM

# FISH TISSUE DATA SHEET

# ORSANCO FISH CONTAMINANTS PROGRAM

## FISH TISSUE DATA SHEET

Waterbody:______________________ Date:______________

Location: ________________________________________

________________________________________

Collectors:________________________________________

Filleted by: ________________________________________

Data Transcriber: ________________________________________

Method of Collection: ________________________________________

| | Species | Length | Weight | Condition |
|---|---|---|---|---|
| 1. | | | | |
| 2. | | | | |
| 3. | | | | |
| 4. | | | | |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

Field Parameters: Time collected________________________________________

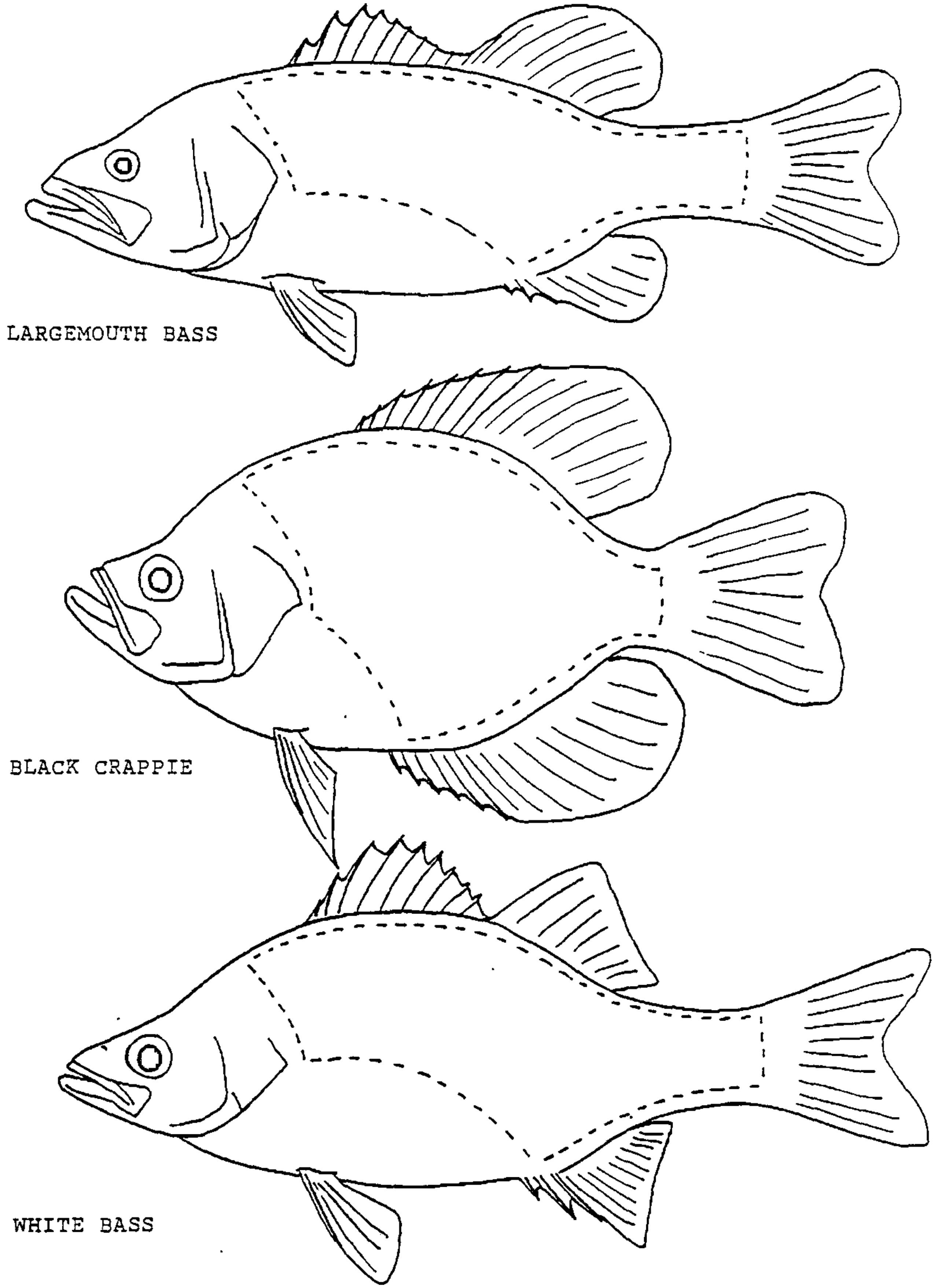
Temp.______________ D.O. __________ pH ______________ Cond.______________

Secchi______________ Other________________________________________

Attachment A

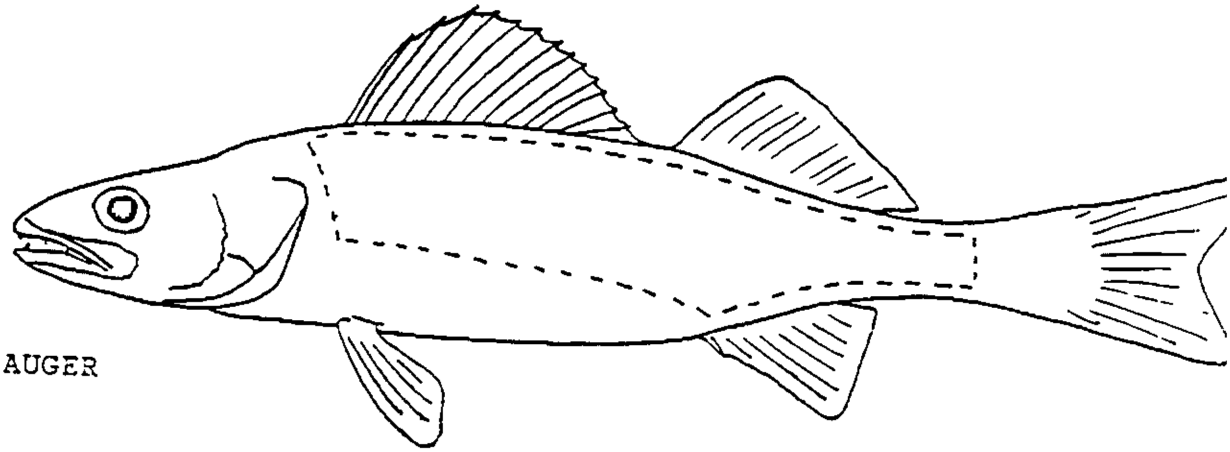
ORSANCO FISH CONTAMINANTS PROGRAM

Attachment B

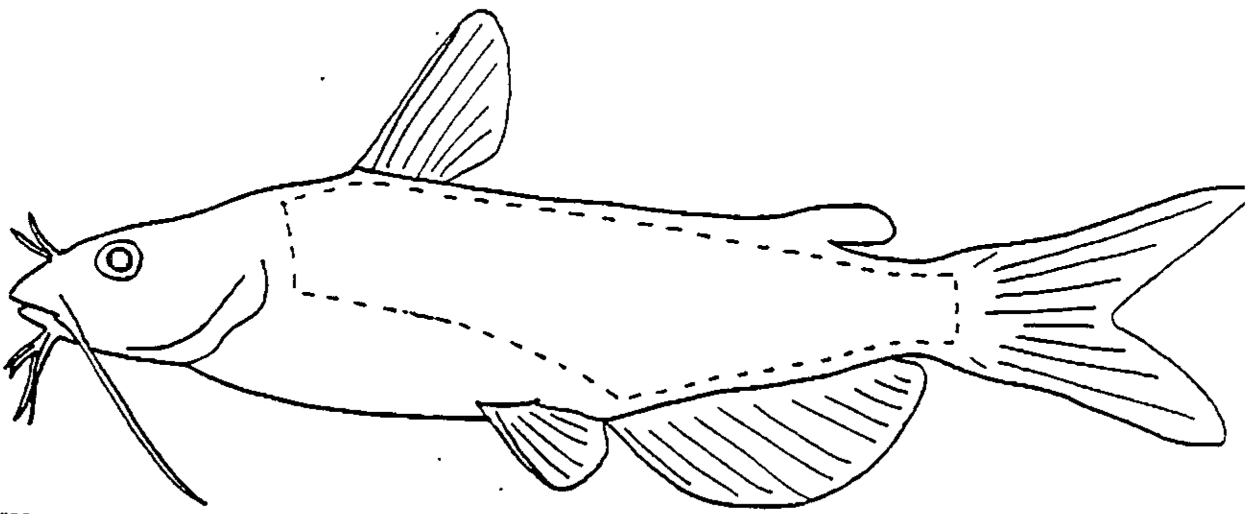



Attachment B-1

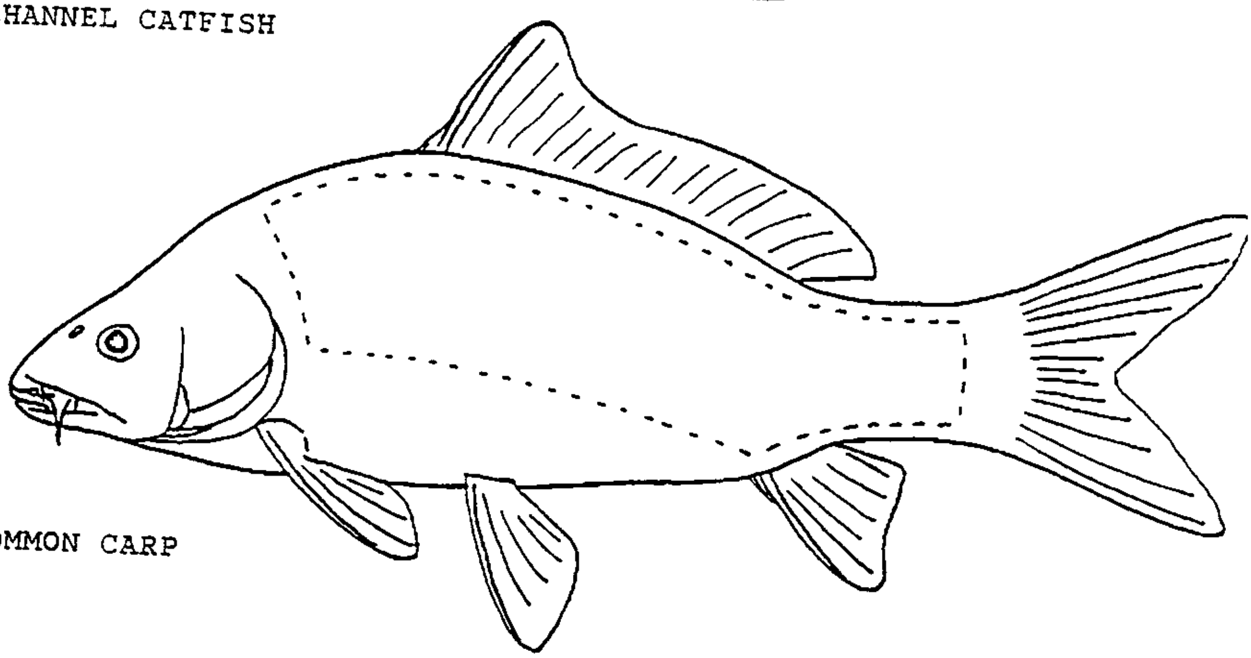
FISH FILLET LOCATIONS ON SELECTED SPECIES



SAUGER



CHANNEL CATFISH



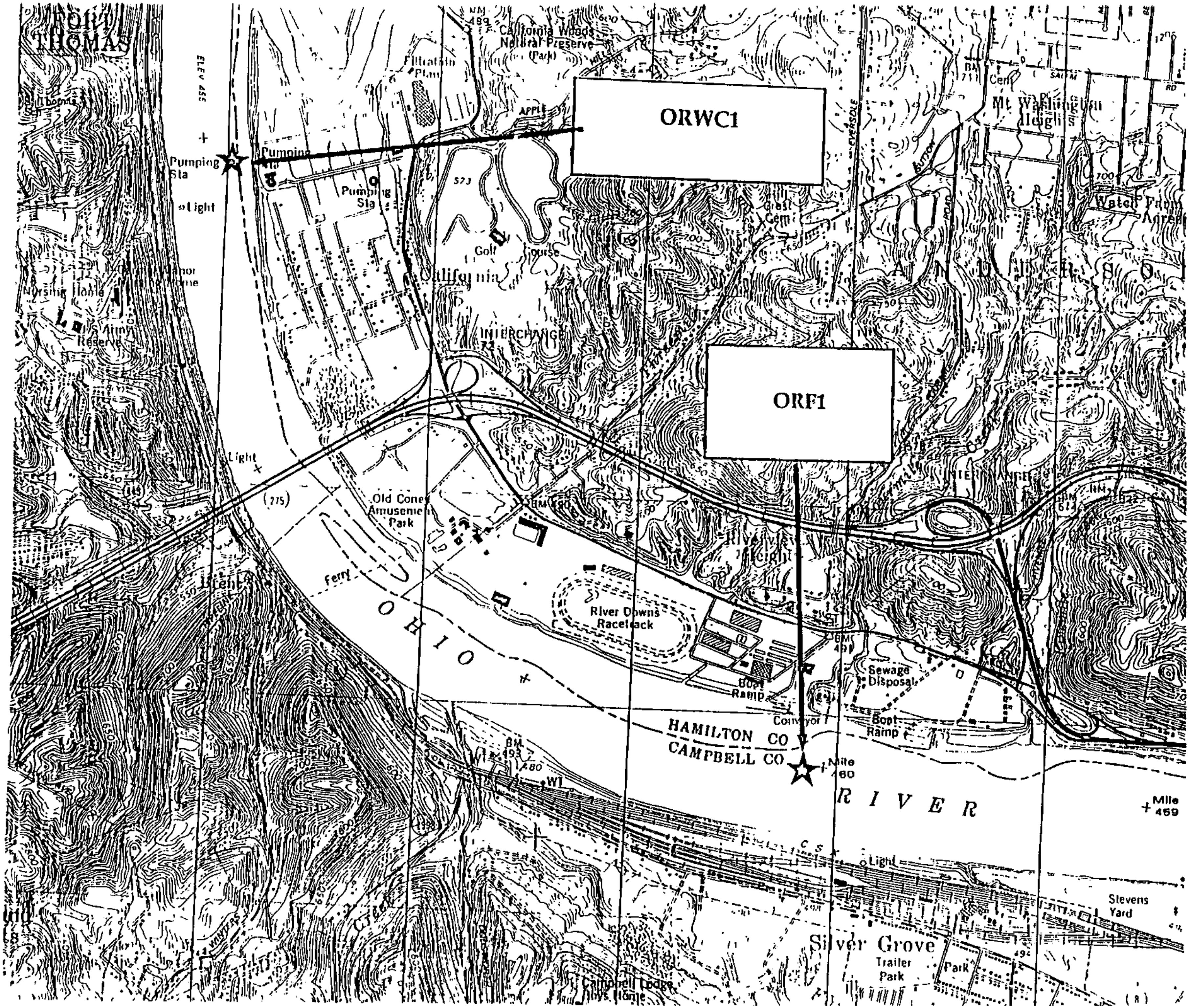
COMMON CARP

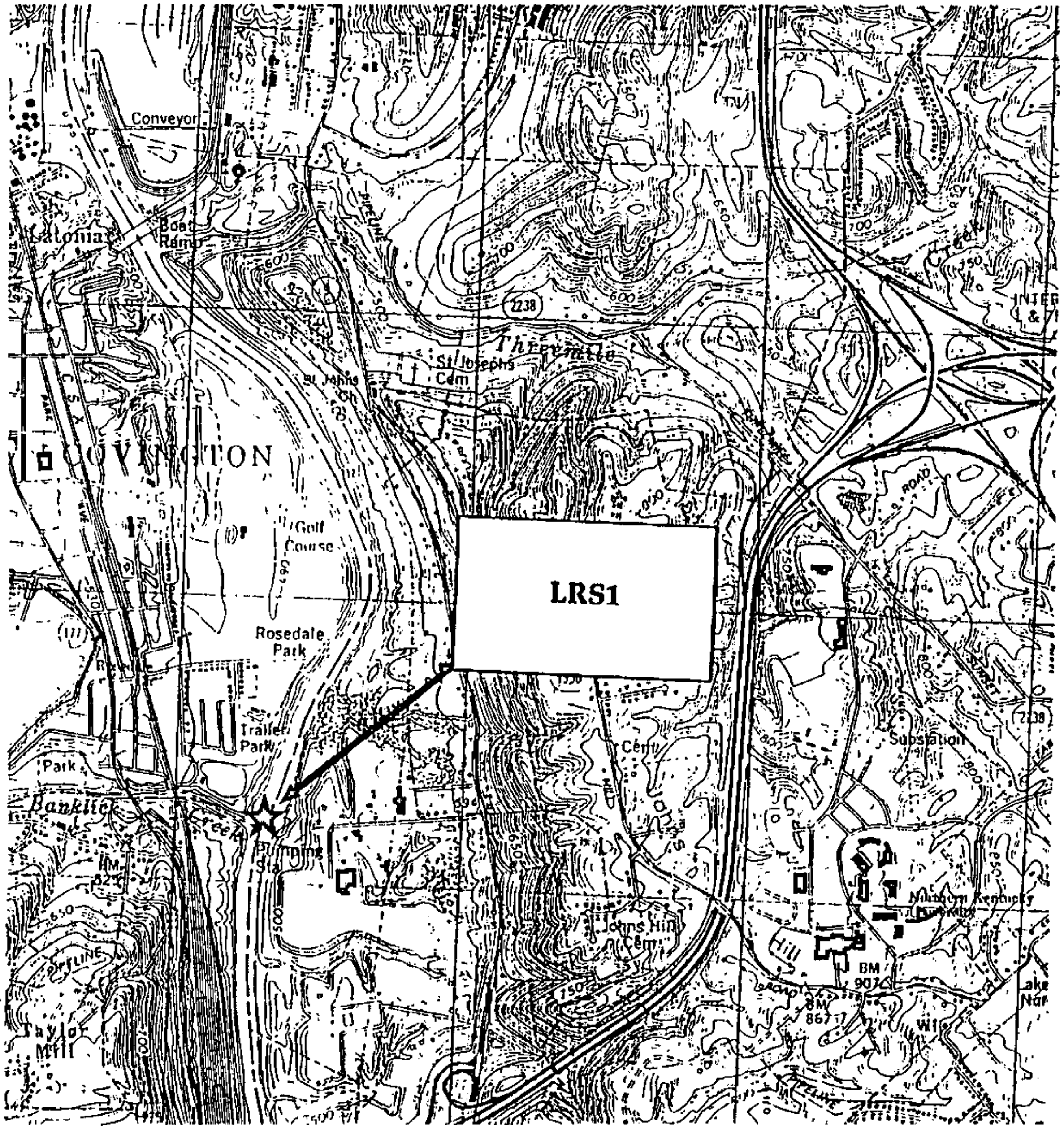
Attachment B-2

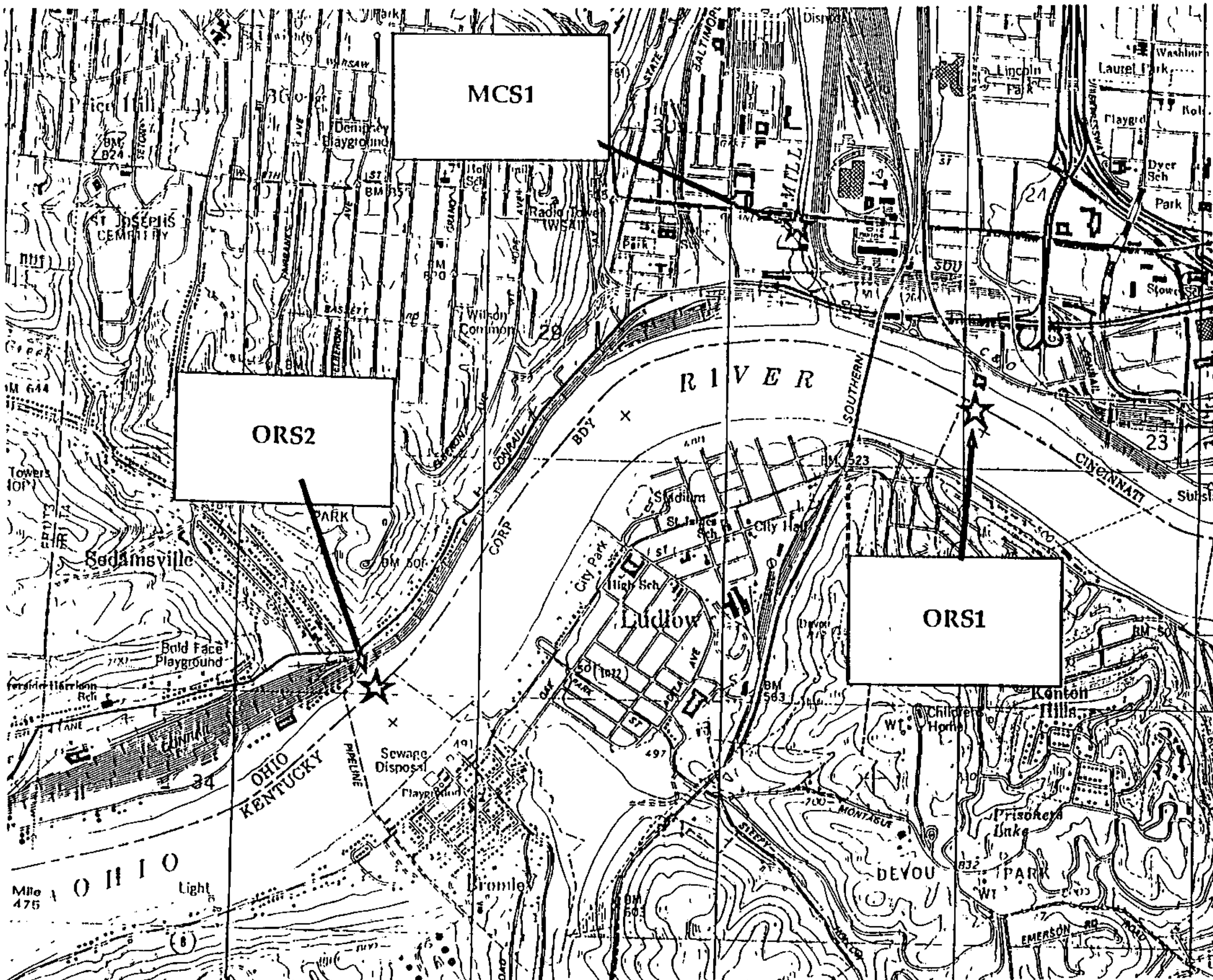
FISH FILLET LOCATIONS ON SELECTED SPECIES

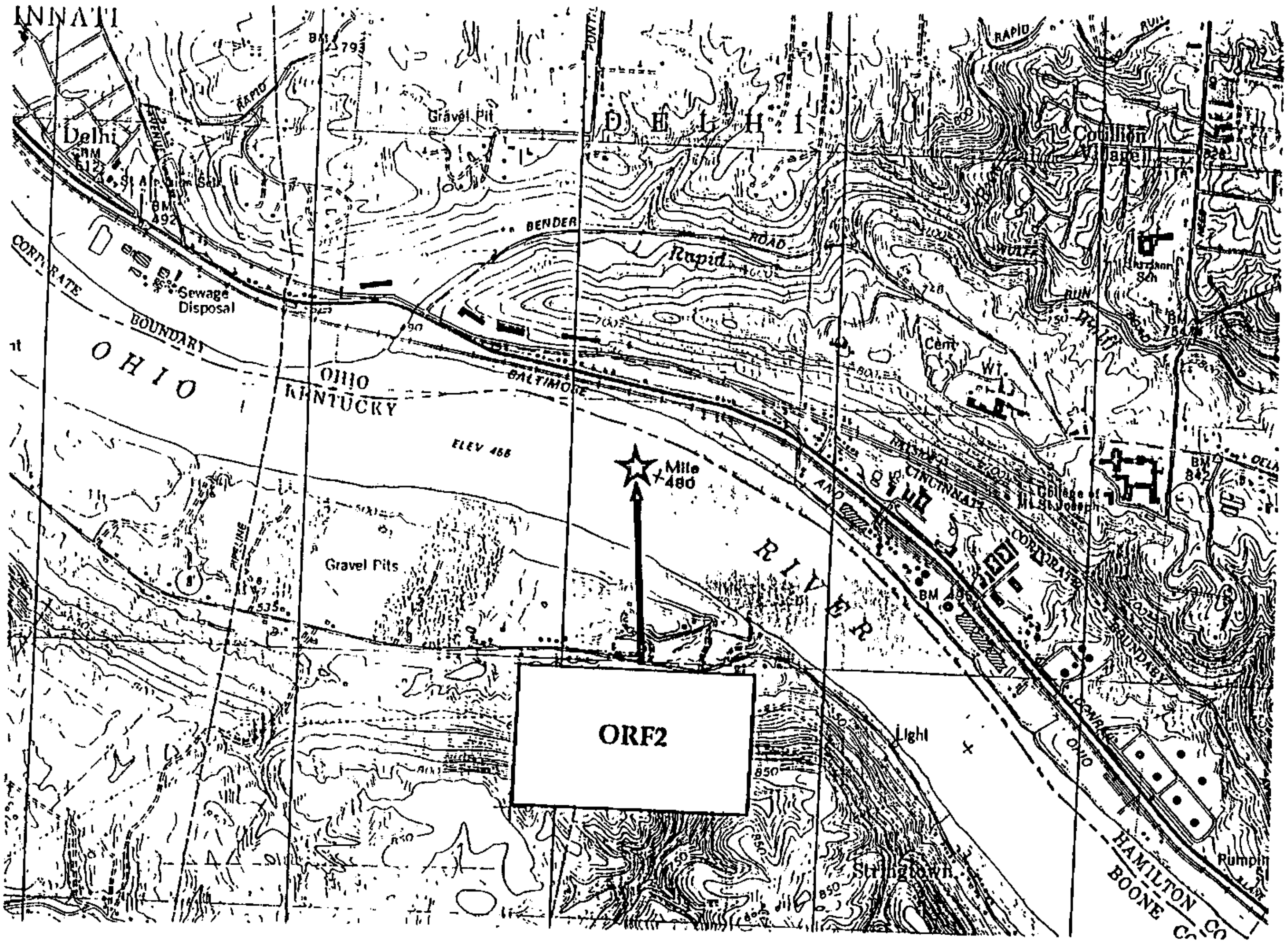
# APPENDIX C

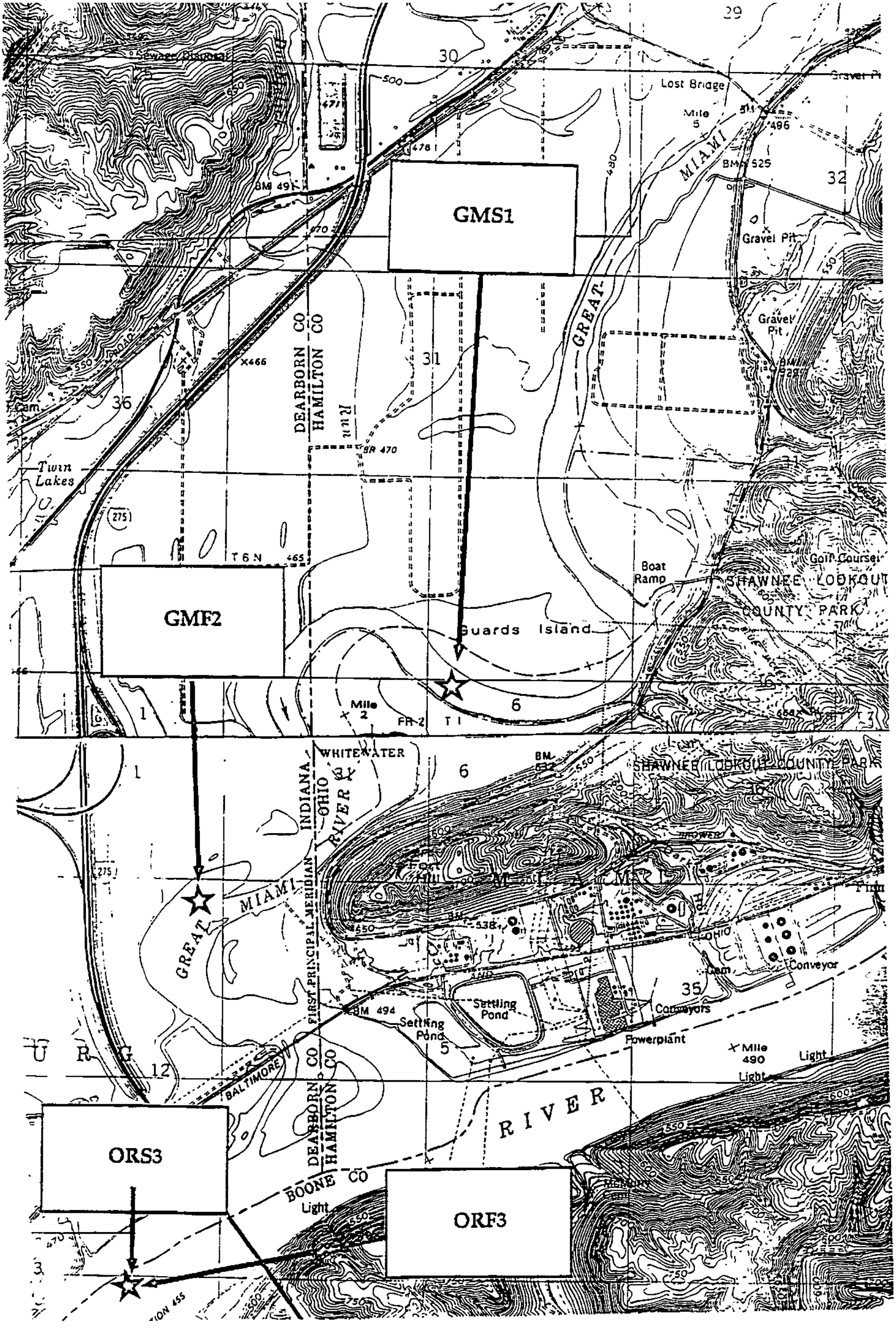
# SAMPLING LOCATIONS

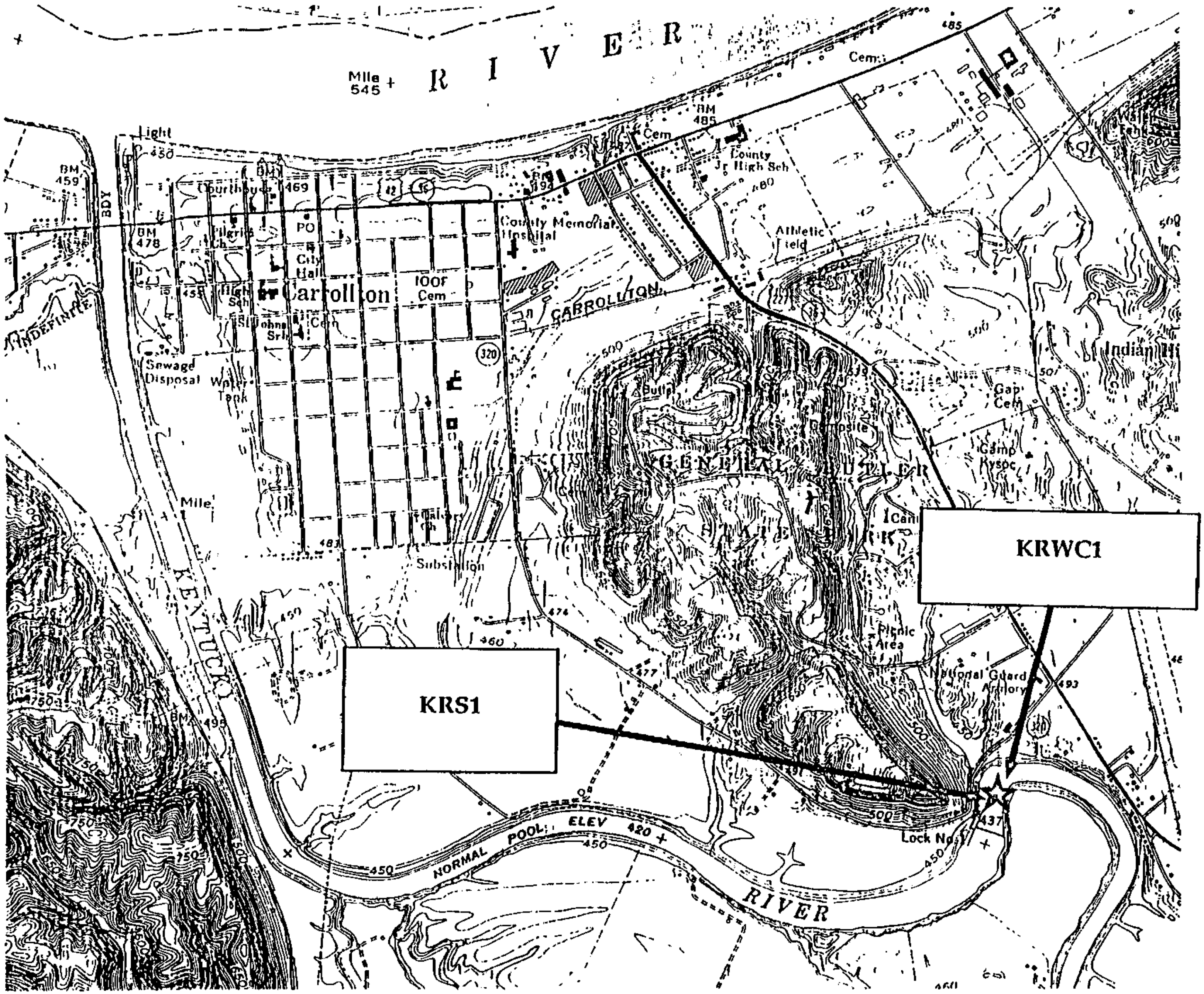

ORWC1
ORF1
FORT THOMAS
Pumping Sta
Light
California Woods Natural Preserve (Park)
Filtration Plant
Pumping Sta
Golf Course
INTERCHANGE 72
Old Coney Amusement Park
Ferry
OHIO
RIVER
River Downs Racetrack
Boat Ramp
Sewage Disposal
Conveyor
HAMILTON CO
CAMPBELL CO
Mile 460
Mile 469
Mt Washington Heights
Silver Grove
Trailer Park
Stevens Yard
CSX

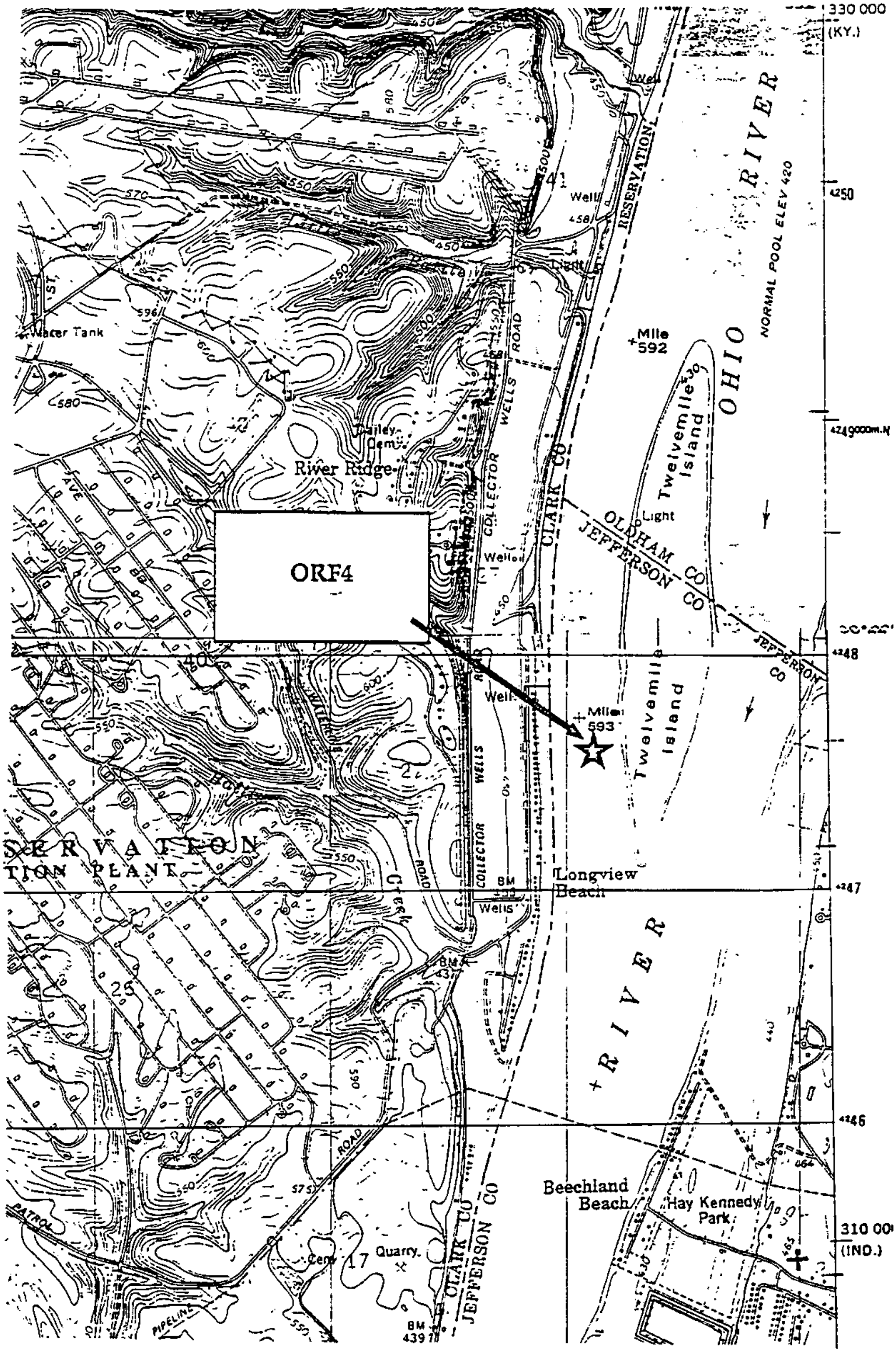

LRS1
COVINGTON
Conveyor
Latonia
Boat Ramp
Golf Course
Rosedale Park
Trailer Park
Park
Banklick Creek
St Josephs Cem
Threemile
Cem
Johns Hill Cem
Substation
Taylor Mill
Hill


MCS1
ORS2
ORS1
RIVER
OHIO
KENTUCKY
Ludlow
Sedamsville
City Park
DEVOU
PARK
CINCINNATI
SOUTHERN
Sewage Disposal
Bold Face Playground
Dempsey Playground
ST JOSEPHS CEMETERY
Wilson Common
Stadium
High Sch
Childrens Home
Prisoners Lake
Kenton Hills
Lincoln Park
Laurel Park
Dyer Sch
PIPELINE
CORP
BDY
CONRAIL
MILL

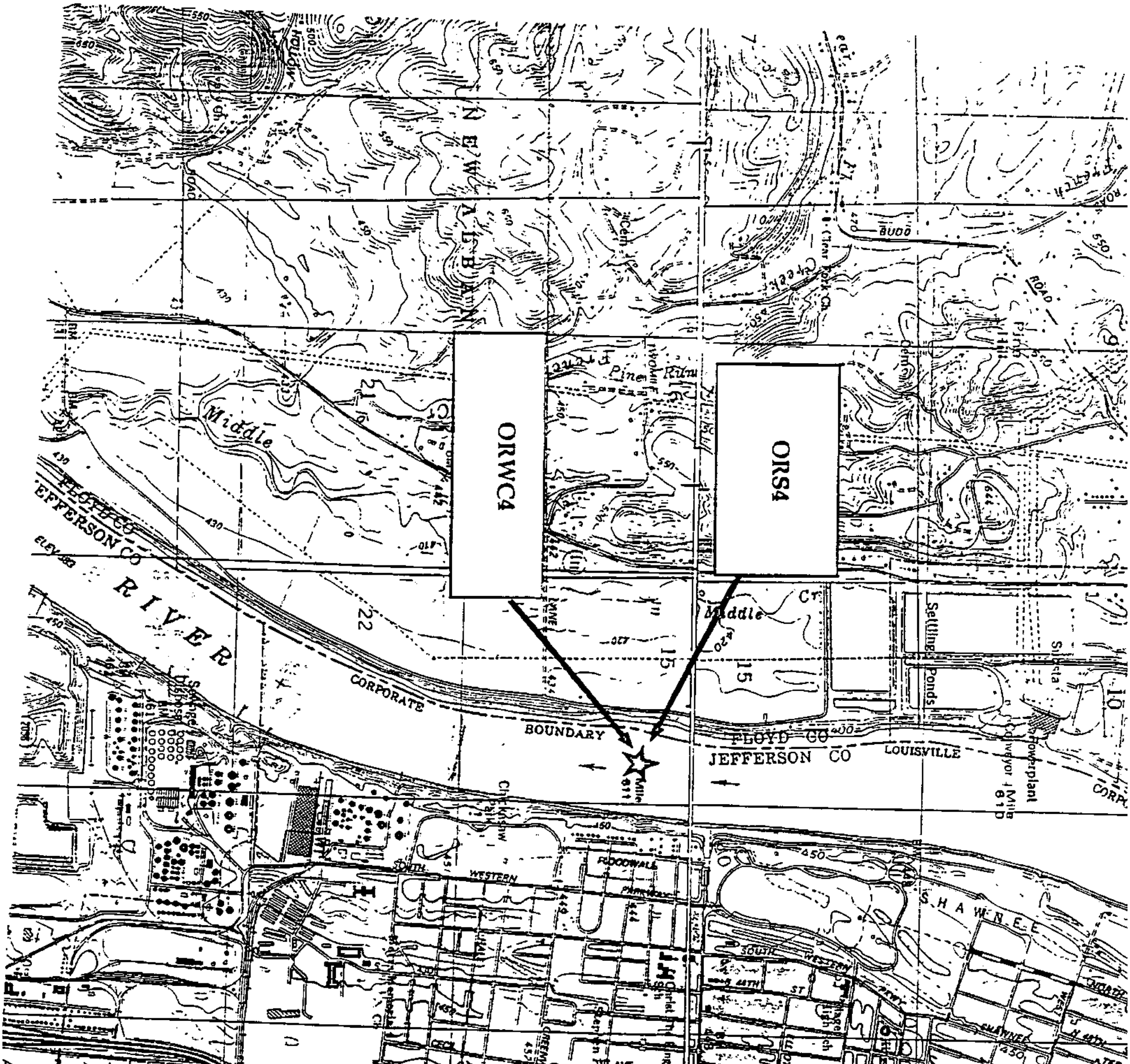

ORF2
Mile 480
OHIO RIVER
OHIO
KENTUCKY
ELEV 456
Gravel Pits
Gravel Pit
DELHI
Delhi
Sewage Disposal
CORPORATE BOUNDARY
BENDER ROAD
Rapid
BALTIMORE
CINCINNATI
Light
Stringtown
HAMILTON CO
BOONE CO
PIPELINE
Cem
Rumph

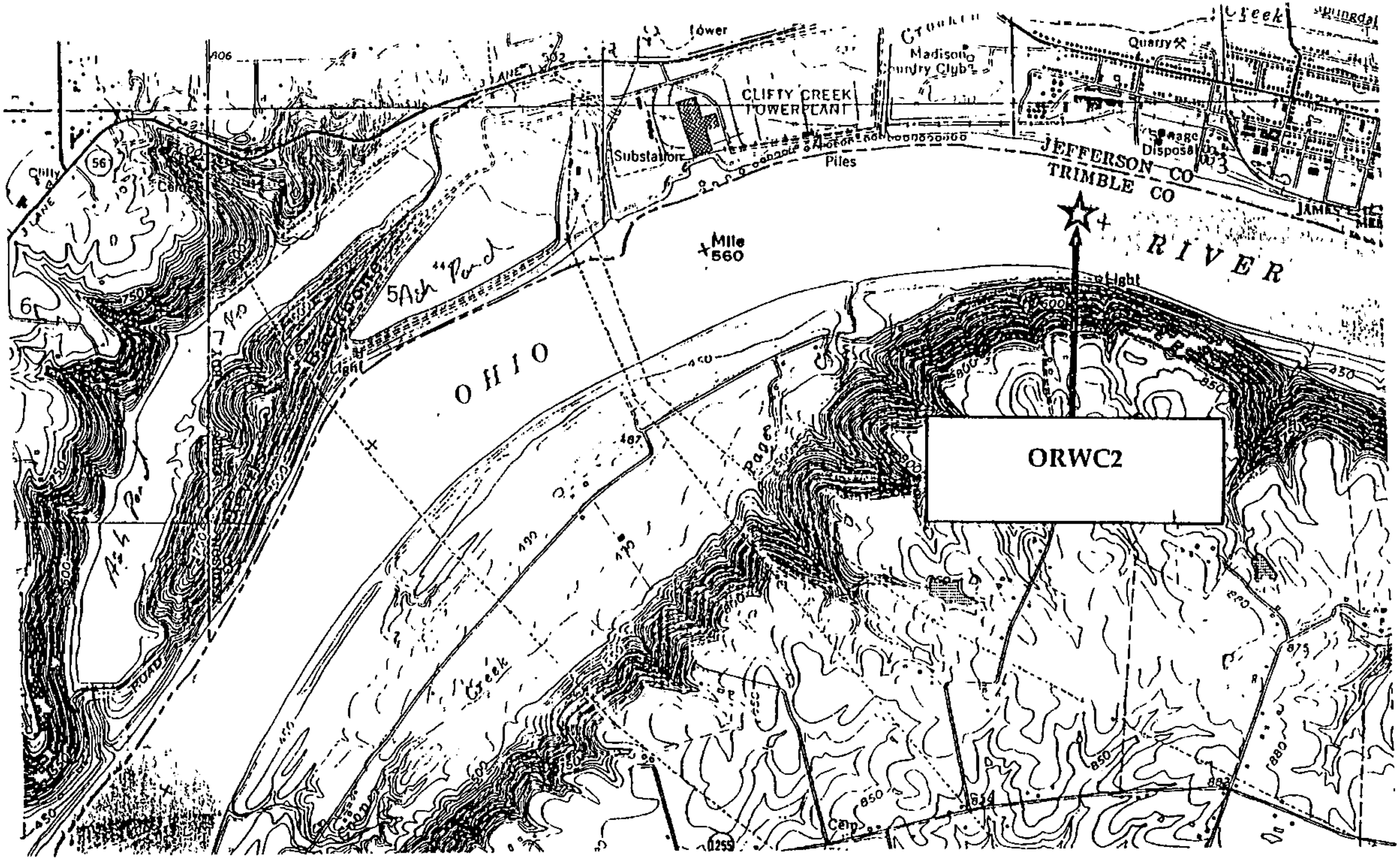

GMS1
GMF2
ORS3
ORF3
Sewage Disposal
Lost Bridge
Gravel Pit
Mile 5
GREAT MIAMI
Guards Island
Boat Ramp
SHAWNEE LOOKOUT COUNTY PARK
Golf Course
Twin Lakes
DEARBORN CO
HAMILTON CO
INDIANA
OHIO
WHITEWATER
RIVER
FIRST PRINCIPAL MERIDIAN
Settling Pond
Conveyors
Conveyor
Powerplant
Mile 490
Light
RIVER
BOONE CO
BALTIMORE
Mile 2
T 6 N


RIVER
Mile 545
Carrollton
Courthouse
PO
City Hall
IOOF Cem
County Memorial Hospital
CARROLLTON
County Jr High Sch
Athletic Field
Sewage Disposal
Water Tank
Substation
KENTUCKY
NORMAL POOL ELEV 420
RIVER
Lock No
Picnic Area
National Guard Armory
Gap Cem
Camp Kysoc
KRS1
KRWC1

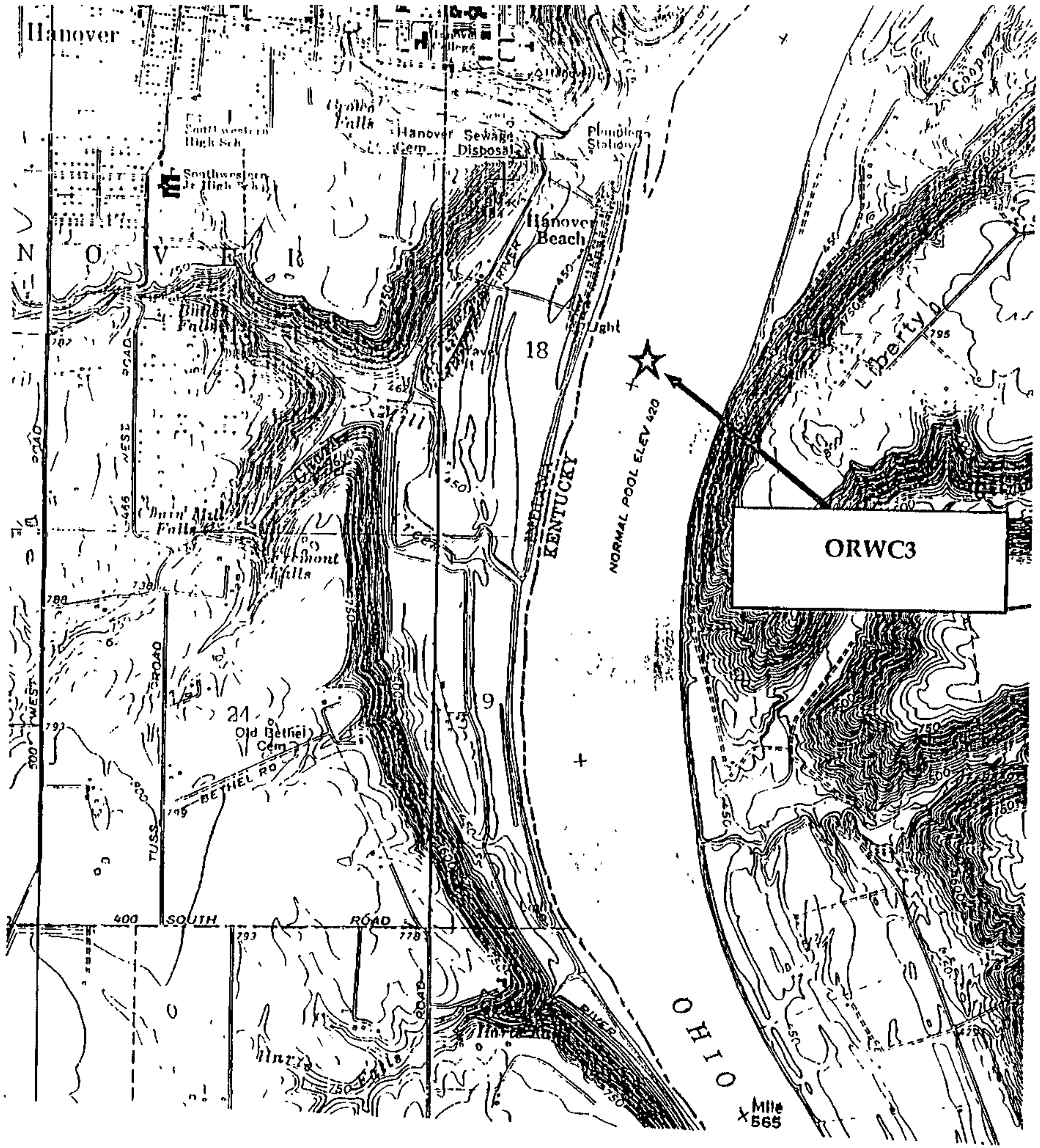


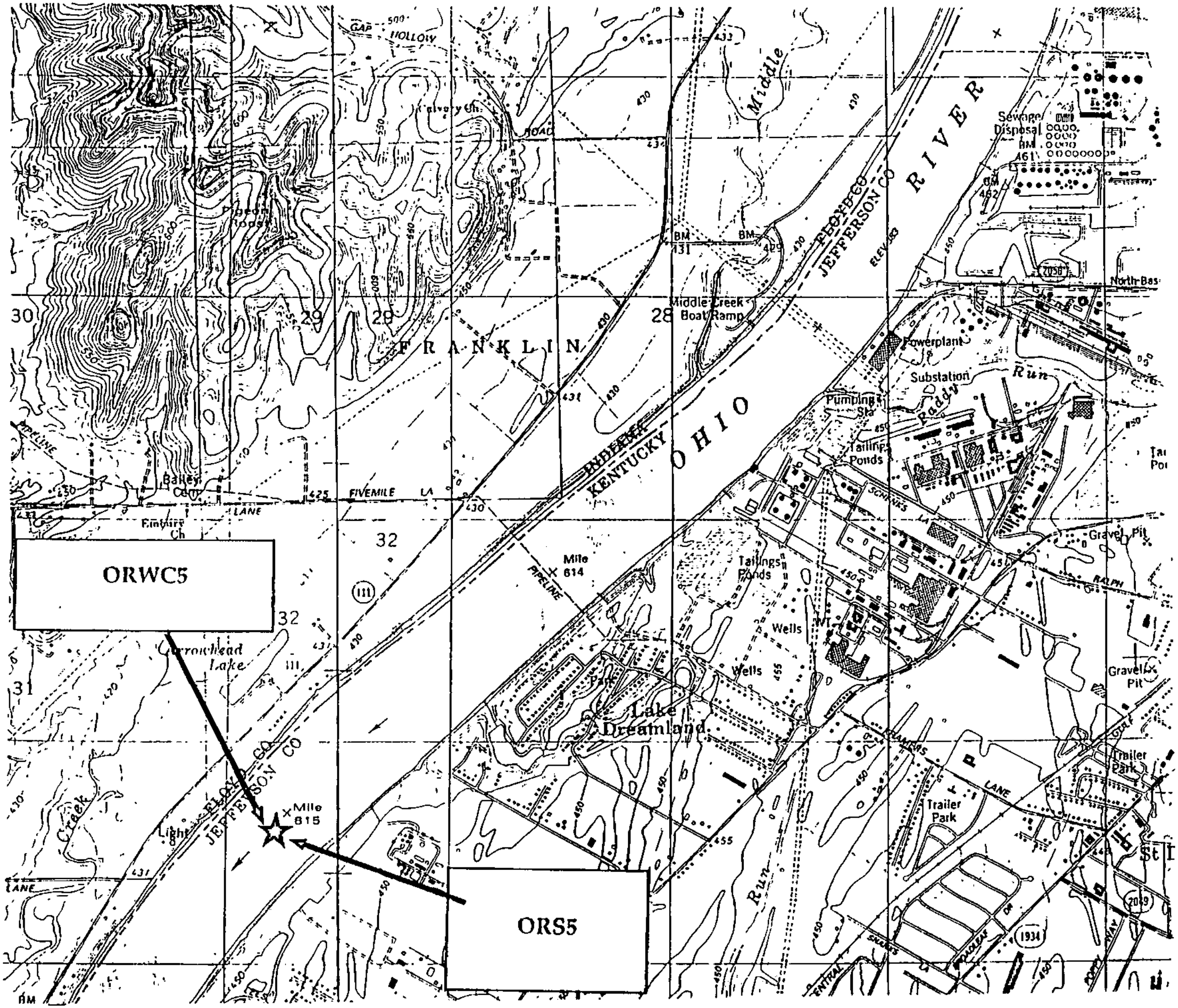
ORF4
OHIO RIVER
NORMAL POOL ELEV 420
Mile 592
Mile 593
Twelvemile Island
River Ridge
Bailey Cem
Water Tank
RESERVATION
COLLECTOR WELLS ROAD
CLARK CO
OLDHAM CO
JEFFERSON CO
Longview Beach
Beechland Beach
Hay Kennedy Park
Quarry
Light
Well
Wells
330 000 (KY.)
310 000 (IND.)
4250
4249000m.N
4248
4247
4246

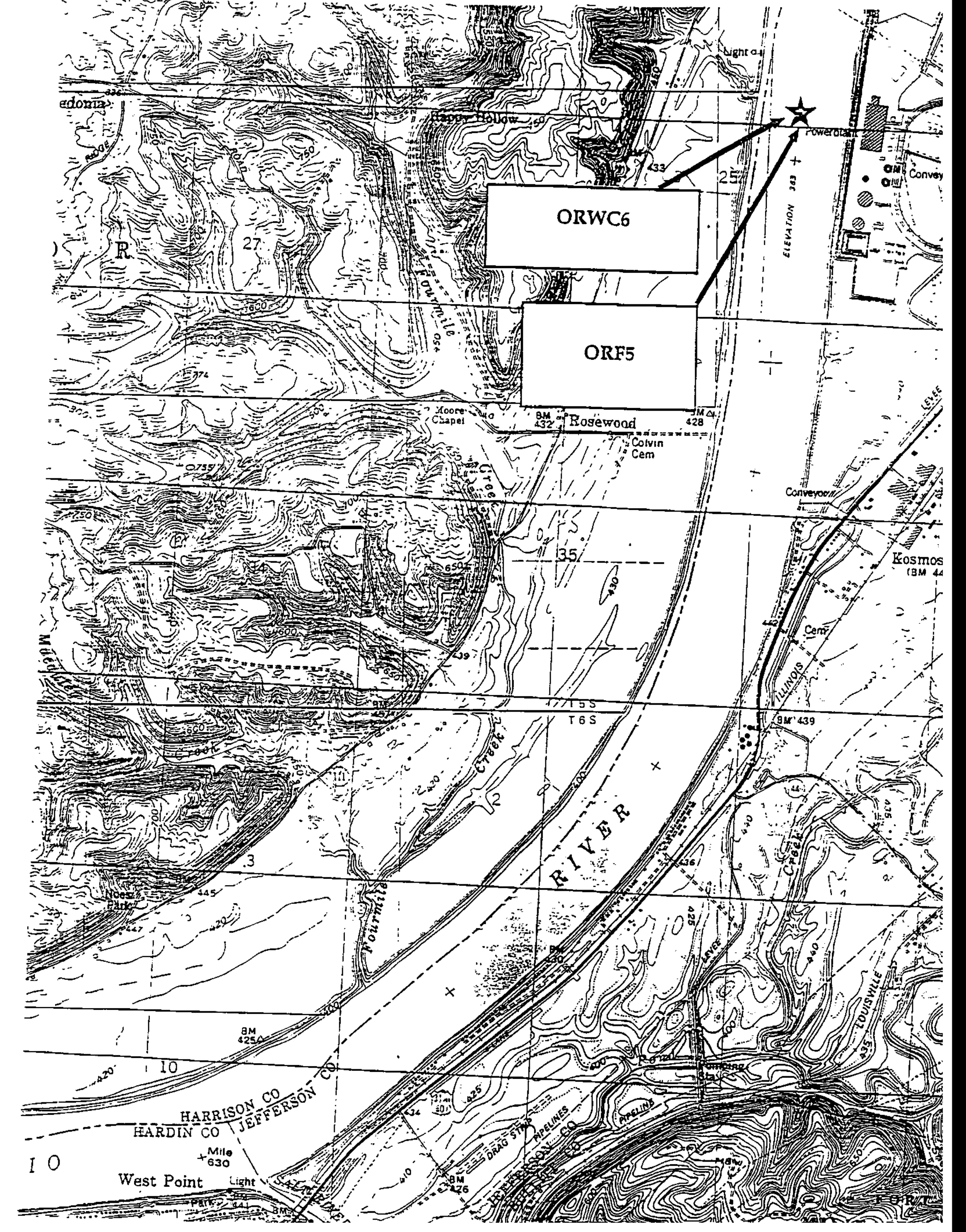

ORWC4
ORS4
FLOYD CO
JEFFERSON CO
LOUISVILLE
CORPORATE
BOUNDARY
RIVER
Middle
Settling Ponds
Powerplant
SHAWNEE
Pine Run
Greenwood Cem



ORWC2
OHIO
RIVER
CLIFTY CREEK
POWERPLANT
Substation
Piles
JEFFERSON CO
TRIMBLE CO
Mile
560
Madison
Country Club
Quarry
Sewage
Disposal
Light
Ash Pond


ORWC3
NORMAL POOL ELEV 420
KENTUCKY
INDIANA
OHIO
RIVER
Mile 565
Hanover
Hanover Beach
Hanover Sewage Disposal
Hanover Cem
Pumping Station
Southwestern Jr High Sch
Southwestern High Sch
Old Bethel Cem
BETHEL RD
TUSS ROAD
400 SOUTH ROAD
500 WEST ROAD
455 WEST ROAD
Liberty
18
9


ORWC5
ORS5
Mile 615
Mile 614
OHIO RIVER
INDIANA
KENTUCKY
FLOYD CO
JEFFERSON CO
FRANKLIN
Middle Creek Boat Ramp
Powerplant
Substation
Pumping Sta
Tailings Ponds
Wells
Lake Dreamland
Trailer Park
Gravel Pit
Sewage Disposal
Arrowhead Lake
Light
FIVEMILE LA
Pigeon Roost
Bailey Cem
Paddy Run
Middle
Creek


ORWC6
ORF5
Happy Hollow
Powerplant
Conveyor
ELEVATION 383
Moore Chapel
BM 432
Rosewood
BM 428
Colvin Cem
Fourmile Creek
Conveyor
Kosmos
Cem
ILLINOIS
T 5 S
T 6 S
BM 439
RIVER
Noes Park
LEVEE
LOUISVILLE
HARRISON CO
JEFFERSON CO
HARDIN CO
Mile 630
West Point
Light
DRAG STRIP
PIPELINES
PIPELINE
Pumping Sta