First Chemical Corporation
A DuPont Company

PASCAGOULA BASELINE STUDY/REPORT FOR FIRST CHEMICAL CORPORATION PASCAGOULA, MISSISSIPPI

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS

Acronym	Definition / Description
APFO	Ammonium perfluorooctanoate
BCF	Bioconcentration Factor
BAF	Bioaccumulation Factor
COC	Chain of Custody
DuPont	E. I. du Pont de Nemours and Company
FCC	First Chemical Corporation
LC/MS/MS	Liquid chromatography-tandem mass spectrometry
LOD	Limit of detection
LOQ	Limit of quantitation
MDEQ	Mississippi Department of Environmental Quality
MDL	Method Detection Limit
MDMR	Mississippi Department of Marine Resources
MS	Matrix spike
ND	Non-detect
NQ	Not Quantifiable
µg/Kg	Micrograms per kilogram (parts per billion)
µg/L	Micrograms per liter (parts per billion)
ng/g	Nanograms per gram (parts per billion)
NERR	National Estuarine Research Reserve
PBS	Pascagoula Baseline Study
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctanesulfonate
POTW	Publicly-Owned Treatment Works
Ppb	Parts Per Billion
PQL	Practical Quantitation Limit
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative Percent Difference
SNUR	Significant New Use Restrictions
SOP	Standard Operating Procedures
STL	Severn Trent Laboratories
SWPPP	Storm Water Pollution Prevention Plan
WWTP	Waste Water Treatment Plant

EXECUTIVE SUMMARY

Background and Purpose:

The purpose of the Pascagoula Baseline Study (PBS) was to conduct one sampling event to analyze for PFOA (perfluorooctanoic acid), and provide a "snapshot of" the environment in various media (water, sludge, biota) prior to the startup of a new fluorotelomer operation at the First Chemical site in Pascagoula. The new fluorotelomer operation will significantly reduce levels of PFOA and other impurities in fluorotelomer products. All sampling for this study was conducted prior to the startup of the new operation. Future studies will be conducted to monitor for potential environmental changes. The study was designed in cooperation with the Mississippi Department of Environmental Quality (MDEQ) and the Mississippi Department of Marine Resources (MDMR). Testing was conducted by independent contract laboratories.

The study measured environmental concentrations of both PFOA and PFOS (perfluorooctanesulfonate). PFOA was measured to provide an assessment of PFOA levels prior to the start-up of the new fluorotelomer operation. PFOS was included in the study to indicate background levels of perfluorinated compounds not associated with First Chemical Pascagoula. PFOS is not generated by operations at the Pascagoula site and will not be generated as part of the new operation. Because both PFOA and PFOS have been manufactured and used by many companies in a variety of applications for a many years, and because both have been reported to be present at very low levels in the environment at various geographic locations, their presence in an area is not necessarily indicative of a local source.

To date, there are no human health effects known to be caused by PFOA. Based on health and toxicological studies conducted by 3M, DuPont and other researchers, DuPont believes the weight of evidence indicates that PFOA exposure does not pose a health risk to the general public. Nonetheless, it is a persistent compound that is present in low levels in the environment and the blood of the general population. As a result, DuPont is taking the lead in evaluating ways to reduce emissions of PFOA. The successful implementation of the new operation at Pascagoula will help DuPont meet the commitment made to the U.S. EPA to reduce the low amounts of PFOA in surface protection (fluorotelomer) products.

Key Findings:

- All concentrations of PFOA found are consistent with general environmental background levels documented in published scientific studies. Furthermore, in nearly all cases where PFOA was detected in this study, very low levels of PFOS were also detected consistent with background numbers associated with historic global use of the materials, and not a result of First Chemical manufacturing.
- All the concentrations of PFOA in water found in this study are well below any current regulatory guidance for drinking water. (While PFOA is not a regulated chemical, a few states have developed allowable interim criteria for PFOA.)

Additional Findings

- PFOA was not detected in Pascagoula drinking water (LOD = 0.0016 µg/L – equivalent to parts per billion).
- PFOA was not quantifiable (detected at levels so low they could not be accurately measured) in the Pascagoula River, Escatawpa River, Bayou Cassotte, Mississippi Sound or Grand Bay.
- PFOA was found at low levels on the First Chemical site and in wastewater discharges from the site to the Regional Wastewater Authority (POTW). Because PFOA has been manufactured and used by many companies in a variety of applications for many years, and because it has been reported to be present at very low levels in the environment at various geographic locations, its presence in an area is not necessarily indicative of a local source.
- PFOA measured in effluent from the First Chemical site to the Regional Wastewater Authority was a small percentage of the total PFOA measured from the Regional Wastewater Authority outfall to the Pascagoula River. Concentrations of PFOA measured from the Regional Wastewater Authority outfall to the Pascagoula River are consistent with two published studies of PFOA concentrations in outfalls of public wastewater treatment plants.
- PFOA was found at low concentrations in some marine life samples. Similar concentrations of PFOA were also detected in laboratory control samples of commercial seafood purchased at a supermarket in another part of the U.S.

1.0 INTRODUCTION

The purpose of the Pascagoula Baseline Study (PBS) was to conduct one sampling event to analyze for PFOA (perfluorooctanoic acid), and provide a "snapshot of" the environment in various media (water, sludge, biota) prior to the startup of a new fluorotelomer operation at the First Chemical site in Pascagoula. The new fluorotelomer operation will significantly reduce levels of PFOA and other impurities in fluorotelomer products. All sampling for this study was conducted prior to the startup of the new operation. Future studies will be conducted to monitor for potential environmental changes. The study was designed in cooperation with the Mississippi Department of Environmental Quality (MDEQ) and the Mississippi Department of Marine Resources (MDMR). Testing was conducted by independent contract laboratories.

The study measured environmental concentrations of both PFOA and PFOS (perfluorooctanesulfonate). PFOA was measured to provide an assessment of PFOA levels prior to the start-up of the new fluorotelomer operation. PFOS was included in the study to indicate background levels of perfluorinated compounds not associated with First Chemical Pascagoula. PFOS is not generated by operations at the Pascagoula site and will not be generated as part of the new operation. Because both PFOA and PFOS have been manufactured and used in a variety of applications for a many years, and because both have been reported to be present at very low levels in the environment at various geographic locations, their presence in an area is not necessarily indicative of a local source.

To date, there are no human health effects known to be caused by PFOA. Based on health and toxicological studies conducted by 3M, DuPont and other researchers, DuPont believes the weight of evidence indicates that PFOA exposure does not pose a health risk to the general public. Nonetheless, it is a persistent compound that is present in low levels in the environment and the blood of the general population. As a result, DuPont is taking the lead in evaluating ways to reduce emissions of PFOA. The successful implementation of the new operation at Pascagoula will help DuPont meet the commitment made to the U.S. EPA to reduce the low amounts of PFOA in surface protection (fluorotelomer) products.

1.1 Background on PFOA and PFOS

Perfluorooctanoic Acid (PFOA) is a fluoropolymer processing aid (or surfactant) having the general structure: $F(CF2)_7CO_2H$. Production of PFOA began in 1947 using the well-known electrochemical fluorination process primarily used by 3M. These particular surfactants, sometimes called "industrial soaps", had many uses due to their chemical stability, surface tension lowering properties and their ability to create stable foams. In particular, these compounds and various derivatives were used in fluoropolymer manufacture, in fluoropolymer dispersions manufacture, in metal plating and various cleaning and coating formulations and in fire-fighting foam formulations. They were also present as impurities in PFOS based products.

Perfluoroctanesulfonate (PFOS) has the general structure $F(CF2)_8SO_3X$, where X is either a metal for the salt form or H for the acid form. Production of PFOS-based products began in the early 1960s using the electrochemical fluorination process. These PFOS-based products and surfactants were used in many applications such as surface protectants, cleaners, and some AFFF (Aqueous Film Forming Foam) fire-fighting foams. 3M ceased production of their entire family of ECF-based fluorochemicals in 2002, including PFOS, and the US EPA established Significant New Use Restrictions (SNUR), restricting applications of PFOS. However, because of their broad use globally and persistent properties, PFOS is found widely in the environment.

As discussed above PFOS has been analyzed in this study to indicate background levels of perfluorinated compounds not associated with FCC manufacturing.

These particular compounds are of increasing regulatory and scientific interest because they have been found broadly in humans as well as wildlife. This has raised the important set of questions about where these materials came from in the environment and their transport and ultimate fate. A recently published peer-reviewed article appeared in the open literature which provided the first detailed accounting of the direct and indirect sources of PFOA released into the global environment (Prevedourous, 2006). This report also contains several references relevant to the general understanding of this complicated subject.

1.2 Report Content

This report documents activities completed pursuant to the PBS Work Plan (DuPont, 2006a) and Quality Assurance Project Plan (QAPP, DuPont, 2006b). This report is organized into the following sections:

Section 2.0 Pascagoula Region Water and Solids Sampling

Section 3.0 Pascagoula Region Fish and Invertebrates Sampling

Section 4.0 References

2.0 PASCAGOULA REGION WATER AND SOLIDS SAMPLING

2.1 Introduction and Background

The PBS included selected on-site and off-site sampling of water and solids. The following media were sampled during the PBS.

- Surface water – including waters in rivers, sounds, bays, bayous, FCC Pascagoula pretreated effluent to a Publicly-Owned Treatment Works (POTW), effluent from a POTW, industrial storm water, and effluent from a POTW used as irrigation water
- Potable and industrial water
- Groundwater
- POTW sludge (solids)

Work described in this report was completed according to PBS Work Plan and Quality Assurance Project Plan (QAPP) except as otherwise noted. The work was completed by FCC and DuPont or its authorized representatives. Analytical work was conducted by independent contract laboratories.

The PBS sampling occurred in July 2006 prior to start-up of the new operation. Surface water sampling was timed to coincide with relative high (flood) tides and low (ebb) tides. Water and solids samples collected are listed in Tables 1a, 1b and 2. Baseline sample locations (Figure 1) were chosen to provide data from various media both on-site and in the geographic vicinity of the site prior to start up of the new operation.

2.2 Water and Solids Field Sampling

2.2.1 Surface Water and Wastewater Sampling

Samples from Rivers, Bayous, Grand Bay, and Mississippi Sound

Surface water samples from open water locations were collected from the Pascagoula and Escatawpa Rivers, Bayou Cassotte, Grand Bay, and the Mississippi Sound. Figure 1 shows the sampling locations, and Tables 1a and 1b provide lists of samples collected. Samples were collected during flood and ebb tides. Surface water samples were collected as grab samples using an alpha sampler at approximately mid-stream and mid-depth. After the sample was obtained, the bottle was capped and placed in a cooler of ice. The chain of custody (COC) form was then completed, and entries were made in the field log indicating the time of sample collection.

Samples obtained were sent to Exygen Research of State College, Pennsylvania for analytical chemical testing.

Samples from POTW Effluent

Pascagoula POTW Discharge to Pascagoula River - An effluent sample from the Pascagoula Regional Wastewater Authority Publicly-Owned Treatment Works (Pascagoula POTW) was collected at a point after chlorination but prior to effluent discharge and mixing with the Pascagoula River. This sample was a single, discrete grab sample collected in the presence of POTW and FCC staff at 0845 hours on July 19, 2006. After the sample was obtained, the bottle was capped and placed in a cooler of ice. The COC form was then completed, and entries were made in the field log indicating the time of sample collection.

FCC Pascagoula to the Pascagoula POTW – A composited sample was collected of FCC Pascagoula effluent being discharged from the site to the POTW. Effluent grab water samples were manually collected every six hours over a 24-hour period from 1300 hours on July 18 to 1300 hours on July 19, 2006 from a tap on the effluent line. The sample point was identified by the FCC Pascagoula staff present at the time of sampling. Each time a grab sample was collected the bottle was capped and then placed in a cooler of ice. When the final grab sample was collected, the individual grab samples were composited and the composite sample bottle was capped and placed in a cooler of ice. The COC form was then completed and entries were made in the field log indicating the time of the sample collection.

Samples obtained were sent to Exygen Research of State College, Pennsylvania for analytical chemical testing.

Sample from Storm Water

The storm water sample was not collected per the protocol described in the PBS Work Plan (DuPont, 2006a) and QAPP, (DuPont, 2006b). The sample was to have been a composited storm water sample discharging from the FCC Pascagoula facility as described in the PBS workplan. Storm water is typically contained by storm sewers and ditches on-site. This storm water is held and evaluated in accordance with FCC Pascagoula's Storm Water Pollution Prevention Plan (SWPPP) prior to discharge.

The FCC facility was not discharging storm water at the time of the sampling event; therefore, a sample of standing water from the storm water Catch Basin at the FCC Pascagoula facility was collected as the storm water sample. Prior to the sampling event, the Pascagoula area had experienced lower than normal rainfall. The sample location is identified on Figure 2.

This sample is not considered to be representative of storm water released from the FCC Pascagoula facility under normal operating conditions. Due to low rainfall conditions prior to the sampling event, the planned composite sample of storm water discharge was not performed. Instead, a single grab sample of impounded, storm water within the catch basin located within the drainage system to Outfall 001 was collected at 1430 hours on July 18, 2006. This outfall drainage basin drains most of the production manufacturing facilities at FCC Pascagoula. After the sample was obtained, the bottle was capped and placed in a cooler of ice. The COC form was then completed and entries were made in the field log indicating the time of sample collection.

Samples obtained were sent to Exygen Research of State College, Pennsylvania for analytical chemical testing.

Samples from Irrigation Water

A sample was collected of West Jackson County Landfarm irrigation water. The irrigation water is treated wastewater that originates in the City of Ocean Springs/West Jackson County and is not associated with the City of Pascagoula water supply or Pascagoula POTW. The grab sample was collected at the wet well intake to the irrigation pumps identified by West Jackson County Landfarm staff. The sample was collected at 1000 hours on July 19, 2006. After the sample was obtained, the bottle was capped and placed in a cooler of ice. The COC form was then completed, and entries were made in the field log indicating the time of sample collection.

Samples obtained were sent to Exygen Research of State College, Pennsylvania for analytical chemical testing.

2.2.2 Potable and Industrial Water Sampling

Potable water was sampled at the City of Pascagoula water plant closest to the FCC Pascagoula facility. The sample was collected at a point prior to treatment from a water tap identified by City of Pascagoula staff. The grab sample was collected in the presence of City of Pascagoula and FCC Pascagoula staff at 0920 hours on July 19, 2006. After the sample was obtained, the bottle was capped and placed in a cooler of ice. The COC form was then completed and entries were made in the field log indicating the time of sample collection.

A sample of industrial water supplied to FCC Pascagoula by the Jackson County Port Authority was collected from an on-site water tap at 1600 hours on July 18, 2006. The FCC Pascagoula staff identified the sample location. After the sample was obtained, the bottle was capped and placed in a cooler of ice. The COC form was then completed, and entries were made in the field log indicating the time of sample collection.

Samples obtained were sent to Exygen Research of State College, Pennsylvania for analytical chemical testing.

2.2.3 Groundwater Sampling

Groundwater was sampled from the first groundwater-bearing unit at the FCC Pascagoula site in the vicinity of the new operation. Sample locations were existing monitor wells MW-17, MW-28, and MW-63, as shown on Figure 2. Sampling was conducted at MW-17 and MW-63 because of their proximity to the new operation. Sampling was conducted at monitor well MW-28 because it is downgradient of the new operation.

Monitor wells MW-17, MW-28 and MW-63 at the FCC Pascagoula site are screened in the upper sand zone at depths from 14 to 16 feet below the ground surface. The upper sand zone is not a source of drinking water. Drinking water in the Pascagoula Area is obtained from wells screened at depths greater than 200 feet below the ground surface. The upper sand zone is separated from deeper zones by confining layers.

Groundwater sampling followed the standard operating procedures (SOPs) for sampling and data collection provided in the "Compliance Monitoring Sampling and Analysis Plan, FCC Pascagoula Facility," Revision 1 (DuPont, April 2006c). After the sample was obtained, the sample bottle was capped and placed in a cooler of ice. The COC form was then completed, and entries were made in the field log indicating the time of sample collection.

Groundwater samples for the PBS were tested for the analytes discussed in the PBS work plan in accordance with the analytical methodology provided in the PBS QAPP. Samples obtained were sent to Exygen Research of State College, Pennsylvania for analytical chemical testing.

2.2.4 Pascagoula POTW Sludge Sampling

Sludge samples were collected from the Pascagoula POTW at the general location depicted in Figure 1 (also see Table 2). As directed by the West Jackson Landfarm staff, the sample was collected from materials on Pad #5 at 1140 hours on July 19, 2006. The composite sample of sludge was collected from the top 12 inches. The composited sample was placed in a stainless steel mixing bowl and homogenized in the field. The sample was then placed in sample bottles, which were placed in a cooler on ice and prepared for shipping to the laboratory using standard soil sampling protocols. The COC form was completed, and entries were made in the field log indicating the time of sample collection.

The samples were shipped to Severn Trent Laboratories (STL-Denver), in Arvada, Colorado.

2.3 Laboratory Analysis and Data Review – Water and Solid Samples

Exygen Research, Inc. performed analysis of PFOA and PFOS in water according to a laboratory SOP. STL-Denver performed analysis of PFOA and PFOS in sludge according to a laboratory SOP. The analytical methods utilize Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS). The methods have been or are being validated for the measurement of PFOA (specifically the PFO ion) and PFOS in all matrices. It is noted that PFOA results are sometimes mathematically converted to and reported as APFO (ammonium perfluorooctanoate) results. Therefore, for completeness, the measured PFOA results have been mathematically converted to APFO results by multiplying the PFOA result by 1.041 (the ratio of the molecular weight of APFO over PFOA). The APFO results, which are values calculated from measured PFOA results, are reported in the Appendices.

Laboratory replicates were analyzed on at least a batch basis in accordance with the Baseline Study QAPP and accompanying laboratory SOPs. These results were evaluated for precision by the laboratory by comparing the field sample result to the corresponding laboratory replicate result.

- If both results are less than the practical quantitation limit (PQL) (comparable to the limit of quantitation [LOQ]), the replicate sample for that analyte is considered to have passed the precision criteria.
- If one or both results are between one and five times the PQL, the replicate is considered to have met the precision criteria if the two results differ by less than the PQL.
- If one result is less than the PQL and the other is not, and if the two results differ by a value less than the PQL, the replicate is said to have met the acceptance criteria.
- If both results are at least five times the PQL, the replicate is considered to have met the criteria if the relative percent difference (RPD) between the two results is less than or equal to 20%. The RPD is the absolute value of the difference of two measurements divided by their average.

When the precision criteria outlined above were met, the laboratories reported the average of the field sample and laboratory replicate results. If criteria for precision were exceeded, the laboratories reported the higher of the sample and laboratory replicate results. Finally, when one result (from the sample/laboratory replicate pair) was above the PQL and one below, the result that was above the PQL was reported.

Matrix spike (MS) samples were also analyzed on at least a batch basis, in accordance with the PBS QAPP and accompanying laboratory SOPs. Results of the MS analysis are used to assess accuracy. The MS recovery value must be between 70% and 130% unless the sample concentration was at least four times the amount spiked. The maximum amount used to spike field samples was 500 micrograms per liter (µg/L).

Some water samples provided MS recoveries below 70% for PFOA and/or PFOS and were subsequently reanalyzed utilizing a modified method. The modified method involved use of a longer chromatographic method to reduce matrix interference and an internal standard to provide a sample-specific bias correction of the results. The laboratory reported the most conservative result (highest result for detections, lowest detection limit for non-detects) for samples analyzed by both methods.

Laboratory method blanks (reagent control or control samples) were analyzed on a batch basis and reported in the laboratory data packages. Criteria for evaluating method blanks, as presented in the PBS QAPP and accompanying laboratory SOPs, were that method blanks must not show levels of the target compound above the LOD (comparable to the method detection limit [MDL]).

Field Quality Control (QC) samples included field or equipment (rinsate) blanks, typically collected at a frequency of one per day, and field duplicate samples, typically collected at a frequency of one per 10 samples or one per sampling event for fewer than 10 samples.

DuPont reviewed all data packages generated by Exygen and STL (included with this report) in-house for compliance with the laboratory SOPs and data usability using the checklist(s) provided in the PBS QAPP. Results of the in-house review indicate that data reported by the laboratories have been generated in compliance with the appropriate laboratory SOP with few exceptions as noted in the individual review summaries.

Based on the in-house review, all data reported by the laboratories have been judged usable for the purposes of the project.

Further data review is ongoing and includes an automated review and qualification of the sample results using a database application, as well as third party review of at least 10% of the sample results generated. These steps were outlined in the PBS QAPP. Significant results of the ongoing data review (for example non-detect results judged unusable due to quality control failures), if any, will be provided in future communications.

2.4 Discussion of Analytical Results

Summaries of analytical results for samples tested for PFOA and PFOS are provided in the following Tables:

- 1a – PFOA Summary Water Samples,
- 1b – PFOS Summary Water Samples,
- 2 – PFOA and PFOS Summary for Solids Samples,
- 3a – PFOA Summary Biological Samples,
- 3b – PFOS Summary Biological Samples,

Complete analytical results are provided in the Appendices. Provided below is a discussion of the findings organized by media.

2.4.1 Surface Water

Rivers, Bayous, Grand Bay NERR and Mississippi Sound

Surface water data are presented in Table 1a for PFOA along with the LOD and LOQs for each analysis. For completeness, the APFO equivalent is reported in the appendices as a calculation from the PFOA analysis and simply represents the concentration of PFOA in the ammonium salt form. Table 1b reports results of PFOS analysis for surface water including the LOQ and LOD.

Surface water samples from the Pascagoula River – River Mile 22 collected during flood tide and from the Grand Bay NERR at ebb tide were non-detect for PFOA (LOD = 0.0016 µg/L equivalent to parts per billion). PFOS in these same samples was present below the limit of quantitation (LOQ = 0.028 µg/L).

PFOA was present below the limit of quantitation (LOQ = 0.0078 µg/L or 0.013 µg/L, as indicated in Table 1a) in surface water samples from:

- Pascagoula River – River Mile 22 at ebb tide
- Pascagoula River – River Mile 1 at flood and ebb tides,
- Escatawpa River – River Mile 3 at flood and ebb tides,
- Bayou Cassotte – River Mile 0 at flood and ebb tides,
- Mississippi Sound at flood and ebb tides
- Grand Bay NERR at flood tide

PFOS was not-detected (LOD = 0.0056 µg/L) in surface water samples from the Pascagoula River – River Mile 1, Escatawpa River – River Mile 3, Bayou Cassotte – River Mile 0, and Mississippi Sound at flood and ebb tides. PFOS was present at levels below the limit of quantitation (LOQ = 0.028 µg/L) in the surface water samples from the Pascagoula River – River Mile 22 at ebb tide and at the Grand Bay NERR at flood tide.

Pascagoula POTW Effluent

PFOA was detected in the Pascagoula POTW effluent sample at a concentration of 0.033µg/L. No PFOS was detected (LOD = 0.0044 µg/L) in this sample.

PFOA was detected in FCC Pascagoula's composited effluent sample to the Pascagoula POTW at a concentration of 0.010 µg/L. No PFOS was detected (LOD = 0.0044 µg/L) in this sample.

Storm water

PFOA and PFOS were detected in the sample from FCC's storm-water Catch Basin at concentrations of 0.46 µg/L and 0.023 µg/L, respectively. This sample is not believed to be representative of storm water discharge at the facility because the sample was collected from standing water during a low rainfall period of the summer months. Concentrations are consistent with results for ponded waters in the U.S. (see discussion in 2.5.1).

Irrigation Water

PFOA was detected in the sample of irrigation water from the City of Ocean Springs/West Jackson County applied by the POTW to the West Jackson County land farm at a concentration of 0.011 µg/L. No PFOS was detected (LOD = 0.0044 µg/L) in this sample. Both concentrations are consistent with concentrations in treated effluent discharges from WWTP in the US and Canada (see discussions in 2.5.3)

Potable and Industrial Water

PFOA and PFOS were not detected (LODs = 0.0016 µg/L and 0.0044 µg/L, respectively) in the sample of potable water supplied by the City of Pascagoula to FCC Pascagoula.

PFOA was not detected (LODs = 0.0016 µg/L) in the sample of industrial process water supplied by the Jackson County Port Authority to FCC Pascagoula. PFOS was detected at levels below the limit of quantitation (LOQ = 0.022 µg/L) in this sample.

2.4.2 Groundwater

PFOA was detected in groundwater from the upper sand zone in monitor wells MW-17 and MW–63 at concentrations of 0.044 and 0.079 µg/L, respectively. PFOS was detected at levels below the limit of quantitation (LOQ = 0.022 µg/L) in these samples.

PFOA was detected at levels below the limit of quantitation (LOQ = 0.0078 µg/L) in groundwater from the upper sand zone in monitor well MW-28. No PFOS was detected (LOD = 0.0044 µg/L) in this sample.

2.4.3 Pascagoula POTW Sludge

As shown in Table 2, PFOA and PFOS were detected in the sludge sample from the Pascagoula POTW at concentrations of 11 µg/Kg and 26 µg/Kg, as received (wet weight).

2.5 General Occurrence of PFOA in the Water and Solids

It has been well documented that PFOA and PFOS have been found widely in the environment. Because both PFOA and PFOS have been manufactured and used by many companies in a variety of applications for many years, and because studies show that both are generally present at very low levels in the environment at various geographic locations, their presence in an area does not necessarily indicate a local source. The following paragraphs provide representative, but not exhaustive, information on the presence of PFOA in the environment.

2.5.1 Discussion of PFOA Concentrations in Fresh Water

Information on PFOA concentrations in fresh water samples (e.g., lakes, rivers, and streams) is available from a variety of geographic locations in several Asian and Nordic countries, Germany, Japan, Canada, and the USA.

For moving fresh water sources (i.e., streams, rivers), PFOA concentrations vary greatly depending upon site specifications with the highest reported concentration being observed during April and May of 2003 near Osaka, Japan. Fifty-two sites were sampled in this area with resultant PFOA concentrations ranging from 0.0045 µg /L (i.e., parts per billion) to 67 µg/L (Saito *et. al*. 2004). The highest concentrations were observed slightly downstream of a waste disposal site and are not considered ambient concentrations.

In North America, the reported highest stream or river PFOA concentration (11 µg /L) was observed in Etobicoke Creek after a spill (approx. 22,000 L) of fire retardant foam from the Toronto airport. However, after a period of 21 days at the same sampling site, the PFOA concentration had dropped to 0.0022 µg /L (Moody *et al.* 2002).

In addition to the aforementioned incident-related concentrations, fluorochemical manufacturing site samples showed elevated PFOA concentrations for nearby rivers/streams. For instance, 22 of 40 samples tested for PFOA in November 2000 along an approximate 40 mile long section of the Tennessee River upstream of a manufacturing site (located in Decatur, AL) were reported as having PFOA concentrations below the reporting limit (MDL = 0.025 µg /L). Once past the manufacturing site, concentrations steadily increased and reached a maximum of 0.598 µg /L in the lake formed by Wilson Dam, approximately 36 miles downstream (Hansen *et al.* 2002). Samples of river water from sites located in close proximity to industrial activities in the northern (Taipei) region of Taiwan along the Tour-Chyan and Nan-Kan rivers reported PFOA concentrations of 0.113 µg /L and 0.181 µg /L, respectively (Tseng, *et. al.* 2006).

The maximum PFOA concentration reported in quiet water sources (i.e., lakes and ponds) was 0.76 µg /L (reported samples from 1999) in Port St. Lucie, Florida, USA which was not reproducible the following year (0.097 µg /L, sampling period 2000) (3M 2001). The maximum PFOA concentration reported for the Great Lakes region was 0.070 µg /L (Lake Ontario, 2003; Boulanger *et. al*., 2004). In total, 26 samples from the Great Lakes area have been reported with a range of PFOA from < 0.0003 µg /L (Simcik & Dorweiler, 2005) to 0.070 µg /L (Boulanger, *et. al.* 2004).

A summary of this background information is provided in Table 4.

2.5.2 Discussion of PFOA Concentrations in Salt Water

A variety of marine samples (e.g., oceans, seas, and coastal waters) have been analyzed for PFOA. The highest result (obtained from a sample collected off the Koshien Coast (Japan) was reported to be 0.447 µg /L (Saito, *et al.* 2004). The majority of measurements (47/55, 86%) were below 0.010 µg /L with the lowest result (0.00002 µg /L) coming from the open Pacific Ocean (Yamashita *et al.* 2004). Samples from near the surface (< 5 m) of the central section of the open oceans contain the overall lowest reported range of PFOA concentrations (0.000015 to 0.000056 µg /L).

There is a correlation of coastal manufacturing activity with the observed concentration of PFOA for near-shore measurements. The highest nearshore (within 50 miles) PFOA concentrations were observed to correlate with large industrial cities, namely: Tokyo Bay, 0.154 – 0.192 µg /L (Tokyo, Japan), Koshien Coast, 0.447 µg /L (Kobe, Osaka, Sakai, Japan), and the western coast of Korea, 0.320 µg /L (Seoul, Korea).

2.5.3 Discussion of PFOA in Waste Water Treatment Facilities

A study (Schultz *et al.* 2006) of in-flow and effluent from a wastewater treatment plan (WWTP) on the west coast of the United States noted that in-flow levels of PFOA to that WWTP were 0.015 µg /L while the effluent levels were 0.011 µg /L. The authors noted that they believed there were no changes (i.e. transformations of precursors to PFOA) occurring in that WWTP.

Another study by Scott, *et al.* in 2006 evaluated various surface waters in Ontario, Canada, at a WWTP in Toronto, and precipitation at various Canadian locations (4). Of particular note was the analysis from the Toronto WWTP that showed 0.031-0.035 µg /L of PFOA.

2.6 Summary of Water and Solids Field Sampling

All concentrations of PFOA found are consistent with general environmental background levels documented in published scientific studies. Furthermore, in nearly all cases where PFOA was detected in this study, very low levels of PFOS were also detected indicating preliminarily that these results are indicative of background numbers associated with historic global use of the materials, and not a result of First Chemical manufacturing.

All the concentrations of PFOA found in this study are well below any current regulatory guidance for drinking water. (While PFOA is not a regulated chemical, a few states have developed allowable interim criteria for PFOA.).

Additional Findings

- PFOA was not detected in Pascagoula drinking water (LOD = 0.0016 µg/L – equivalent to parts per billion).
- PFOA was not quantifiable (detected at levels so low they could not be accurately measured) in the Pascagoula River, Escatawpa River, Bayou Cassotte, Mississippi Sound or Grand Bay.
- PFOA was found at low levels on the First Chemical site and in wastewater discharges from the site to the Regional Wastewater Authority (POTW). Because PFOA has been manufactured and used by many companies in a variety of applications for many years, and because it has been reported to be present at very low levels in the environment at various geographic locations, its presence in an area is not necessarily indicative of a local source.
- Results from the FCC facility samples indicate very low levels in groundwater of both PFOA and PFOS. Because the PFOA levels are so low (i.e., NQ-0.079 µg /L and they are combined with the presence of PFOS, and because both substances are reported to be found at various geographic locations in the environment, its presence in the area is not necessarily indicative of a local source.
- PFOA measured in effluent from the First Chemical site to the Regional Wastewater Authority (POTW) was a small percentage of the total PFOA measured from the Regional Wastewater Authority (POTW) outfall to the Pascagoula River. Concentrations of PFOA measured from the Regional Wastewater Authority outfall to the Pascagoula River are consistent with two published studies of PFOA concentrations in outfalls of public wastewater treatment plants.

3.0 PASCAGOULA REGION FISH AND INVERTEBRATE SAMPLING

3.1 Introduction and Background

Sampling of selected fish and invertebrate species from the Pascagoula region per the PBS Work Plan and Quality Assurance Project Plan (QAPP) was conducted in July 2006. Fish and invertebrate samples collected are listed in Tables 3a (for PFOA) and 3b (for PFOS). Baseline sample locations were chosen to provide data from near the FCC Pascagoula facility and from a control area not known to be influenced by industrial development.

3.2 Fish and Invertebrate Field Sampling

3.2.1 Selected Fish Sampling

Fish were collected using gill nets with various sizes of net openings because the sampling team encountered difficulties in collecting red fish and mullet. Fish caught by gill netting were removed from nets as carefully as possible and placed in holding tanks on the boat. By-catch species or fish not meeting the minimum size objective were returned to the water as soon as possible to avoid injury. Samples were placed in Ziploc™ bags, labeled, frozen on dry ice, and shipped overnight to Exygen Research of State College, Pennsylvania for analytical chemical testing under proper COC.

Originally, redfish (*Sciaenops ocellatus*) and mullet (*Mugil cephalus*) were the target species planned for collection in the PBS. However, it was not possible to collect sufficient numbers of these species. The target species were therefore changed to speckled trout (*Cynoscion nebulosus*, also known as spotted seatrout or spotted weakfish) and catfish (*Arius felis*). Substitution of the target species was reviewed with, and agreed to, by a representative of the Mississippi Department of Environmental Quality (MDEQ). Even with the substitution, it was not possible to collect speckled trout at the Grand Bay National Estuarine Research Reserve (NERR) during the sampling event.

Fish sampling was conducted in Mississippi Sound and at the Grand Bay NERR to establish a baseline for the presence of PFOA and PFOS in fish. Fish samples were collected in Mississippi Sound as close as possible to 0.5 miles beyond the mouth of the Pascagoula River (see Figure 1). Every effort was made to obtain samples within 1000 feet of the proposed Mississippi Sound sampling location. Fish samples were also collected in the Grand Bay NERR in Jose Bay (see Figure 1). The fish samples collected are listed in Tables 3a and 3b. Sample sizes and sampling locations are listed in Table 5. All necessary permits and licenses were obtained prior to sampling.

Six samples (i.e., individual fish) of speckled trout and catfish were collected in Mississippi Sound. No speckled trout were collected in the Grand Bay NERR since they were not available during the sampling event. Five catfish were collected in the Grand Bay NERR, the sixth being unavailable during the sampling event. In general, when six samples were available, three of the samples were of smaller fish (approximately 12-inch to 14-inch speckled trout, 9-inch to 14.5 - inch catfish) and three samples were of larger fish (approximately 16-inch to 18.5-inch speckled trout and 14.5-inch to 17-inch catfish). Both filets from an individual fish were collected as a sample and the remaining carcass was collected as a sample. The filets did not include skin. The carcass sample contained the viscera and remaining carcass (including skin) from each fish. Filet and carcass samples were analyzed for the presence of PFOA and PFOS. Filets or carcasses from multiple fish were not combined as a sample.

3.2.2 Selected Invertebrate Sampling

Invertebrates were sampled in Mississippi Sound and Grand Bay NERR to establish a baseline for the presence of PFOA and PFOS in invertebrates. Samples were collected in the Mississippi Sound as close as possible to within 0.5 miles beyond the mouth of the Pascagoula River (Figure 1). Every effort was made to conduct the sampling within 1000 feet of the proposed sampling location. Invertebrate samples were also collected in the Grand Bay NERR (see Figure 1). A request was made for a Mississippi Department of Marine Resources (MDMR) representative to be present during sampling at the Grand Bay NERR; however, a representative was not available during sample collection. Tables 3a and 3b list the collected invertebrate samples. All necessary permits and licenses were obtained prior to sampling.

Blue crab (*Callinectes sapidus*) and oysters (*Crassostrea virginica*) were the target species for the PBS. Samples were collected using traps for crabs and rakes for oysters. Six samples (i.e., individual crabs) of blue crabs representing a range of sizes were collected at the sample locations from both Mississippi and the Grand Bay NERR. Six samples of oysters were collected from Mississippi but no oysters were found in the Grand Bay NERR at the time of the sampling event. Samples consisted primarily of the soft body and gills from individual crabs and soft tissue from individual oysters. Sizes of crabs and oysters collected are noted in Tables 3a and 3b. Sample sizes and sampling locations are listed in Table 5. Specimens of crab or oyster were placed in holding tanks on the boat after collection. By-catch species not meeting the minimum size criterion were returned to the water as soon as possible to avoid injury.

After collection, samples were placed in Ziploc™ bags, labeled, frozen on dry ice, and shipped overnight to Exygen Research of State College, Pennsylvania for analytical chemical testing under proper COC.

3.3 Laboratory Analysis and Data Review – Fish and Invertebrate Samples

Analysis of PFOA and PFOS in biota (fish, blue crab, and oyster) was performed by Exygen according to a laboratory SOP.

Small, but measurable, background peaks characteristic of PFOA and PFOS were detected in the laboratory instrument (methanol) blanks associated with analysis of fish, blue crab, and oyster samples. Samples of whiting (whole fish), backfin blue crab, and oysters were obtained by Exygen from a local (State College, PA) supermarket and processed as method blanks (control samples) during analysis of the fish, blue crab, and oyster samples from the Pascagoula area.

The supermarket was later contacted by the lab and stated that the whiting (whole fish) were obtained from the northeast U.S., the backfin blue crab were from the Chesapeake Bay, and that the oysters were raised in the U.S. and packaged in Maryland. Control fish sample concentrations ranged from 0.14 - 1.7 ng/g for PFOA and 0.81 - 2.1 ng/g for PFOS. Control crab sample concentrations ranged from 0.09 - 0.11 ng/g for PFOA and 0.68 - 1.0 ng/g for PFOS. Control oyster samples were non-detect for PFOA but contained PFOS at 0.05 ng/g.

Sample results for fish, blue crab, and oyster were qualified (marked by a B in Tables 3a and 3b) by the laboratory when the sample results were less than five times the concentration in the associated method blank. When a result is qualified it indicates that the presence of a target compound in the sample cannot be distinguished from the presence of the target compound in the method blank (background). Qualified sample results may be biased high or exhibit false positives and should be used with caution.

It should also be noted that the LOD/LOQ determination performed by the laboratory during analysis of fish, blue crab, and oysters involved a signal to noise calculation, consistent with the requirements of the Baseline Study QAPP and the accompanying laboratory SOP. The signal to noise calculation was based on the response (signal) measured for a low level standard and the noise measured in the 1 minute interval prior to the target peak retention time of the control sample chromatogram. This determination produces an LOD/LOQ that is likely to be unrealistically low. The low levels determined for LOD/LOQ are not supported by validation studies, nor by low level calibration standards analyzed in the run sequence, and cannot be reported with confidence.

Analytical data were generated and reviewed as discussed in Section 2.3 above.

3.4 Discussion of Analytical Results for Fish and Invertebrates

3.4.1 Fish

Mississippi Sound Samples

PFOA was detected in speckled trout carcasses from Mississippi Sound at concentrations from 1.3 to 1.8 ng/g and in speckled trout filets at concentrations from 1.3 to 1.5 ng/g. PFOS was detected in speckled trout carcasses from Mississippi Sound at concentrations from 4.6 to 12 ng/g (qualified) and in speckled trout filets at concentrations from 0.53 to 1.9 ng/g (qualified).

PFOA was detected in catfish carcasses from Mississippi Sound at concentrations from 1.4 to 2.2 ng/g (qualified) and in catfish filets at concentrations from 0.77 to 1.7 ng/g (one sample qualified). PFOS was detected in catfish carcasses from Mississippi Sound at concentrations from 9.2 to 25 ng/g and in catfish filets at concentrations from 1.7 to 2.5 ng/g (qualified).

Grand Bay NERR Samples

Sufficient speckled trout were not present in Grand Bay during the sampling event.

PFOA was detected in catfish carcasses from Grand Bay at concentrations from 1.5 to 1.7ng/g and in catfish filets at concentrations from 1.4 to 1.6 ng/g (qualified). PFOS was detected in catfish carcasses from Mississippi Sound at concentrations from 9.2 to 64 ng/g and in catfish filets at concentrations from 1.4 to 6.2 ng/g (qualified).

3.4.2 Invertebrates

Mississippi Sound Samples

PFOA was not detected (LOD = 0.0043 µg/L) in two samples of blue crab and was detected at levels below the limit of quantitation (LOQ = 0.021 µg/L) in three additional samples. Only one sample of blue crab had a quantifiable concentration of PFOA of 0.065 ng/g; however, all detections were qualified and should be used with caution. PFOS was detected in blue crab from Mississippi Sound at concentrations from 0.46 to 1.9 ng/g (qualified).

PFOA was not detected (LOD = 0.023 ng/g) in oysters from Mississippi Sound. PFOS was detected in oysters at concentrations from 0.077 to 0.76 ng/g (qualified).

Grand Bay NERR Samples

PFOA was detected in blue crab from Grand Bay NERR at concentrations from 0.058 to 0.15 ng/g (qualified). PFOS was detected in blue crab from Grand Bay NERR at concentrations from 0.28 to 5.1 ng/g (qualified).

PFOA was not detected (LOD = 0.023 ng/g) in oysters from Grand Bay NERR. PFOS was detected in oysters at concentrations from 0.51 to 1.2 ng/g (qualified).

3.5 General Occurrence of PFOA in Fish and Invertebrates

3.5.1 Discussion of PFOA Concentrations in Saltwater Fish

In the published literature, it has been reported that over 33 species of saltwater fish have been sampled in previous studies for PFOA. The geographic distribution of samples is quite diverse and ranges from the Baltic and Mediterranean Seas, to the North Pacific Ocean, various areas of Asia, Europe, Canada and the United States, and the Arctic. Historically, most results were below the limits of quantification. However, recent advances in both instrumental and laboratory methodologies provide the capability to quantify lower PFOA concentrations in fish samples.

The highest concentration of PFOA for fish was reported from a liver sample. Less than 9 percent of the samples reported were above the LOQ and, of those, the highest concentrations were sampled near Denmark (herring, 5.4 ng/g wet weight; Kallenborn *et al.* 2004), and the eastern Canadian Arctic (redfish, 5.3 ng/g wet weight; Tomy *et al.* 2004).

3.5.2 Discussion of PFOA Concentrations in Marine Invertebrates

Concentrations of PFOA in homogenate samples of zooplankton, northern shrimp and blunt gaper clams were reported from the eastern Canadian Arctic in 2002 (clams and zooplankton) and 2000-2001 (shrimp). Zooplankton concentrations (5 samples) ranged from 1.75 ng/g to 3.42 ng/g with an average of 2.58 ng/g. In comparison, only 1 of the 7 shrimp samples (14%) was above the MDL of 0.200 ng/g with a value of 0.520 ng/g. All five clam samples collected in the same region as the zooplankton were below the MDL.

Similarly, 77 oysters sampled from the Gulf of Mexico and the Chesapeake Bay, had PFOA levels below the limit of quantification of 19 ng/g (Giesy and Kannan 2001). Recent analysis of oysters from Taiwan (Tseng et. al.2006) reported higher levels of PFOA with concentrations ranging from 130 ng/g (muscle) to 180 ng/g (homogenate).

3.5.3 Bioaccumulation Discussion

Several studies have shown that PFOA neither bioaccumulates nor biomagnifies. Bioconcentration factors (BCF) represent the ratio of the exposure concentration in water to organism tissue residues while bioaccumulation factors (BAF) represent the ratio of the exposure concentrations in water and diet to tissue residues in the organism. Tissue residues in whole organisms are of concern in ecological risk assessments because predators typically consume entire organisms. Residue concentrations in edible tissues (e.g., fish filets) are generally the focus of human health risk assessments.

Several studies have been completed in different laboratories to directly examine the bioconcentration and/or bioaccumulation potential of PFOA. In a bioconcentration study conducted under static test conditions, the BCF for fathead minnows was determined to be 1.8 (3M Company, 1995). Using a flow-through test method (essentially OECD 305), the bioconcentration of PFOA in fish was tested using common carp (*Cyprinus carpio*) at exposure concentrations of 5 and 50 µg/L (Daikin 2000). For the highest exposure concentration (nominal 50 µg/L), the average steady state BCF was reported to be 3.1. For the lowest exposure concentration (nominal 5 µg/L), the maximum BCF was determined to be 9.4. These are values below the U.S. EPA criteria used to identify bioaccumulative compounds (i.e., BCF > 1000).

Additional peer reviewed data to support that PFOA neither bioaccumulates nor biomagnifies in the food chain can be found in laboratory studies by Martin *et al.* (2003a,b). In two separate laboratory experiments, juvenile rainbow trout (*Oncorhynchus mykiss*) were exposed either via water or diet containing PFOA as part of a mixture of a homologous series of perfluoroalkyl carboxylates and sulfonates. Trout were exposed to the test substances for 32 days followed by a 41-day depuration period (Martin *et al.* 2003a,b). The carcass bioconcentration factor (BCF) for PFOA was determined to be 4.0 ± 0.6 (Martin *et al.* 2003a), while the blood and liver BCF values were 27 and 8, respectively. The carcass bioaccumulation factor (BAF) for PFOA was determined to be 0.038 ± 0.006 (Martin *et al.* 2003b). BCF and BAF values for PFOS from this same set of experiments were all greater than the values for PFOA.

3.6 Summary of Invertebrates and Fish Field Sampling

Based on the values reported above for marine invertebrates and fish, Pascagoula area marine invertebrates and fish contain PFOA at similar or lower concentrations than reported for various locations globally including the Canadian Arctic, the Gulf of Mexico and Chesapeake Bay. Many of the reported data were qualified due to similar values reported in the method blanks prepared from commercially purchased fish and invertebrates.

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TABLES

TABLE 1a
Pascagoula Baseline Study
PFOA Summary Water Samples

Sample Location	Sample Media	Sample Number	PFOA, µg/L (parts per billion)	LOD, µg/L (parts per billion)	LOQ, µg/L (parts per billion)
Pascagoula River Upstream of POTW – River Mile 22	Surface Water – Flood Tide	PAS-W-PR-RM22-1	ND	0.0016	0.0078
Pascagoula River Upstream of POTW – River Mile 22	Surface Water - Ebb Tide	PAS -W-PR-RM22-2	NQ	0.0016	0.0078
Pascagoula River Downstream of POTW – River Mile 1	Surface Water – Flood Tide	PAS -W-PR-RM01-1	NQ	0.0026	0.013
Pascagoula River Downstream of POTW – River Mile 1	Surface Water - Ebb Tide	PAS -W-PR-RM01-2	NQ	0.0026	0.013
Escatawpa River – Upstream of confluence with Pascagoula River – River Mile 3	Surface Water – Flood Tide	PAS -W-E-RM03-1	NQ	0.0026	0.013
Escatawpa River – Upstream of confluence with Pascagoula River – River Mile 3	Surface Water - Ebb Tide	PAS -W-E-RM03-2	NQ	0.0026	0.013
Bayou Cassotte – at mouth of Pascagoula Bay – River Mile 0	Surface Water – Flood Tide	PAS -W-BC-RM00-1	NQ	0.0026	0.013
Bayou Cassotte – at mouth of Pascagoula Bay – River Mile 0	Surface Water - Ebb Tide	PAS -W-BC-RM00-2	NQ	0.0026	0.013
Mississippi Sound – beyond mouth of Pascagoula River near Biological sample location	Surface Water – Flood Tide	PAS -W-MS-1	NQ	0.0026	0.013
Mississippi Sound – beyond mouth of Pascagoula River near Biological sample location	Surface Water - Ebb Tide	PAS -W-MS-2	NQ	0.0026	0.013
Grand Bay NERR – near Biological sample location	Surface Water – Flood Tide	PAS -W-GB-1	NQ	0.0016	0.0078
Grand Bay NERR – near Biological sample location	Surface Water - Ebb Tide	PAS-W-GB-2	ND	0.0016	0.0078
Effluent from Pascagoula POTW to Pascagoula River	Effluent	PAS-Z-POTW EFF-1	0.033	0.0016	0.0078
Effluent from FCC to POTW – 24 hr. composite sample	Effluent	PAS-Z-FCC-EFF-1	0.010	0.0016	0.0078
Stormwater sample from FCC	Storm water	PAS-Z-FCC-SW-1	0.46	0.012	0.06
West Jackson County Landfarm irrigation water	Irrigation Water	PAS-Z-POTW-IR-1	0.011	0.0016	0.0078
Industrial process water supplied to FCC by Jackson County Port Authority	Supply Water	PAS-Z-Ind-H2O-1	ND	0.0016	0.0078
Potable water from City of Pascagoula water system prior to treatment	Potable Water	PAS-D-1	ND	0.0016	0.0078
Monitor Well MW-17	Groundwater	PAS-G-MW17-01	0.044	0.0016	0.0078
Monitor Well MW-28	Groundwater	PAS-G-MW28-01	NQ	0.0016	0.0078
Monitor Well MW-63	Groundwater	PAS-G- MW63-01	0.079	0.0016	0.0078

Notes:

µg/L = micrograms per Liter or parts per billion

ND = Compound not detected

NQ = Compound detected between LOD and LOQ

LOD = Level of Detection

LOQ = Level of quantitation

ND < LOD < NQ < LOQ

data rounded to two significant figures

Samples were analyzed for Perfluorooctanoic acid (PFOA). Results for PFOA can be mathematically converted to results for ammonium perfluorooctanoate (APFO, also known as C-8 or FC-143). Calculated APFO concentrations are provided in the Appendices.

TABLE 1b
Pascagoula Baseline Study
PFOS Summary Water Samples

Sample Location	Sample Media	Sample Number	PFOS, µg/L (parts per billion)	LOD, µg/L (parts per billion)	LOQ, µg/L (parts per billion)
Pascagoula River Upstream of POTW – River Mile 22	Surface Water – Flood Tide	PAS-W-PR-RM22-1	NQ	0.0056	0.028
Pascagoula River Upstream of POTW – River Mile 22	Surface Water - Ebb Tide	PAS -W-PR-RM22-2	NQ	0.0056	0.028
Pascagoula River Downstream of POTW – River Mile 1	Surface Water – Flood Tide	PAS -W-PR-RM01-1	ND	0.0056	0.028
Pascagoula River Downstream of POTW – River Mile 1	Surface Water - Ebb Tide	PAS -W-PR-RM01-2	ND	0.0056	0.028
Escatawpa River – Upstream of confluence with Pascagoula River – River Mile 3	Surface Water – Flood Tide	PAS -W-E-RM03-1	ND	0.0056	0.028
Escatawpa River – Upstream of confluence with Pascagoula River – River Mile 3	Surface Water - Ebb Tide	PAS -W-E-RM03-2	ND	0.0056	0.028
Bayou Cassotte – at mouth of Pascagoula Bay – River Mile 0	Surface Water – Flood Tide	PAS -W-BC-RM00-1	ND	0.0056	0.028
Bayou Cassotte – at mouth of Pascagoula Bay – River Mile 0	Surface Water - Ebb Tide	PAS -W-BC-RM00-2	ND	0.0056	0.028
Mississippi Sound – beyond mouth of Pascagoula River near Biological sample location	Surface Water – Flood Tide	PAS -W-MS-1	ND	0.0056	0.028
Mississippi Sound – beyond mouth of Pascagoula River near Biological sample location	Surface Water - Ebb Tide	PAS -W-MS-2	ND	0.0056	0.028
Grand Bay NERR – near Biological sample location	Surface Water – Flood Tide	PAS -W-GB-1	NQ	0.0056	0.028
Grand Bay NERR – near Biological sample location	Surface Water - Ebb Tide	PAS-W-GB-2	NQ	0.0056	0.028
Effluent from Pascagoula POTW to Pascagoula River	Effluent	PAS-Z-POTW EFF-1	ND	0.0044	0.022
Effluent from FCC to POTW – 24 hr. composite sample	Effluent	PAS-Z-FCC-EFF-1	ND	0.0044	0.022
Stormwater sample from FCC	Storm water	PAS-Z-FCC-SW-1	0.023	0.0044	0.022
West Jackson County Landfarm irrigation water	Irrigation Water	PAS-Z-POTW-IR-1	ND	0.0044	0.022
Industrial process water supplied to FCC by Jackson County Port Authority	Supply Water	PAS-Z-Ind-H2O-1	NQ	0.0044	0.022
Potable water from City of Pascagoula water system prior to treatment	Potable Water	PAS-D-1	ND	0.0044	0.022
Monitor Well MW-17	Groundwater	PAS-G-MW17-01	NQ	0.0044	0.022
Monitor Well MW-28	Groundwater	PAS-G-MW28-01	ND	0.0044	0.022
Monitor Well MW-63	Groundwater	PAS-G- MW63-01	NQ	0.0044	0.022

Notes:

µg/L = micrograms per Liter or parts per billion

ND = Compound not detected

NQ = Compound detected between LOD and LOQ

LOD = Level of Detection

LOQ = Level of quantitation

ND < LOD < NQ < LOQ

data rounded to two significant figures

Samples were analyzed for Perfluorooctanoic acid (PFOA). Results for PFOA can be mathematically converted to results for ammonium perfluorooctanoate (APFO, also known as C-8 or FC-143). Calculated APFO concentrations are provided in the Appendices.

TABLE 2

Pascagoula Baseline Study
PFOA and PFOS Summary for Solids Sample*

Sample Location	Sample Media	Sample Number	PFOA, µg/Kg (parts per billion)	PFOS, µg/Kg (parts per billion)
Sludge from POTW landfarm	Sludge	PAS-X-POTW-S-1	11	26

Notes:

LOD = Level of detection		0.48	0.27
LOQ = Level of quantitation		2.4	2.4

ND < LOD < NQ < LOQ

µg/Kg = micrograms per kilogram or parts per billiion

results reported are as received

data rounded to two significant figures

Samples were analyzed for Perfluorooctanoic acid (PFOA). Results for PFOA can be mathematically converted to results for ammonium perfluorooctanoate (APFO, also known as C-8 or FC-143). Calculated APFO concentrations are provided in the Appendices.

*See appendix for discussion on availability of final data

TABLE 3a
Pascagoula Baseline Study
PFOA Summary Biological Samples

				Carcass or Soft Tissue	Fish Filet Only		
Sample Location	**Sample Media**	**Size, Inches**	**Sample Number**	**PFOA, ng/g (parts per billion)**	**PFOA, ng/g (parts per billion)**	**LOD, ng/g (parts per billion)**	**LOQ, ng/g (parts per billion)**
Mississippi Sound	speckled trout - Large	18.5	PASX-X-MS-WF-L-1	1.3	1.3	0.00082	0.0041
	speckled trout - Large	17.5	PAS-X-MS-WF-L-2	1.5	1.3	0.00082	0.0041
	speckled trout - Large	16.5	PAS-X-MS-WF-L-3	1.5	1.3	0.00082	0.0041
	speckled trout - Small	12	PAS-X-MS-WF-S-1	1.8	1.5	0.00082	0.0041
	speckled trout - Small	12.5	PAS-X-MS-WF-S-2	1.6	1.4	0.00082	0.0041
	speckled trout - Small	12.5	PAS-X-MS-WF-S-3	1.5	1.3	0.00082	0.0041
	catfish – Large	15	PAS-X-MS-CF-L-1	2.2 B	1.7	0.00082	0.0041
	catfish – Large	17	PAS-X-MS-CF-L-2	1.6 B	1.5	0.00082	0.0041
	catfish – Large	15.5	PAS-X-MS-CF-L-3	1.5 B	0.77 B	0.00082	0.0041
	catfish - Small	14	PAS-X-MS-CF-S-1	1.4 B	1.3	0.00082	0.0041
	catfish - Small	14	PAS-X-MS-CF-S-2	1.8 B	1.4	0.00082	0.0041
	catfish - Small	14.5	PAS-X-MS-CF-S-3	1.5 B	1.4	0.00082	0.0041
	blue crab	5.5	PAS-X-MS-BC-1	0.065 B		0.0043	0.021
	blue crab	6.2	PAS-X-MS-BC-2	NQ B		0.0043	0.021
	blue crab	7.8	PAS-X-MS-BC-3	ND		0.0043	0.021
	blue crab	9.4	PAS-X-MS-BC-4	ND		0.0043	0.021
	blue crab	9.2	PAS-X-MS-BC-5	NQ B		0.0043	0.021
	blue crab	8.4	PAS-X-MS-BC-6	NQ B		0.0043	0.021
	oyster	3	PAS-X-MS -O-1	ND		0.023	0.12
	oyster	3.5	PAS-X-MS-O-2	ND		0.023	0.12
	oyster	2.5	PAS-X-MS-O-3	ND		0.023	0.12
	oyster	3.25	PAS-X-MS-O-4	ND		0.023	0.12
	oyster	4.25	PAS-X-MS-O-5	ND		0.023	0.12
	oyster	3	PAS-X-MS-O-6	ND		0.023	0.12
Grand Bay	speckled trout - Large	NA	PAS-X-GB-WF-L-1	NS	NS		
	speckled trout - Large	NA	PAS-X-GB-WF-L-2	NS	NS		
	speckled trout - Large	NA	PAS-X-GB-WF-L-3	NS	NS		
	speckled trout - Small	NA	PAS-X-GB-WF-S-1	NS	NS		
	speckled trout - Small	NA	PAS-X-GB-WF-S-2	NS	NS		
	speckled trout - Small	NA	PAS-X-GB-WF-S-3	NS	NS		
	catfish – Large	15.5	PAS-X-GB-CF-L-1	1.6 B	1.4	0.00082	0.0041
	catfish – Large	14.5	PAS-X-GB-CF-L-2	1.7 B	1.6	0.00082	0.0041
	catfish – Large	15	PAS-X-GB-CF-L-3	1.5 B	1.4	0.00082	0.0041
	catfish - Small	12.25	PAS-X-GB-CF-S-1	1.5 B	1.4	0.00082	0.0041
	catfish - Small	9.25	PAS-X-GB-CF-S-2	1.7 B	1.5	0.00082	0.0041
	catfish - Small	NA	PAS-X-GB-CF-S-3	NS	NS		
	blue crab	5.1	PAS-X-GB-BC-1	0.13 B		0.0043	0.021
	blue crab	5.1	PAS-X-GB-BC-2	0.10 B		0.0043	0.021
	blue crab	5.4	PAS-X-GB-BC-3	0.15 B		0.0043	0.021
	blue crab	5.7	PAS-X-GB-BC-4	0.064 B		0.0043	0.021
	blue crab	6.3	PAS-X-GB-BC-5	0.097 B		0.0043	0.021
	blue crab	6.4	PAS-X-GB-BC-6	0.058 B		0.0043	0.021
	oyster	3	PAS-X-GB-O-1	ND		0.023	0.12
	oyster	3	PAS-X-GB-O-2	ND		0.023	0.12
	oyster	2.5	PAS-X-GB-O-3	ND		0.023	0.12
	oyster	2.5	PAS-X-GB-O-4	ND		0.023	0.12
	oyster	3.5	PAS-X-GB-O-5	ND		0.023	0.12
	oyster	3	PAS-X-GB-O-6	ND		0.023	0.12

Notes:

ng/g = nanograms per gram or parts per billion

ND - Compound not detected

NQ - Compound detected between LOD and LOQ

LOD = Level of detection

LOQ = Level of quantitation

ND < LOD < NQ < LOQ

NS = Not sampled

NA = Not Applicable

NM = Not measured

data rounded to two significant figures

results reported are as received

Samples were analyzed for Perfluorooctanoic acid (PFOA). Results for PFOA can be mathematically converted to results for ammonium perfluorooctanoate (APFO, also known as C-8 or FC-143). Calculated APFO concentrations are provided in the Appendices.

B Reported concentration is within 5X the concentration detected in matrix blank (control) samples.

TABLE 3b

Pascagoula Baseline Study
Draft PFOS Summary Biological Samples

				Carcass or Soft Tissue			Fish Filet Only		
Sample Location	**Sample Media**	**Size, Inches**	**Sample Number**	**PFOS, ng/g (parts per billion)**	**LOD, ng/g (parts per billion)**	**LOQ, ng/g (parts per billion)**	**PFOS, ng/g (parts per billion)**	**LOD, ng/g (parts per billion)**	**LOQ, ng/g (parts per billion)**
Mississippi Sound	speckled trout - Large	18.5	PASX-X-MS-WF-L-1	6.0 B	0.013	0.063	0.53 B	0.0036	0.018
	speckled trout - Large	17.5	PAS-X-MS-WF-L-2	4.6 B	0.013	0.063	1.2 B	0.0036	0.018
	speckled trout - Large	16.5	PAS-X-MS-WF-L-3	5.1 B	0.013	0.063	0.67 B	0.0036	0.018
	speckled trout - Small	12	PAS-X-MS-WF-S-1	6.1B	0.013	0.063	1.2 B	0.0036	0.018
	speckled trout - Small	12.5	PAS-X-MS-WF-S-2	12	0.013	0.063	1.7 B	0.0036	0.018
	speckled trout - Small	12.5	PAS-X-MS-WF-S-3	9.5 B	0.013	0.063	1.9 B	0.0036	0.018
	catfish – Large	15	PAS-X-MS-RF-L-1	9.2	0.0036	0.018	2.4 B	0.0036	0.018
	catfish – Large	17	PAS-X-MS-CF-L-2	20	0.0036	0.018	2.5 B	0.0036	0.018
	catfish – Large	15.5	PAS-X-MS-CF-L-3	23	0.0036	0.018	2.0 B	0.0036	0.018
	catfish - Small	14	PAS-X-MS-CF-S-1	22	0.0036	0.018	1.7 B	0.0036	0.018
	catfish - Small	14	PAS-X-MS-CF-S-2	25	0.0036	0.018	2.1 B	0.0036	0.018
	catfish - Small	14.5	PAS-X-MS-CF-S-3	17	0.0036	0.018	2.4 B	0.0036	0.018
	blue crab	5.5	PAS-X-MS-BC-1	1.8 B	0.0049	0.025			
	blue crab	6.2	PAS-X-MS-BC-2	0.95 B	0.0049	0.025			
	blue crab	7.8	PAS-X-MS-BC-3	1.9 B	0.0049	0.025			
	blue crab	9.4	PAS-X-MS-BC-4	1.4 B	0.0049	0.025			
	blue crab	9.2	PAS-X-MS-BC-5	0.46 B	0.0049	0.025			
	blue crab	8.4	PAS-X-MS-BC-6	0.57 B	0.0049	0.025			
	oyster	3	PAS-X-MS -O-1	0.21 B	0.008	0.04			
	oyster	3.5	PAS-X-MS-O-2	0.18 B	0.008	0.04			
	oyster	2.5	PAS-X-MS-O-3	0.76	0.008	0.04			
	oyster	3.25	PAS-X-MS-O-4	0.077 B	0.008	0.04			
	oyster	4.25	PAS-X-MS-O-5	0.13 B	0.008	0.04			
	oyster	3	PAS-X-MS-O-6	0.17 B	0.008	0.04			
Grand Bay	speckled trout - Large	NA	PAS-X-GB-WF-L-1	NS			NS		
	speckled trout - Large	NA	PAS-X-GB-WF-L-2	NS			NS		
	speckled trout - Large	NA	PAS-X-GB-WF-L-3	NS			NS		
	speckled trout - Small	NA	PAS-X-GB-WF-S-1	NS			NS		
	speckled trout - Small	NA	PAS-X-GB-WF-S-2	NS			NS		
	speckled trout - Small	NA	PAS-X-GB-WF-S-3	NS			NS		
	catfish – Large	15.5	PAS-X-GB-CF-L-1	9.2	0.0036	0.018	3.7 B	0.0036	0.018
	catfish – Large	14.5	PAS-X-GB-CF-L-2	40	0.0036	0.018	1.9 B	0.0036	0.018
	catfish – Large	15	PAS-X-GB-CF-L-3	28	0.0036	0.018	1.4 B	0.0036	0.018
	catfish - Small	12.25	PAS-X-GB-CF-S-1	64	0.0036	0.018	4.5 B	0.0036	0.018
	catfish - Small	9.25	PAS-X-GB-CF-S-2	58	0.0036	0.018	6.2 B	0.0036	0.018
	catfish - Small	NA	PAS-X-GB-CF-S-3	NS			NS		
	blue crab	5.1	PAS-X-GB-BC-1	1.9 B	0.0049	0.025			
	blue crab	5.1	PAS-X-GB-BC-2	1.2 B	0.0049	0.025			
	blue crab	5.4	PAS-X-GB-BC-3	5.1	0.0049	0.025			
	blue crab	5.7	PAS-X-GB-BC-4	0.58 B	0.0049	0.025			
	blue crab	6.3	PAS-X-GB-BC-5	0.38 B	0.0049	0.025			
	blue crab	6.4	PAS-X-GB-BC-6	0.28 B	0.0049	0.025			
	oyster	3	PAS-X-GB-O-1	0.86	0.008	0.04			
	oyster	3	PAS-X-GB-O-2	0.90	0.008	0.04			
	oyster	2.5	PAS-X-GB-O-3	1.1	0.008	0.04			
	oyster	2.5	PAS-X-GB-O-4	0.89	0.008	0.04			
	oyster	3.5	PAS-X-GB-O-5	0.51	0.008	0.04			
	oyster	3	PAS-X-GB-O-6	1.2	0.008	0.04			

Notes:

ng/g = nanograms per gram or parts per billion
ND - Compound not detected
NQ - Compound detected between LOD and LOQ
LOD = Level of detection
LOQ = Level of quantitation
ND < LOD < NQ < LOQ
NS = Not sampled
NA = Not Applicable
NM = Not measured
data rounded to two significant figures
results reported are as received
Samples were analyzed for Perfluorooctanoic acid (PFOA). Results for PFOA can be mathematically converted to results for ammonium perfluorooctanoate (APFO, also known as C-8 or FC-143). Calculated APFO concentrations are provided in the Appendices.
B Reported concentration is within 5X the concentration detected in matrix blank (control) samples.

Table 4. Summary of Background Information on PFOA from the Literature Cited in This Report.

Matrix	Location	Literature Cited PFOA Concentrations	Pascagoula PFOA Results
Sewage sludge	US (8 WWTPs)	< 1 µg/Kg – 29.4 µg/Kg (Higgins et al. 2005)	11 µg/Kg
	5 cities, 1 plant site	< 0.2 µg/Kg – 3.1 µg/Kg (244 µg/Kg)* (3M 2001)	
Sewage effluent	US, Canada, Taiwan, Nordic area	0.001 – 0.675 µg/L (2.42 µg/L)* (3M 2001)	0.033 µg/L
Ground water	US	< LOD – 322,000 µg/L (DuPont 2003)	NQ (LOQ = 0.0078 µg/L) to 0.079 µg/L
Fresh surface water	Japan	0.0045 – 67 µg/L (Saito et al. 2004)	ND (LOD = 0.0016 µg/L) to NQ (LOQ = 0.013 µg/L)
	Canada	0.0022 µg/L (Moody et al. 2002)	
	Florida	0.097 - 0.76 µg/L (3M 2001)	
	Great Lakes	<0.0003 ng/ml – 0.070 µg/L (Simcik and Dorweiler 2005, Boulanger et al. 2004)	
Salt water	open Pacific Ocean	typically < 0.01 µg/L (Yamashita et al. 2004)	ND (LOD = 0.0016 µg/L) to NQ (LOQ = 0.013 µg/L)
	nearshore Japan, Korea	0.154 – 0.447 µg/L Saito et al. 2004)	
Saltwater invertebrates	Canadian Arctic	< 0.2 ng/g – 3.42 ng/g (Tomy et al. 2004)	ND (LOD = 0.023 ng/g) to 0.15 ng/g B
	Gulf of Mexico, Chesapeake Bay	< 19 ng/g (Giesy and Kannan 2001)	
	Taiwan	130 – 180 ng/g (Tseng et al. 2006)	
Saltwater fish	Denmark	5.4 ng/g wet wt. (Kallenborn et al. 2004)	0.77 ng/g B to 2.2 ng/g B
	Canadian Arctic	5.3 ng/g wet wt. (Tomy et al. 2004)	

Notes:
B Reported concentration is within 5X the concentration detected in matrix blank (control) samples.
ND - Compound not detected
NQ - Compound detected between LOD and LOQ
LOD = Level of detection

µg/L = micrograms per Liter or parts per billion
ng/g = nanograms per gram or parts per billion

*Numbers reported in parenthesis associated with manufacturing site.

TABLE 5
Biological Sample Sizes

Sample Location	Sample Media	Sample Number	Size, Inches	Carcass Weight, gms	Filet Weight, gms
Mississippi	speckled trout - Large	PAS-X-MS-WF-L-1	18.5	1016.7	143.8
Sound	speckled trout - Large	PAS-X-MS-WF-L-2	17.5	654	171.6
30.32751N	speckled trout - Large	PAS-X-MS-WF-L-3	16.5	532	106.8
88.56678W	speckled trout - Small	PAS-X-MS-WF-S-1	12	209.7	72.5
	speckled trout - Small	PAS-X-MS-WF-S-2	12.5	264.3	64.2
	speckled trout - Small	PAS-X-MS-WF-S-3	12.5	184.2	38.1
30.32751N	catfish – Large	PAS-X-MS-RF-L-1	15	501.487	83.97
88.56678W	catfish – Large	PAS-X-MS-CF-L-2	17	697.1	83.76
	catfish – Large	PAS-X-MS-CF-L-3	15.5	355.08	64.45
	catfish - Small	PAS-X-MS-CF-S-1	14	549.5	84.51
	catfish - Small	PAS-X-MS-CF-S-2	14	349.92	78.51
	catfish - Small	PAS-X-MS-CF-S-3	14.5	379.88	96.13
30.32629N	blue crab	PAS-X-MS-BC-1	5.5	122.9	
88.57475W	blue crab	PAS-X-MS-BC-2	6.2	163.6	
	blue crab	PAS-X-MS-BC-3	7.8	121.2	NA
	blue crab	PAS-X-MS-BC-4	9.4	193.6	
	blue crab	PAS-X-MS-BC-5	9.2	240.3	
	blue crab	PAS-X-MS-BC-6	8.4	171.1	
30.33557N	oyster	PAS-X-MS -O-1	3	42.71	
88.58569W	oyster	PAS-X-MS-O-2	3.5	44.04	
	oyster	PAS-X-MS-O-3	2.5	39.23	NA
	oyster	PAS-X-MS-O-4	3.25	41.91	
	oyster	PAS-X-MS-O-5	4.25	43.65	
	oyster	PAS-X-MS-O-6	3	35.86	
Grand Bay	speckled trout - Large	PAS-X-GB-WF-L-1			
30.35722N^	speckled trout - Large	PAS-X-GB-WF-L-2			
88.418056W^	speckled trout - Large	PAS-X-GB-WF-L-3	NA	NA	NA
	speckled trout - Small	PAS-X-GB-WF-S-1			
	speckled trout - Small	PAS-X-GB-WF-S-2			
	speckled trout - Small	PAS-X-GB-WF-S-3			
	catfish – Large	PAS-X-GB-CF-L-1	15.5	500.53	83.57
	catfish – Large	PAS-X-GB-CF-L-2	14.5	362.16	84.07
	catfish – Large	PAS-X-GB-CF-L-3	15	366.49	68.12
	catfish - Small	PAS-X-GB-CF-S-1	12.25	280.62	59.15
	catfish - Small	PAS-X-GB-CF-S-2	9.25	98.93	48.09
	catfish - Small	PAS-X-GB-CF-S-3	NA	NA	NA
	blue crab	PAS-X-GB-BC-1	5.1	212.22	
	blue crab	PAS-X-GB-BC-2	5.1	87.75	
	blue crab	PAS-X-GB-BC-3	5.4	103.79	NA
	blue crab	PAS-X-GB-BC-4	5.7	103.03	
	blue crab	PAS-X-GB-BC-5	6.3	156.42	
	blue crab	PAS-X-GB-BC-6	6.4	176.02	
	oyster	PAS-X-GB-O-1	3	30.37	
	oyster	PAS-X-GB-O-2	3	34.53	
	oyster	PAS-X-GB-O-3	2.5	38.76	NA
	oyster	PAS-X-GB-O-4	2.5	31.58	
	oyster	PAS-X-GB-O-5	3.5	47.07	
	oyster	PAS-X-GB-O-6	3	29.77	

Notes:

No abnormalities noted.

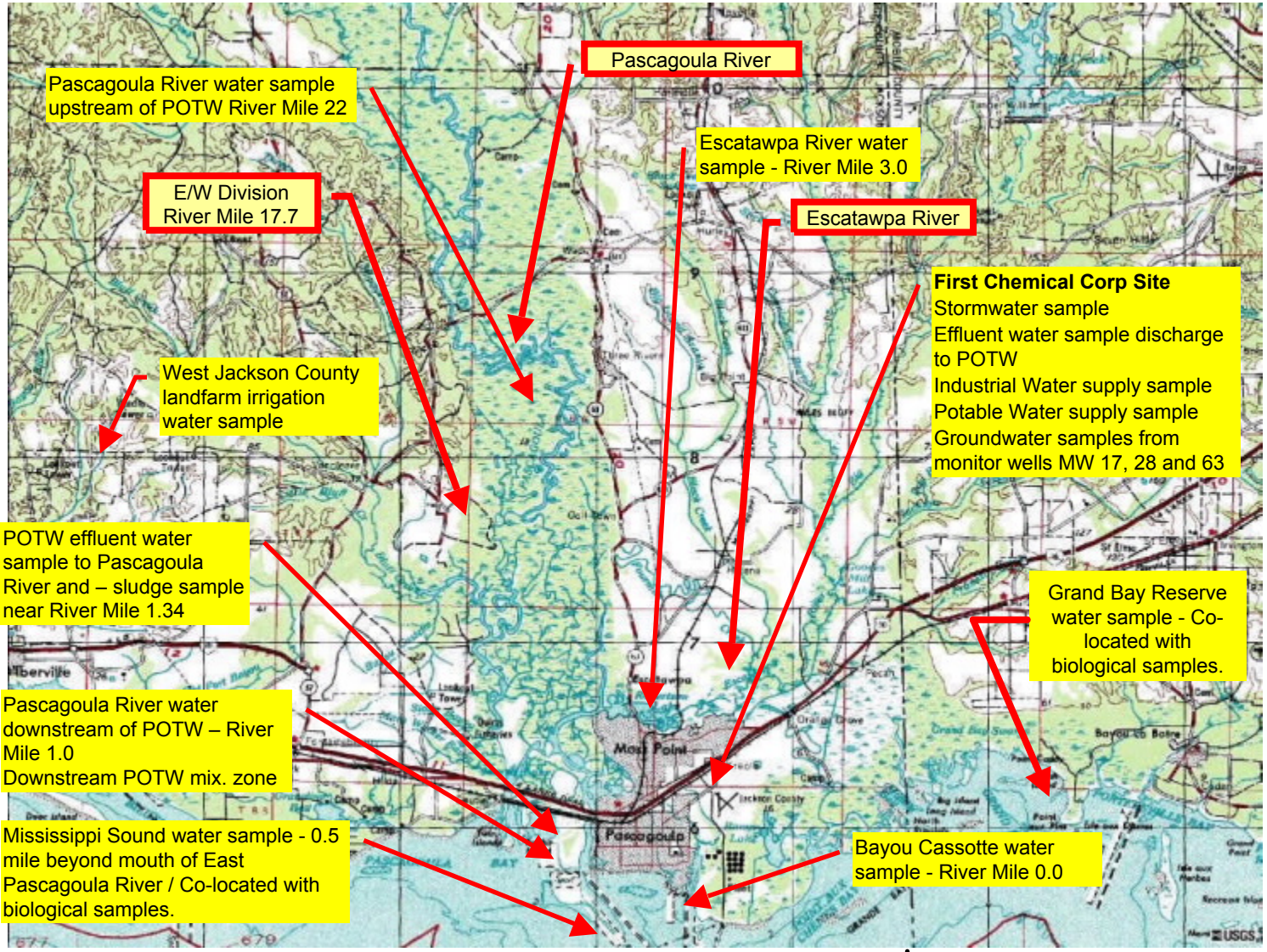
Two filets taken from each fish specimen.

Weight as received at lab.

^ Sample locations are general coordinates for Jose Bay due to equipment failure.

NA = Not applicable

FIGURES



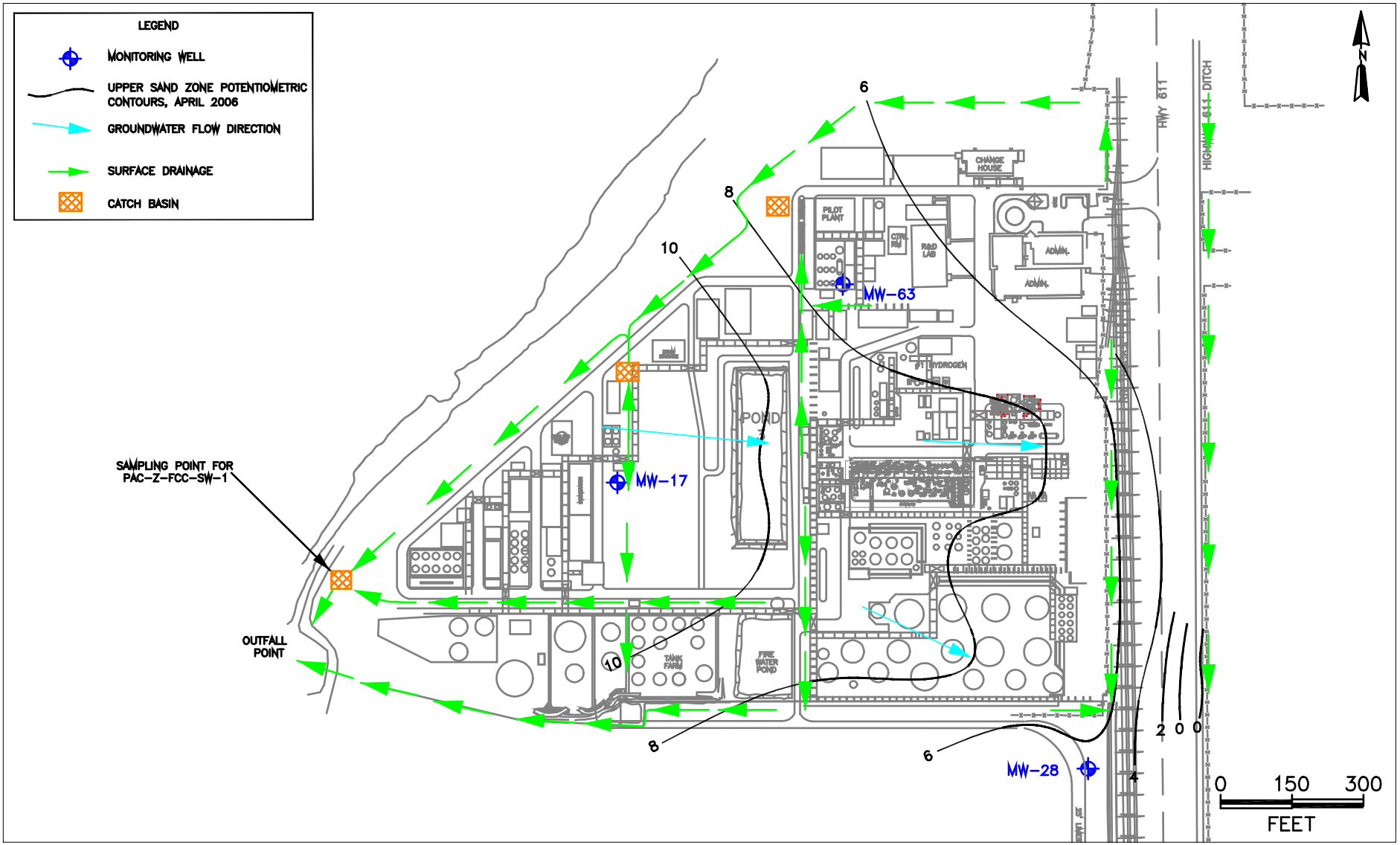
First Chemical Corporation
A DuPont Company

TITLE:

Baseline Study Sampling Locations
Pascagoula Baseline Study / Report
First Chemical Corp., Pascagoula, MS

DWN: LWG	DES.:	PROJECT NO.: 18984786.06051
CHKD:	APPD:	
DATE: 5/25/2006	REV.: 10/11/06	FIGURE NO.: 1

WP\Pascagoula\18984356 FirstChem Baseline Study\Figure 1 Sampling Locations



PASCAGOULA\GEO\MAPS\BASELINE SITE (SEPT 2006 8.5x11)

First Chemical Corporation
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TITLE:
Groundwater and Storm Water Sample Locations
Pascagoula Baseline Study
First Chemical Corp., Pascagoula, MS

DWN: RAH	DES.:	PROJECT NO.: 4438.06010	
CHKD:	APPD:		
DATE: 10/11/06	REV.:	FIGURE NO.: 2	

APPENDIX
ANALYTICAL DATA

STL-DENVER LOT #D6G200288
(SOILS)

Samples PAS-X-POTW-S-1
PAS-X-POTW-S-1-DUP
PAS-K-EQBLK-1

The above-referenced report is undergoing final revision and will be forwarded under separate cover. The analytical reporting limit (LOD/LOQ) determination provided in a draft report is being re-evaluated by the laboratory in order to meet the requirements of the Pascagoula Baseline Study Quality Assurance Project Plan (QAPP). The LOD/LOQ values previously reported are subject to change. Associated sample results from the above-referenced report are not expected to change.