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SOP: HERRINGTON LAKE YOUNG-OF-THE-YEAR (YOY) BASS ASSESSMENT AND PHASE II FISH TISSUE SAMPLING

RAMBOLL

DOCUMENT DEVELOPMENT AND APPROVAL

Title and Approval Sheet

Action By	Signature	Date
Prepared by: Richard Lockwood, Ramboll		5/02/2018
Reviewed by: Mary Sorensen, Ramboll		5/02/2018
Approved by: Mark Nielsen, Ramboll		5/02/2018

REVISION HISTORY

This table documents the revisions over time to the QAPP. The most recent iteration should be listed in the first space, with consecutive versions following. Signatures may be required for revised documents.

Date of Revision	Page(s)/Section(s) Revised	Revision Explanation
May 02, 2018		First Draft

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LIST OF FIGURES

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

CAP	Corrective Action Plan
CCR	Coal Combustion Residue
cm	Centimeters
COC	Chain of Custody
DUP	Field Duplicate
DOW	Division of Water
EPA	Environmental Protection Agency
ESB	The Cabinet Environmental Services Branch
GPS	Global Positioning System
KDOW	Kentucky Department for Environmental Protection Division of Water
KPDES	Kentucky Pollutant Discharge Elimination System
KU	Kentucky Utilities
LHL	Lower Herrington Lake
MS/MSD	Matrix spike/matrix spike duplicate
NOV	Notice of Violation
Parent Sample	'Parent' here refers to the original field sample from which QAQC samples can also be collected
QAPP	Quality Assurance Project Plan
QAQC	Quality Assurance Quality Control
Sample ID	Sample Identifier
SOP	Standard operating procedure
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
YOY	Young-of-the-Year

1 OVERVIEW

This *Standard Operating Procedure (SOP)* is provided for the Young-of-the-Year (YOY) bass assessment planned for Herrington Lake. This SOP is provided to the Kentucky Energy and Environment Cabinet (Cabinet) in accordance with the August 2017 Corrective Action Plan (CAP) for Herrington Lake (Ramboll 2017a). The CAP for Herrington Lake was developed and submitted to the Cabinet as part of efforts to resolve the January 11, 2017 Notice of Violation (NOV) received by Kentucky Utilities Company (KU) due to detections of selenium in whole-body fish-tissue from Herrington Lake at concentrations above Kentucky's water quality standard for protection of aquatic life. To resolve the NOV, KU entered into an Agreed Order with the Cabinet on January 30, 2017 that required an investigation of Herrington Lake for selenium and other constituents that can be associated with Coal Combustion Residue (CCR). The Phase I field investigation for the CAP was conducted in October through December of 2017. The Phase I Technical Memorandum and Phase II Plan (hereafter described as the Phase II Plan) was submitted to the Cabinet on May 2 (Ramboll 2018a).

This SOP describes only the YOY bass field collection effort and collection of YOY bass samples for tissue residue analysis proposed in the Phase II Plan that were not previously identified in the CAP or previous SOPs. The YOY assessment focuses on largemouth and spotted (Kentucky) bass species. This SOP is provided concurrently with a Quality Assurance Project Plan (QAPP) Addendum specific to the YOY Assessment (Ramboll 2018b). The QAPP Addendum describes the laboratory portion of the YOY Assessment that was not previously described in the Herrington Lake QAPP (Ramboll 2017b).

The Phase II Plan also proposes additional sampling of adult fish, surface water, sediment pore water, and sediment for the measurement of metals via laboratory analysis. Except as specifically noted below, the Phase II collection of adult fish, surface water, sediment pore water, and sediment will be conducted in accordance with the following SOPs developed for the Phase I field effort that were reviewed and approved by the Cabinet:

- Standard Operating Procedures: Fish Sampling and Analysis (Ramboll 2017c).
- Standard Operating Procedures: Surface Water Sampling and Analysis (Ramboll 2017d).
- Standard Operating Procedures: Sediment Pore Water and Sediment Sampling and Analysis (Ramboll 2017e).

2 PROCEDURES FOR YOY AND ADULT FISH SAMPLE COLLECTION

This section describes YOY bass sample collection and sample handling procedures prior to receipt by the laboratory. The YOY bass collection for assessment and YOY tissue sampling described in this SOP is consistent with:

- The Kentucky Department for Environmental Protection Division of Water (KDOW) SOPs for fish sample collection and for fish sample preparation (KDOW 2016, 2017).
- Biological Criteria for the Protection of Aquatic Life: Volume III. Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities, Ohio Environmental Protection Agency (Ohio EPA 2015).
- Illustrated Field Guide for Assessing External and Internal Anomalies in Fish. United States Geological Survey (USGS), Information and Technology Report (USGS 2002).
- United States Environmental Protection Agency (USEPA) Concepts and Approaches for the Bioassessment of Non-wadeable Streams and Rivers (Flotemersch et al. 2006).
- Previous YOY sampling methodology for fish collected in Curds Inlet (Downstream Strategies 2016).

2.1 YOY Bass Collection for Assessment

The collection of YOY bass will be conducted at 6 locations, as was described in the Phase II Plan and listed below:

- Curds Inlet (middle portion of Curds Inlet)
- Curds Inlet (at the mouth of Curds Inlet)
- HQ Inlet
- LHL3 Cove located across from Curds Inlet
- LHL1 Rocky Run
- LHL6 Cove

The YOY fish collection will target 500 YOY bass from each location. Two distinct locations in Curds Inlet for YOY bass are planned if sufficient YOY bass can be collected. If sufficient numbers of YOY bass cannot be collected, the Curds Inlet locations may be combined into a single sample.

- The target size of the young bass will be within the size range of 2–5 centimeters (cm) (approximately 1–2 ½ inches) total length.
    - The YOY assessment will be conducted in June, at a timeframe when water temperatures are favorable for bass spawning. Efforts will be made to collect all of the YOY bass in a single sampling effort. However, if spawn results are limited at the time of initial sampling, a second field effort may be conducted (2018 spring weather measurements at Dix Dam are illustrated in Figure 1).
    - YOY sample collection will be conducted by sein, minnow traps, or electroshocking. Seining will be the primary collection method and minnow traps may be used. Electroshocking will be used if the other two methods are not productive to obtain sample counts needed. Electroshocking will only be used to collect fish greater than 4

cm (approximately 2 inches) in length, as potential electroshock burns (if any) are more easily discernable on the larger size fish and can be clearly distinguished from deformities or abnormalities being considered in this assessment. Electroshocking may also allow characterization of larger YOY fish that may be more effective at avoiding the seine nets (Jackson and Noble 1995). YOY bass collected by electrofishing methods will be composited separately from the fish collected by netting or minnow trap. The YOY bass collection form provided in Attachment A will be used to document the collection day, methods, and time spent with collection. It is assumed that a maximum of 1 day of YOY fish sampling effort per station will be expended as part of this Phase II YOY fish sampling effort.

2.2 YOY and Adult Fish Tissue Collection for Tissue Residue Analysis

YOY Bass Tissue Collection for Residue Analysis

- YOY bass will be also be collected for analysis of selenium in whole-body tissues. Twelve individual YOY bass tissue samples will be collected and each individual sample will be composited from up to 10 individual bass. These fish will be randomly selected from the living pool of YOY bass collected for the assessment (i.e., before they are preserved). Random selection will involve simple netting from the livewell.
- Fish will be weighed and photographed prior to shipment to the lab.
- Fish retained for tissue residue analysis will not be preserved. They will then be sealed in bags, on ice, and frozen, as described for adult fish samples.

Adult Fish Collection for Tissue Analysis

The adult fish tissue collection will occur at each of the following areas, as described in the Phase II Plan:

- Curds Inlet (bluegill, bass, and catfish)
- HQ Inlet (bluegill only)
- LHL3 Cove located across from Curds Inlet (bluegill only)
- LHL1 Rocky Run (bluegill, bass, and catfish)
- LHL6 Cove (bluegill, bass, and catfish)

Adult fish will be collected and handled as described in the fish sampling and analysis SOP (Ramboll 2017c), with the following exceptions:

- A single composite fish sample of each of the adult fish species will be collected, as indicated in the Phase II Plan and in the list above, for a total of 5 bluegill composite samples, 3 composite bass samples, and 3 composite catfish samples. The adult fish will be collected for the size ranges as identified in the Phase I fish sampling and analysis SOP.
- The composite fish samples will be comprised of 2–5 fish per location, as was done for the Phase I collection effort. However, the fish will be analyzed as whole-body samples and will be analyzed for selenium and lipids only, as was described in the Phase II Plan.
- A maximum of 1 day per collection area is assumed for this sampling event.

3 SAMPLE NOMENCLATURE AND FIELD NOTES

The Phase II Plan identifies the transect-numbering protocols planned for the Herrington Lake sample locations, as follows:

- LHL – lower Herrington Lake sections 1, 3, 6
- CI – Curds Inlet (possible subdivisions with upper/middle and middle/lower)
- HQ – HQ Inlet

Within the Phase II Plan, the LHL, transects are further numbered as Transect 1, 3, 6, for each portion of the lake (e.g., LHL-1).

Quality assurance samples for fish tissue samples will be labeled as follows:

- "DUP" – for field duplicate samples; and
- "MS/MSD" or "M" – for matrix spike/matrix spike duplicates.

The following sample identification convention for the discrete YOY fish tissue composite samples will be followed using the prefix "YOY"

- "YOY" – YOY composite of 10 individuals

Each discrete sample will use the following general identification convention:

- [sample matrix code] - [discrete sampling number] - [YOY-specific sampling region]

An example discrete YOY fish sample identification number is as follows:

- YOYBASS-001-LHL6 indicates that it is the first (001) bass (BASS) YOY fish composite (YOY) collected from Lower Herrington Lake (LHL6) fish sample region 6.
- The nomenclature for blind field duplicate samples will include the YOYBASS indicator but not the sample location, for example:
- YOYBASS-DUP-01
- After laboratory analyses, a reference table (aka lookup table) will report all parent and blind field duplicate, or MS/MSD sample pairs

Field notes will include data collection forms as indicated in Attachment A. Field notes will be recorded during fish sampling activities, such as the following:

- Names of field crew and oversight personnel
- Sample location (GPS-Based Geographic Location of the CAP transect)
- Date, time, and duration of sampling - this may include multiple dates to complete the YOY sampling for one sampling region
- General weather conditions
- Sample information (including matrix, sampling method, sample mass, sample ID, sample date and time)
- Photograph number when pictures are taken (if necessary)

4 HANDLING, PACKING, AND SHIPPING

4.1 YOY Bass Assessment

- Collected non-target fish will be immediately released. Upon collection of target YOY fish, the bass will be transferred alive to temporary holding containers (aka "livewells") until sampling for the area is complete, and sorting for species and size is accomplished.
- The YOY bass collected for assessment will be preserved in 95% denatured alcohol and stored in one-gallon plastic bottles after sorting for species and size.
- YOY samples will be transported to the Ramboll ecotoxicology laboratory in Nashville, TN for evaluation of abnormalities, as described in the QAPP Addendum for YOY Fish (Ramboll 2018b). Preserved YOY fish samples will be retained for 3 years following the assessment.
- Samples for YOY anomaly assessment will be stored in one-gallon plastic bottles preserved in denatured alcohol. Samples will not be frozen. These YOY samples will be maintained via COC and transported by ground to the Ramboll, Nashville ecotoxicology laboratory. For any transport to third-party review laboratories, the excess alcohol is poured off and specimens shipped on ice via overnight express.
- The third-party validation is described generally in Section 5 and in more detail in the QAPP Addendum for the YOY Fish Assessment.

4.2 YOY Bass Tissue and Adult Fish Tissue Analyses

- YOY fish and adult fish will be composited as described in Section 2 of this SOP. Multiple fish will be combined into a single sample. The fish will be frozen and wrapped in aluminum foil for shipment to the lab, as described in the SOP for Fish from the Phase I effort (Ramboll 2017c). The double-bagged samples will be placed on ice (12-hour maximum hold time on ice) until transported to a freezer and all fish samples will be frozen before transport to the lab. Frozen fish samples will be maintained via COC until shipped on dry ice to the analytical laboratory via FedEx.
- The YOY and adult fish samples retained for tissue residue analysis will be processed and analyzed in the lab within the hold time of 1 year for frozen fish samples.
- YOY bass composite sample preparation will be conducted in a laboratory environment, and processing (i.e., freeze-drying) will be conducted in accordance with the SOP for Preparation and Homogenization of Fish Tissue Samples (KDOW 2017). The fish freeze-dry process will dry whole-body fish.

5 QUALITY ASSURANCE/QUALITY CONTROL

This section provides a brief discussion of the Quality Assurance/Quality Control (QA/QC) to supplement the QA/QC information in the QAPP Addendum for YOY sampling and the 2017 QAPP.

5.1 YOY Bass Assessment

A third-party quality assurance deformities evaluation will be conducted on a random twenty-five percent of all fish with no identified deformities and on 100 percent of any fish with identified deformities. The third-party review will be conducted by Dr. John Hawke (Department of Pathobiological Sciences, Aquatic Diagnostic Laboratory, Louisiana State University School of Veterinary Medicine). The assessment method and the third-party validation is discussed in the QAPP Addendum for YOY Fish Assessment.

5.2 YOY Bass Tissue and Adult Fish Tissue

ALS Lab QA/QC: Quality assurance and quality control samples will be analyzed from a location to be determined in the field based on sample availability for a duplicate and for MS/MSD analysis, as done for the Phase I field effort. One duplicate sample will be analyzed for every 10 composite tissue samples. One MS/MSD tissue sample will be analyzed for 20 tissue samples.

Third Party Data Validation for Phase II Fish Tissues: Third party data Level II and Level IV validation will be performed as described in the 2017 QAPP.

Kentucky Environmental Services Branch QA/QC Split Samples: Approximately 10 percent of fish tissue samples will be submitted as split samples for analysis by the laboratory and by The Cabinet Environmental Services Branch (ESB). Portions (aka aliquots) of the laboratory freeze-dried whole-body fish will be shipped to ESB directly from the lab. Ramboll staff will coordinate with the laboratory staff and ESB to ensure that adequate sample volume for each of the species is provided to ESB.

6 YOY BASS ASSESSMENT PROCEDURE: ANALYTICAL PREPARATION AND TISSUE RESIDUE ANALYSES

This section provides a brief discussion of the procedure for YOY deformity assessment and the analytical preparation and a brief description of the tissue residue analyses planned for the adult fish.

6.1 YOY Bass Assessment

The YOY assessment will be conducted at the Ramboll Ecotoxicology Laboratory. Each individual fish will be examined and all fish will be photographed with ruler to show scale. The fish anomalies and deformities (if any) will be recorded and photographed.

6.2 YOY and Adult Fish Tissue

- YOY and adult fish preparation for tissue residue analysis will occur at the laboratory. Phase II YOY laboratory analyses will include only whole-body bass tissue samples. The YOY samples will composited from multiple collected YOY bass (i.e., 10 YOY bass per sample, minimum 5 grams total wet weight).
- The Phase II adult fish tissues (bluegill, bass, and catfish) will also only be whole-body tissue samples. Preparation of whole-body tissues that will be done for Phase II fish collection is different from the Phase I effort where fish were processed as fillet tissues and remains separately.
- YOY and adult fish whole-body composite tissues will be analyzed by USEPA SW846 Method 6020 for selenium.
- The laboratory will conduct fish freeze-dry homogenization per the Herrington Lake fish sampling and analysis SOP (Ramboll 2017c), which includes the KDOW 2017 SOP "Standard Operating Procedure for Preparation and Homogenization of Fish Tissue Samples, Commonwealth of Kentucky, Energy and Environment Cabinet, Department for Environmental Protection, Division of Water Effective Date: May 11, 2017."
- It is anticipated that all freeze-drying for fish will occur at the ALS laboratory doing the laboratory analyses.
- All whole-body fish tissue results will be reported in both wet and dry weight.

7 REFERENCES

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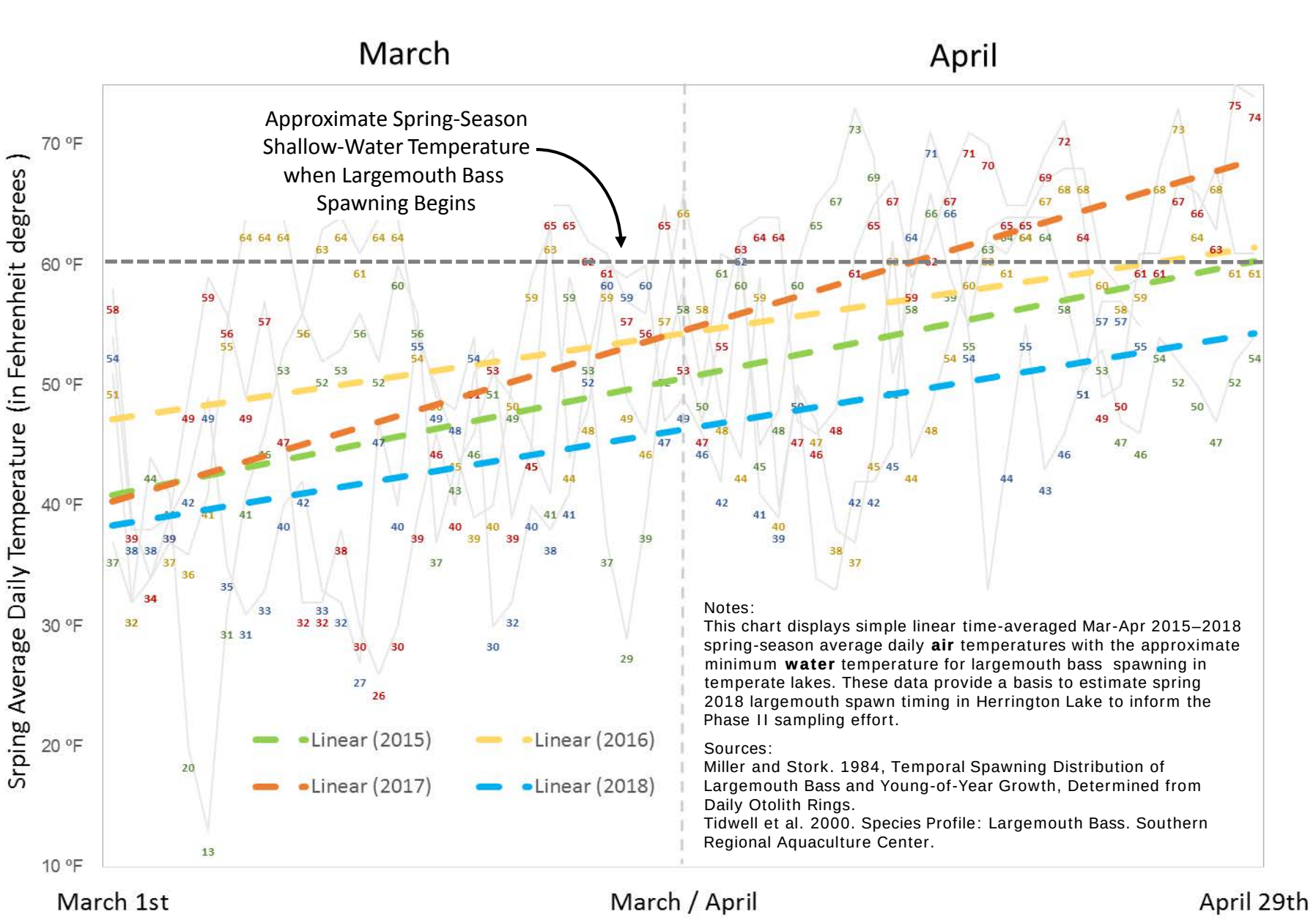
Figures



RAMBOLL

DRAFTED BY: AJS, April 26, 2018

Spring-Season Average Daily Air Temperatures for the Years of 2015–2018 Recorded at Dix Dam and the Approximate Minimum Water Temperature for Largemouth Bass Spawning

Herrington Lake CAP Phase II Field Sampling Plan Standard Operating Procedures (SOP)
Mercer County, Kentucky

FIGURE 1

Attachment A

Herrington Lake Young-Of-The-Year (YOY) Fish Collection Effort Form

Herrington Lake Young-Of-The-Year (YOY)
FISH COLLECTION EFFORT FORM

Primary Fish Collector(s):	**Notes:**
Sampling Date(s):	
Weather Forecast:	
Air Temp: **Water Temp:**	

YOY Bass Sampling Region (circle one):

Curds Inlet **HQ Inlet** **LHL1(Rocky Arm)** **LHL3 Cove** **LHL 6 Cove**

Sample ID: e.g. (YOYBASS-001-LHL6)	**Sampling Location Description** e.g. 50' north of CI2, west shore)	**Sampling Method** (Seine, Electrofish, Minnow Trap etc.)	**Start Time** (24hr clock)	**Sampling Duration** (in hrs)	**Sample Size** (N=)

Attachment B

Herrington Lake Adult Fish Tissue Field Collection Form

Source:
KDOW 2014 Methods for the Collection of Selenium Residue in Fish Tissue Used to Determine KPDES Permit Compliance

available at: http://water.ky.gov/Documents/QA/Surface%20Water%20SOPs/SOP%20Selenium%20FishTissue.pdf

SELENIUM FISH TISSUE
CHAIN-OF-CUSTODY

Station #: _____ **Date: _____**

Stream / Location: _____ Time: _____

KPDES Permit#: _____

County: _____ **Lat/Long Upstream Reach: _____**

Lat/Long Downstream Reach:_____

Outfall #: _____ **Duplicate/Replicate (circle one): yes no**

Flow status (circle one): runoff event high flow low flow normal other

Fish #	Genus	Species	Length (mm)	Comments
001				
002				
003				
004				
005				
006				
007				

Length (mm) of 75%tile of Longest Fish:_____
Total # Fish Collected in Sample:_____

Collected by: _____	Date: _____	Time: _____
Relinquished by: _____	Date: _____	Time: _____
Received by: _____	Date: _____	Time: _____