

**MULTI-CITY STUDY**  
**FINAL FIELD REPORT FOR COLUMBUS GEORGIA AND**  
**PORT ST. LUCIE FLORIDA – BATTELLE DUXBURY ACTIVITIES**

**For**

**Project Number**  
**N100672-01**

**Submitted to**

**October 26, 1999**

**Prepared by**

**Kelly A. Irizarry**

**Battelle**  
**397 Washington Street**  
**Duxbury, MA 02332**  
**(617) 934-0571**

## TABLE OF CONTENTS

|                                          |    |
|------------------------------------------|----|
| 1. INTRODUCTION .....                    | 1  |
| 1.1 SURVEY SPECIFIC APPROVAL .....       | 1  |
| 2. METHODS .....                         | 1  |
| 3. CHRONOLOGY .....                      | 2  |
| 4. RESULTS.....                          | 4  |
| 4.1 SAMPLE MATRIX AVAILABILITY .....     | 4  |
| 4.2 ONSITE OBSERVATIONS .....            | 4  |
| 4.3 INSTRUMENTATION RESULTS .....        | 10 |
| 4.4 COMMUNICATIONS.....                  | 11 |
| 5. DEVIATIONS AND CORRECTIVE ACTION..... | 13 |

## LIST OF TABLES

|                                                                          |    |
|--------------------------------------------------------------------------|----|
| TABLE 1 MUNICIPALITIES SAMPLED AND APPROVALS GRANTED DURING SURVEY ..... | 1  |
| TABLE 2 CHRONOLOGY OF EVENTS ON JULY 26, 1999 .....                      | 2  |
| TABLE 3 CHRONOLOGY OF EVENTS ON JULY 27, 1999 .....                      | 2  |
| TABLE 4 CHRONOLOGY OF EVENTS ON JULY 28, 1999 .....                      | 3  |
| TABLE 5 CHRONOLOGY OF EVENTS ON JULY 29, 1999 .....                      | 3  |
| TABLE 6 CHRONOLOGY OF EVENTS ON JULY 30, 1999 .....                      | 4  |
| TABLE 7 COLLECTED SAMPLES FROM COLUMBUS GA .....                         | 5  |
| TABLE 8 COLLECTED SAMPLES FROM PORT ST LUCIE FL .....                    | 7  |
| TABLE 9 SAMPLING SITE POSITIONS IN COLUMBUS GA .....                     | 11 |
| TABLE 10 SAMPLING SITE POSITIONS IN PORT ST. LUCIE FL .....              | 11 |
| TABLE 11 GPS POSITION VERIFICATION RESULTS .....                         | 11 |

## 1. INTRODUCTION

The objective of the sampling task in this study is to collect representative samples for trace-level analysis of FOSE-based fluorochemical (FC) residuals, to assess sources, dispersion in the environment, and human exposure via the food chain. The cities selected for sample collection will be considered 'study' or 'control' cities. 'Study' cities are considered those areas with FC production facilities or large FC consumers. 'Control' cities do not contain FC production or consumption facilities and are matched to study cities based on general location, population size, and drinking water source.

During the initial phase of the study, phone calls were made to municipal agencies requesting access to various matrices of interest. Based upon the level of cooperation received from the municipal agencies, appropriate sampling strategies were developed. The Quality Assurance Project Plan (QAPP) and the Survey Plan contain the appropriate information concerning the matrices for collection and methods to be utilized for this process.

The full project sampling scope is accomplished using two field teams: 1) Battelle's Duxbury Personnel collect drinking water, POTW, landfill and urban air samples, and 2) Battelle's Marine Sciences Laboratory (MSL) personnel collect surface water microlayer, bulk water and finfish samples. This report summarizes the Duxbury team effort. A separate report summarizes the MSL activities.

### 1.1 Survey Specific Approval

In Columbus GA, approval was obtained for sample collection at the Publicly Owned Treatment Works (POTW), municipal drinking water plant, the municipal landfill, and the Columbus Fire Department (for atmospheric sampling). In Port St. Lucie FL, approval was obtained for the POTW, municipal drinking water plant, the municipal landfill and the Port St. Lucie Fire Department (for atmospheric sampling). Table 1 highlights the cities visited during this survey and the approvals granted by municipal departments.

Table 1. Municipalities Sampled and Approvals Granted During Survey

| City               | Study or Control | Fire Department (Air Sampling) | POTW | Drinking Water Plant | Municipal Landfill |
|--------------------|------------------|--------------------------------|------|----------------------|--------------------|
| Columbus GA        | Control          | ✓                              | ✓    | ✓                    | ✓                  |
| Port St. Lucie, FL | Control          | ✓                              | ✓    | ✓                    | ✓                  |

## 2. METHODS

The collection of environmental samples was conducted according to Standard Operation Procedures (SOP's). The SOP's used in the Multi-City Study were written by Battelle and are used to train personnel prior to field activities and also serve as reference documents while in the

field. These documents, along with the QAPP, serve as the guidance documents for the collection of field samples. The methods used for collection are summarized below.

The collection of position data (latitude and longitude) was completed at the Columbus and Port St. Lucie sampling location using a Garmin 12XL GPS unit according to Battelle SOP 3-164-01. Instrument accuracy was validated by comparing an acquired position versus a position of known location. The collection of air samples was completed using a General Metals Model PS-1 atmospheric sampler. The sampling was conducted according to Battelle SOP M3-MC-F-1.1. The use of this system allows the separate collection of particulate and vapor phase compounds using a glass-fiber filter for particulate matter and Polyurethane foam (PUF) for the vapor phase. Water samples from drinking water supplies, POTW's, and landfills were collected according to SOP M3-F-2.0. Surface water samples were collected via direct submersion, tap water and drinking water supplied by the municipal plant were collected via a valve system, and effluent was collected using either a bucket or small sampling beaker. Sediment samples were collected using a stainless steel spoon, according to Battelle SOP M3-F-7.0. Sludge in Columbus was collected using a valve system. Sludge in Port St. Lucie was collected using a small collection bucket.

### 3. CHRONOLOGY

Tables 2 through 6 describe the events that occurred each day of the survey. Sample matrix collection times have been transcribed from the sample log; all other times have been estimated based on the events that transpired during the survey. All times are recorded in Eastern Daylight Time.

**Table 2. Chronology of Events on July 26, 1999**

|           |                                                                                                                              |
|-----------|------------------------------------------------------------------------------------------------------------------------------|
| 0815-1500 | Battelle Duxbury personnel depart Boston                                                                                     |
|           | Arrive in Columbus, GA                                                                                                       |
|           | Pick up rental vehicle and proceed to Federal Express to pick up supplies                                                    |
|           | Proceed to meet with Chief Waters, Columbus Fire Department. Discuss location of Atmospheric sampler, we agree on Station #1 |
|           | Arrive at fire station #1 and place air sampling unit behind building for sample collection                                  |
| 1620      | Conduct calibration of air sampler and start sampling for 12hr period                                                        |
| 1650      | Made phone calls for the collection of water samples on July 27 <sup>th</sup>                                                |
| 1700      | Return to hotel                                                                                                              |

**Table 3. Chronology of Events on July 27, 1999**

|      |                                                                                                                                                                                                         |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0820 | Arrive at Fire Station #1; collect filter and PUF sample. Cleaned sampler and collected quality control samples                                                                                         |
|      | Site 2 tap water samples collected at Station #1 following the completion of air sampling                                                                                                               |
| 0950 | Arrive at Columbus Water Works, contacted Jim Patterson for collection of Drinking water samples. Finished water collected at the facility, untreated water collected at the pumping station at the Dam |

|           |                                                                                                                                                     |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1030      | Site 1 Surface water and sediment samples collected outside of the pumping station at the Dam                                                       |
| 1100      | Site 2 surface water and sediments samples collected at the Municipal Marina                                                                        |
| 1115      | Site 3 surface water and sediments samples collected at the Municipal Marina                                                                        |
| 1140      | Site 3 Tap water taken from restroom of Municipal Marina                                                                                            |
| 1215      | Arrived at Stonewoods Farm where the Quiet body of water was collected                                                                              |
| 1415      | Arrived at the Pine Grove Land fill. With the assistance of Mr. Ralph Jackson, sample was collected from leachate well, directly into sample bottle |
| 1600      | Arrived at Columbus wastewater Treatment Plant. Talked with Mr. Tom West. Effluent samples collected via plastic container                          |
| 1630      | Collected sludge sample via collection valve                                                                                                        |
| 1700-1900 | Arrived at the Holiday Inn Columbus collected site 1 Tap water                                                                                      |
|           | Began spiking field spike samples                                                                                                                   |
|           | Prep sample coolers for final shipment to designated sites                                                                                          |
|           | Arrive at Federal Express for the shipment of samples                                                                                               |

**Table 4. Chronology of Events on July 28, 1999**

|           |                                                                                                          |
|-----------|----------------------------------------------------------------------------------------------------------|
| 1115-1720 | Depart Columbus for W. Palm Beach                                                                        |
|           | Arrive W. Palm Beach                                                                                     |
|           | Pick up van, head to Port St. Lucie. Made call to Ron Parish to make arrangements for air sampler set up |
|           | Checked into hotel. Headed to station #5 to set up air sampler                                           |
|           | Set up air sampler                                                                                       |
|           | Started air sampler for the period of 12 hours                                                           |

**Table 5. Chronology of Events on July 29, 1999**

|           |                                                                                                                                                                          |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0800-0820 | Arrive station # 5 collect filter and PUF sample. Cleaned sampler and collected quality control samples                                                                  |
|           | Site 2 Tap water samples collected from outside faucet at station #5                                                                                                     |
| 0930      | Arrive Port St. Lucie Drinking Water Plant. With the approval of Gary Basham, untreated water was collected from outside faucet, finished water was collected in the lab |
| 1130      | Arrived at Northport WWTP effluent collect via collection bucket. Sludge was taken from Chlorine contact chamber via small collection bucket                             |
| 1205      | Arrived at Port St. Lucie Landfill. Contacted Ron Roberts who gave approval to sample leachate from the leachate pond via bucket                                         |
| 1345      | Site 1 surface water / sediment collected from Pendarvis Cove Park                                                                                                       |
| 1345      | Site 3 Tap water collected from restroom of Pendarvis Cove Park                                                                                                          |
| 1415      | Site 2 Surface water / sediment collected from Martin County Marina                                                                                                      |
| 1500      | Quiet Body of water collected at a pond on the corner of SW Mapped Rd. and SW Chapman Way                                                                                |
| 1530      | Site 3 Surface water / sediment collected from the North side of Roosevelt drawbridge, Stuart FL                                                                         |
| 1730-1800 | Site 1 Tap water collected from Holiday Inn Port. St. Lucie                                                                                                              |
|           | Packed coolers with ice in preparation for shipment on July 30 <sup>th</sup>                                                                                             |

**Table 6. Chronology of Events on July 30, 1999**

|           |                                                                         |
|-----------|-------------------------------------------------------------------------|
| 0800-1600 | Arrive at Federal Express to ship samples. Samples shipped successfully |
|           | Drive to W. Palm Beach for a 10 am flight to Orlando Florida            |
|           | Leave Orlando Florida for Boston                                        |
|           | Arrive at Logan International Airport Boston                            |

## 4. RESULTS

This survey, as part of the Multi-City Study, resulted in the collection of the samples described in Tables 3-5 of the QAPP and Amendment 1 to Revision 1. The following sections describe the results of the sample collection effort that occurred during this survey.

### 4.1 Sample Matrix Availability

Per client instructions no food items were collected during survey. Due to scheduling and permit issues no finfish were collected during this survey. The collection of POTW influent did not occur at either Columbus or Port St. Lucie due to health concerns. Both POTW influent streams available for sampling contained biological hazards. The staff at facilities in both cities indicated that the chlorination process occurs following secondary treatment.

Also collected, but not included in the QAPP, was a sample of quiet/undisturbed surface water. This sample is intended for use in a long-term transport study that is currently being conducted. The sampling location in Port St. Lucie was altered, with the approval of the project manager (Marcia Nishioka), from the original site due to a distance of 40 miles each way to the sample site. In Columbus, the sample site was located on private property. Permission was granted by one of the residents of Stone Woods Farm.

### 4.2 Onsite Observations

**Columbus, GA:** The POTW diffuses its water 100 feet from the river. The landfill leachate pond is gravity fed into a confined manhole, which was not accessible due to safety reasons. Leachate was collected using modified collection methods. Quiescent water was collected from private property after receiving permission from a resident of the property. Mr. Jesse Eldridge (3M client) was present at all sampling sites. The POTW sludge is dried and put out in the fields to be mixed with soil on site. Drinking water influent was sampled from a pumping station about 1.5 miles from the drinking water plant.

**Port St. Lucie, FL:** Surface water was taken from brackish (slightly saline) waters, indicating some tidal/seawater influence at this location within the river/estuary system. Multiple oyster shells and mangrove were observed. The WWTP is a much smaller facility than the drinking water plant. Mr. Gary Basham is the director of both facilities. With complete cooperation, all samples were collected successfully.

Table 7. Collected Samples from Columbus Georgia

| Matrix                     | Sample ID | Volume Collected (L)<br>*Sediment Mass (g) | Location Collected        |
|----------------------------|-----------|--------------------------------------------|---------------------------|
| Drinking Water Unprocessed | MC-515B   | 1                                          | Pumping Station @ the Dam |
| Drinking Water Unprocessed | MC-516B   | 1                                          | Pumping Station @ the Dam |
| Drinking Water Unprocessed | MC-517B   | 1                                          | Pumping Station @ the Dam |
| Drinking Water Unprocessed | MC-518B   | 1                                          | Pumping Station @ the Dam |
| Drinking Water Unprocessed | MC-519B   | 1                                          | Pumping Station @ the Dam |
| Drinking Water Unprocessed | MC-520B   | Blank                                      | Pumping Station @ the Dam |
| Drinking Water Unprocessed | MC-515K   | 1                                          | Pumping Station @ the Dam |
| Drinking Water Unprocessed | MC-516K   | 1                                          | Pumping Station @ the Dam |
| Drinking Water Unprocessed | MC-517K   | 1                                          | Pumping Station @ the Dam |
| Drinking Water Unprocessed | MC-518K   | 1                                          | Pumping Station @ the Dam |
| Drinking Water Unprocessed | MC-519K   | 1                                          | Pumping Station @ the Dam |
| Drinking Water Unprocessed | MC-520K   | Blank                                      | Pumping Station @ the Dam |
| Drinking Water Unprocessed | MC-515H   | 1                                          | Pumping Station @ the Dam |
| Drinking Water Unprocessed | MC-517H   | 1                                          | Pumping Station @ the Dam |
| Drinking Water Unprocessed | MC-518H   | 1                                          | Pumping Station @ the Dam |
| Drinking Water Unprocessed | MC-519H   | 1                                          | Pumping Station @ the Dam |
| Drinking Water Unprocessed | MC-520H   | Blank                                      | Pumping Station @ the Dam |
| Drinking Water Processed   | MC-521B   | 1                                          | Columbus Water Works      |
| Drinking Water Processed   | MC-522B   | 1                                          | Columbus Water Works      |
| Drinking Water Processed   | MC-523B   | 1                                          | Columbus Water Works      |
| Drinking Water Processed   | MC-524B   | 1                                          | Columbus Water Works      |
| Drinking Water Processed   | MC-525B   | 1                                          | Columbus Water Works      |
| Drinking Water Processed   | MC-521K   | 1                                          | Columbus Water Works      |
| Drinking Water Processed   | MC-522K   | 1                                          | Columbus Water Works      |
| Drinking Water Processed   | MC-523K   | 1                                          | Columbus Water Works      |
| Drinking Water Processed   | MC-524K   | 1                                          | Columbus Water Works      |
| Drinking Water Processed   | MC-525K   | 1                                          | Columbus Water Works      |
| Drinking Water Processed   | MC-521H   | 1                                          | Columbus Water Works      |
| Drinking Water Processed   | MC-523H   | 1                                          | Columbus Water Works      |
| Drinking Water Processed   | MC-524H   | 1                                          | Columbus Water Works      |
| Drinking Water Processed   | MC-525H   | 1                                          | Columbus Water Works      |
| Tap Water Site #1          | MC-526B   | 1                                          | Holiday Inn               |
| Tap Water Site #1          | MC-527B   | 1                                          | Holiday Inn               |
| Tap Water Site #1          | MC-528B   | 1                                          | Holiday Inn               |
| Tap Water Site #1          | MC-529B   | 1                                          | Holiday Inn               |
| Tap Water Site #1          | MC-530B   | 1                                          | Holiday Inn               |
| Tap Water Blank            | MC-533B   |                                            | Holiday Inn               |
| Tap Water Blank            | MC-534B   |                                            | Holiday Inn               |
| Tap Water Site #1          | MC-526K   | 1                                          | Holiday Inn               |
| Tap Water Site #1          | MC-527K   | 1                                          | Holiday Inn               |
| Tap Water Site #1          | MC-528K   | 1                                          | Holiday Inn               |
| Tap Water Site #1          | MC-529K   | 1                                          | Holiday Inn               |
| Tap Water Site #1          | MC-530K   | 1                                          | Holiday Inn               |
| Tap Water Blank            | MC-533K   |                                            | Holiday Inn               |
| Tap Water Blank            | MC-534K   |                                            | Holiday Inn               |
| Tap Water Site #1          | MC-526H   | 1                                          | Holiday Inn               |
| Tap Water Site #1          | MC-528H   | 1                                          | Holiday Inn               |
| Tap Water Site #1          | MC-529H   | 1                                          | Holiday Inn               |
| Tap Water Site #1          | MC-530H   | 1                                          | Holiday Inn               |
| Tap Water Blank            | MC-533H   |                                            | Holiday Inn               |

| Matrix                | Sample ID | Volume Collected (L)<br>*Sediment Mass (g) | Location Collected             |
|-----------------------|-----------|--------------------------------------------|--------------------------------|
| Tap Water Blank       | MC-534H   |                                            | Holiday Inn                    |
| Tap Water Site #2     | MC-531B   | 1                                          | CFD Station #1                 |
| Tap Water Site #2     | MC-531K   | 1                                          | CFD Station #1                 |
| Tap Water Site #2     | MC-531H   | 1                                          | CFD Station #1                 |
| Tap Water Site #3     | MC-532B   | 1                                          | Metropolitan Boat Ramp         |
| Tap Water Site #3     | MC-532K   | 1                                          | Metropolitan Boat Ramp         |
| Tap Water Site #3     | MC-532H   | 1                                          | Metropolitan Boat Ramp         |
| Surface Water Site #1 | MC-501B   | 1                                          | Pumping Station behind the Dam |
| Surface Water Site #1 | MC-502B   | 1                                          | Pumping Station behind the Dam |
| Surface Water Site #1 | MC-503B   | 1                                          | Pumping Station behind the Dam |
| Surface Water Site #1 | MC-504B   | 1                                          | Pumping Station behind the Dam |
| Surface Water Site #1 | MC-505B   | 1                                          | Pumping Station behind the Dam |
| Surface Water Blank   | MC-508B   |                                            | Pumping Station behind the Dam |
| Surface Water Blank   | MC-509B   |                                            | Pumping Station behind the Dam |
| Surface Water Site #1 | MC-501K   | 1                                          | Pumping Station behind the Dam |
| Surface Water Site #1 | MC-502K   | 1                                          | Pumping Station behind the Dam |
| Surface Water Site #1 | MC-503K   | 1                                          | Pumping Station behind the Dam |
| Surface Water Site #1 | MC-504K   | 1                                          | Pumping Station behind the Dam |
| Surface Water Site #1 | MC-505K   | 1                                          | Pumping Station behind the Dam |
| Surface Water Blank   | MC-508K   |                                            | Pumping Station behind the Dam |
| Surface Water Blank   | MC-509K   |                                            | Pumping Station behind the Dam |
| Surface Water Site #1 | MC-501H   | 1                                          | Pumping Station behind the Dam |
| Surface Water Site #1 | MC-503H   | 1                                          | Pumping Station behind the Dam |
| Surface Water Site #1 | MC-504H   | 1                                          | Pumping Station behind the Dam |
| Surface Water Site #1 | MC-505H   | 1                                          | Pumping Station behind the Dam |
| Surface Water Blank   | MC-508H   |                                            | Pumping Station behind the Dam |
| Surface Water Site #2 | MC-506B   | 1                                          | Municipal Marina               |
| Surface Water Site #2 | MC-506K   | 1                                          | Municipal Marina               |
| Surface Water Site #2 | MC-506H   | 1                                          | Municipal Marina               |
| Surface Water Site #3 | MC-507B   | 1                                          | Municipal Marina               |
| Surface Water Site #3 | MC-507K   | 1                                          | Municipal Marina               |
| Surface Water Site #3 | MC-507H   | 1                                          | Municipal Marina               |
| Sediment Site #1      | MC-510B   | 200*                                       | Pumping Station behind the Dam |
| Sediment Site #1      | MC-510K   | 200*                                       | Pumping Station behind the Dam |
| Sediment Site #2      | MC-511B   | 200*                                       | Municipal Marina               |
| Sediment Site #2      | MC-511K   | 200*                                       | Municipal Marina               |
| Sediment Site #3      | MC-512B   | 200*                                       | Municipal Marina               |
| Sediment Site #3      | MC-512K   | 200*                                       | Municipal Marina               |
| Sediment Blank        | MC-513B   |                                            | Municipal Marina               |
| Sediment Blank        | MC-513K   |                                            | Municipal Marina               |
| Sediment Blank        | MC-514B   |                                            | Municipal Marina               |
| Sediment Blank        | MC-514K   |                                            | Municipal Marina               |
| POTW Effluent         | MC-539B   | 1                                          | Columbus WWTP                  |
| POTW Effluent         | MC-540B   | 1                                          | Columbus WWTP                  |
| POTW Effluent         | MC-541B   | 1                                          | Columbus WWTP                  |
| POTW Effluent         | MC-542B   | 1                                          | Columbus WWTP                  |
| POTW Effluent Blank   | MC-543B   | 1                                          | Columbus WWTP                  |
| POTW Effluent Blank   | MC-543K   | 1                                          | Columbus WWTP                  |
| POTW Effluent Blank   | MC-543H   | 1                                          | Columbus WWTP                  |
| POTW Effluent         | MC-539K   | 1                                          | Columbus WWTP                  |
| POTW Effluent         | MC-540K   | 1                                          | Columbus WWTP                  |



| Matrix                           | Sample ID | Volume Collected (L)<br>*Sediment Mass (g) | Location Collected  |
|----------------------------------|-----------|--------------------------------------------|---------------------|
| POTW Effluent                    | MC-541K   | 1                                          | Columbus WWTP       |
| POTW Effluent                    | MC-542K   | 1                                          | Columbus WWTP       |
| POTW Effluent                    | MC-539H   | 1                                          | Columbus WWTP       |
| POTW Effluent                    | MC-541H   | 1                                          | Columbus WWTP       |
| POTW Effluent                    | MC-542H   | 1                                          | Columbus WWTP       |
| POTW Sludge                      | MC-544B   | 200*                                       | Columbus WWTP       |
| POTW Sludge                      | MC-544K   | 200*                                       | Columbus WWTP       |
| POTW Sludge Blank                | MC-545B   |                                            | Columbus WWTP       |
| POTW Sludge Blank                | MC-545K   |                                            | Columbus WWTP       |
| Urban Air (Vapor)                | MC-546B   | 1 PUF                                      | CFD Station #1      |
| Urban Air (Particulate)          | MC-547B   | 1 Filter                                   | CFD Station #1      |
| Urban Air Field Spike            | MC-548B   | 1PUF                                       | CFD Station #1      |
| Urban Air Field Spike            | MC-549B   | 1Filter                                    | CFD Station #1      |
| Urban Air Field Blank            | MC-550B   | 1PUF                                       | CFD Station #1      |
| Urban Air Field Blank            | MC-551B   | 1Filter                                    | CFD Station #1      |
| Landfill Leachate                | MC-535B   | 1                                          | Pine Grove Landfill |
| Landfill Leachate                | MC-535K   | 1                                          | Pine Grove Landfill |
| Landfill Leachate                | MC-535H   | 1                                          | Pine Grove Landfill |
| Landfill Leachate Blank          | MC-536B   |                                            | Pine Grove Landfill |
| Landfill Leachate Blank          | MC-536K   |                                            | Pine Grove Landfill |
| Landfill Leachate Blank          | MC-536H   |                                            | Pine Grove Landfill |
| Quiet Surface Water <sup>1</sup> | MC-584B   | 1                                          | Stone Wood Farm     |
| Quiet Surface Water <sup>1</sup> | MC-584K   | 1                                          | Stone Wood Farm     |
| Quiet Surface Water <sup>1</sup> | MC-584H   | 1                                          | Stone Wood Farm     |
| Quiet Surface Water <sup>1</sup> | MC-585B   | 1 Trip Blank                               | Stone Wood Farm     |
| Quiet Surface Water <sup>1</sup> | MC-586B   | 1 Trip Blank                               | Stone Wood Farm     |

<sup>1</sup> Samples are not part of this study

Table 8. Collected Samples from Port St. Lucie FL

| Matrix                     | Sample ID | Volume Collected (L)<br>*Sediment Mass (g) | Location Collected                |
|----------------------------|-----------|--------------------------------------------|-----------------------------------|
| Drinking Water Unprocessed | MC-615B   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Unprocessed | MC-616B   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Unprocessed | MC-617B   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Unprocessed | MC-618B   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Unprocessed | MC-619B   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Unprocessed | MC-615K   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Unprocessed | MC-616K   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Unprocessed | MC-617K   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Unprocessed | MC-618K   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Unprocessed | MC-619K   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Unprocessed | MC-620B   | Blank                                      | St. Lucie Drinking Water Facility |
| Drinking Water Unprocessed | MC-620K   | Blank                                      | St. Lucie Drinking Water Facility |
| Drinking Water Unprocessed | MC-620H   | Blank                                      | St. Lucie Drinking Water Facility |
| Drinking Water Unprocessed | MC-615H   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Unprocessed | MC-617H   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Unprocessed | MC-618H   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Unprocessed | MC-619H   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Processed   | MC-621B   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Processed   | MC-622B   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Processed   | MC-623B   | 1                                          | St. Lucie Drinking Water Facility |

| Matrix                    | Sample ID | Volume Collected (L)<br>*Sediment Mass (g) | Location Collected                |
|---------------------------|-----------|--------------------------------------------|-----------------------------------|
| Drinking Water Processed  | MC-624B   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Processed  | MC-625B   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Processed  | MC-621K   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Processed  | MC-622K   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Processed  | MC-623K   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Processed  | MC-624K   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Processed  | MC-625K   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Processed  | MC-621H   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Processed  | MC-623H   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Processed  | MC-624H   | 1                                          | St. Lucie Drinking Water Facility |
| Drinking Water Processed  | MC-625H   | 1                                          | St. Lucie Drinking Water Facility |
| Tap Water Site #1         | MC-626B   | 1                                          | Holiday Inn                       |
| Tap Water Site #1         | MC-627B   | 1                                          | Holiday Inn                       |
| Tap Water Site #1         | MC-628B   | 1                                          | Holiday Inn                       |
| Tap Water Site #1         | MC-629B   | 1                                          | Holiday Inn                       |
| Tap Water Site #1         | MC-630B   | 1                                          | Holiday Inn                       |
| Tap Water Site #1         | MC-626K   | 1                                          | Holiday Inn                       |
| Tap Water Site #1         | MC-627K   | 1                                          | Holiday Inn                       |
| Tap Water Site #1         | MC-628K   | 1                                          | Holiday Inn                       |
| Tap Water Site #1         | MC-629K   | 1                                          | Holiday Inn                       |
| Tap Water Site #1         | MC-630K   | 1                                          | Holiday Inn                       |
| Tap Water Site #1         | MC-626H   | 1                                          | Holiday Inn                       |
| Tap Water Site #1         | MC-628H   | 1                                          | Holiday Inn                       |
| Tap Water Site #1         | MC-629H   | 1                                          | Holiday Inn                       |
| Tap Water Site #1         | MC-630H   | 1                                          | Holiday Inn                       |
| Tap Water Site #2         | MC-631B   | 1                                          | Port St. Lucie FD Station #5      |
| Tap Water Site #2         | MC-631K   | 1                                          | Port St. Lucie FD Station #5      |
| Tap Water Site #2         | MC-631H   | 1                                          | Port St. Lucie FD Station #5      |
| Tap Water Site #3         | MC-632B   | 1                                          | Pendarvis Park Martin County      |
| Tap Water Site #3         | MC-632K   | 1                                          | Pendarvis Park Martin County      |
| Tap Water Site #3         | MC-632H   | 1                                          | Pendarvis Park Martin County      |
| Tap Water Blank           | MC-633B   |                                            | Pendarvis Park Martin County      |
| Tap Water Blank           | MC-633K   |                                            | Pendarvis Park Martin County      |
| Tap Water Blank           | MC633H    |                                            | Pendarvis Park Martin County      |
| Tap Water Blank           | MC-634B   |                                            | Pendarvis Park Martin County      |
| Tap Water Blank           | MC-634K   |                                            | Pendarvis Park Martin County      |
| Surface Water Site #1     | MC-601B   | 1                                          | Pendarvis Park Martin County      |
| Surface Water Site #1     | MC-602B   | 1                                          | Pendarvis Park Martin County      |
| Surface Water Site #1     | MC-603B   | 1                                          | Pendarvis Park Martin County      |
| Surface Water Site #1     | MC-604B   | 1                                          | Pendarvis Park Martin County      |
| Surface Water Site #1     | MC-605B   | 1                                          | Pendarvis Park Martin County      |
| Surface Water Field Blank | MC-608B   |                                            | Pendarvis Park Martin County      |
| Surface Water Field Blank | MC-608K   |                                            | Pendarvis Park Martin County      |
| Surface Water Field Blank | MC-608H   |                                            | Pendarvis Park Martin County      |
| Surface Water Field Blank | MC-609B   |                                            | Pendarvis Park Martin County      |
| Surface Water Field Blank | MC-609K   |                                            | Pendarvis Park Martin County      |
| Surface Water Site #1     | MC-601K   | 1                                          | Pendarvis Park Martin County      |
| Surface Water Site #1     | MC-602K   | 1                                          | Pendarvis Park Martin County      |
| Surface Water Site #1     | MC-603K   | 1                                          | Pendarvis Park Martin County      |
| Surface Water Site #1     | MC-604K   | 1                                          | Pendarvis Park Martin County      |
| Surface Water Site #1     | MC-605K   | 1                                          | Pendarvis Park Martin County      |

| Matrix                  | Sample ID | Volume Collected (L)<br>*Sediment Mass (g) | Location Collected           |
|-------------------------|-----------|--------------------------------------------|------------------------------|
| Surface Water Site #1   | MC-601H   | 1                                          | Pendarvis Park Martin County |
| Surface Water Site #1   | MC-603H   | 1                                          | Pendarvis Park Martin County |
| Surface Water Site #1   | MC-604H   | 1                                          | Pendarvis Park Martin County |
| Surface Water Site #1   | MC-605H   | 1                                          | Pendarvis Park Martin County |
| Surface Water Site #2   | MC-606B   | 1                                          | Martin County Marina         |
| Surface Water Site #2   | MC-606K   | 1                                          | Martin County Marina         |
| Surface Water Site #2   | MC-606H   | 1                                          | Martin County Marina         |
| Surface Water Site #3   | MC-607B   | 1                                          | Stuart Harbor                |
| Surface Water Site #3   | MC-607K   | 1                                          | Stuart Harbor                |
| Surface Water Site #3   | MC-607H   | 1                                          | Stuart Harbor                |
| Sediment Site #1        | MC-610B   | 200*                                       | Pendarvis Park Martin County |
| Sediment Site #1        | MC-610K   | 200*                                       | Pendarvis Park Martin County |
| Sediment Site #2        | MC-611B   | 200*                                       | Martin County Marina         |
| Sediment Site #2        | MC-611K   | 200*                                       | Martin County Marina         |
| Sediment Site #3        | MC-612B   | 200*                                       | Stuart Harbor                |
| Sediment Site #3        | MC-612K   | 200*                                       | Stuart Harbor                |
| Sediment Field Blank    | MC-613B   |                                            | Stuart Harbor                |
| Sediment Field Blank    | MC-613K   |                                            | Stuart Harbor                |
| Sediment Field Blank    | MC-614B   |                                            | Stuart Harbor                |
| Sediment Field Blank    | MC-614K   |                                            | Stuart Harbor                |
| POTW Effluent           | MC-639B   | 1                                          | North Port WWTP              |
| POTW Effluent           | MC-640B   | 1                                          | North Port WWTP              |
| POTW Effluent           | MC-641B   | 1                                          | North Port WWTP              |
| POTW Effluent           | MC-642B   | 1                                          | North Port WWTP              |
| POTW Effluent           | MC-639K   | 1                                          | North Port WWTP              |
| POTW Effluent           | MC-640K   | 1                                          | North Port WWTP              |
| POTW Effluent           | MC-641K   | 1                                          | North Port WWTP              |
| POTW Effluent           | MC-642K   | 1                                          | North Port WWTP              |
| POTW Effluent           | MC-639H   | 1                                          | North Port WWTP              |
| POTW Effluent Blank     | MC-643B   |                                            | North Port WWTP              |
| POTW Effluent Blank     | MC-643K   |                                            | North Port WWTP              |
| POTW Effluent Blank     | MC-643H   |                                            | North Port WWTP              |
| POTW Effluent           | MC-640H   | 1                                          | North Port WWTP              |
| POTW Effluent           | MC-641H   | 1                                          | North Port WWTP              |
| POTW Effluent           | MC-642H   | 1                                          | North Port WWTP              |
| POTW Sludge             | MC-644B   | 200*                                       | North Port WWTP              |
| POTW Sludge             | MC-644K   | 200*                                       | North Port WWTP              |
| POTW Sludge Blank       | MC-645B   |                                            | North Port WWTP              |
| POTW Sludge Blank       | MC-645K   |                                            | North Port WWTP              |
| Urban Air (Vapor)       | MC-646B   | 1PUF                                       | Port St. Lucie FD Station #5 |
| Urban Air (Particulate) | MC-647B   | 1Filter                                    | Port St. Lucie FD Station #5 |
| Urban Air Field Spike   | MC-648B   | 1PUF                                       | Port St. Lucie FD Station #5 |
| Urban Air Field Spike   | MC-649B   | 1Filter                                    | Port St. Lucie FD Station #5 |
| Urban Air Field Blank   | MC-650B   | 1PUF                                       | Port St. Lucie FD Station #5 |
| Urban Air Field Blank   | MC-651B   | 1Filter                                    | Port St. Lucie FD Station #5 |
| Landfill Leachate       | MC-635B   | 1                                          | Port St. Lucie Landfill      |
| Landfill Leachate       | MC-635K   | 1                                          | Port St. Lucie Landfill      |
| Landfill Leachate       | MC-635H   | 1                                          | Port St. Lucie Landfill      |
| Landfill Leachate Blank | MC-636B   |                                            | Port St. Lucie Landfill      |
| Landfill Leachate Blank | MC-636K   |                                            | Port St. Lucie Landfill      |
| Landfill Leachate Blank | MC-636H   |                                            | Port St. Lucie Landfill      |

| Matrix                           | Sample ID | Volume Collected (L)<br>*Sediment Mass (g) | Location Collected      |
|----------------------------------|-----------|--------------------------------------------|-------------------------|
| Quiet Surface Water <sup>1</sup> | MC-684B   | 1                                          | Mapp Rd./SW Chapman Way |
| Quiet Surface Water <sup>1</sup> | MC-684K   | 1                                          | Mapp Rd./SW Chapman Way |
| Quiet Surface Water <sup>1</sup> | MC-684H   | 1                                          | Mapp Rd./SW Chapman Way |
| Quiet Surface Water <sup>1</sup> | MC-685B   | 1 Trip Blank                               | Mapp Rd./SW Chapman Way |
| Quiet Surface Water <sup>1</sup> | MC-686B   | 1 Trip Blank                               | Mapp Rd./SW Chapman Way |

### 4.3 Instrumentation Results

Air samples were collected using a General Metals Model PS-1 air sampler. According to SOP M3-MC-F1.1, the air sampler calibration is acceptable if it is within 10% of the expected results. To determine the acceptable results a calibration was conducted in Duxbury prior to the initiation of the study. The initial calibration curve resulted in a  $R^2$  value of 0.995. The calibration curves generated in Columbus and Port St. Lucie had  $R^2$  values of 0.999 and 0.995 respectively. The percent difference in recorded values from the initial calibration ranged from 0.0% to -6.73% for Columbus and 0.0% to 5.26% for Port St Lucie.

Site locations were determined using a Garmin 12X L GPS. The accuracy of the GPS unit was verified prior to departure from Duxbury by comparing a verified location on Battelle property versus the location determined by the instrument. The distance between the benchmark and instrument value was 32.19 meters.

The GPS operation was verified in Columbus GA using a benchmark at the Pine Grove Landfill. Following shipment to Georgia the instrument was reinitialized automatically. This was conducted at the fire station on July 26<sup>th</sup>. Within several minutes of the process, the unit was displaying maps and locations of the local area, which indicated that it was working properly. The results of the verifications for each sampling day are presented in Table 11.

The coordinates for the benchmark were in northing and easting. They were recorded on the log forms in this format and were converted to latitude and longitude by Ned Morse of Battelle Duxbury Operations. The result of the verification for Columbus was a difference of 10 meters between the benchmark value and the instrument value. The readings were then entered into the GPS and calculated in latitude and longitude.

No benchmark reference verification was obtained from Port St. Lucie. The Garmin 12XL Operators Manual states that if two cities are within 500 miles of each other, a second verification is not needed. Because Port St. Lucie FL is within 500 miles of Columbus GA, a second verification was not conducted and no position for this city was obtained.

According the QAPP, the minimum distance between sediment sampling site positions should be  $\geq 500$  feet. The following results have been calculated using the Garmin GPS. The distance from Columbus Site 1 to Site 2 is 1378 ft., the distance from Site 2 to Site 3 is 787 ft. and the distance from Site 1 to Site 3 is 2132 ft. The distance from Port St. Lucie Site 1 to Site 2 is 1574 ft.; the distance from Site 2 to Site 3 is 7808.8 ft. and the distance from Site 1 to Site 3 is 6496 ft.

Table 9. Sampling Site Positions in Columbus GA

| Sampling Location                  | Latitude      | Longitude     | Address                              |
|------------------------------------|---------------|---------------|--------------------------------------|
| Fire Station #1, Tap water site #2 | N 32°27'55.5" | W 84°59'22.1" | 201 10 <sup>th</sup> Avenue          |
| Holiday Inn, Tap water site #1     | N 32°28'18.7" | W 84°59'20.0" | 1325 Veterans PKWY                   |
| Metro Boat Ramp                    | N 32°31'19.0" | W 84°59'29.3" | River Road                           |
| Pumping Station Site #1            | N 32°31'03.8" | W 84°59'46.6" | River Road                           |
| Municipal Marina Site #2           | N 32°31'12.8" | W 84°59'34.6" | River Road                           |
| Municipal Marina Tap water Site #3 | N 32°31'19.0" | W 84°59'29.3" | Oliver Lake \River Rd.               |
| Columbus Water works (effluent)    | N 32°31'03.5" | W 84°59'14.7" | River Road                           |
| Columbus Water Works (influent)    | N 32°31'02.1" | W 84°59'47.8" | Pumping station at<br>Dam \River Rd. |
| Columbus WWTP                      | N 32°24'35.2" | W 84°58'44.7" | S. Lumkin Rd.                        |
| Quiet Water Stonewoods Farm        | N 32°34'17.3" | W 85°00'48.6" | Better's Lake                        |
| Pine Grove Landfill                | N 32°28'56.3" | W 84°51'17.0" | 7160 Sacerdate Lane                  |

Table 10. Sampling Site Positions in Port St. Lucie, FL

| Sampling Location           | Latitude      | Longitude     | Address                                |
|-----------------------------|---------------|---------------|----------------------------------------|
| Holiday Inn Site #1 Tap     | N 27°16'46.2" | W 80°17'30.1" | S. Federal Hwy                         |
| Fire Station #5 Site #2 Tap | N 27°16'21.8" | W 80°18'14.6" | 1616 Port St. Lucie Blvd               |
| Pendarvis Park Site #3 Tap  | N 27°11'15.2" | W 80°16'12.9" | Martin county, Pendarvais<br>Park      |
| Northport WWTP              | N 27°20'10.7" | W 80°21'08.7" | 281 St. James Ave                      |
| Drinking Water Plant        | N 27°18'32.1" | W 80°20'37.8" | 1001 S. Prineville Rd                  |
| Port St. Lucie Landfill     | N 27°23'21.4" | W 80°23'53.1" | 6120 Glades Cutoff Rd                  |
| Quiet Water Palm City, FL.  | N 27°11'00.1" | W 80°16'20.4" | Mapp Rd \SW Chapman<br>Way             |
| Pendarvis site #1           | N 27°11'15.2" | W 80°16'12.9" | Pendarvis Cove Park                    |
| Municipal Marina site #2    | N 27°11'00.1" | W 80°16'08.7" | Martin County Marina                   |
| Stuart Harbor site #3       | N 27°12'13.6" | W 80°15'43.0" | North side of Roosevelt<br>draw bridge |

Table 11. GPS Position Verification Results

| Calibration Locations                       | Columbus GA                    | Port St. Lucie                                          |
|---------------------------------------------|--------------------------------|---------------------------------------------------------|
| Waypoint Position at Landfill<br>(Accepted) | N 32°29'18.96"/W 84°51'10.48"  | Not needed cities are within 500<br>miles of each other |
| GPS Derived Position<br>(Measured)          | N 32°29'18.83" / W 84°51'09.9" |                                                         |
| Difference                                  | 0.1 kilometers - bearing 00°   |                                                         |

#### 4.4 Communications

There were no pertinent conversations surrounding the collection of samples at the various facilities that were sampled. Contacts and employees of the facilities in both cities were very helpful to our sampling process. During the course of collecting surface water samples in both

Columbus and Port St. Lucie, members of the general public inquired about the sampling effort. In each case a general answer was offered and all interested parties were satisfied.

## 5. DEVIATIONS AND CORRECTIVE ACTIONS

During the collection of samples from Columbus, GA and Port St. Lucie, FL the following QAPP deviations were encountered

- POTW inlet samples were not collected in either city, due to health risks.
- A final lpm reading was not documented for the air sampler at the end of the collection period. Thus only the initial value was used to determine the "average" flow rate.
- The client requested that food items not be collected.
- Weather notations were not included in the field record.
- Manufacturer labels were used because of problems with the Battelle labels.
- The air samples were not field spiked but rather laboratory spiked at Battelle Duxbury.

The following deviations were noted during the Columbus Georgia survey:

- Pine Grove Landfill in Columbus has gravity fed leachate pond, which is accessible through a manhole. A single attempt to collect samples from this leachate source was unsuccessful. Due to noxious fumes and confined space entry, an alternate method was developed, with the help of the site supervisor, Mr. Ralph Jackson. Using jumper cables, sample bottles and pre-approved packing tape we were able to collect the sample successfully. A telescopic pole and bucket was purchased for future situations.
- Contrary to the QAPP the spiked filter and PUF for Columbus were shipped to the field on blue ice. The PUF, filter, and blue ice were each individually sealed in zip lock bags that did not leak and so blue ice did not come in contact with the filter or the PUF. In the future the filter and PUF will be sent on dry ice.

The following deviations occurred during the Port St. Lucie Florida survey

The QA Project Plan Section 7.3.5. states that "whole (bulk) water will be collected from three sites within a surface water source of drinking water, and at the water treatment plant influent and outflow... If the drinking water source is groundwater then the surface water samples will be collected from any selected lake, pond, or river...". In Port St. Lucie, drinking water is pumped from groundwater and so the surface water collected does not relate to drinking water supplies. Sampling specifics follow:

- The project manager gave coordinates for surface water collection; these coordinates were not accessible due to private property and needed to be modified. Surface water from Port St. Lucie was collected from the Port St. Lucie River, which is brackish (partially mixed with seawater and slightly saline). Intake and outflow drinking water samples were collected from the municipal drinking water plant.
- Sludge from the Port St. Lucie POTW was pre-treated sludge. After sampling at the POTW, it was discovered that plant staff did not take sludge from the appropriate sludge chamber. The plant manager, Mr. Carl Norton was contacted to confirm the exact sampling location. He informed us that the sludge was collected from the Chlorine Contact Chamber.
- The accuracy of the GPS was not verified in Port St. Lucie. At this city a benchmark could not be found and the accuracy of the GPS was not verified. The manual for the GPS indicates however that if two cities are within 500 miles than a second verification is not needed.

Quiescent water was not sampled at the pre-designated site because it was far from the other sampling sites and time was short. The Battelle project manager, Marcia Nishioka approved changing the location for this reason.

## Field Report Addendum – Columbus, Georgia and Port St. Lucie, Florida Surveys

Atmospheric Sampling Details. The following details are included here to complete the field record with respect to sampler positioning.

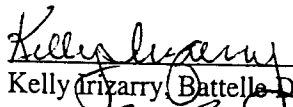
Columbus, GA: The air sampler at this site was positioned approximately 1 foot from the 2-story fire station (station #1) located at 201 10th Street.

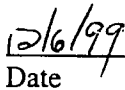
Port St. Lucie, FL: The air sampler in Port St. Lucie was positioned approximately 3 feet from the 2-story fire station (station #5) located at 1616 Port St. Lucie Boulevard.

Surface Water Sampling. The following details are included here to complete the field record with respect to site characteristics.

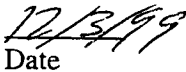
Columbus, GA: The surface water collected at each of 3 sites located within Oliver Lake in every case was collected within 2 m of shore in ca. 0.5 m depth. The client audited this site. Samples were collected as a team: one person waded into the water, the second person prepared and transferred the sample bottles as recommended by the client. In this way the field crew reduced the risk of re-suspending sediments. Re-suspended bottom sediments were avoided.

Port St. Lucie, FL: The surface water collected at each of the 3 sites within the Port St. Lucie River System was collected in each case within 2 m of shore in ca. 0.5 m depth. Re-suspended bottom sediments were avoided in each case.

  
Kelly Trizarry, Battelle Duxbury Operations

  
Date

  
Chris Gagnon, Battelle Duxbury Operations

  
Date