Prepared for:

HONEYWELL

REVISION 1 OF WORK PLAN FOR SAMPLING IN THE FORMER BRUNSWICK-ALTAMAHA CANAL, SOUTH OF THE LCP CHEMICALS SITE BRUNSWICK GEORGIA

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March 31, 2011

EPS

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March 31, 2011

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EPS

REVISION 1 OF WORK PLAN FOR SAMPLING IN THE FORMER BRUNSWICK-ALTAMAHA CANAL SOUTH OF THE LCP CHEMICALS SITE

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1 INTRODUCTION

1.1 Purpose

Revision 1 to the Work Plan for Sampling in the Former Brunswick-Altamaha Canal was prepared in response to a request from the Environmental Protection Agency (EPA) in a letter to Honeywell dated November 17, 2010, and a subsequent letter dated March 9, 2011 providing comments on the December 2010 draft Work Plan. The letter references the work and recommendations made by the Agency for Toxic Substances and Disease Registry (ATSDR) for additional nature and extent site characterization work to be performed at the LCP Chemicals Site, Brunswick, Georgia (LCP Site) and in the former Brunswick-Altamaha Canal, in a canal segment south of the LCP Site. Honeywell and EPA agreed to separate the on-site and off-site sampling and this revised Work Plan is being submitted to EPA to address the off-site sampling to be performed in the Brunswick-Altamaha Canal.

1.2 Background

The Brunswick-Altamaha Canal was constructed in the mid-1800s to serve as a transportation corridor between harbors at Brunswick, Georgia and the Altamaha River approximately 12 miles to the north. A segment of the canal once traversed the shoreline area along the west edge of the LCP Site uplands, although there is no surface expression of the canal today. South of the LCP Site, the canal feature is preserved to a variable extent along the rest of its length to the southern terminus of the canal at Academy Creek. Along this southern segment, the canal width varies from about 30 to 80 feet wide, with about 8 to 10 feet of vertical relief.

Recent field reconnaissance by EPS observed this southern segment of the canal to be tidally influenced along its entire length. Several point-source and non point-source discharges are evident along the canal from the adjoining properties of Koch Cellulose, Selden Park, Greenwood Cemetery, Palmetto Cemetery, and the City of Brunswick Publicly-owned Treatment Works (POTW). Other anthropogenic sources of potential contamination likely exist along the canal, including “early twentieth century refuse and fill near Academy Creek (Brunswick-Glynn County Joint Planning Commission report, August, 1981). All of these sources potentially affect the condition of the canal sediments as well as fish and shellfish which may frequent the area. The features are shown on Figure 1.

2 SCOPE OF WORK

2.1 Proposed Sampling Locations and Depths

The objective of the canal sediment sampling is to provide information on the potential for human exposure due to direct contact with surface sediments or consumption of fish and shellfish from the canal.

2.1.1 Canal Sediment Sampling

Surficial sediment samples (upper 6 inches) will be obtained from the canal segment between the LCP Site (northern limit) and T Street (southern limit) at the City of Brunswick POTW. Each sample will be comprised of a grab sample, randomly selected from each 300-ft stretch of the canal. The total length of the canal between the two end points is approximately 5,400 ft; thus, there will be 18 sampling locations along the canal.[1] Actual grab sampling locations will be established in the Geographic Information System (GIS) project setup by first creating a systematic grid across each 300-ft segment of the canal and using a random number selector to establish the single point grab sampling location. Sample selection sites will be limited to the intertidal zone of the canal where human exposure potential exists. This sampling approach was discussed with Mr. Galo Jackson (EPA) during a March 18, 2011 phone call with Mr. Kessler of EPS.

2.2 Fish Tissue Sampling

The objective of the fish sampling is to evaluate potential human exposure from consumption of fish caught from the canal. The entire length of the canal is tidally influenced and of sufficient water depth at high tide that various salt water fish species may migrate up the canal to feed. Target species are those that are popular with local fishers and include the following finfishes and shellfishes:

- Spotted seatrout (Cynoscion nebulosus);
- Red drum (Sciaenops ocellatus);
- Black drum (Pogonias cromis);
- Spot (Leiostomus xanthurus);
- Sheepshead (Archosargus probatocephalus);
- Striped mullet (Mugil cephalus);
- Blue crab (Callinectes sapidus); and

[1] Subject to Honeywell obtaining access to the Brunswick Cellulose property.

- Penaeid shrimp (*Penaeus spp.*).

Incidental species of finfishes that will be evaluated include:

- Southern flounder (Paralichthys lethostigma);
- Atlantic croaker (Micropogonias undulatus); and
- Southern kingfish (Menticirrhus americanus).

These are the same species targeted in past surveys within the Turtle River. All of these fishes are amenable to capture in a gill net and a collection permit has been acquired by EPS from the Georgia Department of Natural Resources (DNR), Coastal Resources Division to allow capture and testing of these fishes. The goal will be to obtain 3 samples from each finfish and shellfish species. Fish collection will be "opportunistic" and up to 3 full field days will be allocated in attempts to capture the full list of target species. Each species will be grouped according to size and composited if more than 3 individuals of a given species are captured (up to 5 fish per class range will be composited to form the 3 samples of each species). These protocols are identical to those employed in past surveys of the Turtle River estuary by EPS personnel and formerly by the Georgia DNR (see Sampling and Quality Assurance Plan dated 2004 attached as Appendix A to this Work Plan).

2.3 Analytical Methods

Samples will be analyzed for the following:

- Metals mercury and lead;
- Polynuclear Aromatic Hydrocarbons (PAHs);
- Polychlorinated biphenyls (i.e., Aroclors); and
- Polychlorinated dibenzodioxins and polychlorinated dibenzofurans (Dioxins/Furans)[2].

The table below provides the specific analytical methods that comprise the analytical list for the various sample matrices to be collected. Appendix B shows a comparison of the proposed analytical method detection limits with EPA's Regional Screening Level (RSL) values for soil (sediment) and fish consumption (EPA, 2010a,b)

[2] 20% of the sediment samples will be analyzed for dioxins/furans.

Matrix	Method	Parameter
Sediment	160.3M[3]	% moisture
	1631E[2]	mercury
	6020A[2]	lead
	8082A[2]	Aroclors
	8270D[2]	PAHs
	8290	Dioxins/Furans
	ASTM D4129-82M[2]	Total Organic Carbon (TOC)
Fish and Shellfish Tissue	160.3M[2]	% moisture
	D2216[2]	% lipid
	1631E[2]	Mercury
	6020A[2]	Lead
	8082A[2]	Aroclors
	8270D[2]	PAHs

[3] The specific analytical methods that are currently used by Columbia Analytical Services will be employed.

3 GENERAL FIELD PROCEDURES FOR SAMPLING

3.1 Sampling Procedures

3.1.1 Sediment Sampling Procedures

Sediment samples will be collected in accordance with the EPA Region IV Field Branches Quality System and Technical Procedures (EPA, 2010c). Given the shallow depths of sampling, soils can be obtained using a standard stainless steel hand auger assembly. Given only surface sediment is being obtained, only one pre-cleaned auger bucket per location is required. Contents from each sampling site will be emptied into a pre-cleaned stainless steel bowl and homogenized prior to placing the sediment into the sample jar.

3.1.2 Fish Sampling Procedures

Procedures for the fish and shellfish collection will be consistent with a previous sampling plan prepared for this type of work (SQAP, 2004) and approved by the Georgia Department of Natural Resources (see Section 4 of the SQAP attached as Appendix A).

Nets will be deployed at multiple places within the canal in attempts to capture finfish. Nets will be deployed at slack high tide (after the majority of fish would have moved into the canal from the estuary), and stretched the entire width of the canal to catch fish as they leave during ebb tide. Nets will be placed approximately every 1000 linear feet of canal. Cast nets will be used to collect shrimp, and standard crab traps used to collect blue crab. The goal will be to obtain 3 samples from each finfish and shellfish species caught – each species will be grouped according to size and composited if more than 3 individuals of a given species are captured (up to 5 fish per class range will be composited to form the 3 samples of each species). Finfish will be scaled and filleted (leaving skin on the fillet) to remove only edible tissue for testing. Blue crab and shrimp will likewise be processed to remove for testing only edible tissue (shellfish processing will be performed by the laboratory). Refer to Appendix A for further details. Each replicate sample will be grouped into a single sample container and each container will be uniquely labeled, to avoid any mixing of individual specimens by the laboratory personnel.

3.2 Sample Containers, Preservatives, and Holding Times

Sample containers, preservatives, and holding times will be selected in accordance with Appendix A of the USEPA Region IV "Environmental Investigations Standard Operating Procedures and Quality Assurance Manual" (USEPA, 2001). All sample containers (and

preservatives, where required) for samples submitted for laboratory analyses will be provided by the commercial laboratory. Containers will be new, pre-cleaned, or pre-baked as appropriate.

3.3 Sample Packing, Shipping and Documentation

3.3.1 Sample Packing

The samples obtained in this sampling program will be placed in shipping coolers with enough ice, freezer packs or dry ice to maintain a temperature of 4ºC or -78.5 ºC (dry ice), and with sufficient bubble pack to prevent breakage during shipping. Temperature blanks provided by the laboratories will be placed in each cooler. All samples in a shipping container will be listed on the chain-of-custody form enclosed in the shipping container. Once the samples are securely packaged, the container will be sealed with tape and a custody seal will be placed over the top edge.

3.3.2 Sample Shipping

All samples will be shipped via courier service (e.g., Federal Express, Airborne, etc.). A shipping document with a tracking number for the courier service will be completed for each shipment. The following day the laboratory will be contacted to verify the shipment was received in sound condition.

3.3.3 Sample Documentation

3.3.3.1 Overview

Documents for recording sampling events will include a daily field activity log, field measurement logs, and photographs as appropriate. Sample information to be included on sample labels, custody seals, and chain-of-custody forms is described below.

3.3.3.2 Sample Identification and Documentation

After sample collection, all sample containers will be labeled with an identification number that uniquely identifies the sample. The samples will be identified with a unique alpha-numeric identification that follows the format “YYDDD-Z” where:

- YY is the year the sample was taken;
- DDD is the Julian date of sample collection; and
- Z is the location designation.

Each sample container will have a sample label. The sample identification number will be logged in the field log book, along with the following information about the sampling event:

- Sampling personnel
- Date and time of collection

- Field sample location and depth (if appropriate)
- Observations on ambient conditions
- Type of sampling (composite or grab)
- Method of sampling
- Sampling matrix or source
- Results of field screening
- Intended analyses

3.3.3.3 Sample Labels

Each sample container will be labeled with the following information: date and time of sample collection, unique sample number, project name and/or number, and sampler's initials. Indelible ink will be used to record information on the sample label. Quality Assurance/Quality Control (QA/QC) Samples (e.g., duplicate sample) will also be labeled with a unique sample ID and will not be distinguishable as a QA/QC sample to the laboratory.

3.3.3.4 Custody Seals

Custody seals will be used when a sample shipment is picked up by the laboratory or sent to the laboratory by overnight courier. Signed and dated custody seals will be attached to the top of the shipping container in such a way that it is necessary to break the seal to open the container. Custody seals ensure that any tampering during transportation will be detected by the receiving laboratory.

3.3.3.5 Chain-of-Custody Forms

Chain-of-custody forms provide the documentation to trace sample possession from the time of sample collection until receipt by the laboratory. One chain-of-custody form will be filled out for each cooler or shipping container and will list all the samples contained in the cooler or container. One copy of the completed form will be placed in a plastic bag taped to the inside lid of the shipping container and one copy will be kept with the project files.

3.4 Sample Equipment Decontamination

Field sampling equipment will be decontaminated on-site according to the procedures outlined in US EPA Region IV Field Branches Quality System and Technical Procedures (USEPA, 2008). The general procedures for decontaminating the equipment are listed below.

1. Tap water wash with non-phosphate soap;
2. Tap water rinse;
3. Distilled water rinse;
4. Rinse with laboratory grade isopropyl alcohol;
5. Deionized water rinse;

6. Air dry (totally); and
7. Aluminum foil wrap.

Tap water from any municipal water treatment system or distilled/deionized water may be used for initial equipment rinses. The use of an untreated potable water supply is not an acceptable substitute for tap water.

4 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

4.1 Control Parameters

QA/QC involves the collection of field QC samples, as well as control of field operations, sampling, and measurements as described below.

4.2 Field QC Samples

The following field QC samples will be collected. Descriptions of each sample type, as well as the frequency of collection, are summarized in the table below.

Field QC Samples
LCP Chemicals, Brunswick, Georgia

Type	Collection	Definition	Frequency
Field Duplicate	Sediment	A field duplicate is collected at the same sampling location in a manner similar to other environmental samples, so the laboratory cannot distinguish them. The field duplicate is designed to check variability arising from sampling activities or lack of sample homogeneity. The duplicate will be identified in a manner similar to other environmental samples so the laboratory cannot distinguish them.	Five percent (i.e., 1 in 20) of all environmental samples shall be field duplicates. Both duplicates (e.g., the sample and the duplicate) shall be analyzed for the same parameters in the laboratory. One duplicate will be collected for each matrix.
Equipment Rinsate Blanks	Sediment	An equipment blank is designed to detect contamination of environmental samples caused by contamination of sampling equipment. An equipment blank is analyte free water that is poured into or pumped through the sampling device, transferred to a sample bottle, and transported to a laboratory for analysis.	One equipment blank shall be taken by each sampling team for each set of equipment used on the first day of sampling and weekly thereafter. This blank shall be analyzed for all laboratory analyses requested for water environmental samples collected on that day.

4.3 Field Operations

Control of field operations and sampling methods will be established through the following:

- Ensuring that each field team member is familiar with the provisions of the Work Plan, and Health and Safety Plan (HASP). The EPS Project Manager shall ensure that each field team member is familiar with the Work Plan prior to implementation of field activities.
- Providing a QA review of field activities at the beginning of field activities to ensure that all procedures are followed and at least one additional time during the execution of this project for each sampling team through on-site monitoring of representative field activities. The Project Manager will regularly check field notebooks and forms.

5 GENERAL FIELD DOCUMENTATION PROCEDURES AND GUIDELINES

5.1 Overview

General field documentation procedures and guidelines to be used in performing investigations are addressed in this section. If deviations from these procedures are necessary, alternative procedures and the reason for their use will be documented in the appropriate field activity log for that task.

5.2 Field Activity Logs

5.2.1 Introduction

A field logbook will be maintained to record the details of field investigation activities and field data. This logbook will be bound and will have sequentially numbered pages. Entries will be written in indelible ink and will be initialed and dated by the field personnel recording the information. Several types of field activity logs will be maintained, including site health and safety logs, equipment calibration logs, and field sampling logs.

5.2.2 Field Sampling Logs

In addition to the descriptions of field investigation activities and field data recorded in the field log book, details of sampling information may be provided on field sampling logs. Field sampling logs will generally include the following information:

- date and weather;
- personnel;
- time and description of investigative activities;
- sample medium and type (i.e., grab, composite, duplicate, etc.);
- sample collection technique(s);
- sample containers, analyses, and preservatives;
- sample number, location, and depth;
- sampling times;
- pertinent field observations; and
- field parameters (e.g., temperature and dissolved oxygen).

5.2.3 Corrections to Documentation

All documents will be completed in permanent, waterproof ink. None of the field documents are to be destroyed or thrown away, even if they are damaged or contain inaccuracies that require a replacement document. Corrections will be made by crossing out mistakes with a single line and then dating and initialing the correction. The documents used during the field investigation will remain on-site in the field office during the field effort.

6 DATA EVALUATION, VALIDATION AND REPORTING

6.1 Data Evaluation

Caution should be used when evaluating the sediment and fish data collected at the Altamaha Canal. There are numerous anthropogenic sources in the area of the Altamaha Canal that can influence the detected results of the samples. Furthermore, the fish likely travel other sections of the Turtle River estuary and would thus be subject to other industrial sources; therefore their chemical uptake likely occurs from other portions of the estuary in addition to the Altamaha Canal. Data from the sampling event will be discussed with the EPA to determine whether any follow up investigation is required.

Fish and shellfish results will be evaluated according to the same protocols utilized by the Georgia DNR for establishing human consumption guidelines. EPS personnel are familiar with these protocols and have worked closely with the State Toxicologist with the DNR on past surveys conducted in the Turtle River estuary.

6.2 Data Validation

A Microsoft® (MS) Access normalized relational database will store the data. A database is defined as a large collection of data organized especially for rapid search and retrieval. Data are organized into standardized, structured tables that are specifically related to one another. MS Access is an industry-standard relational application for small to medium databases.

Before data is added to the database, it undergoes a validation process. In the case of hand written notes and hard copies, records are manually entered into an electronic spreadsheet, checked twice by two different people. Electronic records are then imported into a separate database (Build database) where several queries are used to perform additional data validation. In order to maintain internal consistency, each parameter is spell checked to ensure proper encoding, each Sample ID and date pair is evaluated to prevent duplicate entries, and all data are checked for proper units, methods, and matrix types.

The database is designed for use by two classes of users: the Database Manager (DM) and the End-User. A DM designs and maintains the structure of the database, appropriately prepares data for entry (outside of Access), correctly executes validation tests within Access during data entry, and informs end-users of any limitations to the dataset. An End-User queries data for day-to-day work (analysis, reports, thought experiments, etc.) and links data to outside applications (GIS, outside databases). There is one DM and any number of End-Users.

The database is not simply one database, but rather a collection of three separate databases: Build, Master, and Main. The Build database links directly to the Master database and is used exclusively by the DM to validate, format, and finally enter data into the Master database. The Master database stores all the data and is managed only by the DM. The Main database is an exact replicate of the Master database that is linked to by End-Users for day-to-day work. When changes are made to the Master database it is copied over to the Main database. This procedure, known as "compacting", ensures that the Main database always has the most up to date records, and that there is separation between the original records and those used on a daily basis.

The work necessary to validate raw data is performed in queries. A query in its basic form allows the user to select fields for a table or multiple tables. Queries can also perform statistical calculations, replace values, add and remove records, create and delete tables. Because of the heterogeneity of the raw data, DMs modify queries and update key fields in order to maintain proper encoding. The following is a step by step process used to “clean” raw data:

- Raw data is imported into a temporary table that has the same structure as the Master database’s Data table.
- Each set of raw data is assigned a batch number in order to track its addition.
- Raw data is checked for duplicate records. If duplicate records exist, they are assigned the proper Dup code. The database is designed to store all duplicate records that often are the result of multiple analysis methods and lab replicates. Original values are given a Dup code of 0. Duplicate records are given values that are the sum their duplicate characteristics. Characteristic codes are listed below:

  1 - Duplicate sample sent to the same lab (often with a different Sample ID)
  2 - Split sample sent to different lab: generally with the same Sample ID
  4 - A duplicate analysis by the same lab generally by another method
  8 – A duplicate due to reporting both the diluted and undiluted result
  16 – Miscellaneous
- The parameter name is checked for spelling to ensure proper encoding.
- Units and Methods are checked to ensure proper encoding.
- In order to maintain database consistency, non-detected values are assigned a “0” Result and a “U” Result Modifier. This is necessary because different analytical laboratories use dissimilar codes for non-detected values.
- Missing values are checked in order to prevent errors of omission.
- Sample ID / Date pairs are checked.
- Sample IDs in the raw data are cross-checked with existing locations. New locations are added when necessary.
- All raw records are checked against the Master database’s Data table to prevent duplicate entries.
- “Clean” data is added to the Master database.
- All temporary tables are deleted.

While the term "cleaning" can sometimes imply that "dirty" data is removed, this is not the case in the database. There is no "dirty" data left behind or not entered. Instead of being thrown out, all data is categorized to allow database End-Users flexibility in analyzing data: Records are given Dup codes, data quality flags, matrix codes, area designations, etc. Because the database is a living database, DMs often have to modify table structures and add keys to key tables to input new sources of data in order to categorize additional records. These modifications do not change existing records, but instead build upon them.

6.3 Data Reporting

Data deliverables from the analytical laboratory will consist of the following items:

- Case Narrative;
- Laboratory Final Reports;
- Surrogate Recovery Summary;
- Matrix Spike/Matrix Spike Duplicate Recovery Summary;
- Method Blank Summary;
- Laboratory Control Sample (LCS) Recovery Summary;
- Initial Calibration Summary Gas Chromatograph (GC) Method Printout;
- Continuing Calibration Summary;
- Analytical Sequence Printout;
- Chromatographs and Quantification Reports for all Samples, Standards, and QC Samples;
- Copies of Extraction Log Pages; and
- Copies of Chain-of-Custody Document.

For consistency and ease of review, the data deliverables will be organized in the same manner. The arrangement will be as follows:

- Sample Narrative;
- Final Reports;
- QC Summary Information;
- Analytical Sequence Printout(s);
- Sample Raw Data (arranged by sample number);
- Instrument Calibration Data (in chronological order);
- Raw QC Data;
- Blanks;

- LCS;
- Matrix Spike/ Matrix Spike Duplicate (MS/MSD);
- Extraction Logbook Pages; and
- Chain-of-Custody Documents.

7 REFERENCES

Brunswick-Glynn County Joint Planning Commission. August 1981. Brunswick-Altamaha Canal Study.

GeoSyntec Consultants. 2004. Sampling and Quality Assurance Plan (SQAP) for an Assessment of Chemical Residue in Seafood from the Turtle River, Brunswick, Georgia.

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Available at: http://www.epa.gov/region4/sesd/fbqstp/index.html.

FIGURES

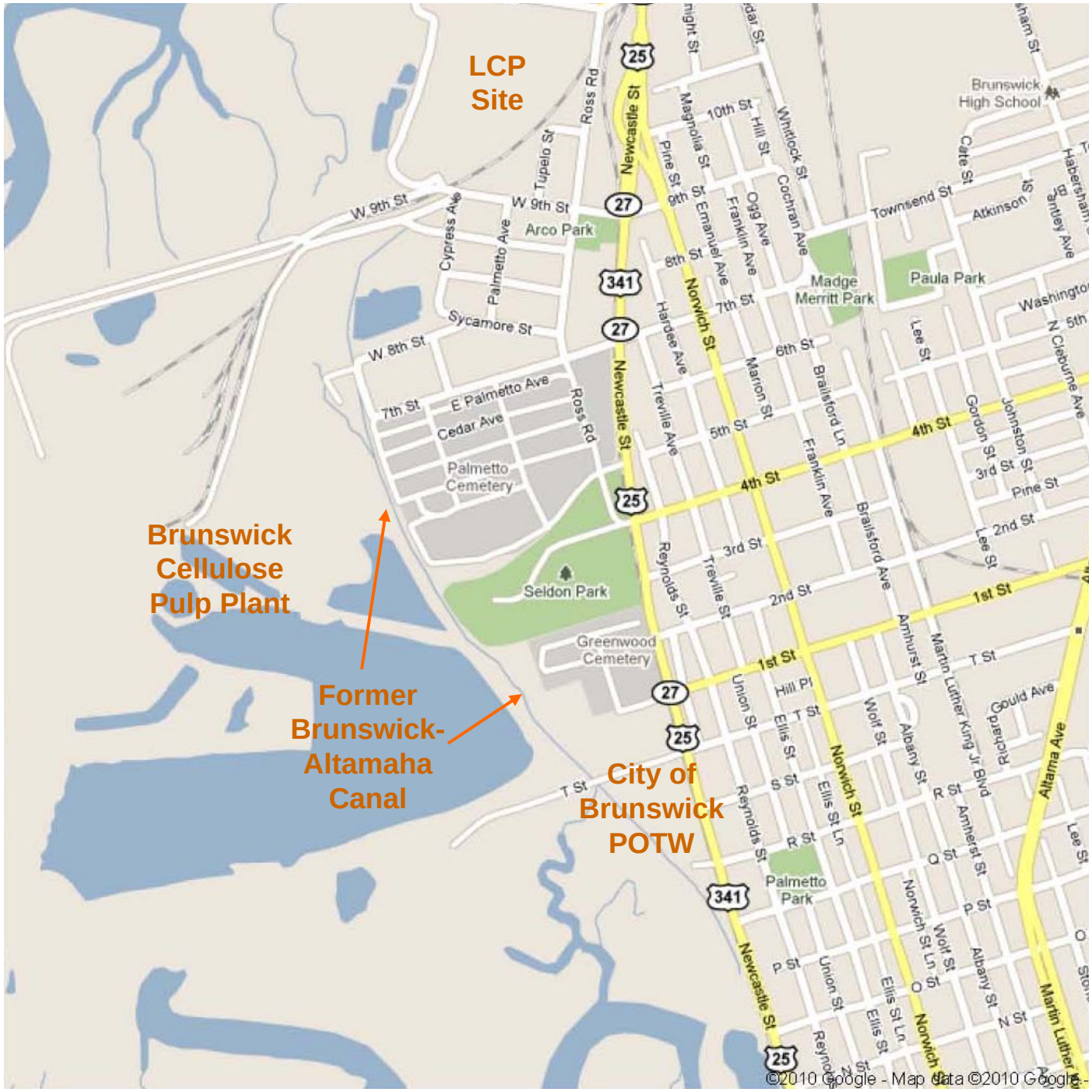

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Figure Not To Scale

FIGURE 1
General Features Along Southern Segment of Brunswick-Altamaha Canal

Brunswick Altamaha Canal
Segment South of LCP Chemicals Site

0 250 500
Feet

N
W E
S

Legend

Canal Trace South of LCP

Figure 2

APPENDIX A

December 6, 2002

Randall O. Manning, Ph.D., DABT
Georgia Department of Natural Resources
Environmental Protection Division
Environmental Technology
745 Gaines School Road
Athens, GA 30605

Linda Harn
Georgia Department of Natural Resources
Environmental Protection Division
Water Protection Branch
4220 International Parkway, Suite 101
Atlanta, GA. 30354

Subject: Transmittal of the Sampling and Quality Assurance Plan (SQAP)
2002 Seafood Survey, Turtle River and Associated Tributaries, Brunswick, Georgia

Dear Dr. Manning and Ms. Harn:

GeoSyntec Consultants (GeoSyntec) is pleased to provide the above referenced document "Sampling and Quality Assurance Plan" (SQAP) for the 2002 seafood survey of the Turtle River and associated tributaries in the vicinity of Brunswick, Georgia. This version of the SQAP incorporates edits made on the basis of your review comments of a draft submitted 9 December 2002. The SQAP has been prepared to be consistent with EPD's new September 24, 2002 draft guidance, which was provided with the October 22, 2002 letter from Commissioner Barrett. We understand that EPD intends to apply this new draft Guidance not only for data collected for the purpose of listing and de-listing TMDL (303(d)) impaired waters, but also for the collection of seafood tissue data to be used by EPD as a basis for assessing fish consumption guidelines.

Since early fall 2002, GeoSyntec has been in consultation with you with respect to the design of the fish sampling program for the Turtle River estuary. Additionally, as a quality assurance measure, institutional knowledge from previous agency-based tissue surveys within this estuary has been incorporated into the design of the SQAP. Mr.

Marshall Gaddis, the former leader of EPD's Intensive Surveys Unit and one of the original designers of previous tissue studies, and Jim Music, DNR's former Commercial Fisheries Program Manager and co-designer of previous tissue studies, participated directly in the project planning and development of the SQAP. They were also heavily involved in the seafood collection efforts as team leaders of the two collection crews.

The attached SQAP was prepared to be consistent with DNR's "Draft Guidance On Submitting Water Quality Data For Use By The Georgia Environmental Protection Division In Listing Impaired Water". We believe that the enclosed SQAP includes the required elements described in DNR's draft guidance for developing a Sampling and Quality Assurance Plan.

We appreciate your review and comments on the SQAP. Please contact us if you have any questions.

Sincerely,
GeoSyntec Consultants, Inc.

Kirk J. Kessler. P.G.
Principal

Anthony R. Dodd
Senior Scientist

Cc: Marshall Gaddis
Jim Music

Enclosure: SQAP

:

SAMPLING AND QUALITY ASSURANCE PLAN FOR AN ASSESSMENT OF CHEMICAL RESIDUE IN SEAFOOD FROM THE TURTLE RIVER, BRUNSWICK, GEORGIA

:

LCP CHEMICAL SITE BRUNSWICK, GEORGIA

September 2004

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1.0 INTRODUCTION

1.1 Objective

The purpose of this document is to present the basic experimental design and methodology for conducting an assessment of chemical residue in seafood from portions of the Turtle River, Brunswick, Georgia. It is the understanding of this investigation team that the State of Georgia does not have funds available to conduct another regularly scheduled fish and seafood tissue assessment at this site. This survey provides an extension of previous surveys conducted by the Environmental Protection Division (EPD) and Coastal Resources Division (CRD) of the Georgia Department of Natural Resources (GDNR). The current study was designed in consultation with former GDNR investigators to replicate the most recent scopes of work employed by the GDNR in 1995 and 1997. As quality control measure, the current survey is being conducted with direct oversight by Mr. Marshall Gaddis, former leader of the EPD's Intensive Survey Unit, Atlanta, Georgia, and Mr. Jim Music, former leader of the Commercial Fisheries Unit of the Coastal Resources Division (CRD), Department of Natural Resources, Brunswick, Georgia.

1.2 Background

Previous seafood contamination assessment surveys were conducted in the study area by natural resources agencies during 1991, 1992, 1993, 1995, and 1997 (Figure 1). Surveys conducted in 1991 and 1992 were limited in scope (Table 1), whereas later surveys were more comprehensive. The later surveys focused on nine designated study area zones (Zones A – I; Figure 1), and targeted eight species of finfishes and shellfishes. Target species included spotted seatrout (*Cynoscion nebulosus*), red drum (*Sciaenops ocellatus*), black drum (*Pogonias cromis*), spot (*Leiostomus xanthurus*), sheepshead (*Archosargus probatocephalus*), striped mullet (*Mugil cephalus*), blue crab (*Callinectes sapidus*), and penaeid shrimp (*Penaeus spp.*). Several additional species were incidentally collected as bycatch during prior surveys. The most common incidental species included southern flounder (*Paralichthys lethostigma*), Atlantic croaker (*Micropogonias undulatus*), and southern kingfish (*Menticirrhus americanus*).

The analytical objective of the 1991-1992 surveys was typically based on composite sampling. Three composite samples of edible tissue were sought for each of the eight target species from each study area zone. Composite samples consist of left and right fillets from five individual finfishes, tissue from five blue crabs, and 300 to 400 g of penaeid shrimp. The total tissue collection goal established for the entire nine study area zone study area included 810 individual finfishes, 135 blue crabs, and 27 shrimp samples. Additionally, finfishes were to be of harvestable size (minimum creel size limit). To qualify as a composite for finfishes, the "75 percent rule" was to be adhered to (i.e., the length of the smallest of the five individuals in a given composite sample measures at least 75 percent of the length of the largest individual in the same composite).

Individual finfishes were measured to the nearest 1/10 of an inch. Only blue crabs (either males or females) equal to or greater than 130 mm carapace-width were processed. Composite samples of all fishes were analyzed for the full scan of metals, pesticides and PCBs. Mercury and PCBs were the focus of the reports as drivers of the guidelines. The 1991 survey generated five composite combination samples of blue crabs and oysters including one sample from a tributary to Purvis Creek near the ruins of the LCP boardwalk; two samples from Purvis Creek (Zone H); and two samples from the lower stretch of the Turtle River from Georgia Highway 303 downstream to Channel Marker 9 (Zone D). The 1992 survey was directed primarily on Zone D (Table 1). The 1993 survey extended the study area to include sampling in the immediate vicinity of the closed area (Table 1). The 1995 and 1997 surveys maintained the basic sampling frame established in 1993 (Table 1).

2.0 PLAN OBJECTIVES

The 2002 survey objective is to provide adequate information for EPD to update their risk-based guidelines for consumption of seafood from the Turtle River in the Brunswick area. An adequate level of information is defined in this study design as a collection of sample numbers and types equal to or greater than those collected in the five previous EPD surveys. The survey will be based on the expanded study plan developed by the EPD in June of 1993.

All nine study areas, Zones A through I, will be evaluated and the primary goal will be to collect three composite samples of the eight target species using the "75 percent rule" for eight target species (previously listed in Section 1.2) at a success (catch) rate equal to or greater than the success rate realized in previous surveys (Table 1). A secondary goal will be to collect three composite samples of species of finfishes that were incidentally evaluated in previous surveys; in particular, southern flounder, Atlantic croaker, and southern kingfish. Every effort will be made to collect only fishes of harvestable size (minimum creel size limit, if such a limit exists). However, it is recognized that as in the previous surveys this may not be possible in all cases. In addition, the goal for each composite sample of finfish and blue crabs is for the composite to consist of five individuals (two fillets from each finfish) unless gross differences in size (lack of adherence to the "75% rule") requires that fishes be distributed into composites containing less than five individuals. In the case of penaeid shrimp, three composite samples (each typically weighing about 100 to 400 grams) of a variable number of individuals will be collected from each zone. All finfishes will be measured (fork or total length as appropriate; nearest 5 mm), weighed (nearest gram), sexed, evaluated for gonadal maturity, and selectively assessed for stomach content (frequency of numerical occurrence) and age (scale method). Blue crabs will be measured (carapace width from point to point), weighed, and sexed. Composite samples of penaeid shrimp will be weighed and sized according to "count" ("heads on"). Fishes will be processed as described later in this document. All composite samples of fishes will be analyzed for total mercury and Aroclor 1268 and, additionally, the numerous other constituents evaluated in the 1995 survey (Table 2).

It is important to emphasize several key points regarding the preparation and composition of composite samples of finfishes and the "75 percent" rule. The principal

objective in compositing will be to generate an equal number of data points for statistical interpretation. The secondary objective in the compositing strategy will be to represent a distribution of length classes among composites for a given species from a given sampling zone dependent upon available numbers and sizes of individual fishes.

For each target species in each zone, every effort will be made to generate three composite samples of fish, each of which contains the fillets of five or at least four fish that are similar in length (the smallest fish being at least 75 percent of the length of the largest fish).

However, due to the actual availability of fishes at the end of the fish collection effort, the number of fish of a particular species collected in a particular zone may be more or less than can be combined into five-fish composite samples. In these cases, the objective will be to allocate the "additional" fish (up to three fish) in a manner that, together with any five- or four-fish composites, will result in a total of three samples of fish (ultimately three sets of chemical data points).

2.1 Sampling Areas

The sampling areas will be defined as follows:

- Zone A: Turtle River from Ga. Hwy. 303 to Buffalo River;
- Zone B: Turtle River upstream of Buffalo River;
- Zone C: Buffalo River upstream of Turtle River;
- Zone D: Turtle River from Ga. Hwy. 303 to Channel Marker 9;
- Zone E: Turtle River from Channel Marker 9 to U.S. Hwy. 17;
- Zone F: South Brunswick River from its mouth to Hillary Creek and Fancy Bluff Creek from South Brunswick River to U.S. Hwy. 17.
- Zone G: Brunswick River from U.S. Hwy. 17 to Channel Marker 22 (Parsons Creek);

- Zone H: Purvis Creek; and
- Zone I: Gibson Creek - east of Ga. Hwy. 303.

2.2 Target Species

Target species of finfishes and shellfishes consist of:

- Spotted seatrout (*Cynoscion nebulosus*) (SS);
- Red drum (*Sciaenops ocellatus*) (RD);
- Black drum (*Pogonias cromis*) (BD);
- Spot (*Leiostomus xanthurus)* (SPOT);
- Sheepshead (*Archosargus probatocephalus*) (SH);
- Striped mullet (*Mugil cephalus*) (SM);
- Blue crab (*Callinectes sapidus*) (BC); and
- Penaeid shrimp (*Penaeus spp.*).

Incidental species of finfishes that will be evaluated include:

- Southern flounder (*Paralichthys lethostigma*) (F);
- Atlantic croaker (*Micropogonias undulatus*) (AC); and
- Southern kingfish (*Menticirrhus americanus*) (SK).

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

A project organization chart is presented in Figure 2. The chart lists personnel involved and the lines of authority. A description of the key personnel and their responsibilities is presented below.

Project Director: Kirk J. Kessler, P.G. (404-705-9500)

The Project Director, located at 1100 Lake Hearn Drive, Suite 200, Atlanta, GA 30342 (kkessler@geosyntec.com), provides overall direction of the technical and administrative functions within the program. He will be responsible for the implementation of and modification to all program plans and the coordination of, and communication among, groups involved. He is also responsible for project deliverables. Mr. Kessler is a Principal with GeoSyntec Consultants with 17 years of experience in site assessment in the Eastern United States.

Project Coordinator: Anthony R. Dodd (404-705-9500)

The Project Coordinator, located at 1100 Lake Hearn Drive, Suite 200, Atlanta, GA 30342 (adodd@geosyntec.com), provides leadership to the team of project scientists and support for field sampling logistics and biological sampling expertise. Mr. Dodd has 15 years of experience working as an aquatic biologist, beginning his professional career as a biologist with the Brunswick, Georgia office of the DNR. He has conducted numerous fisheries and other aquatic ecological investigations throughout the southern, eastern, and upper mid-western United States. He has extensive experience with fisheries, water quality surveys, ecological assessments, and fish biomonitoring investigations stemming from a variety of sources including FERC hydroelectric re-licensing activities for major utility companies, NPDES programs for paper mills, EPA Superfund investigations, and other private industries located throughout the southern United States.

Project Scientist 1: Curt D. Rose,Ph.D. (954-927-1165)

Dr. Rose, located at 6001 N. Ocean Drive (Suite 1103), Hollywood, FL 33019 (clrose@gowebway.com), will be responsible for overseeing all biological activities involving identification of collected finfishes and shellfishes, determination of sex and

sexual maturity of fishes, and evaluation of age and food habits of selected fishes. Dr. Rose is a fisheries biologist and applied statistician with over 40 years experience in his academic fields. He has served as Research Associate Professor and the Director of the Shellfish Division of the Chesapeake Biological Laboratory at the University of Maryland, directed one of the first research projects sponsored by the National Sea Grant Program (extensive culture of penaeid shrimp in Louisiana estuaries), and performed much of the original life-history research on the dolphin fish. Dr. Rose is also the author of the statistical section of a major manual prepared by EPA's Office of Solid Wastes (Test Methods for Evaluating Solid Waste, second edition).

Project Scientist 2: Marshall Gaddis

Mr. Gaddis is the former leader of the Intensive Survey Unit, Environmental Protection Division, based in Atlanta, Georgia. Mr. Gaddis was a principal designer of the previous agency-conducted seafood tissue surveys statewide including the LCP site. Now retired from the Department of Natural Resources, Mr. Gaddis will be participating in project planning, field sampling decisions, and sample collection as an independent subcontractor to GeoSyntec.

Project Scientist 3: James Music

Mr. Music is a career fisheries biologist and former leader of the Commercial Fisheries Unit, Coastal Resources Division (CRD), Department of Natural Resources, Brunswick, Georgia. Mr. Music was co-designer along with Mr. Gaddis for the early agency sponsored fish tissue surveys at the LCP site. Now retired from the Department of Natural Resources, Mr. Music will be participating in project planning, field sampling decisions, and sample collection as an independent subcontractor to GeoSyntec.

Quality Assurance Officer: Marie A. Weber-Goeke (404-705-9500)

The QA Officer, located at 1100 Lake Hearn Drive, Suite 200, Atlanta, GA 30342 (mweber-goeke@geosyntec.com), will be responsible for assuring the integrity of the Sampling Quality Assurance Plan (SQAP) and will coordinate all QA activities. The QA Officer will coordinate all functions with the field team and assure that appropriate analytical procedures are employed by the laboratory. The QA Officer will be

responsible for data validation and will advise the Project Scientists with respect to data management. The QA Officer will supervise all of the quality aspects of the field team and determine and fulfill record-keeping requirements. The QA Officer will also be responsible for performance and/or systems audits of the laboratory. Ms. Weber-Goeke is an environmental scientist with over 3 years experience in site investigations, site assessment, and analysis of laboratory data.

Subcontractors – Laboratory Testing Services

Severn Trent Laboratory (STL) Mobile, located at 900 Lakeside Drive, Mobile, AL 36693, will provide analytical services for the fish survey. Laboratory Project Managers will be:

- Dale Darley – STL Laboratories, Mobile (251-666-6633);
- Van Pham, Ph.D. – STL Laboratories, Mobile (251-666-6633); and
- Jesse L. Smith – STL Laboratories, Mobile (251-666-6633).

The Laboratory Project Managers will be responsible for the day-to-day management of the laboratory work (to include data processing and data processing QA), verification that laboratory QA/QC procedures are being maintained, and that a technical review of reports has been performed. Although various laboratory functions will be performed by different individuals, it is the Laboratory Project Managers who will provide signature approvals to laboratory-generated information and assume laboratory responsibilities. Attachment B shows the laboratory credentials sheet.

4.0 SAMPLING PROCEDURES FOR FIELD ACTIVITIES

The fish survey will be conducted by a four-person field team and a three-person field-laboratory team. All biological sampling activity will be conducted under authority of a Georgia Scientific Collecting Permit (Permit No. 29-WMB-02-65) issued by the GDNR. Field teams will be equipped with two boats and a variety of biological sampling equipment. At least one crew member on each boat will be an experienced aquatic or fisheries biologist. Each team will be equipped with an array of gear including gill nets of varying mesh sizes, hook-and-line gear, trammel nets, baited crab traps for collecting blue crabs, and cast nets or otter trawls for collecting shrimp. The teams will collect finfishes primarily with gill nets. Hook-and- line gear will be used to collect target species on an opportunistic basis depending on netting success and availability of optimal angling conditions. Specimens not required for chemical analysis will be released.

4.1 Gill Net Sampling

A gill net consists of a single wall of mono-filament nylon mesh netting vertically suspended between a float line on top and a weighed lead line at the bottom. Fish are captured in a gill net when they swim into the mesh and their bodies and gill coverings (opercles) become entangled. Two lengths of gill nets will be used including nets measuring 125 ft in length x 6 ft deep and nets measuring 250-ft long and 6 feet deep. The float-line consists of a polypropylene rope with an inner core of ½-inch closed-cell foam for flotation. The foot rope or lead-line consists of a braided nylon rope with a 30-lb lead core braid. The 125-foot nets consist of either 2-7/8-inch or 2-1/2 inch stretch mesh in the wall of netting. Netting on the 250-foot nets consists of 2-7/8 inch stretch mesh. It is anticipated that these size meshes will be optimal for collecting the same types and sizes of fish captured in earlier surveys and fishes mostly of legal harvestable size (typically about 20 to 30 cm in length depending on the species sought). Nets will be fished during daylight hours through the ebb and flood tide cycles.

To keep nets in a vertical orientation, especially in areas where tidal currents are present, anchors will be attached to the ends of the lead line. The ends of the float line will be tied to marker floats. Nets fished in the tidal areas of the study area will

typically be set in the shallows along bankside habitats, where water depth is usually eight feet deep or less during high tide.

Equipment required for collecting samples with gill nets consists of the following:

- Gill nets;
- Net containers (large plastic tubs or trash cans);
- Buoys, floats, or jugs;
- Anchors (traditional, bricks, concrete blocks, etc.);
- Small diameter lines for floats;
- Sample coolers;
- Boats; and
- Net pick or pocket knife (if needed for extracting ensnared fish or crabs).

Setting Gill Nets

The gill net is retrieved from its container and staged onto an open, unobstructed boat bow for quick deployment. Anchors are attached to both ends of the lead line, and surface marker buoys are attached to both ends of the float lines. Setting the net set is begun by casting the net anchor of the shoreward end of the net onto shore, then slowly backing the boat away from shore in the direction desired for the net set. The remainder of netting on the bow is carefully paid out of the boat as the boat moves astern. Once the off shore end of the net is reached, the boat is slowed or stopped as water and wind conditions permit. The net is pulled until taut. Once the net is taut, the offshore lead line anchor is dropped overboard which will sink the offshore end of the net to the bottom. The net is fished during the desired sampling period before retrieval.

Retrieving Gill Nets

The boat is maneuvered to the offshore end of the net to retrieve the buoy and anchor. The net is hauled on board and stacked in coils in the storage bucket or on the

foredeck as the boat moves toward the shore. As fish are encountered in the net, they are removed by lifting the mesh over their opercula (gill coverings) and sliding it off their bodies. The mesh is frequently extremely tight around the fish's body and may require the use of a net pick or knife to free the specimen. Captured target specimens are transferred into a sample cooler and preserved with wet ice until later processing. Specimens not needed for analysis are released on site. The net is reset in the original manner if sampling continues at the same collection site.

4.2 Hook-and-Line Sampling

A variety of hook and line techniques may be used on an opportunistic basis. Fishing rods typically will be medium or heavy-weight 6 to 7 ft long spinning or bait casting rods made of fiberglass or graphic composite. Terminal tackle, referred to as fish finders, float rigs or bottom rigs, will be used for angling for target species. Fish finder rigs include a weight at the end of the monofilament line with a 12- to 18-inch leader and hook tied at the terminus. Fish finder rigs are fished on the bottom near or under the boat with the line held taut between the fishing rod and the weight on the bottom. Fishing in this way allows the baited hook and leader to move freely beyond the moored fishing weight on the bottom. The fish finder rig is baited with live or dead shrimp or bait fish. Float rigs, as the name implies, includes a baited hook and leader attached to a weighted line suspended under a large visible fishing float. Baits in these rigs are fished near the surface of the water and the depth of the hook and bait can be adjusted to fish the water at a desired depth. Bottom rigs usually consist of a weighted leader on the terminal tackle with one or more baited hooks. Bottom rigs are baited with live or dead shrimp or various bait fishes. The bait will be fished in a "tight" line manner under or near the boat.

As target species are caught, they are transferred into a sample cooler with wet ice. Specimens not needed for analysis are released on site.

4.3 Trawl Sampling

This method is specific to "otter" trawls, which typically consist of a nylon-mesh bag of varying dimensions, outer control boards, and tow lines. An eight-foot trawl will

be used for this survey. The mouth of the net measures eight feet wide. This size net can be easily handled from a small boat. A small outboard boat can easily pull a trawl of this size.

Rigging Trawls

Trawl doors, trawl bridles, and towlines are necessary components of otter trawls. Many fishermen prefer this system because doors can be retrieved independently if the trawl snags the bottom. The trawl operator should understand how the doors and net function to get maximum performance from his gear. Otter doors or boards of the trawl regulate the horizontal spread of the net mouth. Doors also keep the trawl on the bottom. Water pressure and towing speed exert force on the doors and net, creating an interaction that controls trawl performance in the water.

Setting Trawls

When setting out the trawl doors, care must be taken that the doors do not flip over and twist the towlines. The trawl bag should be tied with a knot that can be untied when a full catch is brought aboard (e.g., shrimper's bag knot).

Trawl towlines should be stowed on the boat in such a manner that they will not become tangled when the trawl is set out. As a safety precaution, net handlers should be careful not to become entangled in the gear as it goes over the side. Maintaining a low speed is essential until the net and line are completely out of the boat. Doors should be watched as they enter the water to be sure that they enter in a correct upright position. To avoid tangles, maintain a small amount of tension on the towlines and watch the doors as they begin to spread. It is important that a net operator pay out enough towline for efficient trawling. The length of towline necessary for trawling depends on the water depth and trawl size. Generally, a small trawl should use about 60 feet of line in shallow water.

Towing times are usually short, ranging from five to 30 minutes. When the trawl is completely overboard, boat speed can be increased. The trawl should be pulled at an average walking speed, about 1½ miles per hour. Trawls can be pulled at any speed, with faster speeds producing more shrimp. However, speed tends to create lift on the net, which necessitates more weight on the footrope to hold the trawl to the bottom. Too

much lift on the net can also force it off the bottom, causing partial or complete loss of catch. When retrieving the net, it is important to remain away from other boat traffic. The boat should be on the downwind side of the trawl to prevent tangling the gear in the propeller. The towline and door must be kept straight as they are placed in the boat. The net retrievers must watch where they grip the net webbing because biological hazards such as fish spines can cause painful injuries to sample handlers.

Once collected from the trawl bag, shrimp and other target species will be removed from the catch and handled in the same manner as described for fishes collected with gill nets.

4.4 Cast-Net Sampling

Cast netting techniques may be used to capture target fish or shrimp in shallow, water with unobstructed substrates. Cast net netting typically consists of small mesh-sized fine monofilament nylon. Nets are constructed in a round shape with radii usually ranging from 1.5 to 12 feet long. Cast nets used in this survey will have either an 8 or 10 ft radius with 5/8-inch sized mesh netting. Cast nets feature a lead line (foot rope) at the outer perimeter of the net, which allows the net to sink quickly through the water column. The center or head of the net features a ring or "horn" through which tied leaders (braille lines) constructed of heavy monofilament line attach the lead line to the hand line that connects the net components at its center.

In deploying a cast net, the net is cast out over the water with rotation of the body and arms of the cast netter. The net sinks to the bottom entrapping fish and shrimp. The net collapses at its center onto the catch when the hand line is pulled to retrieve the net. The catch is hauled to the cast netter and retrieved from the net. The net is prepared for another cast and redeployed.

Target specimens are handled in the same manner as described for fishes collected with gill nets. Species not needed for analysis are released on site.

4.5 Blue Crab Sampling

The crab trap consists of a rectangular wire box measuring 2 ft x 2 ft x 1.7 ft. The trap is constructed of coated wire with a mesh size of 2 inches x 1.5 inches. Three sides of the trap include a wire funnel (narrow end inside the body of the trap) that allows crabs to crawl inside the trap toward the bait. Egress of crabs out of the funnels is restricted due to the orientation of the funnel opening. Bait such as dead fish is contained in a woven wire, cylindrical bait holder located near the center of the trap. The bait holder allows trap handlers to place bait into the trap from an external door on the bait holder. Once captured, crabs can be removed from the trap through a door or a hinged side of the trap that is latched to another side or edge of the trap. A line and buoy are affixed to the trap for deployment. The line is measured to allow the buoy to float on the water surface throughout tidal fluctuation.

The trap is deployed by first baiting the trap then submerging it to the bottom at the desired location. The trap is fished for a desired length of time (usually overnight) and retrieved the following day.

Upon retrieval, the buoy line is picked up and the trap raised into the boat. Crab handlers should exercise extreme caution when handling live crabs in order to avoid being pinched or pierced by the crab pincers. Live, large crabs can inflict painful and fairly serious wounds if mishandled. Handlers can wear heavy gloves or use tongs to safely handle crabs. Ideally, crabs can be transferred from the trap into an open cooler.

Crabs of desired size are removed from the trap and placed in coolers on wet ice. Crabs not needed for analysis are released on site.

4.6 Biological Measurements and Observations of Target Finfishes

The biological measurements and observations that will be conducted on individual fishes consist of length, weight, gender, reproductive condition, age (using the scale method), and food habits (the frequency-of-numerical-occurrence method). Equipment required for making biological measurements and removing fish fillets consists of the following:

- Measuring board;
- Analytical balance;
- Fillet board;
- Fish scale removers (“scalers”);
- Stainless-steel filleting knives with non-wooden handles;
- Coin (fish-scale) envelopes;
- Aluminum foil;
- Ziploc® bags;
- Disposable nitrile gloves;
- Alconox®;
- Isopropanol; and
- Collection buckets.

4.6.1 Length and Weight

Length and weight measurements will be made on collected finfishes and shellfishes within 24 hours after collection. In the case of finfishes:

1) Place each fish on the measuring board with the most anterior part of the fish touching the board and its side resting along the ruler of the board.

2) Measure total length (length to the longest part of the caudal fin after the two caudal lobes have been pushed together). Record fish length to the nearest 5 mm.

3) With the balance tray placed on the analytical balance and press TARE. Wait for a reading of 0.0 g.

4) Place the fish in the balance tray.

5) Allow the weight reading to stabilize, and record the weight to the nearest gram.

For blue crabs, the same basic above-described procedures will be followed, with length being recorded as width of the carapace from point-to-point. Penaeid shrimp will only be weighed, with weight being reported as "heads-on" count.

4.6.2 Tissue Processing

Tissue processing procedures for finfishes will consist of scaling and filleting of the fishes. These procedures will reflect the same processes employed by fishermen to remove edible muscle tissue from fishes. Scaling and filleting, which will occur immediately after length and weight measurements have been recorded for each fish, will proceed as follows:

1) Decontaminate all scaling and filleting equipment (scaler, filleting knife, fillet board) with Alconox®, deionized water, and isopropanol, in sequence. After the isopropanol rinse, allow the equipment to air dry.

2) Cover the fillet board with a piece of aluminum foil, dull side facing up.

3) Place each fish on its side on the fillet board using a new pair of non-contaminating, disposable nitrile gloves.

4) Remove all scales from the caudal fin to the head.

5) Make a diagonal cut from the base of the cranium, following just behind the gill to the ventral side just behind the pectoral fin.

6) Remove the flesh, including some of the belly flap, from each side of the fish by cutting from the cranium along the spine and dorsal fin to the caudal fin.

7) Place the two fillets from each fish in a labeled Ziploc® bag and freeze at -20°C.

Blue crabs and penaeid shrimp will be immediately frozen for shipment to the analytical laboratory, where exoskeletons will be removed prior to extracting edible flesh for chemical analysis.

4.6.3 Determination of Gender and Reproductive State

Finfish

The gender and reproductive state of finfishes will be determined according to the following general classification:

Females:

Stage I: Virgin individuals – wine-red torpedo-shaped ovaries; no eggs visible to naked eye.

Stage II: Advanced virgins, spent individuals, or recovering spents – as above, but with some tiny eggs visible to naked eye; ovaries slack and containing mostly a matrix in spent individuals.

Stage III: Individuals approaching spawning condition – ovaries swollen, yellowing in color.

Stage IV: Ripe individuals – ovaries greatly swollen and sometimes resembling tapioca; largest eggs transparent.

Males:

Stage I: Virgin individuals or recovering spents – flat, small testes clinging close to backbone; whitish in color

Stage II: Individuals approaching spawning condition – testes swollen, milky in appearance.

Stage III: Ripe individuals – large, lobed testes emitting milt freely.

Stage IV: Spent individuals – testes slack, containing an abundance of connective tissue.

Blue Crab

The gender of blue crabs will be determined by observing the shape of their abdomen. Male blue crabs have a narrow, T-shaped abdomen that is readily distinguishable from the triangular shaped abdomens (with fused segments) found on female blue crabs.

4.6.4 Age Determination

The age of finfishes is commonly determined by counting the number of annuli on hard structures such as scales, spines, otoliths, vertebrae, and opercular bones. For this survey, scales will be used for age determination of a limited number of selected fishes.

1) Only personnel experienced in the process of fish-scale age determinations will be assigned to this task.

2) Remove several scales from each fish from the humeral area just above the lateral line. Blunt forceps or a knife tip may be useful for this task. Be careful not to break the margins of the scales or scratch the surfaces. Scales that are broken, irregularly shaped, or contain an opaque center (replacement scales) will be discarded.

3) Transfer fish scales to a labeled coin envelope for later age determination.

4) Include a scale sample identifier on the coin envelope for each fish sampled. The identifier will cross reference vital data for each fish, including species, length, weight, sex, date of collection, and location of collection.

5) Inspect and clean scales before mounting them for microscopic viewing. If mucus, skin pigments, or dirt is present on the scale, scales will be soaked in water for about two hours and scrubbed with a small brush or piece of cloth after the soaking period. The best five to ten scales will be retained for mounting and viewing.

6) Mount the viewing scales between two microscope slides, making sure that the scales do not overlap.

7) Project the mounted scales with a microprojector (microfiche reader) and identify the scales that have a complete set of rings emanating outward from their center. The microprojector should provide an enlarged image to about 50 times the natural size of the scale.

8) Count the number of annual rings (annuli) on each scale. Each "true" annulus represents one year of growth. Care will be taken not to misinterpret "false" annuli. An important consideration for aging fish via scale marks is to understand the time of annulus formation, which can vary with latitude, spawning, migration, and food habits of the sampled fish population, as well as environmental influences including water temperature.

4.6.5 Determination of Food Habits

A limited number of selected finfishes will be evaluated for food habits by the frequency-of-numerical-occurrence method.

5.0 SAMPLE CUSTODY

Sample collection and sample custody are designed so that field custody of samples is maintained and documented. These procedures provide identification and documentation of the sampling event and the sample chain-of-custody from shipment of sample collection to receipt of the sample by the subcontracted laboratory.

A sample, or other physical evidence, is in custody if:

- it is in the field investigator's, transferee's, or lab technician's actual possession;
- it is the field investigator's, transferee's, or lab technician's view, after being in his/her physical possession;
- it was in the field investigator's, transferee's, or lab technician's physical possession and then he/she secured it to prevent tampering; or
- it is placed in a designated secure area.

5.1 Chain-of-Custody Record

The Chain-of-Custody Record is used to record the custody of all samples or other physical evidence collected and maintained. The Chain-of-Custody Record also serves as a sample logging mechanism for the analytical laboratories' sample custodians.

The following information must be included in the Chain-of-Custody Record:

- project name and numeric identifier;
- date and time of sample collection;
- sample identification;
- physical or chemical analyses required;

- remarks needed to clarify procedures to be followed by the analytical laboratory;
- number of sample containers submitted for each type of analysis;
- total number of packing containers (e.g., coolers) submitted in each shipment to the analytical laboratory;
- signatures, dates, and times required to document chain-of-custody; and
- Fedex labels copied and attached to the COC in the project file.

The Chain-of-Custody Record is a serialized document. Once the Record is completed, it becomes an accountable document and must be maintained in the project file.

5.2 Field Custody Procedures

Sample collection and processing procedures concerning sample identification and documentation, field log books and forms, sample packing, and sample shipping are described in the following sections.

5.2.2 Sample Identification and Documentation

All samples will be labeled with a unique identification number indicating the zone of collection, sample species, and sample sequence number.

5.2.1 Field Log Books and Forms

Sampling personnel will use a bound field log book with moisture-resistant pages to record pertinent sampling information with pencil. Each log book will identify the project name, project number, and geographic location of the site. Daily field activities and sampling information will be entered in the log book on serially-numbered pages. At the end of each day's entries, sample-collection personnel will sign and date the entry. Corrections will be made to entries by initialed and dated line-out deletions. A

diagonal line will be drawn across the remaining blank space of the last page of each day's entry.

Information that will be recorded during field activities (including both fishing operations and fish processing) is identified in the forms contained in Attachment A.

5.2.3 Sample Packing

Samples will be packed for shipping in ice chests and coolers. Individual composites will be sealed in Zip-loc® or other similar plastic bags prior to packing. Dry ice will be double-bagged in plastic bags and insulated with newspaper to help maintain the samples in a frozen condition during shipping.

Chain-of-Custody Records will be sealed in waterproof plastic bags and taped inside the cooler lids.

After packing, cooler lids will be sealed with strapping tape. Custody seals will be signed, dated and affixed from the cooler lid to the cooler body, and covered with clear tape. This will ensure that any tampering with the cooler contents would be immediately evident to sample custodians on the receiving end of shipment.

5.2.4 Sample Shipping

Sample coolers will be shipped by overnight express courier to the analytical laboratory. A copy of the bill of lading will be retained by the QA Officer and become part of the sample custody documentation.

5.3 Laboratory Custody Procedures

Standard Operating Procedures (SOPs) for sample custody protocols will be maintained by the analytical laboratories and adhered to by laboratory personnel. These sample custody SOPs will be contained in the laboratories' Standard Operating Procedures (SOPs; Attachment C).

Following receipt at the laboratory, samples will remain frozen or on ice during sample log-in period. Each sample's unique identification number will be recorded

along with sample weight and description in the sample tracking log book as the samples are being processed. A laboratory label will be attached to the processed samples with all descriptive data clearly written in indelible ink. Archive samples will be retained in frozen storage for 6 month after the project has been completed.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

The following calibration procedures apply only to laboratory operations.

6.1 Preparation of Standards and Reagents

A critical element in the generation of quality data is the purity/quality and traceability of the standard solutions and reagents used in the analytical operations. The preparation and maintenance of standards and reagents will be performed per the specified analytical method. The quality of reagents and standard solutions will be monitored through a series of well-documented procedures. Information on standard sources and preparation of standard solutions are provided in the laboratory's SOPs located in Attachments C.

6.2 Calibration and Tuning of Instruments

Calibration of instruments is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established reporting limits. Each instrument will be calibrated with standard solutions appropriate to the type of instrument and the linear range established for the given analytical method. The frequency of calibration, calibration verification, and the concentration of calibration standards are determined by the manufacturer's guidelines and the analytical method. Details regarding instrument calibration and tuning are provided in the laboratory's literature in Attachments C of this document.

7.0 LABORATORY METHODS

Laboratory analyses will be performed by STL Mobile. A selection of the parameters to be analyzed is summarized in Table 2. A description of the laboratory's facilities, equipment, supplies, and credentials is provided in Attachment B.

The laboratory maintains and follows a documented quality assurance program that conforms to USEPA guidance document "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," (QAMS-005/80, December 1980). Copies of STL-Mobile's SOPs are provided in Attachments C.

7.1 Laboratory Tissue-Grinding Equipment Cleaning Procedures

Equipment will be washed between processing each composite. Two tissue grinders will be available for use including a Grindomax and a Cuisinart. Neither the blades nor the bowls are interchangeable.

1) All equipment grinding equipment will be washed in a solution of warm/hot water and Liquinox.

2) Equipment will then be rinsed two to three times with warm tap water.

3) Equipment will then be rinsed two to three times with deionized water.

4) Isopropyl alcohol will then be used for the final single rinse.

5) Equipment will be air dried before beginning the next composite.

6) All refuse will be kept in a lined garbage can. The liner will be removed to an outside dumpster at end of each sample day.

7.2 Equipment Blank Preparation

1) Equipment blanks will be generated at the end of each composite batch of 20 or fewer samples.

2) After a composite is completed, wash the grinder as outlined in the previous cleaning instructions.

3) The grinder must be allowed to air dry completely.

4) Pour deionized water into the container that holds the sample and fill it to the top. Be sure the blades are in place.

5) Leave the water in the container for 15 to 20 seconds.

6) Pour the water into a liter amber bottle for semi-volatiles determination, and into a 250mL Nalgene for metals analysis. (Semi-volatiles will require a minimum of 900mL; metals will require a minimum of 100mL.)

7) The equipment blank samples will accompany their respective sample batch to the semi-volatiles or metals departments for analytical preparation.

7.3 Tissue Handling and Homogenization Procedures

No personnel are to participate in the homogenization process until they have been trained and become familiar with the instructions outlined below.

7.3.1 Finfish Preparation

1) The samples are located in the upright deep freezer in the warehouse. Samples are grouped in a box/bag according to a page in the chain of custody. Fish samples should be allowed to thaw for about one hour at room temperature. They will be stored in a refrigerator when not being processed.

2) Each large Zip-lock® bag contains five (or fewer) small Zip-lock® bags. The small bags contain one set of fish fillets. These individual fillet sets will become one sample composite.

3) NOTE: Some samples may be considered as a composite even though less than five fillet sets are available.

4) Cut each set of fillets into approximately one-inch squares before they go into the Grindomix grinder.

5) Grind each set of fillets for seven seconds at 2500 rpm.

6) Put ground sample back into original plastic bag and proceed to the next fillet. The Grindomix does not have to be washed between fillets of the same composite. However, be sure to remove as much sample from the container as possible. Grind the remaining fillet sets for that sample in the same manner.

7) Weigh the samples in the Zip-lock® bags to determine the smallest weight for the composite. Place the entire smallest sample into a tared weigh boat (remove enough ground fish so that the sample is measured to the nearest whole gram). Record this weight in the sample composite tracking log. See previous entries for examples.

8) Discard excess sample into garbage can lined with a plastic bag. Be sure to take the trash out to the dumpster at the end of the work day.

9) Place the weighed sample back into the original plastic bag. Weigh the same amount of the other ground fillets, and place into bag with the first sample. The same weigh boat and plastic spoon may be used for all samples within a composite.

10) Process combined samples in the Grindomix. If entire sample exceeds 200 grams of fish, the sample will need to be ground in two or more batches (so that the grinder will not overheat). Grind for four seconds at 2500 rpm two times.

11) Place final composite into a quart size Zip-lock® bag labeled with the STL log number, client name, sample description, the word “composite”, date composited, and analyst initials.

12) Make sure the sample composite tracking log is filled out with the following information: STL log number, weight of fillets used for composite, sample description of each fillet used (found on small Zip-lock® bags), analyst initials, and the date composited. See previous entries for examples.

13) Box the final composites together per each page of the chain of custody (or some other logical grouping, such as 20 consecutive LIMS ID numbers). Return the samples to the chest-style deep freezer in the warehouse.

14) Check the temperatures of both the upright and chest freezers once a day and record them in the log book stored on the front of the upright freezer.

7.3.2 Blue Crab Preparation

1) Analyze only the skeletal muscle (white meat). Crabs are easier to work with when they are completely frozen. Each sample is composed of five crabs in small Zip-lock® bags within a larger Zip-lock® bag. These five crabs will become one composite.

2) Tools required: an oyster knife and heavy cutting shears.

3) Remove one crab from the Zip-lock® bag and place it upside down (legs in the air) onto clean bench paper. Pull off the front two legs (claws)

4) Push the oyster knife down between the mouthparts and the bottom carapace. Do not go all the way through the crab body.

5) Then push the knife down through the space where the front legs were located. Work the knife back and forth until the top carapace can be easily detached from the crab body. Use the knife as a lever if needed.

6) Remove the internal organs (orangish material) and the gills.

7) Use the knife to separate the muscle containing chitin sections. Squeeze the frozen meat out into a large weigh boat. Try not to get too much shell in the sample.

8) Use heavy cutting shears to cut/crack the entire claw leg. Clean out all the meat with the knife.

9) When all the meat is removed from the crab, place entire sample on the weigh boat back into its original Zip-lock® bag.

10) Once all five crabs in a sample group are cleaned, proceed to the compositing step (Step 6 of the Fish Preparation section).

7.3.3 Penaeid Shrimp Preparation

1) Each bag of shrimp represents a composite sample.

2) Thaw a bag, then count and weigh the shrimp before peeling the shrimp.

3) Record the number of shrimp in the sample.

4) Record the weight of the shrimp (pre-peeled).

5) Clean the shrimp (no de-veining) by cutting off the head, peeling off the exoskeleton, and removing the tail.

6) Proceed to Step 9 of the Fish Preparation section and composite the cleaned meat.

7) This will yield one composite.

8) Repeat with all bags – each bag represents a single composite sample.

7.4 Quality Assurance Program

The laboratory maintains and follows a documented quality assurance program that conforms to USEPA guidance document “Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans" (QAMS-005/80, December 1980).

The quality assurance program provides for the following:

- traceable documentation of project records,
- verification that reports and documentation are technically accurate,
- assurance of the availability of proper equipment that is correctly calibrated and used, and
- adherence to the scope of work.

The laboratory quality assurance program will provide traceable documentation of an adequate level of project records, verification that analytical reports and documentation are technically accurate, assurance of the availability of proper analytical equipment that is correctly calibrated and used, and adherence to the scope of work.

7.5 Analytical Methods

Analytical procedures are documented in the Laboratory SOPs (Attachment C). Table 2 indicates the methods employed in this project. Detection limits to be employed in this project are also presented in Table 2.

TABLES

Table 1

Percent (%) Success in Meeting Major Objectives of Assessment of Chemical Residue in Seafood from Portions of the Turtle River, Brunswick, Georgia[a]

Zone (area) evaluated[b]	Year of survey[c]					
	1991	1992	1993	1995	1997	2002 (goal)
A (Turtle River from GA Hwy. 303 to Buffalo River)	0	0	45.8	**62.5** (PCB in black drum)	75.0	80.0
B (Turtle River upstream of Buffalo River)	0	0	50.0	33.3	75.0	80.0
C (Buffalo River upstream of Turtle River)	0	0	50.0	62.5	83.3	80.0
D (Turtle River from GA Hwy. 303 to Channel Marker 9)	4.2	**37.5** (mercury in red drum, black drum sheepshead, Atlantic croaker, blue crab)	**41.7** (mercury in blue crab)	**37.5** (mercury in blue crab)	**62.5** (mercury in blue crab)	85.0
E (Turtle River from Channel Marker 9 to U. S. Hwy 17)	0	0	45.8	62.5	70.8	80.0
F (South Brunswick River from mouth of Hillary Creek south to mouth of Fancy Bluff Creek)	0	0	45.8	41.7	75.0	80.0
G (Brunswick River from U. S. Hwy. 17 to Channel Marker 22)	0	0	33.3	66.7	83.3	80.0
H (Purvis Creek)	**12.5** (PCB in blue crab)	**4.2** (mercury in penaeid shrimp)	0	**62.5** (mercury in blue crab; PCB in striped mullet, Atlantic croaker)	**75.0** (mercury in blue crab; Aroclor 1268 in striped mullet, spot, Atlantic croaker)	85.0
I (Gibson Creek -- east of GA Hwy. 303)	0	0	0	**66.7** (mercury in blue crab)	58.3	85.0
Mean (all zones):	1.9	4.6	34.7	55.1	73.1	81.7

[a]Percent success in each zone for each year of the survey is determined as the percent (%) of complete composite samples (each sample assummed to consist of five finfishes, five blue crabs, or numerous penaeid shrimp of similiar size) in comparision to survey objectives established in 1992 by the Georgia Department of Natural Resources (GDNR) -- three complete composite samples of similiar size for each of eight targeted species (spotted seatrout, red drum, black drum, spot, sheepshead, striped mullet, blue crab, and penaeid shrimp).

[b]Zones identified in **bold print** are zones that the GDNR has closed to commercial fishing and advised against consumption of any seafood.

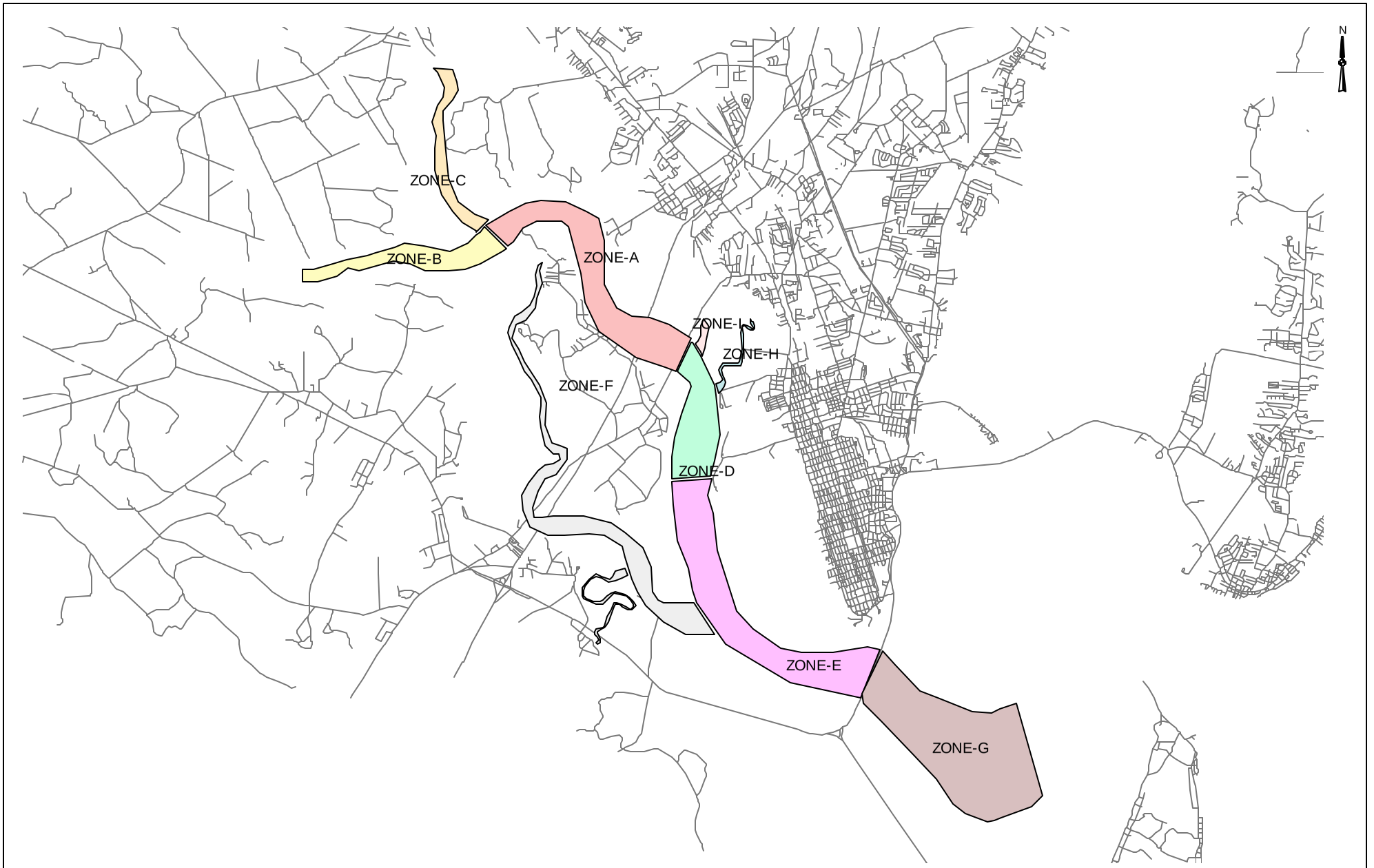
[c]Percent success identified in **bold print** signifies cases in which at least one composite sample of fish equaled or exceeded the FDA Action Level for mercury (1 ppm, wet wt) or PCBs (2 ppm, wet wt). Species of contaminated fishes are parenthetically identified .

Table 2

Parameter List and Detection Limits for 2002 Assessment of Chemical Residue in Seafood from Portions of the Turtle River, Brunswick, Georgia

Parameter		Detection Limit	Method
		mg/kg	
Metals	Antimony	1	SW6010/SW7471
	Beryllium	1	SW6010/SW7471
	Cadmium	1	SW6010/SW7471
	Chromium, Total	1	SW6010/SW7471
	Copper	1	SW6010/SW7471
	Lead	1	SW6010/SW7471
	Mercury	0.01	SW6010/SW7471
	Nickel	1	SW6010/SW7471
	Silver	1	SW6010/SW7471
	Thallium	1	SW6010/SW7471
	Zinc	1	SW6010/SW7471
Pesticides/PCB			
	Aldrin	0.01	SW8081
	a-BHC	0.01	SW8081
	b-BHC	0.01	SW8081
	d-BHC	0.01	SW8081
	g-BHC (Lindane)	0.01	SW8081
	Chlordane	0.04	SW8081
	4,4-DDD	0.01	SW8081
	4,4-DDE	0.01	SW8081
	4,4-DDT	0.01	SW8081
	Endosulfan I	0.02	SW8081
	Endosulfan II	0.03	SW8081
	Endosulfan Sulfate	0.05	SW8081
	Endrin	0.01	SW8081
	Endrin Aldahyde	0.05	SW8081
	Heptachlor	0.01	SW8081
	Heptachlor Epoxide	0.01	SW8081
	Toxaphene	0.1	SW8081
	PCB-1016	0.1	SW8082
	PCB-1221	0.1	SW8082
	PCB-1232	0.1	SW8082
	PCB-1242	0.1	SW8082
	PCB-1248	0.1	SW8082
	PCB-1254	0.1	SW8082
	PCB-1260	0.1	SW8082
	PCB-1268	0.1	SW8082
	Methoxychlor	0.05	SW8081
	HCB	0.01	SW8081
	Mirex	0.1	SW8081
	Pentachloroanisole	0.01	SW8270
	Chlorpyrifos	0.05	SW8270
	Total Lipid	%	SW9071

FIGURES



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DATE: November 2002	
PROJECT NO. GS3117	FIGURE NO. 1
DOCUMENT NO. GA020644	FILE NO. Figure1.apr

N:\LCPGA\ECO_Study_2002\DNR Sampling 2002\SQAP\Figure1.apr

PROJECT ORGANIZATION CHART
FOR 2002 SEAFOOD SURVEY

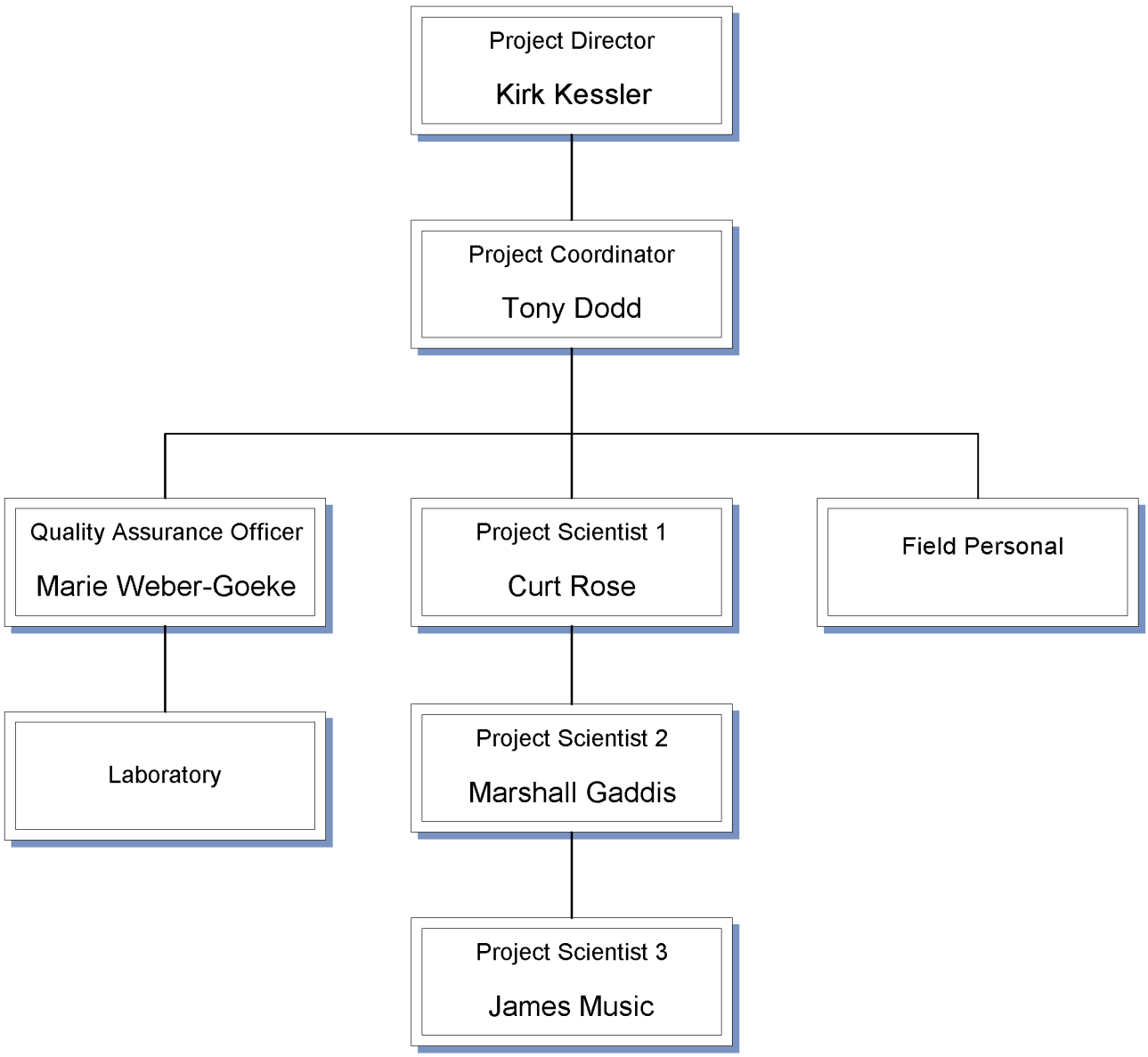

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FIGURE NO.	2
PROJECT NO.	GS3117
DOCUMENT NO.	GA020644
FILE NO.	FLOW.VSD

ATTACHMENT A
FIELD FORMS

PRELIMINARY FISH DATA SHEET

ZONE ____

Fish identification (zone - abbreviated common name - number)[a]	Length (mm)[b]	Weight (g)	Sex (M/F)	Gonadal condition (Stages I - V)[c]	Scales taken (Y)	Stomach contents taken (Y)	Anomolies

[a]Abbreviations for target fish are provided on separate sheet. An example would be A - SS - 1 (the first spotted seatrout captured from Zone A). T type of coding will be written on Ziploc bags.

[b]All fish length is total length unless fork length (FL) is indicated.

[c]Stage I - V gonadal conditions are described on separate sheet.

FISH DATA SHEET

Project Name LCP Chemicals Project No. _____ Location _____

Date _____ Time of Day Caught _____ Zone _____

Lab Sample ID	Sample ID	Species	Total Length (mm)	Total Weight (g)	File Weight (g)	Sex M/F	Maturity/ Gonadal	Scale Sample Taken (Y)	Stomach Sample (Y)	Gear	Anomolies

Sample Duration _____

No. of Sets _____

ATTACHMENT B
LABORATORY CREDENTIALS

ATTACHMENT C
LABORATORY STANDARD OPERATING PROCEDURES (SOPS)

APPENDIX B

Appendix B
Comparison of Method Detection Limits to EPA Regional Screening Levels

Sediment						
Test Method	Prep Method	Analyte	Units	Method Reporting Limit	Method Detection Limit	Residential Soil RSL [a]
1631E	3541	Mercury	mg/kg	0.001	0.0003	0.78
6020A	3541	Lead	mg/kg	0.05	0.009	400
8270D	3541	Acenaphthene	mg/kg	0.005	0.0005	340
8270D	3541	Acenaphthylene	mg/kg	0.005	0.00056	170
8270D	3541	Anthracene	mg/kg	0.005	0.00055	1700
8270D	3541	Benz(a)anthracene	mg/kg	0.005	0.00072	0.15
8270D	3541	Benzo(a)pyrene	mg/kg	0.005	0.00076	0.015
8270D	3541	Benzo(b)fluoranthene	mg/kg	0.005	0.00092	0.15
8270D	3541	Benzo(g,h,i)perylene	mg/kg	0.005	0.00085	170
8270D	3541	Benzo(k)fluoranthene	mg/kg	0.005	0.00087	1.5
8270D	3541	Chrysene	mg/kg	0.005	0.0008	15
8270D	3541	Dibenz(a,h)anthracene	mg/kg	0.005	0.0008	0.015
8270D	3541	Fluoranthene	mg/kg	0.005	0.00098	230
8270D	3541	Fluorene	mg/kg	0.005	0.00061	230
8270D	3541	Indeno(1,2,3-cd)pyrene	mg/kg	0.005	0.00087	0.15
8270D	3541	1-Methylnaphthalene	mg/kg	0.005	0.00039	22
8270D	3541	2-Methylnaphthalene	mg/kg	0.005	0.00051	31
8270D	3541	Naphthalene	mg/kg	0.005	0.0006	3.6
8270D	3541	Phenanthrene	mg/kg	0.005	0.0014	170
8270D	3541	Pyrene	mg/kg	0.005	0.00076	170
8082A	3541	Aroclor-1016	mg/kg	0.010	0.002	0.39
8082A	3541	Aroclor-1221	mg/kg	0.020	0.002	0.14
8082A	3541	Aroclor-1232	mg/kg	0.010	0.002	0.14
8082A	3541	Aroclor-1242	mg/kg	0.010	0.002	0.22
8082A	3541	Aroclor-1248	mg/kg	0.010	0.002	0.22
8082A	3541	Aroclor-1254	mg/kg	0.010	0.002	0.22
8082A	3541	Aroclor-1260	mg/kg	0.010	0.002	0.22
8082A	3541	Aroclor-1262	mg/kg	0.010	0.002	0.22
8082A	3541	Aroclor-1268	mg/kg	0.010	0.002	0.22
8290	3541	1,2,3,4,6,7,8-HpCDD	mg/kg	2.5E-06	5.0E-07	NA
8290	3541	1,2,3,4,7,8-HxCDD	mg/kg	2.5E-06	6.4E-07	NA
8290	3541	1,2,3,6,7,8-HxCDD	mg/kg	2.5E-06	5.0E-07	NA
8290	3541	1,2,3,7,8,9-HxCDD	mg/kg	2.5E-06	5.4E-07	NA
8290	3541	1,2,3,7,8-PeCDD	mg/kg	2.5E-06	5.4E-07	NA
8290	3541	2,3,7,8-TCDD	mg/kg	5.0E-07	2.0E-07	4.5E-06
8290	3541	OCDD	mg/kg	5.0E-06	4.8E-06	NA
8290	3541	1,2,3,4,6,7,8-HpCDF	mg/kg	2.5E-06	5.0E-07	NA
8290	3541	1,2,3,4,7,8,9-HpCDF	mg/kg	2.5E-06	5.0E-07	NA
8290	3541	1,2,3,4,7,8-HxCDF	mg/kg	2.5E-06	5.0E-07	NA
8290	3541	1,2,3,6,7,8-HxCDF	mg/kg	2.5E-06	5.0E-07	NA
8290	3541	1,2,3,7,8,9-HxCDF	mg/kg	2.5E-06	5.0E-07	NA
8290	3541	2,3,4,6,7,8-HxCDF	mg/kg	2.5E-06	5.0E-07	NA
8290	3541	1,2,3,7,8-PeCDF	mg/kg	2.5E-06	5.0E-07	NA
8290	3541	2,3,4,7,8-PeCDF	mg/kg	2.5E-06	5.0E-07	NA
8290	3541	2,3,7,8-TCDF	mg/kg	5.0E-07	1.4E-07	NA
8290	3541	OCDF	mg/kg	5.0E-06	1.3E-06	NA

Fish Tissue						
Test Method	Prep Method	Analyte	Units	Method Reporting Limit	Method Detection Limit	Fish Tissue RSL[a]
1631E	3541	Mercury	mg/kg	0.001	0.0003	0.014
6020A	3541	Lead	mg/kg	0.02	0.005	0.371[b]
8270D	3541	Acenaphthene	mg/kg	0.0005	0.000052	8.1
8270D	3541	Acenaphthylene	mg/kg	0.0005	0.000047	4.1
8270D	3541	Anthracene	mg/kg	0.0005	0.00019	41
8270D	3541	Benz(a)anthracene	mg/kg	0.0005	0.00016	0.0043
8270D	3541	Benzo(a)pyrene	mg/kg	0.0005	0.000061	0.00043
8270D	3541	Benzo(b)fluoranthene	mg/kg	0.0005	0.00014	0.0043
8270D	3541	Benzo(g,h,i)perylene	mg/kg	0.0005	0.000058	4.1
8270D	3541	Benzo(k)fluoranthene	mg/kg	0.0005	0.000092	0.043
8270D	3541	Chrysene	mg/kg	0.0005	0.0002	0.43
8270D	3541	Dibenz(a,h)anthracene	mg/kg	0.0005	0.000045	0.00043
8270D	3541	Fluoranthene	mg/kg	0.0005	0.00015	5.4
8270D	3541	Fluorene	mg/kg	0.0005	0.000095	5.4
8270D	3541	Indeno(1,2,3-cd)pyrene	mg/kg	0.0005	0.0001	0.0043
8270D	3541	1-Methylnaphthalene	mg/kg	0.0005	0.000067	0.11
8270D	3541	2-Methylnaphthalene	mg/kg	0.001	0.00006	0.54
8270D	3541	Naphthalene	mg/kg	0.001	0.00008	2.7
8270D	3541	Phenanthrene	mg/kg	0.0005	0.00032	4.1
8270D	3541	Pyrene	mg/kg	0.0005	0.00012	4.1
8082A	3541	Aroclor-1016	mg/kg	0.01	0.0024	0.0095
8082A	3541	Aroclor-1221	mg/kg	0.02	0.0024	0.0016
8082A	3541	Aroclor-1232	mg/kg	0.01	0.0024	0.0016
8082A	3541	Aroclor-1242	mg/kg	0.01	0.0024	0.0016
8082A	3541	Aroclor-1248	mg/kg	0.01	0.0024	0.0016
8082A	3541	Aroclor-1254	mg/kg	0.01	0.0024	0.0016
8082A	3541	Aroclor-1260	mg/kg	0.01	0.0024	0.0016
8082A	3541	Aroclor-1262	mg/kg	0.01	0.0024	0.0016
8082A	3541	Aroclor-1268	mg/kg	0.01	0.0024	0.0016

Footnotes:

[(a)] RSLs for all noncarcinogens (except lead) are adjusted downward by factor of 10.

[(b)] Value for lead was obtained from the Risk Assessment Information System (RAIS) online preliminary remediation goal (PRG) calculator (http://rais.ornl.gov/cgi-bin/prg/PRG_search?select=chem).