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| Prepared For the U.S. Department of Energy, Assistant Secretary for Environmental Management<br>By Washington River Protection Solutions, LLC., PO Box 850, Richland, WA 99352<br>Contractor For U.S. Department of Energy, Office of River Protection, under Contract DE-AC27-08RV14800<br><br>TRADEMARK DISCLAIMER: Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States government or any agency thereof or its contractors or subcontractors. Printed in the United States of America. |  |                                                                                                                |                                          | <div style="border: 2px solid red; padding: 10px; display: inline-block;"> <b style="color: red; font-size: 1.2em;">DATE:</b><br/> <b style="color: red; font-size: 1.2em;">Feb 28, 2018</b> </div> <div style="border: 2px solid red; padding: 10px; display: inline-block; margin-left: 20px;"> <b style="color: red; font-size: 0.8em;">HANFORD<br/>RELEASE</b> </div> |  |
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| Checker                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  | KRAFT, DOUGLAS P                                                                                               |                                          | KRAFT, DOUGLAS P                                                                                                                                                                                                                                                                                                                                                          |  |
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| Originator                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  | MEZNARICH, HUEI K                                                                                              |                                          | MEZNARICH, HUEI K                                                                                                                                                                                                                                                                                                                                                         |  |
| Responsible Manager                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  | COOKE, GARY A                                                                                                  |                                          | COOKE, GARY A                                                                                                                                                                                                                                                                                                                                                             |  |
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# Investigation of Tank 241-AW-104 Composite Floating Layer

Author Name:

H. K. Meznarich      J. S. Lachut  
S. D. Bolling

Washington River Protection Solutions, LLC  
Richland, WA 99352  
U.S. Department of Energy Contract DE-AC27-08RV14800

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**Abstract:** Seven grab samples and one field blank were taken from Tank 241-AW-104 (AW-104) on June 2, 2017, and received at 222-S Laboratory on June 5, 2017. A visible layer with brown solids was observed floating on the top of two surface tank waste samples (4AW-17-02 and 4AW 17 02DUP). The floating layer from both samples was collected, composited, and submitted for chemical analyses and solid phase characterization in order to understand the composition of the floating layer. Tributyl phosphate and tridecane were higher in the floating layer than in the aqueous phase. Density in the floating layer was slightly lower than the mean density of all grab samples. Sodium nitrate and sodium carbonate were major components with a trace of gibbsite and very small size agglomerates were present in the solids of the floating layer. The supernate consisted of organics, soluble salt, and particulates.

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# Investigation of Tank 241-AW-104 Composite Floating Layer

**H. K. Meznarich**

**S. D. Bolling**

**J. S. Lachut**

**G. A. Cooke**

Washington River Protection Solutions LLC

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## Executive Summary

Tank 241-AW-104 was last sampled for solids-waste core samples in 2001 and had its last large-scale waste transfer in 2003. A visible layer with brown solids was observed floating on the top of the 4AW-17-02 and 4AW-17-02DUP samples (surface tank waste) taken in June 2017. The floating layers from both samples were collected, composited, and analyzed for semivolatile organic analysis and solid phase characterization in order to understand the composition of the floating layer. A liquid sample collected from the mid-section of the aqueous phase of 4AW-17-02 was also submitted for semivolatile organic analysis to serve as a comparison to the floating layer sample. This document reports the composition of the composite floating layer based on the semivolatile organic, density, and solid phase characterization results.

Tributyl phosphate and tridecane (a tentatively identified compound) were found in the composite floating layer sample. A trace of tributyl phosphate, tridecane, and a number of unknown hydrocarbons were present in the aqueous phase of sample 4AW-17-02. The concentration of tributyl phosphate and the estimated concentration of tridecane were much higher in the floating layer than in the aqueous phase. Density in the composite floating layer was slightly lower than the mean density of all eight grab samples. Both results complemented each other and showed high content of tributyl phosphate and tridecane in the floating layer.

Total organic carbons from the small organic acids (including acetate, formate, glycolate, and oxalate) were calculated based on the concentration of small organic acids and were compared against the total organic carbons determined either by the persulfate oxidation or the furnace oxidation. The total organic carbons from the small organic acids for samples 4AW-17-02 to 4AW-17-08, relative to the total organic carbons, ranged from 54 – 62% indicating the presence of other organic species. The ratios did not have a wide variation, indicating other organic species were present from the top of the tank supernate to the bottom of the supernate.

Sodium nitrate and sodium carbonate were major inorganic components with a trace of gibbsite, and very small size agglomerates ( $<10\ \mu\text{m}$ ) were present in the solids of the floating layer based on solid phase characterization. Agglomerates were possibly made of gibbsite, thermonatrite, nitratine, natrophosphate, hematite, cejkaite/clarkeite, and metal-containing materials. Sodium hydroxide and organic coating particulates (uranyl nitrate tributyl phosphate complex) were also found in the solids of floating layer. The yellow supernate (with the presence of soluble uranyl nitrate) of the floating layer consisted of organics, soluble salt, and fine-grained particulates. The presence of carbonate indicated the chemical reactions of dissolved carbon dioxide with hydroxide ion or ongoing oxidation of organics. The presumed formation of uranyl nitrate tributyl phosphate complex (uranyl nitrate is soluble in tributyl phosphate) resulted from a reaction similar to what was used to extract uranyl nitrate from the acidified spent fuel in the plutonium uranium extraction process, which used a mixture of tributyl phosphate and kerosene.

The re-formation of a floating layer over time was observed on 4AW-17-02 and 4AW-17-02DUP reflecting chemical reactions occurred. Subsampling of the re-formed floating layer for small organic acids and total organic carbons has been scheduled and will be included in a revision of this report when the results are available.

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## LIST OF TERMS

### Abbreviations and Acronyms

|                    |                                                            |
|--------------------|------------------------------------------------------------|
| AW-104             | Tank 241-AW-104                                            |
| EDS                | energy dispersive spectroscopy (spectrometry)              |
| GC                 | gas chromatography                                         |
| IC                 | ion chromatography                                         |
| ID                 | identification                                             |
| MS                 | mass spectrometry or matrix spike                          |
| Na                 | not applicable                                             |
| ND                 | not determined                                             |
| OH                 | free hydroxide                                             |
| PCB                | polychlorinated biphenyl                                   |
| PLM                | polarized light microscope(py)                             |
| PUREX              | Plutonium and Uranium Extraction                           |
| Q                  | qualifier                                                  |
| QC                 | quality control                                            |
| RI                 | refractive index                                           |
| RT                 | retention time                                             |
| SOA                | small organic acids                                        |
| SD                 | standard deviation                                         |
| SEM                | scanning electron microscopy                               |
| SPC                | solid phase characterization                               |
| SVOA               | semivolatile organic analysis                              |
| TBP                | tributyl phosphate                                         |
| TC                 | total carbon                                               |
| TIC                | total inorganic carbon or tentatively identified compounds |
| TOC                | total organic carbon                                       |
| TOC <sub>SOA</sub> | total organic carbon from small organic acids.             |
| TOC <sub>p</sub>   | total organic carbon determined by the persulfate method.  |
| TOC <sub>f</sub>   | total organic carbon determined by the furnace method.     |
| WAI                | Wastren Advantage, Inc.                                    |
| WHL                | Wastren Advantage, Inc., Hanford Laboratory                |
| XRD                | X-ray diffraction                                          |

### Units

|    |              |
|----|--------------|
| g  | gram(s)      |
| hr | hour         |
| L  | liter        |
| µg | microgram(s) |
| µm | micrometer   |
| M  | molarity     |
| mg | milligram    |
| mL | milliliter   |
| %  | percent      |

## 1 INTRODUCTION

Seven grab samples and one field blank were taken from Tank 241-AW-104 (AW-104) on June 2, 2017 (RPP-PLAN-61252, *Tank 241-AW-104 Grab Sampling and Analysis Plan – Fiscal Year 2017*), and received at 222-S Laboratory on June 5, 2017. Sample 4AW-17-01 was not taken, and a visible layer with brown solids floating on the top of the 4AW-17-02 and 4AW-17-02DUP samples was observed (RPP-RPT-60261, *Final Report for Tank 241-AW-104 Grab Sampling 2017*). The floating layer from both samples was collected, composited, and submitted for chemical analyses and solid phase characterization (SPC) in order to understand the composition of the floating layer. Due to limited availability of the composite floating layer sample, only semivolatile organic analysis (SVOA) and SPC were performed.

Tank AW-104 entered service in 1980 when it first received dilute caustic solution (LA-UR-97-311, *Waste Status and Transaction Record Summary (WSTRS)*). Since then, AW-104 also received waste from various tanks including Tank 241-AY-101 (1981); decladding waste from the Plutonium Uranium Extraction (PUREX) facility (1982-1983); Tank 241-AZ-101 supernatant waste (1983); and transfers of PUREX miscellaneous waste (1982 and from 1986 to 1991) (RPP-RPT-58671, *Derivation of Best-Basis Inventory for Tank 241-AW-104 as of May 1, 2015*). In addition, AW-104 received periodic additions of flush water through its history (LA-UR-97-311). Waste in AW-104 tank was also transferred to other tanks, such as dilute non-complexed waste to Tank 241-AW-105 in 1982 and 1983, supernatant waste to Tank 241-AW-102 as 242-A Evaporator feed (1982 – 1989), and a transfer to 241-AW-102 in support of Evaporator Campaign 01-10 (2001) (RPP-RPT-58671). Tank AW-104 has not had any waste transaction since 2003 except some loss due to evaporation (RPP-13639, *Caustic Limits Report for Period Ending March 30<sup>th</sup>, 2017*). The tank was last sampled for solids/core samples in 2001 and for two grab samples in 2003 (RPP-58671).

Tank AW-104 contains supernatant liquid, saltcake, and sludge (RPP-RPT-58671) with approximately 289 inches of supernatant depth (RPP-PLAN-61252). A uniform liquid surface with no visually discernable crust or solids layer was observed from images taken during in-tank inspection in 2009 (RPP-13639). The supernatant waste phase is suspected to contain at least two separate layers of liquid based on samples taken in 2003, and a secondary liquid phase was suspected near the surface of the supernatant liquid (RPP-PLAN-61252). Twenty inches of supernatant liquid was left in the tank after a waste transfer in 2001. This supernatant waste had a lower density than the waste pumped into the tank in 2003 and is thought to have moved to the top layer in the tank (RPP-PLAN-61252).

In order to ensure the waste remains in compliance with the corrosion mitigation requirements, liquid grab samples were collected from AW-104 on June 2, 2017, in accordance with RPP-PLAN-61252. In addition, sample data may be needed for a compatibility assessment to support future waste transfer(s) from AW-104 and for modelling to support mission planning.

This document reports the investigation of the composite floating layer from the two surface tank samples (4AW-17-02 and 4AW-17-02 DUP) taken on June 2, 2017.

## 2 SAMPLES

### 2.1 THE FIRST FLOATING LAYER

Seven grab samples and one field blank were taken from AW-104 on June 2, 2017, and received at 222-S Laboratory on June 5, 2017. Figure 1 taken from RPP-PLAN-61252 Figure 3-1 is provided to illustrate the location where the AW-104 grab samples were taken. The exact location of the samples taken is in the Field Work Supervisor data sheet per the relevant sampling work order. Although three grab samples (4AW-17-01, 4AW-17-02, and 4AW-17-02DUP) were originally scheduled to be collected at the surface of the supernatant liquid, the 4AW-17-01 grab sample was not successfully collected.

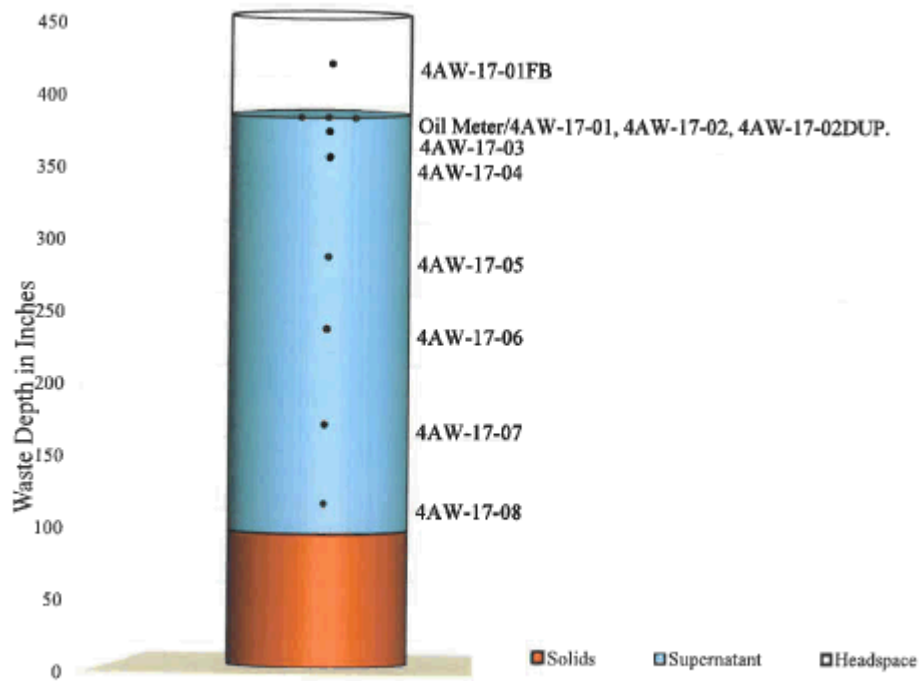
When they were received at the 222-S Laboratory, samples 4AW-17-02 and 4AW-17-02 DUP appeared as yellow liquid with light cloudy to brownish solids suspended in the liquid or floated on the top of the liquid (Figure 2, left). A thin dark layer remained on the surface of both 4AW-17-02 and 4AW-17-02 DUP samples 60 hr after receipt at the laboratory (Figure 2, right).

Subsampling of the dark floating layers of both 4AW-17-02 and 4AW-17-02 DUP was performed in the 222-S Laboratory 11A hot cell by Wastren Advantage, Inc., (WAI) Hanford Laboratory (WHL) personnel per the client's instruction (RPP-PLAN-61252). Approximately 1 g of each top layer was taken from 4AW-17-02 and 4AW-17-02 DUP to make samples S17T019207 and S17T019217, respectively. Aliquots of sample S17T019217 were transferred into the sample jar of S17T019207 on July 12, 2017, in 222-S Laboratory room 2B by the WHL personnel to make the composite sample (S17T023360, a composite from the floating layer, see Appendix A, page 34). Subsequently, S17T023360 was split into two subsamples, S17R000148 and S17R000149.

Only 0.5 mL of S17T023360 was used to determine the density by WHL (on July 12, 2017) due to inadequate sample amount in S17T023360. After the density measurement, this 0.5-mL aliquot of S17T023360 was assigned a new identification number (S17R000149) for SPC analysis. Only polarized light microscopy (PLM) and scanning electron microscopy - energy dispersive spectrometry analysis (SEM-EDS) were performed on S17R000149; no X-ray diffraction (XRD) was performed due to inadequate sample material. The remainder of S17T023360 was assigned a new identification number as S17R000148, and then submitted for SVOA, small organic acids (SOA) by ion chromatography (IC), and total inorganic carbon/total organic carbon (TIC/TOC) by persulfate oxidation method. Only SVOA analysis was performed on S17R000148; SOA and TIC/TOC were not performed due to inadequate sample amount of S17R000148.

A liquid sample collected from the mid-section of the aqueous phase of 4AW-17-02 (S17T023353) was also submitted for SVOA analysis in order to compare the SVOA results in the aqueous phase against the SVOA results of the floating layer.

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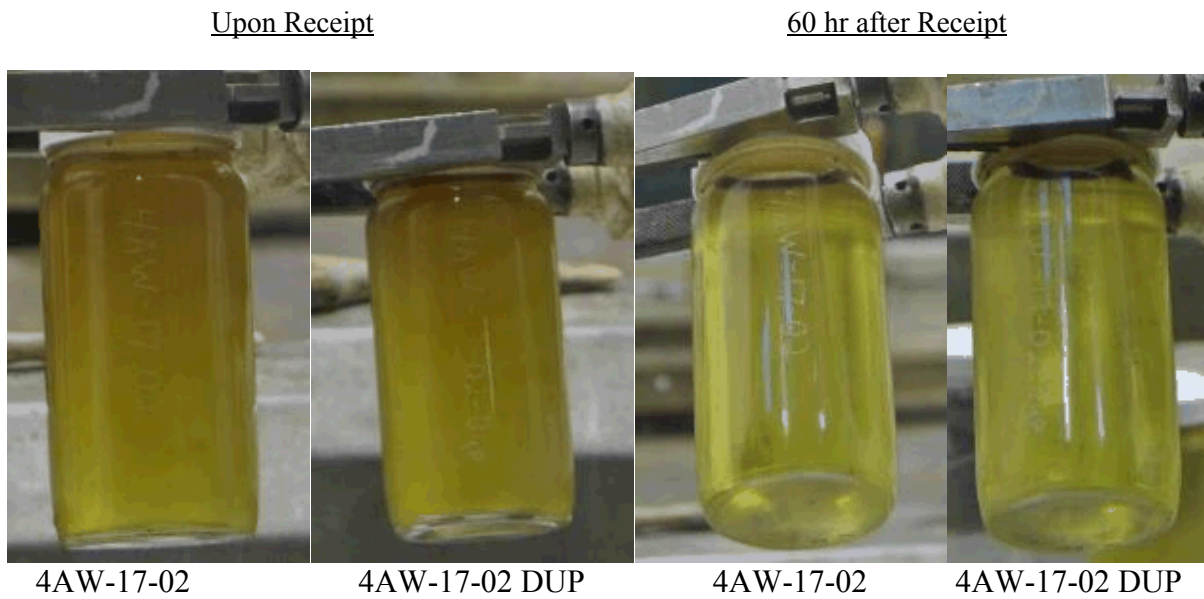
Notes: Riser 14 is not in the center of the tank. The diagram above is not intended to represent horizontal position.

**Figure 1. Approximate Sample Locations for AW-104 2017 Sampling Event  
(Taken from RPP-PLAN-61252, Figure 3-1).**

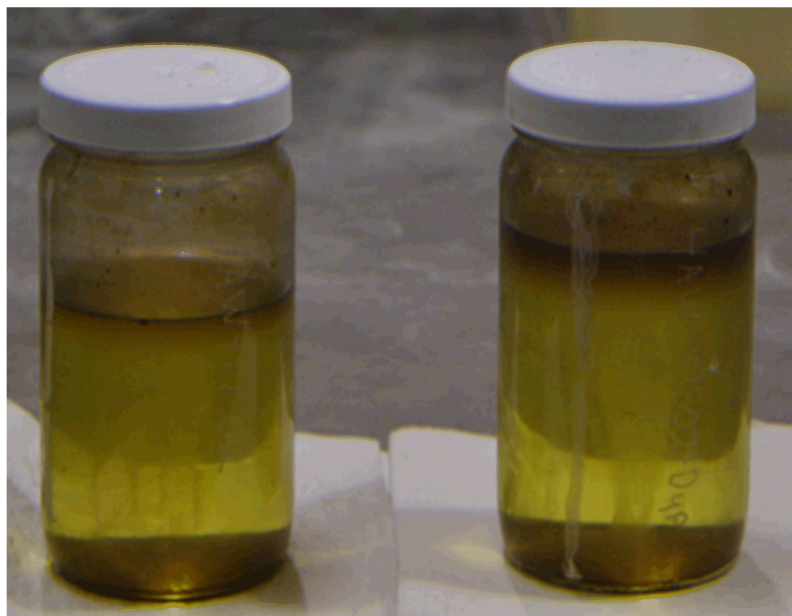
## 2.2 SECOND FLOATING SAMPLE AFTER COLLECTING THE FIRST FLOATING LAYER

Samples 4AW-17-02 and 4AW-17-02 DUP have been largely undisturbed since the subsampling of the top layer taken in late June of 2017. A second subsampling of both 4AW-17-02 and 4AW-17-02 DUP was attempted on October 2, 2017, for a viscosity study; it was discovered that a visible floating layer had reformed on both samples (Figure 3). Per client instruction, the second floating layer will be collected from both samples (4AW-17-02 and 4AW-17-02 DUP) and will be composited to make sample S17R000246. Aliquots of sample S17R000246 with a new identification (ID) number, S17R000247, will be submitted to WHL for anions and SOAs by IC, TIC/TOC, and total carbon (TC)/TOC by furnace (see Appendix A, page 42). Aliquots of sample S17R000246 will also be submitted for PLM, SEM, and/or XRD analyses pending the availability of sample S17R000246. This report will be revised to include the results from the second floating sample and further observations of the floating layer.

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**Figure 2. 4AW-17-02 and 4AW-17-02 DUP upon Receipt and 60 hr after Receipt.**



**Figure 3. Photos of 4AW-17-02 (on the left) and 4AW-17-02 DUP (on the right) on October 2, 2017.**



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**Table 1. Laboratory Sample Identification Numbers and Analyses for the First Floating Layer.**

| Sample Identification / Actions                            | Grab Samples                      |                       |
|------------------------------------------------------------|-----------------------------------|-----------------------|
|                                                            | 4AW-17-02                         | 4AW-17-02 DUP         |
| Sample ID of Organic Layer                                 | S17T019207                        | S17T019217            |
| Sample ID for Composite of Organic Layer                   | S17T023360                        |                       |
| Split the Composite of Organic Layer and New Laboratory ID | S17R000148                        | S17R000149            |
| Requested Analyses                                         | SVOA, anions and SOA, and TIC/TOC | Density, PLM, and SEM |
| Liquid Sample from Mid-section of Aqueous Phase for SVOA   | S17T023353 for SVOA analysis      | na                    |

**Table 2. Laboratory Sample Identification Numbers and Analyses for the Second Floating Layer (results not available in revision 0 of this report).**

| Sample Identification / Actions                  | Grab Samples               |                       |
|--------------------------------------------------|----------------------------|-----------------------|
|                                                  | 4AW-17-02                  | 4AW-17-02 DUP         |
| Sample ID of Organic Layer                       | S17T015732                 | S17T015773            |
| Sample ID for Composite of Organic Layer         | S17R000246                 |                       |
| Composite of Organic Layer and New Laboratory ID | S17R000247                 |                       |
| Requested Analyses                               | Anions and SOA, and TC/TOC | Density, PLM, and SEM |

### 2.3 ANALYSES

Tables 1 and 2 summarize the requested analyses for the composite floating layer sample (S17R000148 and S17R000149) and for the future composited sample (S17R000247) collected from the second formation of the floating layer. The composite floating layer sample (S17R000149) was analyzed for SPC including PLM and SEM/EDS. Chemical analyses were requested for the composite floating layer sample (S17R000148), including anions and SOA by IC, density, SVOA by gas chromatography/mass spectrometry (GC/MS), TIC/TOC by the persulfate method, and/or TC/TOC by the furnace method. However, IC, TIC/TOC, and TC/TOC were not performed on the composite floating sample (S17R000148) due to inadequate sample material.

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One aqueous sample (S17T023353) was extracted by the continuous liquid-liquid methylene chloride extraction method under both basic and acidic conditions. The composite floating layer sample (S17R000148) was diluted with an applicable amount of methylene chloride for a direct injection. Aliquots of extracts obtained from the continuous liquid-liquid extraction or aliquots of the methylene chloride diluted floating layer sample were injected into a GC/MS system for SVOA analysis.

Analyses were performed by WHL per their analytical procedures (see Table 3) for anions and SOAs by IC, density (in g/mL), SVOA, TIC/TOC by persulfate oxidation and coulometric detection, and TC/TOC by the furnace method. Process Chemistry of the 222-S Laboratory performed SPC including PLM and SEM-EDS per the applicable procedures listed in Table 3.

**Table 3. Analytical and Solid Phase Characterization Procedures.**

| Analyte(s) or Method           | Procedure Number | Procedure Title                                                                                 |
|--------------------------------|------------------|-------------------------------------------------------------------------------------------------|
| Anions and Small Organic Acids | LA-533-166       | Ion Chromatographic Analysis of Anions and Small Organic Acids on DIONEX Model ICS 3000         |
| Density                        | LA-510-112       | Determination of Density for Free Liquid Samples                                                |
| Free Hydroxide (OH)            | LA-211-102       | Determination of Free OH <sup>-</sup> /OH <sup>+</sup> Using Metrohm Titrand                    |
| SVOA, Liquid-Liquid Extraction | LA-523-115       | Semivolatiles and PCBs from Aqueous Samples Using Semimicro Continuous Liquid-Liquid Extraction |
| SVOA                           | LA-523-135       | Semivolatile Organics by Gas Chromatography/Mass Spectrometry, Based on SW-846, Method 8270D    |
| TIC/TOC                        | LA-342-100       | Determination of Carbon by Hot Persulfate Oxidation and Coulometric Detection                   |
| TC/TOC by Furnace              | LA-344-105       | Determination of Carbon in Solutions by Combustion and Coulometry                               |
| Solid Phase Characterization   | Procedure Number | Procedure Title                                                                                 |
| PLM                            | ATS-LT-519-107   | 222-S Laboratory Polarized Light Microscopy                                                     |
| SEM, Preparation               | ATS-LT-161-104   | SEM Sample Preparation Procedure                                                                |
| SEM                            | ATS-LT-161-103   | 222-S Laboratory Technology Procedure for the ASPEX Explorer Scanning Electron Microscope       |

PCB = polychlorinated biphenyl

### 3 RESULTS AND DISCUSSION

S17R000148 contained a darker brown solid residue with a brownish yellow supernate. S17R000149 was a clear, brownish yellow supernate and did not appear to contain residues of

solids (after density study and solids were excluded). Residues of solids (trace amount) were visible in the original container of S17R019217.

### 3.1 SEMIVOLATILE ORGANIC RESULTS

Semivolatile organic results and the associated quality control (QC) results are provided in Appendix B. The liquid sample (S17T023353, aqueous phase of 4AW-17-02) had no particulate formation during the base-neutral step of the extraction, but a fine, white precipitate formed during the acidic step, and then settled in the methylene chloride layer. The final extract appeared completely clear following filtration through sodium sulfate.

The majority of the routine QC samples associated with the liquid sample extraction met their method acceptable criteria with some exceptions. Low responses of internal standards were found for perlyene-D12 in the liquid sample and for acenaphthalene-D10 in the matrix spike (MS) sample due to matrix effects. Acid surrogates (2-fluorophenol, phenol-D6, and 2,4,6-tribromophenol) were eliminated due to nitration by the matrix. Benzylbutyl phthalate and bis (2-ethylhexyl) phthalate were detected in the blank, but were below the reporting limits. The liquid sample was extracted outside the 7-day holding time requirement as the request for this analysis was added after sample receipt (RPP-PLAN-61252, 17-CCN-10, Characterization Change Notice).

Note that recoveries of acid surrogates in sample S17R000148, which was not extracted by methylene chloride extraction, failed low; however, there was no evidence of nitration of acid surrogates.

Table 4 summarizes SVOA results including the detected target compounds and tentatively identified compounds (TICs) for the composite floating layer sample (S17R000148) and the aqueous phase of 4AW-17-02 (S17T023353) (RPP-RPT-60261 and Appendix 10). Only one target analyte, tributyl phosphate (TBP) and one TIC, tridecane, were found in the floating layering. A trace amount of TBP and small amounts of phenols, tridecane, and tetradecane were present in the aqueous phase of 4AW-17-02. Two phthalates found in the aqueous phase could be contaminants acquired during the analytical process because they were also present in the blank. Another 18 unknown TICs were also found in the aqueous phase, but were not detected in the floating layer, possibly due to a much higher detection limit caused by the much smaller sample size and dilute/direct injection to GC/MS without the concentration step in sample preparation. A further evaluation of the TIC's spectra was performed (Appendix C). The majority of these TICs were unknown hydrocarbons which may be the degradation products of hydrocarbons.

The hydrocarbon-based compound (butanoic acid) was most likely the degradation product of the hydrocarbons that converted to the acid form due to methylene chloride extraction at low pH. Note that the qualitative acetic results by GC/MS method (0.01 mg/mL) was much lower than the acetate result determined by the IC (1.45 mg/mL, see RPP-RPT-60261, page 72), possibly due to either low acetate solubility in methylene chloride or loss of acetate during the concentration step after methylene chloride extraction.

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The estimated tridecane concentration was approximately 20 times higher in the floating layer than in the aqueous phase, and the TBP concentration was also much higher in the floating layer than in the aqueous phase, indicating the floating layer of 4AW-17-02 consisted of mainly hydrocarbons and TBP, while the aqueous phase consisted of mainly degradation products of hydrocarbons.

**Table 4. Semivolatile Results on Composite Floating Layer and Aqueous Phase. (2 pages)**

| S17R000148, Composite Floating Layer   |        |                |        | 4AW-17-02 (S17T023353), Aqueous Phase   |       |                  |        |
|----------------------------------------|--------|----------------|--------|-----------------------------------------|-------|------------------|--------|
| Compounds                              | µg/L   | Q              | RT min | Compounds                               | µg/L  | Q                | RT min |
| Tri-n-butyl phosphate                  | 123000 | J <sup>1</sup> | 13.21  | Tri-n-butyl phosphate                   | 815   | J <sup>1</sup>   | 13.17  |
| na                                     | na     | na             | na     | Pentachlorophenol                       | 550   | J <sup>1,b</sup> | 14.29  |
| na                                     | na     | na             | na     | 2,4-Dinitrophenol <sup>b</sup>          | 1110  | J <sup>1,b</sup> | 12.22  |
| na                                     | na     | na             | na     | 4,6 Dinitro-2-methylphenol <sup>b</sup> | 552   | J <sup>1,b</sup> | 13.11  |
| na                                     | na     | na             | na     | 4-Nitrophenol <sup>b</sup>              | 709   | J <sup>1,b</sup> | 12.31  |
| na                                     | na     | na             | na     | Butylbenzylphthalate                    | 564   | J <sup>1</sup>   | 18.03  |
| na                                     | na     | na             | na     | N-Nitrosodimethylamine                  | 989   | J <sup>1</sup>   | 4.00   |
| na                                     | na     | na             | na     | bis (2-Ethylhexyl) phthalate            | 603   | J <sup>1</sup>   | 19.03  |
| Tentatively Identified Compounds, µg/L |        |                | RT min | Tentatively Identified Compounds, µg/L  |       |                  | RT min |
| na                                     | na     | na             | na     | Acetic acid                             | 11710 | JNT <sup>2</sup> | 2.83   |
| na                                     | na     | na             | na     | Butanoic acid                           | 8985  | JNT <sup>2</sup> | 4.65   |
| na                                     | na     | na             | na     | Unknown 1, unknown hydrocarbon          | 25762 | 5.34             | 5.34   |
| na                                     | na     | na             | na     | Unknown 2, unknown hydrocarbon          | 34590 | JNT <sup>2</sup> | 5.5    |
| na                                     | na     | na             | na     | Phosgene oxime                          | 4862  | JNT <sup>2</sup> | 5.57   |
| na                                     | na     | na             | na     | Unknown 3, unknown hydrocarbon          | 26106 | JNT <sup>2</sup> | 5.89   |
| na                                     | na     | na             | na     | Unknown 4, unknown hydrocarbon          | 4352  | JNT <sup>2</sup> | 6.07   |
| na                                     | na     | na             | na     | Unknown 5, unknown hydrocarbon          | 10281 | JNT <sup>2</sup> | 6.12   |
| na                                     | na     | na             | na     | Unknown 6, possible hydrocarbon         | 14076 | JNT <sup>2</sup> | 6.33   |
| na                                     | na     | na             | na     | Unknown 7, unknown hydrocarbon          | 27705 | JNT <sup>2</sup> | 6.38   |
| na                                     | na     | na             | na     | Unknown 8, unknown hydrocarbon          | 14461 | JNT <sup>2</sup> | 6.54   |
| na                                     | na     | na             | na     | Unknown 9, unknown hydrocarbon          | 13137 | JNT <sup>2</sup> | 6.79   |

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**Table 4. Semivolatile Results on Composite Floating Layer and Aqueous Phase. (2 pages)**

|           |        |                  |       |                                                        |        |                  |       |
|-----------|--------|------------------|-------|--------------------------------------------------------|--------|------------------|-------|
| na        | na     | na               | na    | Unknown 10, 4-Penten-2-ol                              | 17072  | JNT <sup>2</sup> | 7.26  |
| na        | na     | na               | na    | Unknown 11, 2-Hydroxy-3-pentanone                      | 5710   | JNT <sup>2</sup> | 7.40  |
| na        | na     | na               | na    | Unknown 12, Heptane, 2-Bromo-                          | 8400   | JNT <sup>2</sup> | 7.98  |
| na        | na     | na               | na    | Unknown 13, 1-Propene, 3-propoxy-                      | 13708  | JNT <sup>2</sup> | 8.41  |
| na        | na     | na               | na    | Unknown 14, Heptane, 4-methyl-                         | 9276   | JNT <sup>2</sup> | 8.52  |
| na        | na     | na               | na    | Unknown 15, 1-Propene, 3-propoxy-                      | 5564   | JNT <sup>2</sup> | 8.63  |
| na        | na     | na               | na    | Unknown 16, similar hydrocarbon to compound at RT 8.41 | 14816  | JNT <sup>2</sup> | 8.98  |
| na        | na     | na               | na    | Unknown 17, Hydrazinecarboximidamine, nitrate          | 5754   | JNT <sup>2</sup> | 9.1   |
| Tridecane | 220000 | JNT <sup>2</sup> | 10.22 | Tridecane                                              | 10076  | JNT <sup>2</sup> | 10.23 |
| na        | na     | na               | na    | Tetradecane                                            | 8463   | JNT <sup>2</sup> | 11.16 |
| Sum       | 343000 |                  |       | Sum                                                    | 300758 |                  |       |

Q = Qualifier

RT = Retention time

<sup>1</sup> J: Estimated results. Concentration >the method detection limit, but <the estimated quantitation limit.<sup>2</sup> JNT: J is an "unknown" constituent reported for an organic analysis. N and T: Applied to compounds identified based on mass spectrometry library search. Tentatively identified compounds are not target compounds, and the results are only an estimate and not quantitative.<sup>b</sup>: A qualifier. Matrix spike recovery outside the acceptable range.

### 3.2 SMALL ORGANIC ACIDS RELATIVE TO TOTAL ORGANIC CARBONS

The SOA includes acetate, formate, glycolate, and oxalate. Results of SOAs reported in RPP-RPT-60261 for AW-104 grab samples were converted to organic carbon and then summed together as TOC for SOA (TOC<sub>SOA</sub>) (shown in Table 5). The TOC results reported in RPP-RPT-60261, determined either by the persulfate oxidation method (TOC<sub>p</sub>) or by the furnace oxidation method (TOC<sub>f</sub>), were evaluated against the TOC<sub>SOA</sub>. The ratio of TOC<sub>SOA</sub> to TOC<sub>p</sub> or to TOC<sub>f</sub> provides an indication of the presence of other organic species. Table 5 summarizes TOC<sub>SOA</sub>, TOC<sub>p</sub>, TOC<sub>f</sub>, and the ratio of TOC<sub>SOA</sub> to TOC<sub>p</sub> or to TOC<sub>f</sub>.

Note that the concentrations of TOC<sub>SOA</sub>, TOC<sub>p</sub>, and TOC<sub>f</sub> were relatively constant throughout the AW-104 waste. The mean TOC<sub>p</sub> and TOC<sub>f</sub> from the grab samples was 2748 and 2906 µg/mL, respectively. The mean TOC<sub>p</sub> was approximately 95% of the TOC<sub>f</sub>. The discrepancy between TOC<sub>p</sub> and TOC<sub>f</sub> may be due to incomplete persulfate oxidation for some organic species.

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The ratios of  $\text{TOC}_{\text{SOA}}$  to  $\text{TOC}_{\text{p}}$  and  $\text{TOC}_{\text{SOA}}$  to  $\text{TOC}_{\text{f}}$  were relatively constant throughout AW-104 tank waste supernate and typically ranged from 58 to 62% for the former and 54 – 58% for the latter. The less than 100% ratio indicated there are other organic species present, evidenced by the presence of hydrocarbons and/or degradation products of hydrocarbons identified by the SVOA results. Unfortunately, the ratio of  $\text{TOC}_{\text{SOA}}$  to  $\text{TOC}_{\text{p}}$  or  $\text{TOC}_{\text{f}}$  for the floating layer was not available due to inadequate sample material for SOA, TC/TOC, and TIC/TOC analyses. However, the floating layer, having been formed three months later following the first collection of the floating layer, will be collected and analyzed for SOA, TC, and TOC and will provide additional comparison to the aqueous phase.

**Table 5. Contribution of Small Organic Acids to Total Organic Carbons on AW-104 Grab Samples.**

| Samples       | Sample Identification | $\text{TOC}_{\text{SOA}}$ | $\text{TOC}_{\text{p}}$ | $\text{TOC}_{\text{f}}$ | $\text{TOC}_{\text{SOA}} / \text{TOC}_{\text{p}}$ | $\text{TOC}_{\text{SOA}} / \text{TOC}_{\text{f}}$ |
|---------------|-----------------------|---------------------------|-------------------------|-------------------------|---------------------------------------------------|---------------------------------------------------|
|               |                       | µg/mL                     | µg/mL                   | µg/mL                   | %                                                 | %                                                 |
| 4AW-17-01     | S17T015731            | na                        | na                      | na                      | na                                                | na                                                |
| 4AW-17-02     | S17T015748            | 1664                      | 2690                    | 2930                    | 62                                                | 57                                                |
| 4AW-17-02 DUP | S17T015774            | 1641                      | 2760                    | 2870                    | 59                                                | 57                                                |
| 4AW-17-03     | S17T015781            | 1607                      | 2770                    | 2860                    | 58                                                | 56                                                |
| 4AW-17-04     | S17T15788             | 1646                      | 2750                    | 2850                    | 60                                                | 58                                                |
| 4AW-17-05     | S17T015795            | 1623                      | 2790                    | 2980                    | 58                                                | 54                                                |
| 4AW-17-06     | S17T015804            | 1666                      | 2730                    | 2920                    | 61                                                | 57                                                |
| 4AW-17-07     | S17T015811            | 1657                      | 2700                    | 2910                    | 61                                                | 57                                                |
| 4AW-17-08     | S17T015818            | 1652                      | 2790                    | 2930                    | 59                                                | 56                                                |
| Mean          | na                    | 1644                      | 2748                    | 2906                    | 60                                                | 57                                                |
| SD            | na                    | 19                        | 36                      | 41                      | 1.3                                               | 0.9                                               |

SD = standard deviation.

$\text{TOC}_{\text{SOA}}$  = total organic carbon from small organic acids.

$\text{TOC}_{\text{p}}$  = total organic carbon determined by the persulfate method.

$\text{TOC}_{\text{f}}$  = total organic carbon determined by the furnace method.

Note: na: failed to collect this sample.

### 3.3 DENSITY AND FREE HYDROXIDE CONCENTRATION OF GRAB SAMPLES

Table 6 summarizes the density and free hydroxide concentration of AW-104 grab samples and the density of 4AW-17-02 composite floating layer sample. The mean and SD density for the eight grab samples was  $1.350 \pm 0.005$  g/mL and the density of the 4AW-17-02 composite floating layer with one observation was 1.338 g/mL. The aqueous phase (the brown liquid excluded the solid residue) in the composite floating layer was used for the density measurement. The density for the grab samples was measured in the 11A hotcell using a 5-mL sample size.

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The density measurement in the hotcell was not observed, but it was speculated that only the liquid phase was used. The density in the floating layer appeared slightly lower than the density in the aqueous phase, indicating higher concentrations of organics in the floating layer. Density of tridecane and tributyl phosphate is 0.756 g/mL and 0.973 g/mL, respectively, indicating that the organics were not the sole components in the floating layer.

The lower density found in the floating layer agreed with an earlier observation of a layer of lower density supernate which is thought to have moved to the top layer in the tank (RPP-PLAN-61252). Both SVOA and density results complemented each other and showed high content of tributyl phosphate and tridecane in the floating layer.

The concentrations of [OH] of eight grab samples (supernate samples throughout the tank) did not have a wide variation with a higher trend noted near the top (29,400 to 30,000 µg/mL, 1.73M to 1.76M). The concentration of [OH] in the floating layer was not available, but was suggested by SEM-EDS along with nitrate and carbonate by PLM.

**Table 6. Density and Free Hydroxide Concentration of AW-104 Grab Samples.**

| Samples                                                            | Sample Identification<br>Density; [OH] | Density | [OH]  |
|--------------------------------------------------------------------|----------------------------------------|---------|-------|
|                                                                    |                                        | g/mL    | µg/mL |
| 4AW-17-02                                                          | S17T015732; S17T015748                 | 1.348   | 30000 |
| 4AW-17-02 DUP                                                      | S17T015773; S17T015774                 | 1.346   | 29700 |
| 4AW-17-03                                                          | S17T015780; S17T015781                 | 1.348   | 29500 |
| 4AW-17-04                                                          | S17T015787; S17T015788                 | 1.342   | 29700 |
| 4AW-17-05                                                          | S17T015794; S17T015795                 | 1.356   | 29400 |
| 4AW-17-06                                                          | S17T015803; S17T015804                 | 1.351   | 29400 |
| 4AW-17-07                                                          | S17T015810; S17T015811                 | 1.357   | 29400 |
| 4AW-17-08                                                          | S17T015817; S17T015818                 | 1.349   | 29500 |
| --                                                                 | Mean                                   | 1.350   | 29575 |
| --                                                                 | SD                                     | 0.005   | 198   |
| 4AW-17-02 Top Layer                                                | S17R000149                             | 1.338   | ND    |
| SD: standard deviation                                             |                                        |         |       |
| ND: not determined due to inadequate sample available for analysis |                                        |         |       |

### 3.4 POLARIZED LIGHT MICROSCOPY

The organic layer of 4AW-17-02 and 4AW-17-02 DUP was composited to make up sample S17R000149, which is part of sample delivery group 20172604. After the density and pH tests had been completed, S17R000149 was analyzed by PLM.

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The first PLM analysis was performed on July 12, 2017, by S. Bolling and H. Meznarich on sample S17R000149, which had been prepared by L. Dinh. After reviewing the SEM data, sample S17R000149 was re-prepared by J. Eitelman and analyzed by PLM on October 31, 2017, by S. Bolling and M. LaMothe. Both analyses were performed at the 222-S Laboratory using the procedure listed in Table 3.

The primary goal of analyzing this sample was to look for solids forming in the floating layer sample. The PLM is a qualitative technique. Estimates of relative abundance of phases can be made, but these are very rough estimates.

### Description:

Sample S17R000149 was described as having dual phases: yellow supernatant liquid (~3.5 to 16.8 µg/mL Uranium-238 in the grab samples reported in RPP-RPT-60261, possibly causing the yellow color by the presence of soluble uranyl nitrate) as the bottom layer with a brownish-yellow band on top. On July 12, 2017, the dark band made up approximately 20% of the sample. This dark band contained the majority of the solid material found in the sample. On October 31, 2017, only a very thin layer of the dark yellow/brown band was left (partially due to subsample for SEM analysis). The remainder of the sample was the yellow supernate. Table 7 summarizes the abundance of crystals observed on S17R000149 from both dates using PLM.

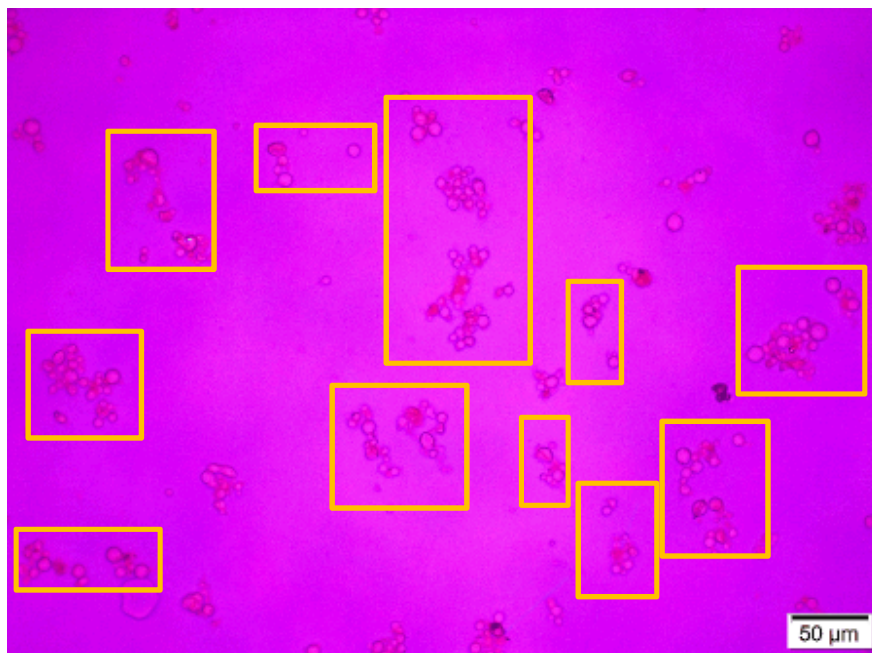
The majority of the material found in the first analysis (mounted in mother liquor) consisted of clusters of isotropic spheres, some of which were coated with particulate (Figures 4 and 5). These spheres were found in both layers although there were fewer present in the supernate than were found in the dark band. This spherical material was originally identified as cancrinite. However, the SEM data did not support this conclusion. Upon further evaluation, it was decided that these isotropic spheres are, in all probability, organic in nature and most likely tiny droplets of water immiscible organics, e.g., uranyl nitrate TBP complex.

**Table 7. Abundance of Crystals Observed using PLM**

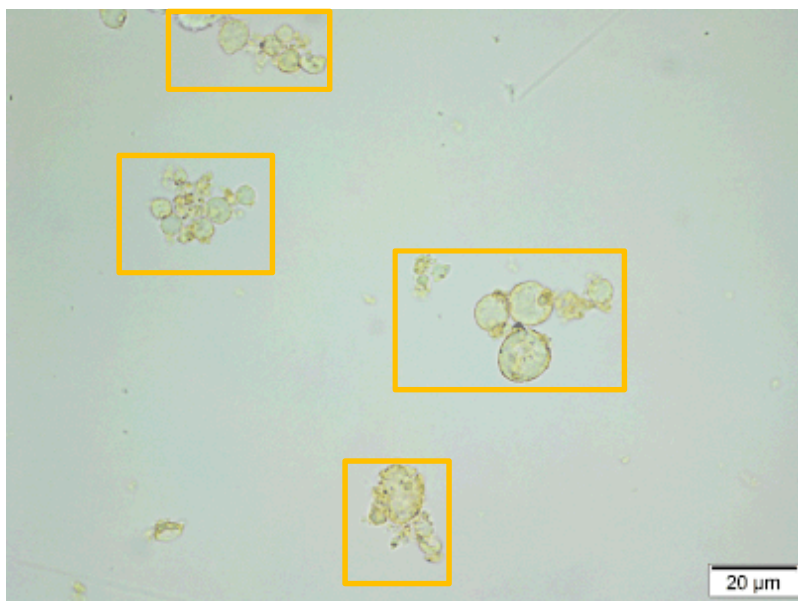
|                          | <b>Chemical Formula</b>                           | <b>S17R000149<br/>(Dark Band)</b> | <b>S17R000149<br/>(Yellow Supernate)</b> | <b>S17R000149<br/>(Dark Band)</b> | <b>S17R000149<br/>(Yellow Supernate)</b> |
|--------------------------|---------------------------------------------------|-----------------------------------|------------------------------------------|-----------------------------------|------------------------------------------|
| Analysis Date            | ---                                               | July 12, 2017                     | July 12, 2017                            | October 31, 2017                  | October 31, 2017                         |
| Sodium Nitrate           | NaNO <sub>3</sub>                                 | N/A                               | N/A                                      | Major                             | N/A                                      |
| Sodium Carbonate         | Na <sub>2</sub> CO <sub>3</sub> •H <sub>2</sub> O | N/A                               | N/A                                      | Major                             | N/A                                      |
| Gibbsite                 | Al(OH) <sub>3</sub>                               | N/A                               | N/A                                      | Trace                             | Trace                                    |
| Fine-grained Particulate | N/A                                               | Major                             | Major                                    | Minor                             | Major                                    |
| Organic Material         | N/A                                               | Major                             | Major                                    | Trace                             | Major                                    |



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**Figure 4. (Photo S17R000149a, Upper Layer, Mounted in Mother Liquor), Crossed Polars with the Red I Compensator Plate in Place, Showing Isotropic Spheres (Peach Rectangles), Some of which are Coated with Particulate.**



**Figure 5. (Photo S17R000149f, Upper Layer, Mounted in Mother Liquor), Uncrossed Polars, Showing Isotropic Spheres (Peach Rectangles), Some of which are Coated with Particulate.**

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The second analysis of the upper layer was very different than the original analysis. In the first analysis, very few solids were found in either layer. In the second analysis, the dark band contained a considerable amount of solid material. Sodium nitrate (light green circles shown in Figures 6 and 7) and sodium carbonate (yellow rectangles shown in Figure 6) were major phases while gibbsite (blue circles in Figure 7) was present in trace amounts. Black shapes found in Figure 6 were micelles which formed when the mother liquor was mounted in refractive index (RI) 1.55 oil. Also a few isotropic spheres, most likely uranyl nitrate TBP complex  $[\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{TBP}]$  (peach rectangle shown in Figure 7), were found.

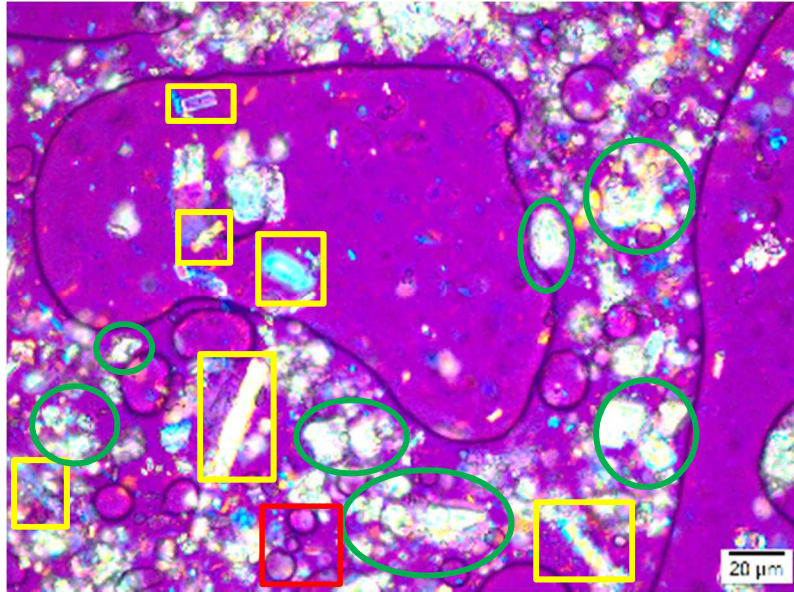
The results from the second analysis of the supernatant layer more closely matched those from the first analysis. Figures 8a and 8b show the isotropic spherical clusters, uranyl nitrate TBP complex (peach rectangles), found in the yellow supernate portion of the sample S17R000149 and a small gibbsite particle (blue circle). The other circles were micelles that formed when mother liquor was mounted in RI oil due to the amphiphilic surfactant property of TBP. The yellow supernate contained isotropic spherical clusters as the major phase and a trace amount of gibbsite.

Samples were mounted in RI oils, water, and/or mother liquor in the second analysis. When mounted in water, all of the solids in both layers dispersed. A mount of the thin dark band in mother liquor was attempted, but the mother liquor quickly dried. It was necessary to add 1.550 RI oil. After adding the RI oil, it was noted that very small 4-quadrant, lightly birefringent, spherical shapes formed. These particles, suspected to be uranyl nitrate TBP complex, were prevalent in addition to sodium nitrate (Figure 9). Based on this observation, it appears that over time, sodium nitrate, sodium carbonate, and uranyl nitrate TBP complex precipitated or formed in sample S17R000149. The presence of carbonate could be the result of chemical reactions between the dissolved carbon dioxide and hydroxide ion or the ongoing oxidation of organics. The formation of uranyl nitrate TBP complex was produced by a chemical reaction similar to that used to extract uranyl nitrate from the acidified spent fuel in the plutonium extraction process, which used a mixture 30% TBP and a hydrocarbon solvent (kerosene). Note that uranyl nitrate is soluble in TBP/hydrocarbon diluent.

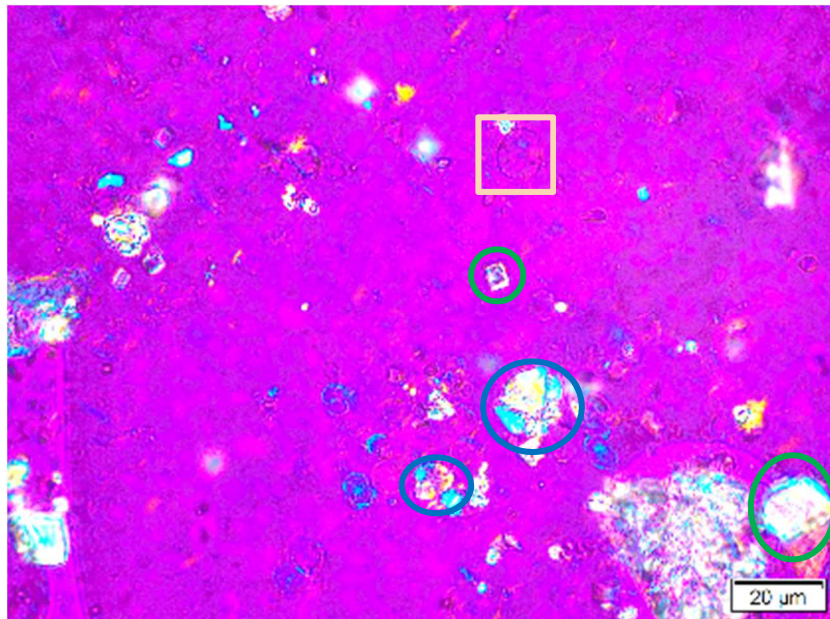
As mentioned previously, the yellow supernate contained primarily isotropic spherical clusters, which dispersed when mounted in water. There were fewer clusters and these clusters were smaller ( $<5 \mu\text{m}$ ) when mounted in RI oils than when mounted in mother liquor, which indicated there was also some dissolution or dispersion of the spheres in the RI oils. Using the Becké line test, it was determined that the RI of these spheres was greater than that of the mother liquor, but less than 1.45. This material is most likely organic in nature (i.e., RI of tridecane is 1.425).

The second PLM results indicated that the solids darker band of the floating layer consisted of major nitrate and sodium carbonate and traces of small size gibbsite. The yellow supernate in the floating layer consisted of organics, fine-grained particulates, and soluble salts. Precipitation occurred in the subsample over time, with inorganic crystals concentrating in the floating layer, e.g., uranyl nitrate TBP complex in the organic-rich floating layer.

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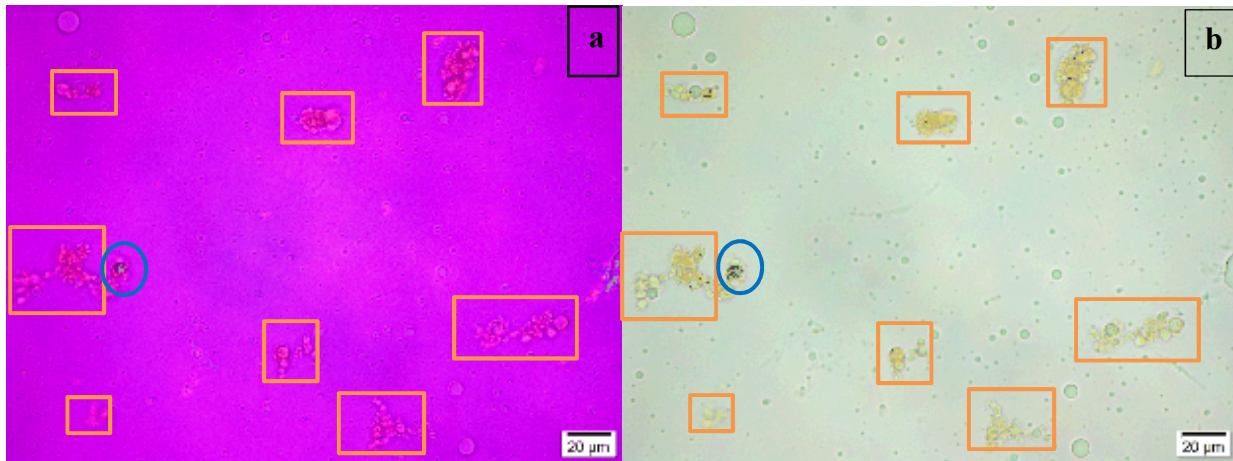
**Figure 6. (Photo S17R000149aa, Upper Layer, Mounted in 1.55 RI Oil), Crossed Polars with the Red I Compensator Plate in Place, Showing Sodium Nitrate (Light Green Circles), Sodium Carbonate (Yellow Rectangles), and Micelles (Red Square).**



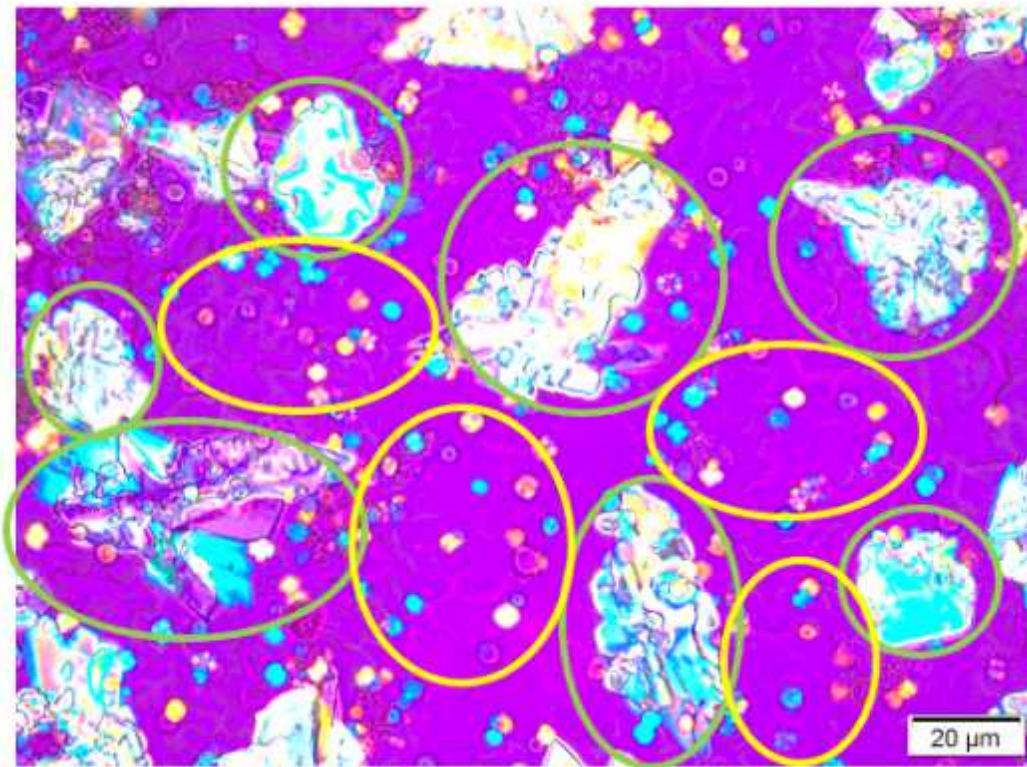
**Figure 7. (Photo S17R000149ee, Upper Layer, Mounted in 1.55 RI Oil), Crossed Polars with the Red I Compensator Plate in Place, Showing Sodium Nitrate (Light Green Circles), Gibbsite (Blue Circles), and Isotropic Sphere (Peach Rectangle).**



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**Figure 8. 8a and 8b. Photo S17R000149pp, Bottom Layer, on the Left, Mounted in 1.45 RI Oil with Crossed Polars and the Red I Compensator Plate in Place. Photo S17R000149qq, (on the Right), the Same View but with Uncrossed Polars. Isotropic Spheres (Peach Rectangles) and Gibbsite (Blue Circle). Micelles can be seen in the Background.**

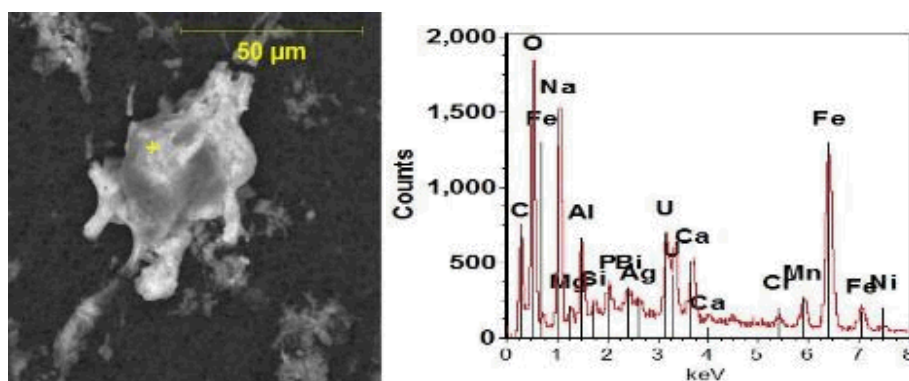


**Figure 9. (Photo S17R000149ee, Upper Layer, Mounted in 1.55 RI Oil after Mother Liquor Evaporated), Crossed Polars with the Red I Compensator Plate in Place, Showing Sodium Nitrate as it Dissolves (Light Green Circles), and Very Small Lightly Birefringent Particles, Suspected to be Uranyl Nitrate TBP Complex (Yellow Circles).**

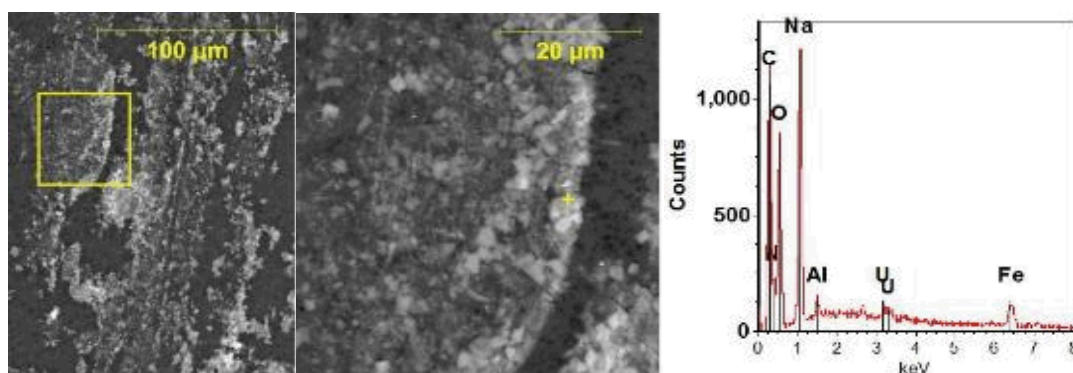
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### 3.5 SCANNING ELECTRON MICROSCOPY – DISPERSIVE ENERGY SPECTROMETRY

The top layer of sample S17R000149 was pipetted off and filtered prior to SEM-EDS analysis (Figures 10 to 16) or filtered without applying vacuum (Figures 17 and 18). Numerous elements were found in this sample. It seems to follow a pattern of most tanks in that the particle size is very small (5-10  $\mu\text{m}$ ) and agglomerate. The compositions of the majority of these particulates/agglomerates possibly included gibbsite ( $\text{Al}(\text{OH})_3$ ), thermonatrite [ $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$ ], hematite ( $\text{Fe}_2\text{O}_3$ ), potassium or sodium chloride ( $\text{KCl}$  or  $\text{NaCl}$ ), cejkaite [ $\text{Na}_4(\text{UO}_2)(\text{CO}_3)_3$ ], clarkeite [ $\text{Na}(\text{UO}_2)\text{O}(\text{OH}) \cdot \text{H}_2\text{O}$ ], uranyl nitrate TBP complex [ $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{TBP}$ ], nitratine ( $\text{NaNO}_3$ ), natrophosphate [ $\text{Na}_7\text{F}(\text{PO}_4)_2 \cdot 19\text{H}_2\text{O}$ ], and sidorenkite [ $\text{Na}_3\text{Mn}(\text{PO}_4)(\text{CO}_3)$ ] (Figures 10 – 17). Soluble uranyl nitrate diffused into the TBP-containing floating layer and formed uranyl nitrate TBP complex (Figures 10, 12, 14, and 16). Higher carbon in the area-scan and the diffuse nature of the particulate indicated particulates coated with organics (Figure 16). In addition, sodium hydroxide ( $\text{NaOH}$ ) was identified when the sample was filtered without applying the vacuum (Figure 18).

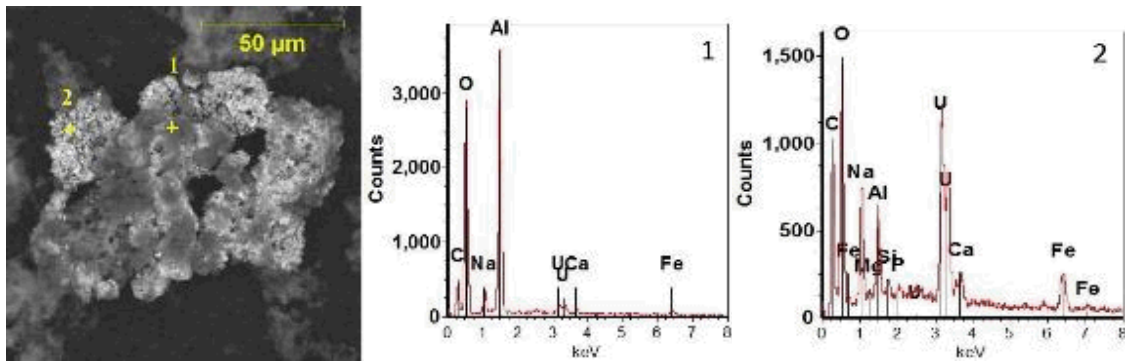


**Figure 10. S17R000149 (Top Layer); Spot-Scan, EDS on the Marked “+” with a Chemistry Consistent with Hematite ( $\text{Fe}_2\text{O}_3$ ), Cejkaite/Clarkeite [ $\text{Na}_4(\text{UO}_2)(\text{CO}_3)_3$ ] / [ $\text{Na}(\text{UO}_2)\text{O}(\text{OH}) \cdot \text{H}_2\text{O}$ ], Uranyl Nitrate TBP [ $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{TBP}$ ], and Other Sodium-rich Compounds. Minor Amounts of Mixed Metal Oxides are Present.**

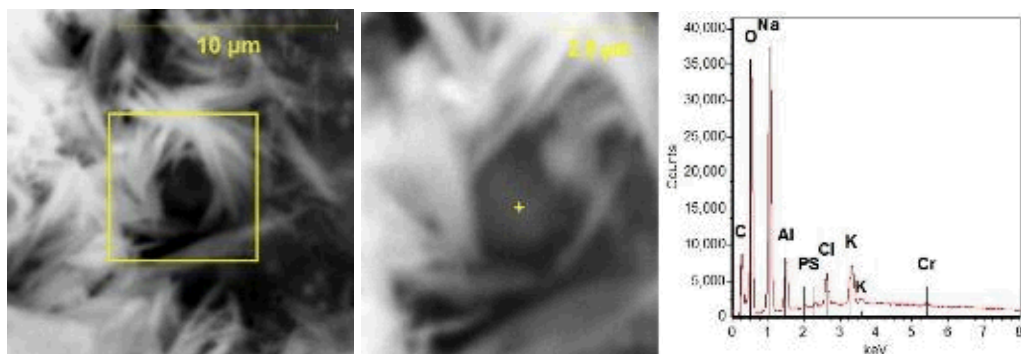


**Figure 11. S17R000149 (Top Layer), Spot-Scan of Particulate, EDS on the Marked “+” with a Chemistry Consistent with Nitratine ( $\text{NaNO}_3$ ) and/or Thermonatrite [ $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$ ]. Trace Amounts of Hematite and Clarkeite/Cejkaite are Present.**

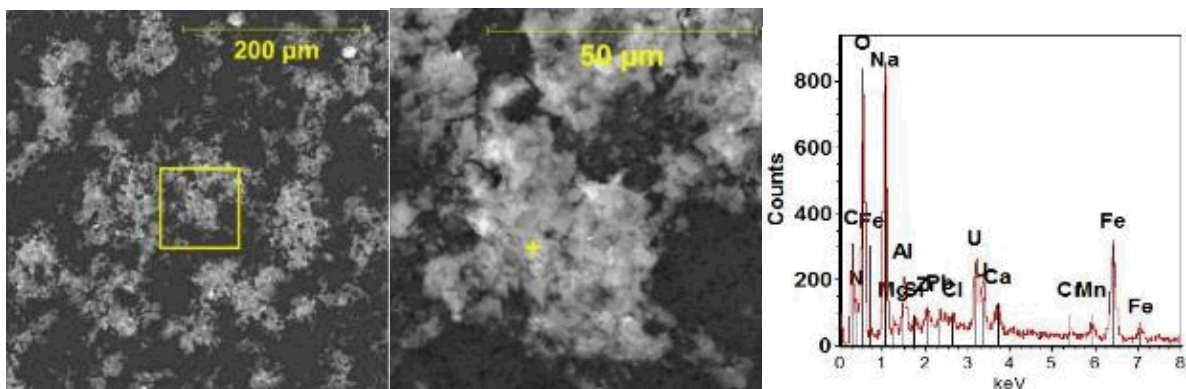
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**Figure 12. S17R000149 (Top Layer), Spot-Scan of Two Particulates (1) and (2), EDS on the Marked “+” with a Chemistry Consistent with Gibbsite ( $\text{Al}(\text{OH})_3$ ) and Trace Amounts of Cejkaite/Clarkeite for Particulate (1), with Cejkaite/Clarkeite, Uranyl Nitrate TBP Complex, Aluminum-rich Components, Smaller Amounts of Hematite, and Metal Oxides for Particulate (2).**



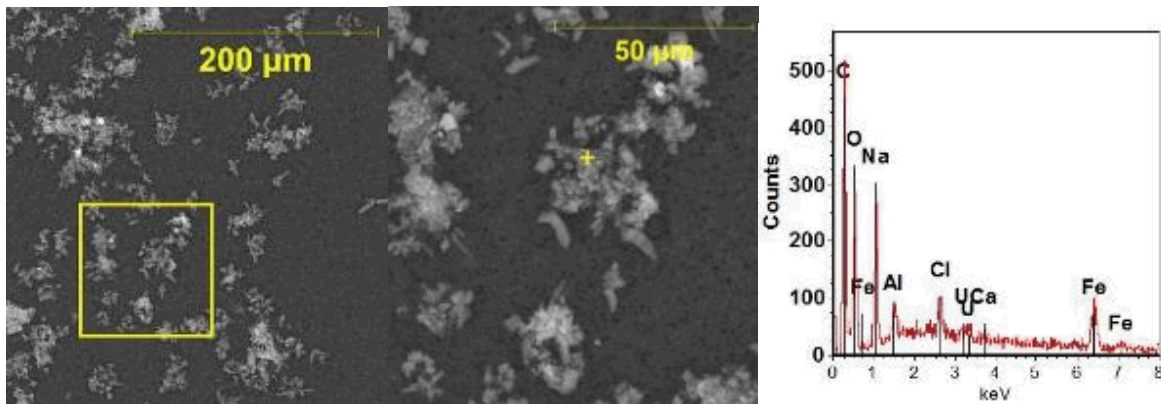
**Figure 13. S17R000149 (Top Layer), Spot-Scan of an Interstitial Space, EDS on the Marked “+” with a Chemistry Consistent with Sodium-rich Salts. Smaller Amounts of Aluminum-containing Components, Potassium Salts, and Possible TBP are Present.**



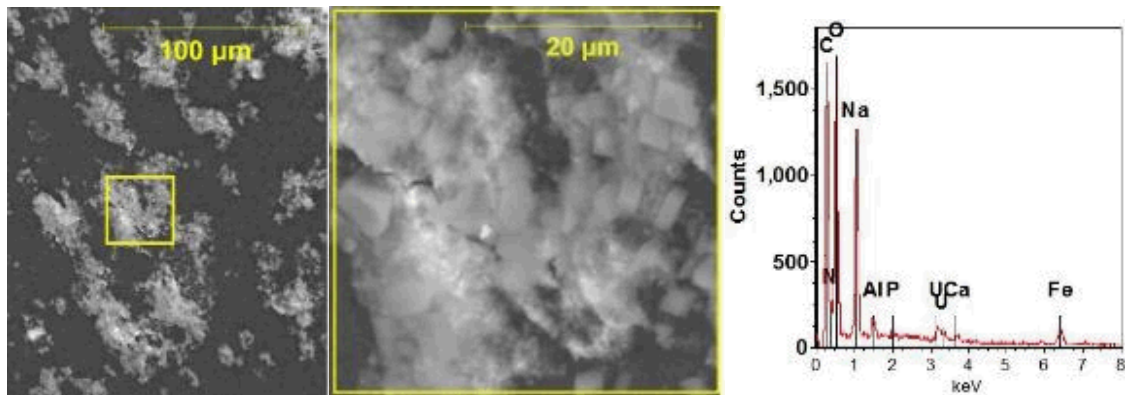
**Figure 14. S17R000149 (Top Layer), Spot-Scan, EDS on the Marked “+” with a Chemistry Consistent with Hematite, Clarkeite/Cejkaite, Uranyl Nitrate TBP, Nitratine, and Sidorenkite [ $\text{Na}_3\text{Mn}(\text{PO}_4)(\text{CO}_3)$ ]. Small Amounts of Metal Oxides are Present.**



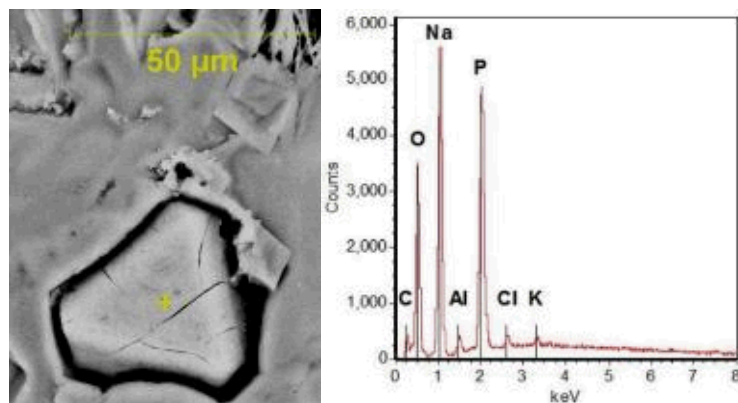
RPP-RPT-60441, Rev. 0



**Figure 15. S17R000149 (Top Layer), Spot-Scan, EDS on the Marked “+” with a Chemistry Consistent with Thermonatrite or Sodium-organic Salts. Small Amounts of Hematite, Clarkeite/Cejkaite, and a Chloride-containing Compound are Present.**

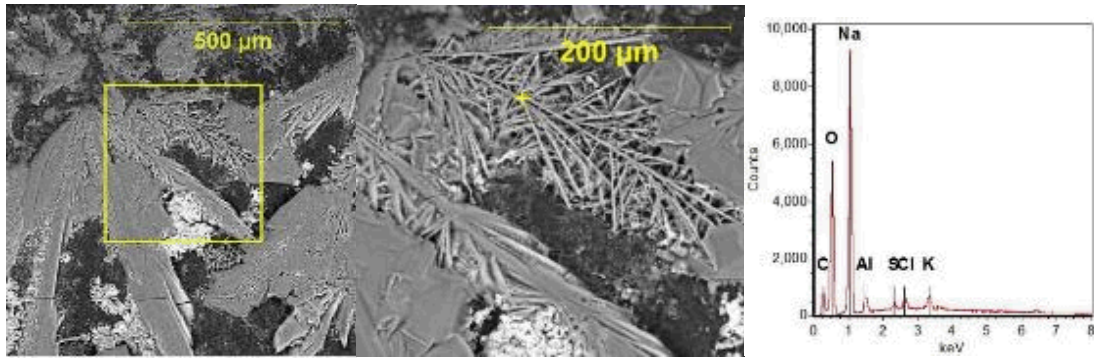


**Figure 16. S17R000149 (Top Layer), EDS of an Area-Scan with a Chemistry Consistent with Thermonatrite, a Small Amount of Hematite, Clarkeite/Cejkaite, and Uranyl Nitrate TBP Complex. The Higher Carbon Content and Diffuse Nature of the Particulate Indicate the Presence of Organic Coating the Particulates.**



**Figure 17. S17R000149 (Top Layer), Spot-Scan, EDS on the Marked “+” with a Chemistry of Natrophosphate  $[\text{Na}_7\text{F}(\text{PO}_4)_2 \cdot 19\text{H}_2\text{O}]$ . Trace Amount of Potassium Chloride is Present.**

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**Figure 18. S17R000149 (Top Layer). Spot-Scan, EDS on the Marked “+” with a Chemistry Consistent with Sodium Hydroxide (NaOH). Small Amounts of Potassium Chloride and Aluminum-containing Components are Present.**

#### 4 SUMMARY

One composited sample taken from two surface AW-104 grab samples (4AW-17-02 and 4AW-17-02DUP) was analyzed for SVOA, PLM, and SEM-EDS. The composite sample had dual phases: yellow supernatant liquid (consistent with the presence of uranyl nitrate which is soluble in TBP) as the bottom layer with a brownish-yellow band on top, reflecting an appearance similar to the floating layer in the parent samples (4AW-17-02 and 4AW-17-02DUP). This dark band contained the majority of the solid material found in the sample. Tributyl phosphate and tridecane (a TIC) were found in the composite floating layer sample. A trace of TBP, tridecane, and a number of unknown hydrocarbons were present in the aqueous phase of sample 4AW-17-02, indicating a different composition in higher amounts of organics in the floating layer than in the aqueous phase. The  $TOC_{SOA}$  from the small organic acids for samples 4AW-17-02 to 4AW-17-08, relative to the  $TOC_p$  or  $TOC_f$ , ranged from 54 – 62%, indicating the presence of other organic species. However, the ratios did not have a wide variation, indicating other organic species were present from the top of the tank to the bottom of the supernate. The lower density found in the floating layer agreed with an earlier observation of a layer of lower density supernate which is thought to have moved to the top layer in the tank.

Sodium nitrate and sodium carbonate were major inorganic components; a trace of gibbsite and very small size agglomerates ( $<10\ \mu\text{m}$ ) were also present in the solids of the floating layer. The yellow supernate of the floating layer consisted of organics (presence of micelles formed by amphiphilic surfactant of TBP), soluble salt, and fine-grained particulates (uranyl nitrate TBP complex). The presence of carbonate via the dissolved carbon dioxide reacting with hydroxide ions or the ongoing oxidation of organics appears to indicate that chemical reactions occurred. The presumed formation of uranyl nitrate TBP complex pointed to a chemical reaction similar to that used to extract uranyl nitrate from the acidified spent fuel in the plutonium uranium extraction process, which used a mixture of TBP and hydrocarbon solvent. The re-formation of a floating layer over time was observed on 4AW-17-02 and 4AW-17-02DUP reflecting chemical reactions occurred. Further evaluation of the re-formation of a floating layer over time is needed and will be reported in the future.



## 5 QUALITY CONTROL

All testing carried out under this test plan followed ATS-MP-1032, *222-S Laboratory Quality Assurance Project Plan*. All data entries specified in the test procedure were retained in controlled laboratory notebooks which were tracked in the project file: HNF-N-832-1, "PSEM Instrument Notebook," HNF-N-395-2, "PLM Sample Log," and HNF-N-841-1, "Studies of Tank Samples e.g., C-105 Dissolution, AN-101 Floating Solids." The Solid Phase Characterization Analyses Tracking form documenting the logbooks used for SPC is filed in the project file.

## 6 ACKNOWLEDGEMENTS

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- Dan Hansen, for his evaluation of spectra for tentatively identified compounds.
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- Peggy Puryear, for her editorial support.

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**APPENDIX A****SAMPLE BREAKDOWN DIAGRAM**

(15 pages, including cover page)

**241-AW 104 Grab 2017-06**

**Group No.: 20171600**

**Charge Code: 002.1020**

**TSCA Regulated PCB**

**LOGIN NOTES:**

**1. Customer: TCD\Corrosion Chemistry Control\Compatability Assessment**

**Sampling Mode: Liquid Grab**

**Riser: 17**

**Customer POC: Sam Diedesch**

**PC: S. Snyder**

**Analytical Due Date: For ( OH, pH, IC- Nitrate, Nitrite) - within 10 working days of receipt of last sample.  
(TIC/TOC, TC/TOC, and Density)- within 15 working days.**

**Analytical Due Date for Format VI data (remaining analyses): 60 calendar days from receipt**

**2. QC login comments at Group level:**

**NO DUP or SPK on the FB**

**DUP, SPK/Batch on OH, IC-Anions/Org Acids, ICP- Metals, TIC/TOC, TC, TOC, and ICP/MS**

**DUP/Batch on Density, TGA, pH, GEA, Sr-90, Pu-241 and Pu/Am.**

**MS/MSD per batch for PCB, and Hg**

**3. Holding times are applicable for this project.**

**4. The TSCA PCB status: TSCA Regulated for PCB ( Concentration: Liquids= 2.04ug/mL; Solids= 2.50E+01ug/g)**

**241-AW 104 Grab 2017-06****Group No.: 20171600****Charge Code: 002.1020****TSCA Regulated PCB****REQUIRED DETECTION LIMITS:**

OH: 17 µg/mL

NO2: 50.6 µg/mL

NO3: 310 µg/mL

PO4: 950 µg/ml

PCB: 23 µg/L

**HOLDING TIMES:**

IC-NO3,NO2 and PO4: 48 hours.

IC-Cl, F, Br, SO4: 28 days.

pH: Analyze immediately.

TOC: 28 days

Hg by CVAA: 28 days

Metals by ICP/AES or ICP/MS: 6 months

PCB Water (7days), Wastewater (14 days) Solids (14 Days)

**241-AW 104 Grab 2017 -06**  
**Grab Samples**  
**Riser: 17**  
**Group 20171600**  
**TSCA Regulated PCB**

**DO NOT REFRIGERATE**

**4AW-17-01FB**  
**Field Blank**



**S17T015725**  
**Breakdown Pig HC**  
**Archive-HC**



**S17T015726**  
**DOSE HC**  
**ICP/AES- Total metals**  
**Samp Amt HC**  
**pH**  
**Ni-63**  
**Ni-Tracer**



**S17T015727**  
**DOSE HC**  
**IC-Anions/org**  
**Samp Amt HC**  
**TIC/TOC**  
**TC by furnace**  
**TOC by furnace**



**S17T015728**  
**Americium**  
**Americium Separation**  
**DOSE HC**  
**GEA**  
**GEA Separation**  
**Plutonium**  
**Plutonium-241**  
**Samp Amt HC**  
**Se-79**  
**Se-79 Separation**



**241-AW 104 Grab 2017 -06**  
**Grab Samples**  
**Riser: 17**  
**Group 20171600**

**TSCA Regulated PCB**

**DO NOT REFRIGERATE**

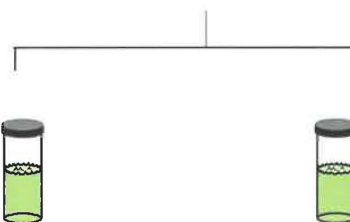
**4AW-17-01**  
**Grab Sample (Total)**



**S17T015729**

**Breakdown Pig HC**  
**Archive-HC**  
**Density-HC**

**Organic Surface Sample**



**S17T015730**

**DOSE HC**  
**IC-Anions/Org**  
**Samp Amt HC**  
**pH**  
**OH**  
**Density**

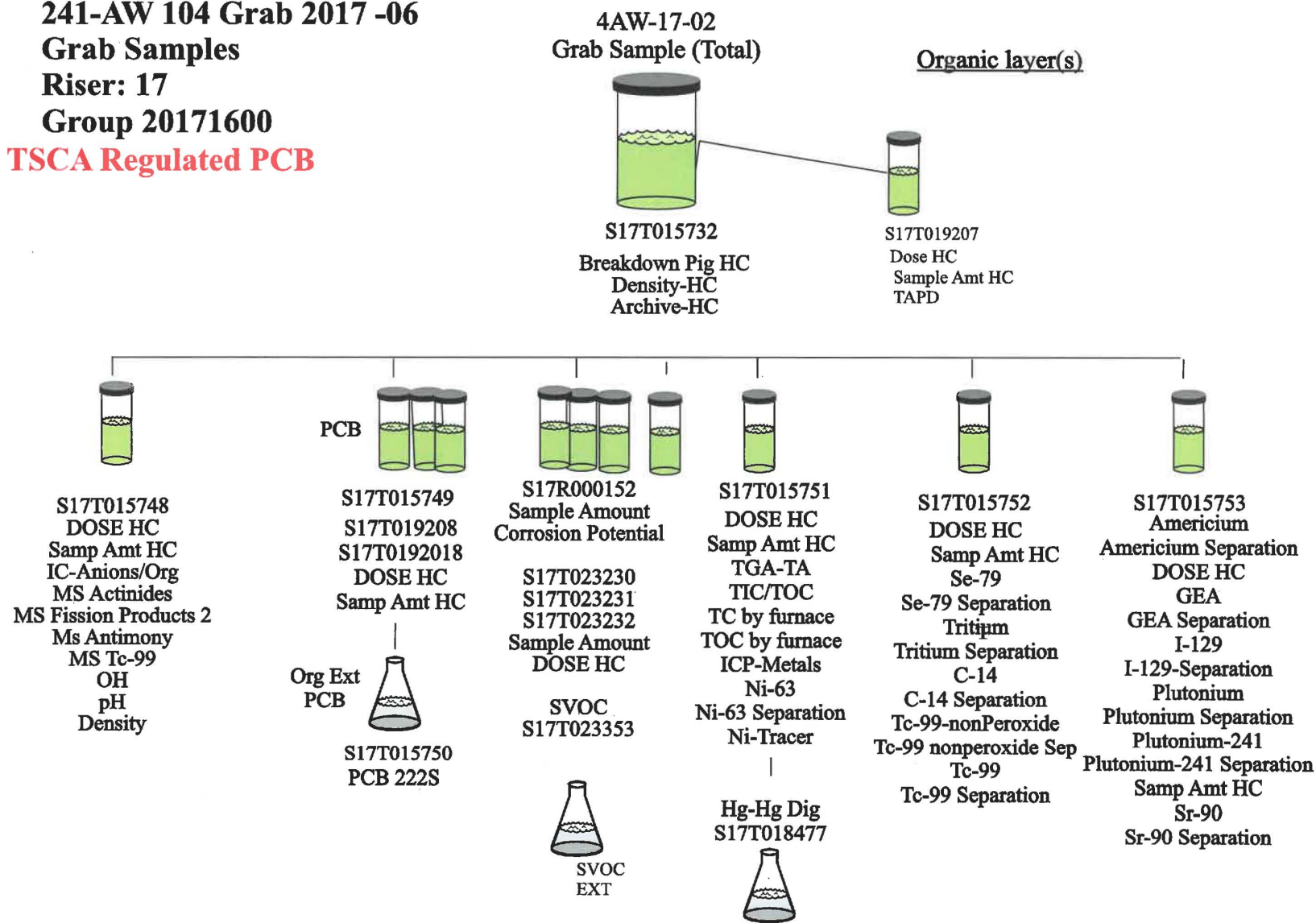
**S17T015731**

**DOSE HC**  
**Samp Amt HC**  
**TOC/TIC**  
**TC by Furnace**  
**TOC by Furnace**

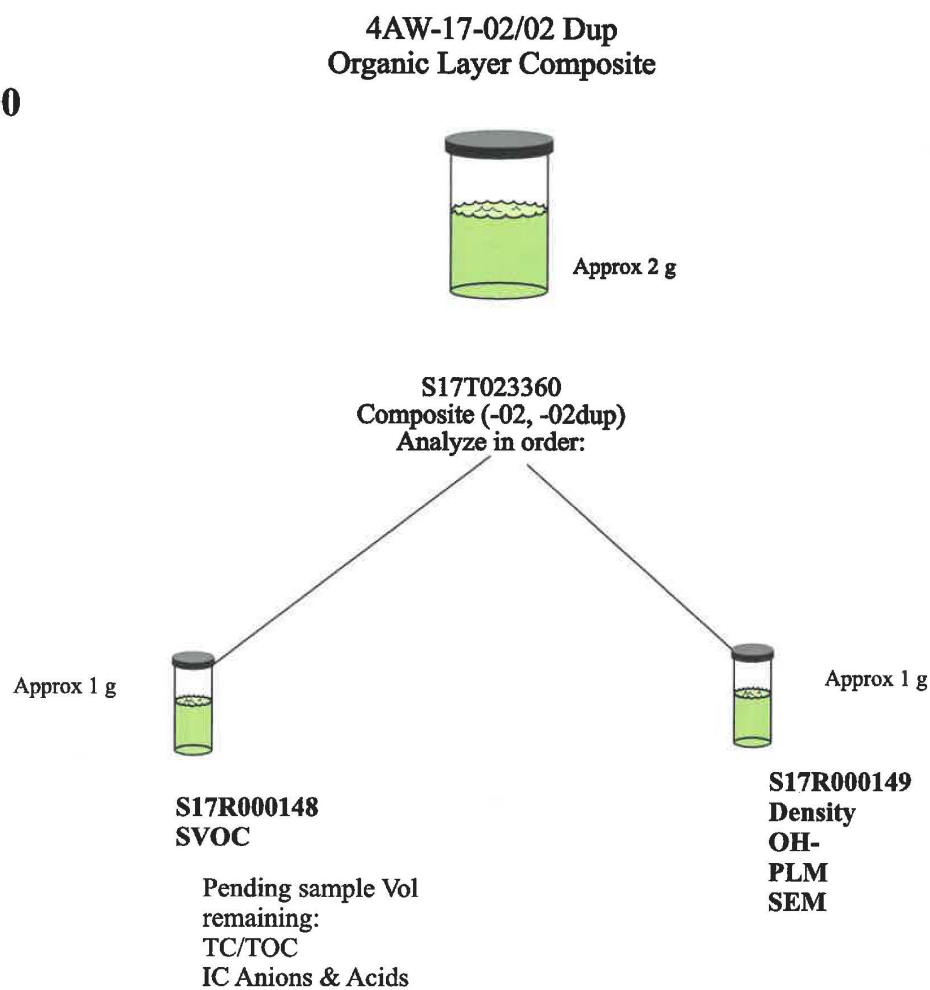
**241-AW 104 Grab 2017 -06**  
**Grab Samples**  
**Riser: 17**  
**Group 20171600**  
**TSCA Regulated PCB**

**DO NOT REFRIGERATE**

SubSurface Grab

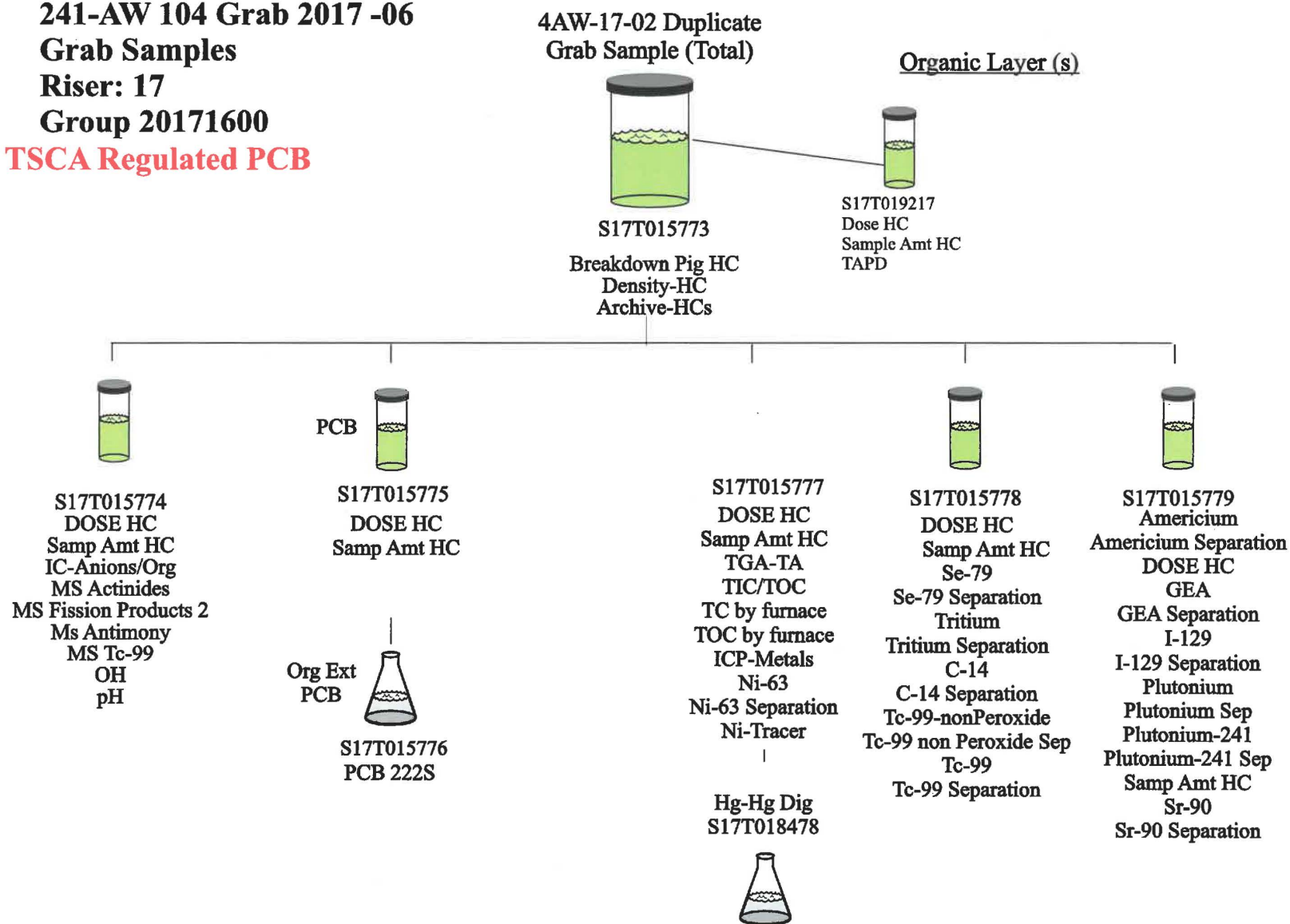


**241-AW 104 Grab 2017 -06**  
**Grab Samples**  
**Riser: 17**  
**Group 20171600**



**241-AW 104 Grab 2017 -06**  
**Grab Samples**  
**Riser: 17**  
**Group 20171600**  
**TSCA Regulated PCB**

**DO NOT REFRIGERATE** SubSurface Grab



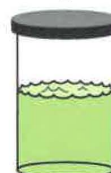
**241-AW 104 Grab 2017 -06**  
**Grab Samples**  
**Riser: 17**  
**Group 20171600**

**TSCA Regulated PCB**

**DO NOT REFRIGERATE**

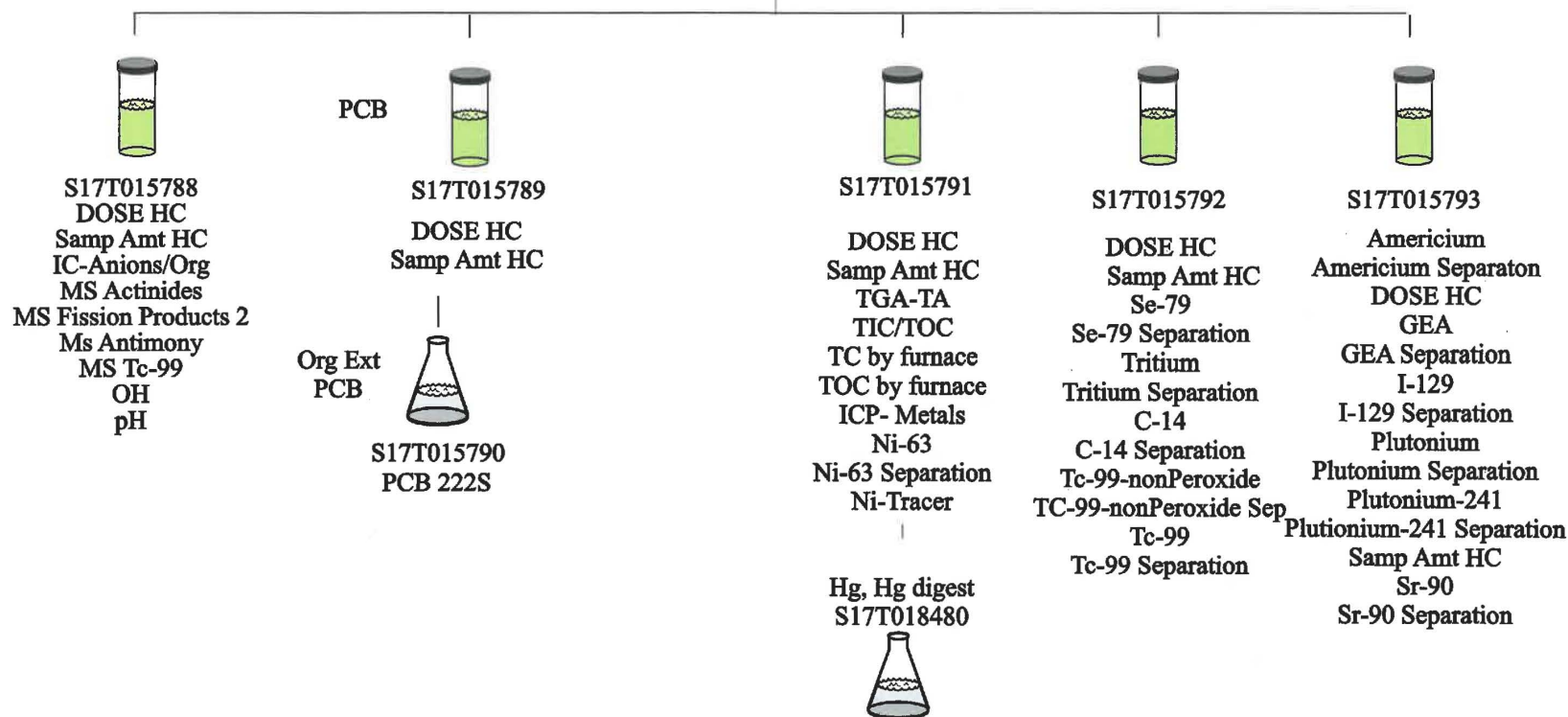
4AW-17-04  
 Grab Sample (Total)

Subsurface Grab



S17T015787

Breakdown Pig HC  
 Density-HC  
 Archive-HC



**DO NOT REFRIGERATE**

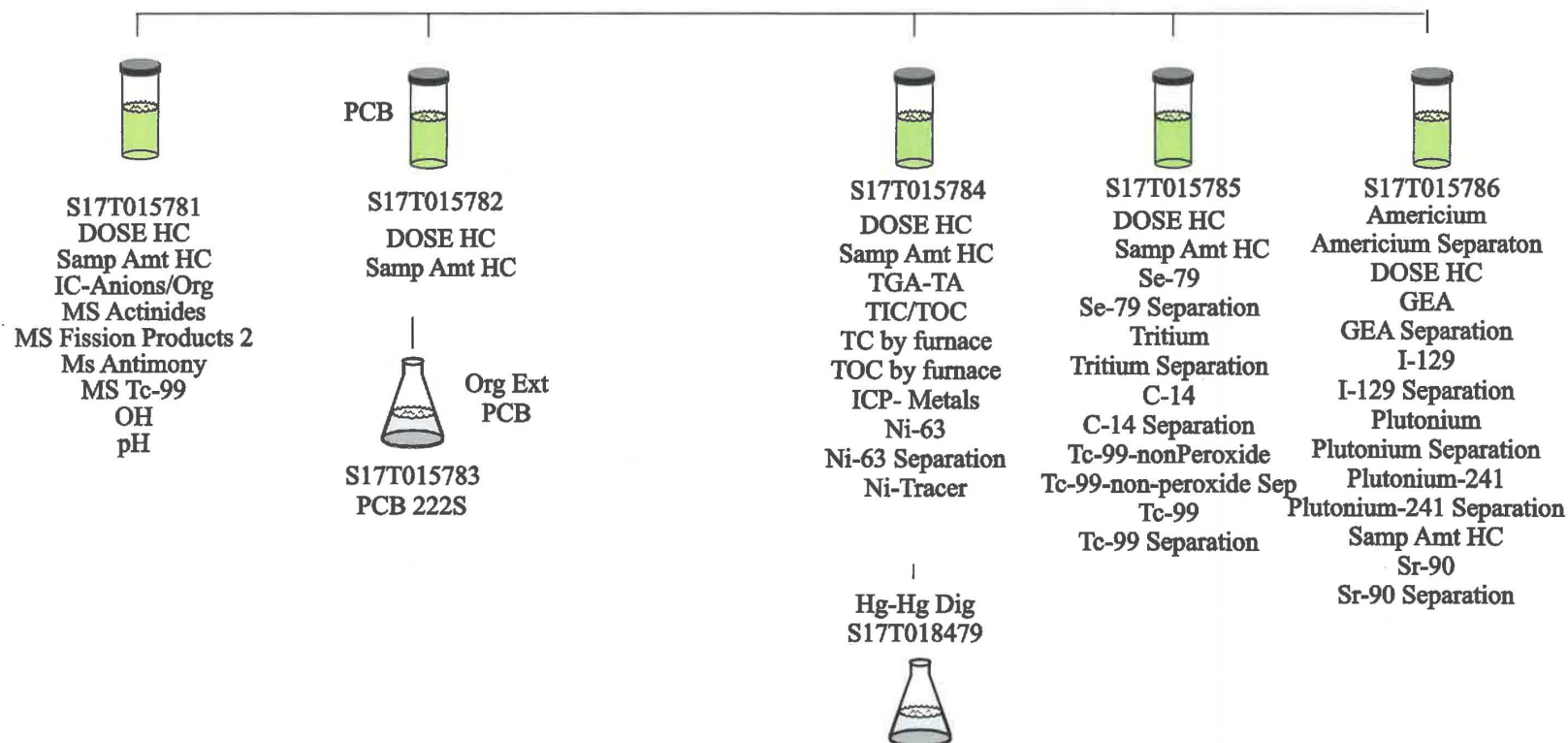
**241-AW 104 Grab 2017 -06**  
**Grab Samples**  
**Riser: 17**  
**Group 20171600**  
**TSCA Regulated PCB**

**4AW-17-03**  
**Grab Sample (Total)**

Subsurface Grab



**S17T015780**  
**Breakdown Pig HC**  
**Density-HC**  
**Archive-HC**





**241-AW 104 Grab 2017 -06**  
**Grab Samples**  
**Riser: 17**  
**Group 20171600**  
**TSCA Regulated PCB**

**DO NOT REFRIGERATE**

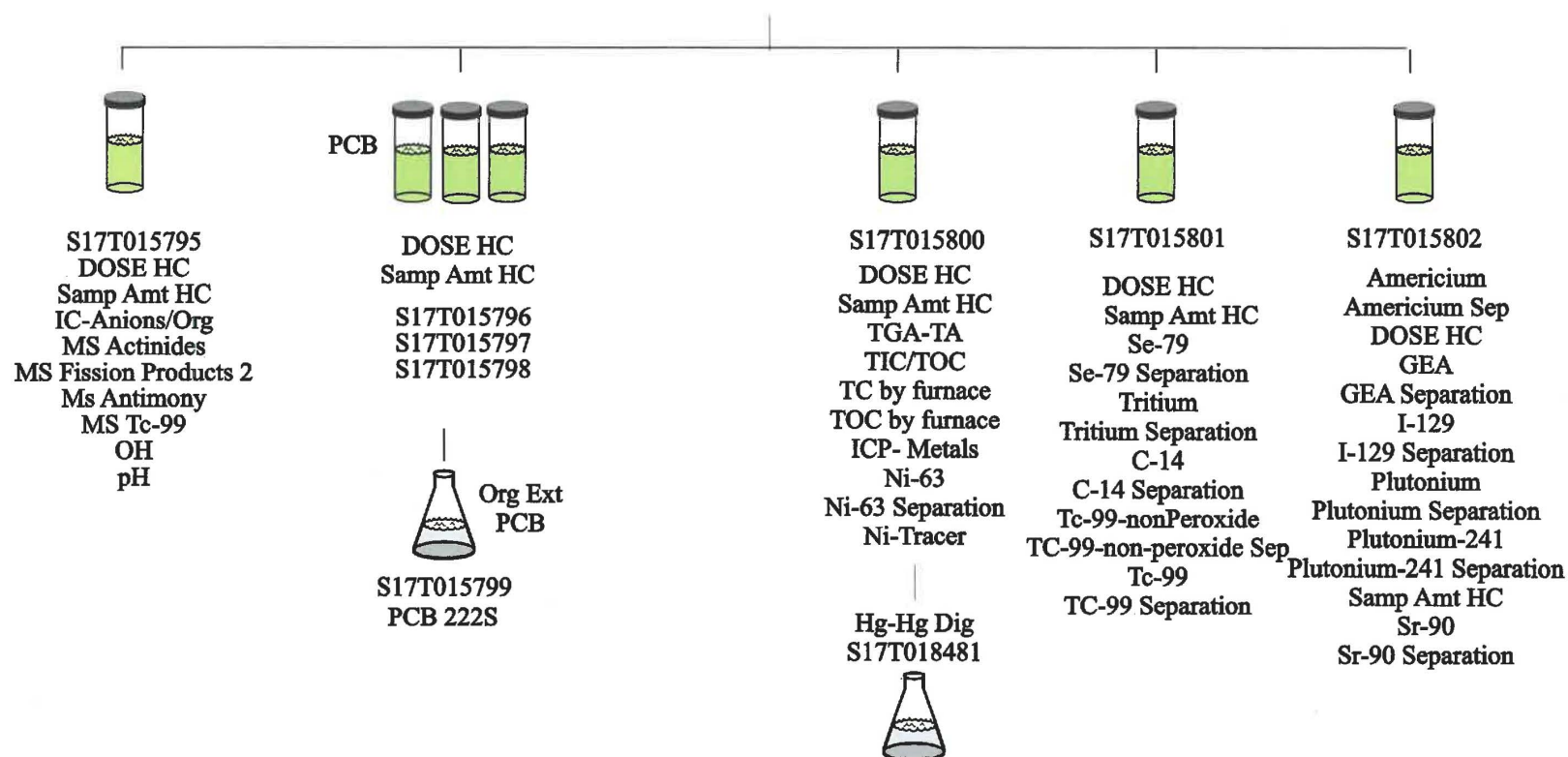
4AW-17-05  
 Grab Sample (Total)



S17T015794

Breakdown Pig HC  
 Density-HC  
 Archive-HC

Subsurface Grab





**241-AW 104 Grab 2017 -06**  
**Grab Samples**  
**Riser: 17**  
**Group 20171600**  
**TSCA Regulated PCB**

**DO NOT REFRIGERATE**

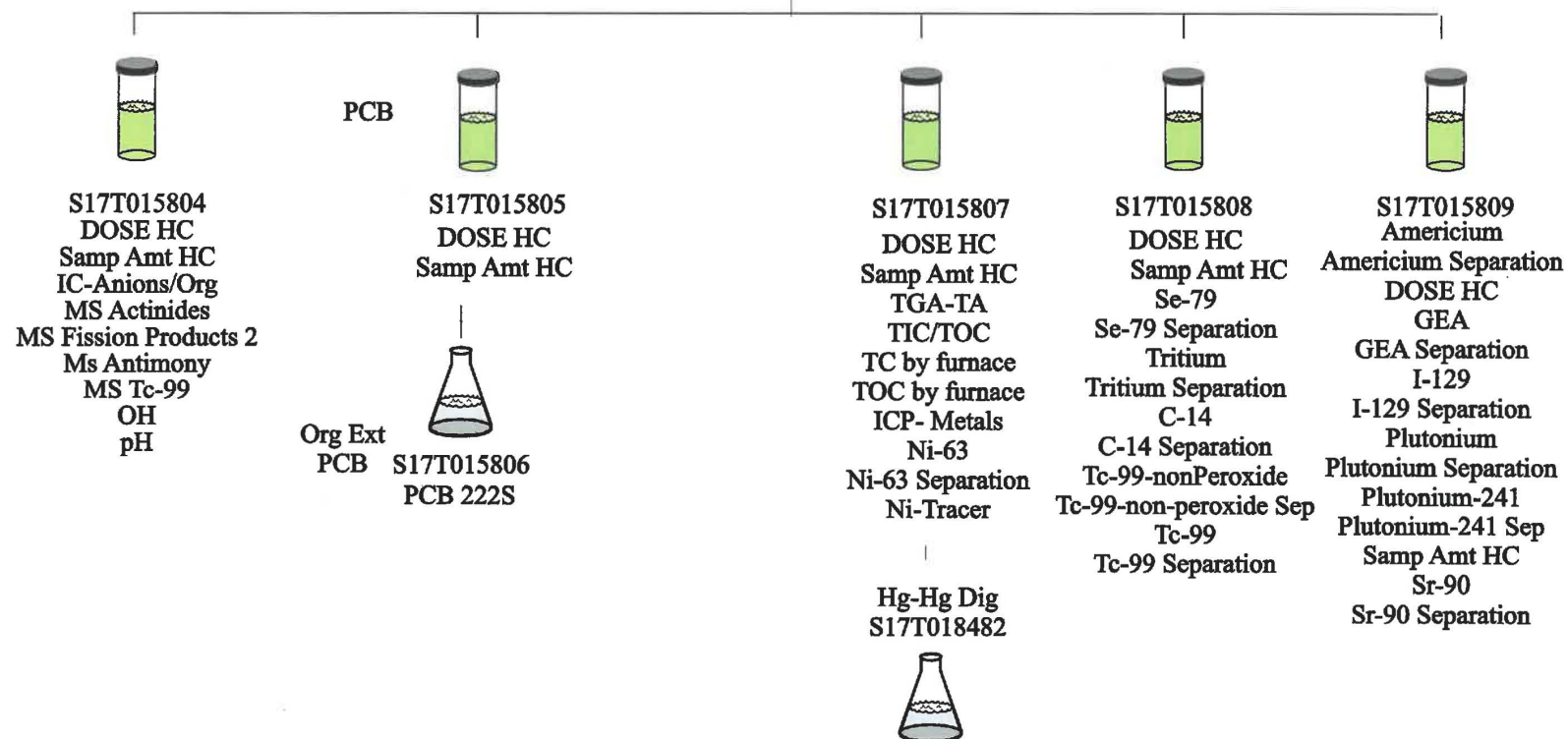
4AW-17-06  
 Grab Sample (Total)



S17T015803

Breakdown Pig HC  
 Density-HC  
 Archive-HC

Subsurface Grab



**241-AW 104 Grab 2017 -06**  
**Grab Samples**  
**Riser: 17**  
**Group 20171600**  
**TSCA Regulated PCB**

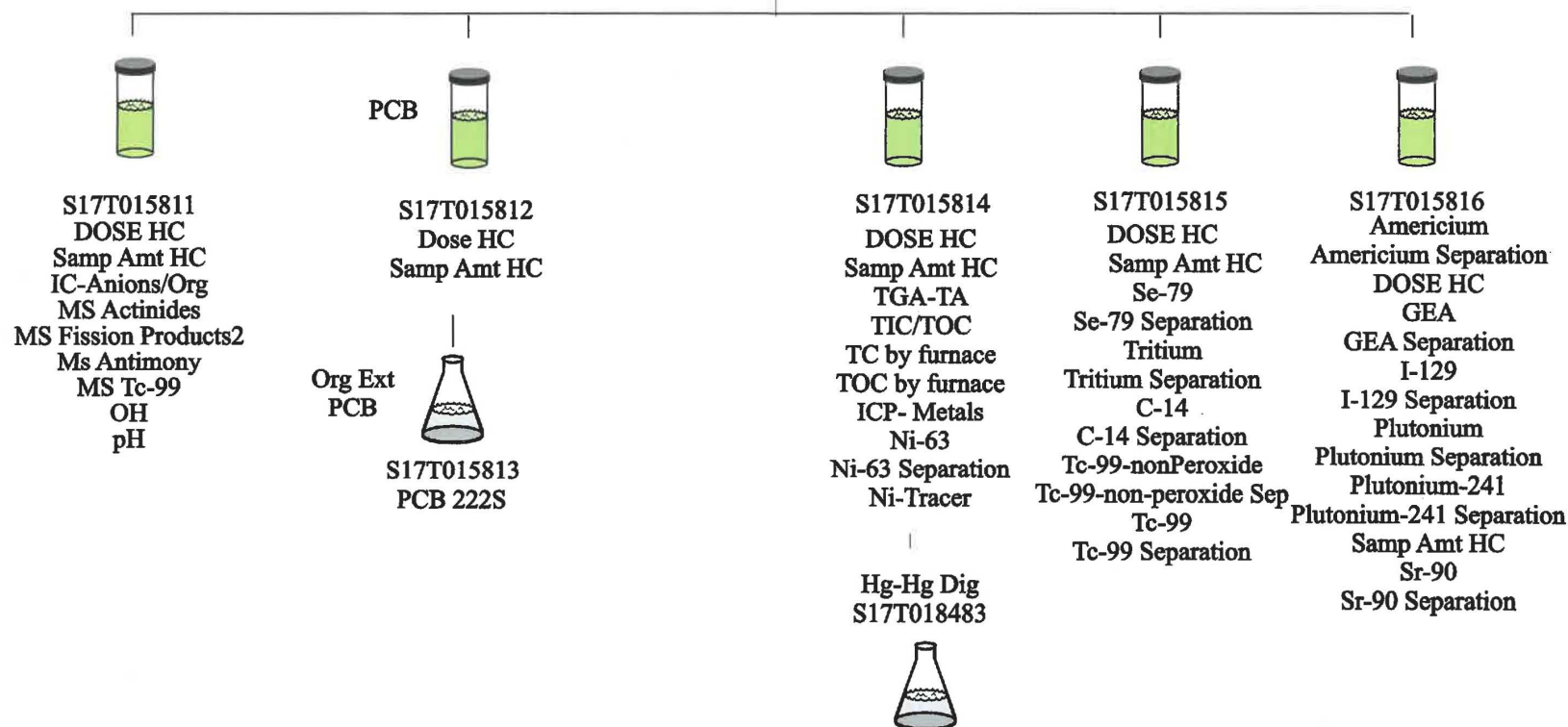
**DO NOT REFRIGERATE**

4AW-17-07  
 Grab Sample (Total)



S17T015810  
 Breakdown Pig HC  
 Density-HC  
 Archive-HC

Subsurface Grab



**241-AW 104 Grab 2017 -06**  
**Grab Samples**  
**Riser: 17**  
**Group 20171600**  
**TSCA Regulated PCB**

**DO NOT REFRIGERATE**

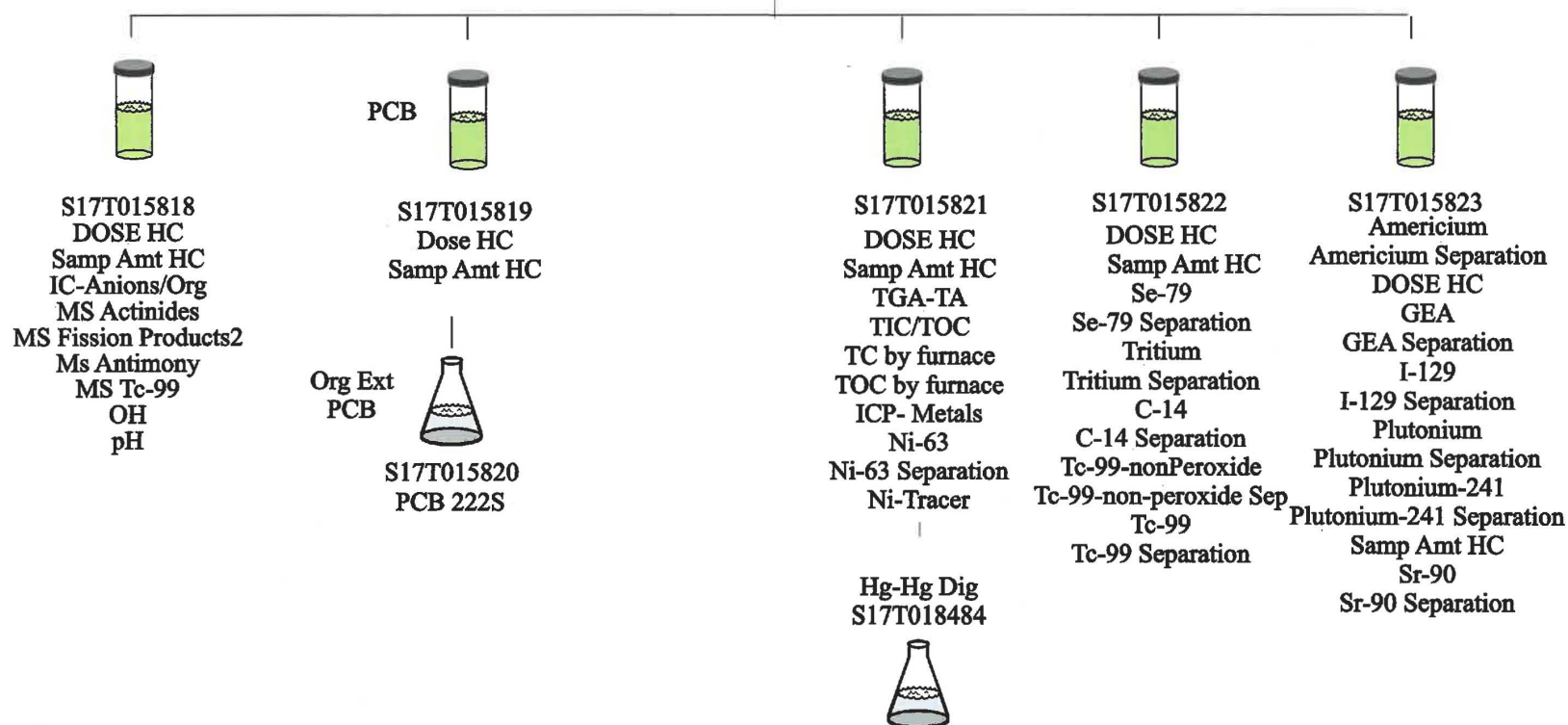
4AW-17-08  
 Grab Sample (Total)

Subsurface Grab



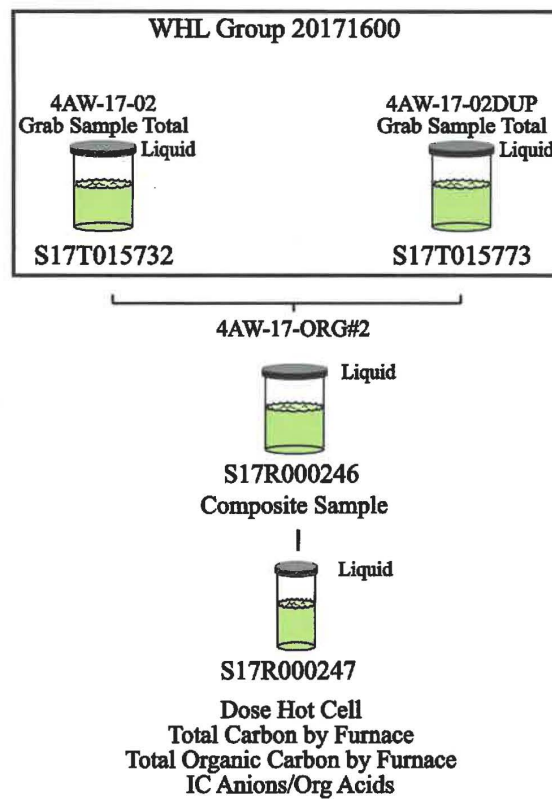
S17T015817

Breakdown Pig HC  
 Density-HC  
 Archive-HC



Customer: RESEARCH  
Project: AW104 2017 APD  
Group: 20172604

**TSCA Regulated  
for PCB**  
Liquids:  $<4.12\text{E-}03$  ug/mL  
Solids  $1.04\text{E-}01$  ug/g



RPP-RPT-604410 Rev. 0

**APPENDIX B****SEMIVOLATILE ORGANIC ANALYSES RESULTS INCLUDING TANK 241-AW-104  
FLOATING LAYER AND ASSOCIATED QUALITY CONTROL SAMPLES –  
ANALYTICAL PROJECT DEVELOPMENT (APD)**

(12 pages, including cover page)

10/3/2017 3:02:02PM  
CompleteBatch Version 3.0.13  
batchreports 3.0.13

Page: 1

## LABCORE Completed Batch Report for Batch# 00075479

Analyst: Vogel, Katherine

Book#: NA  
vrg 10/6/17

Instrument: GCMSD10 (JANEWAY)

Method: SVOA 222S LIQUID, LA-523-135 Rev/Mod 4-2

Specification: 241-AW-104 Grab Sampling 2017-06

Prep Batch: 00074945

Batch Comment:

NA

| Seq Type          | Sample# | Assoc. Sample | RepR | A | * Test                      | Matrix | Actual | Found       | Blank | CTR | Limit<br>(DL/RL/UL) | Unit | Yield | Yield Unit | Flags |
|-------------------|---------|---------------|------|---|-----------------------------|--------|--------|-------------|-------|-----|---------------------|------|-------|------------|-------|
| Sample Sequence 1 |         |               |      |   |                             |        |        |             |       |     |                     |      |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 1,2,4-Trichlorobenzene      | LIQUID |        | <1.3770E+03 |       |     | 1.38E+03            | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 1,2-Dichlorobenzene         | LIQUID |        | <1.3490E+03 |       |     | 1.35E+03            | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 1,4-Dichlorobenzene         | LIQUID |        | <1.3570E+03 |       |     | 1.36E+03            | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 1-Butanol                   | LIQUID |        | <5.5520E+03 |       |     | 5.55E+03            | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2,2-oxybis(1-Chloropropane) | LIQUID |        | <1.3990E+03 |       |     | 1.40E+03            | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2,4,5-Trichlorophenol       | LIQUID |        | <1.3720E+03 |       |     | 1.37E+03            | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2,4,6-Trichlorophenol       | LIQUID |        | <1.3270E+03 |       |     | 1.33E+03            | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2,4-Dichlorophenol          | LIQUID |        | <1.3160E+03 |       |     | 1.32E+03            | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2,4-Dimethylphenol          | LIQUID |        | <6.8800E+02 |       |     | 688                 | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2,4-Dinitrophenol           | LIQUID |        | <4.5100E+02 |       |     | 451                 | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2,4-Dinitrotoluene          | LIQUID |        | <7.2900E+02 |       |     | 729                 | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2,6-bis-4Methylphenol       | LIQUID |        | <6.1700E+02 |       |     | 617                 | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2,6-Dinitrotoluene          | LIQUID |        | <9.2400E+02 |       |     | 924                 | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2-Butoxyethanol             | LIQUID |        | <2.8090E+03 |       |     | 2.81E+03            | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2-Chloronaphthalene         | LIQUID |        | <1.4000E+03 |       |     | 1.40E+03            | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2-Chlorophenol              | LIQUID |        | <1.1780E+03 |       |     | 1.18E+03            | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2-Ethoxyethanol             | LIQUID |        | <1.8640E+03 |       |     | 1.86E+03            | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2-Methylnaphthalene         | LIQUID |        | <1.4120E+03 |       |     | 1.41E+03            | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2-Methylphenol              | LIQUID |        | <1.2620E+03 |       |     | 1.26E+03            | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2-Nitroaniline              | LIQUID |        | <1.0040E+03 |       |     | 1.00E+03            | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2-Nitrophenol               | LIQUID |        | <1.2600E+03 |       |     | 1.26E+03            | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 3 & 4 Methylphenol          | LIQUID |        | <1.1240E+03 |       |     | 1.12E+03            | ug/L |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | Total                       |        |        |             |       |     |                     |      |       |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 3-Nitroaniline              | LIQUID |        | <1.2070E+03 |       |     | 1.21E+03            | ug/L |       |            |       |

Units shown for QC (BLK/BKG) may not reflect the actual units.

\* = Rejected Analyte  
C = Cancelled Analyte  
N, A = Non-reported Analyte

10/31/2017 3:02:04PM

CompleteBatch Version 3.0.13

batchreports 3.0.13

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## LABCORE Completed Batch Report for Batch# 00075479

| Seq Type | Sample# | Assoc. Sample | RepR | A | * Test                         | Matrix | Actual | Found       | Blank | CTR | Limit (DL/RL/UL) | Unit | Yield | Yield Unit | Flags |
|----------|---------|---------------|------|---|--------------------------------|--------|--------|-------------|-------|-----|------------------|------|-------|------------|-------|
| 1        | BLNK    | S1707100047   | 0 0  | O | 4,6-Dinitro-2-methylphe<br>nol | LIQUID |        | <2.9900E+02 |       |     | 299              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | 4-Bromophenyl-phenyle<br>ther  | LIQUID |        | <8.3400E+02 |       |     | 834              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | 4-Chloro-3-methylphen<br>ol    | LIQUID |        | <1.2730E+03 |       |     | 1.27E+03         | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | 4-Chloroaniline                | LIQUID |        | <1.3820E+03 |       |     | 1.38E+03         | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | 4-Chlorophenyl-phenyle<br>ther | LIQUID |        | <1.1520E+03 |       |     | 1.15E+03         | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | 4-Methylphenol                 | LIQUID |        | 0           |       |     |                  | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | 4-Nitroaniline                 | LIQUID |        | <1.0800E+03 |       |     | 1.08E+03         | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | 4-Nitrophenol                  | LIQUID |        | <7.3300E+02 |       |     | 733              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Acenaphthene                   | LIQUID |        | <1.2980E+03 |       |     | 1.30E+03         | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Acenaphthylene                 | LIQUID |        | <1.5010E+03 |       |     | 1.50E+03         | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Anthracene                     | LIQUID |        | <6.2000E+02 |       |     | 620              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Benzo(a)anthracene             | LIQUID |        | <5.6400E+02 |       |     | 564              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Benzo(a)pyrene                 | LIQUID |        | <5.4200E+02 |       |     | 542              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Benzo(b)fluoranthene           | LIQUID |        | <6.2200E+02 |       |     | 622              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Benzo(g,h,i)perylene           | LIQUID |        | <5.3000E+02 |       |     | 530              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Benzo(k)fluoranthene           | LIQUID |        | <6.0200E+02 |       |     | 602              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Butylbenzylphthalate           | LIQUID |        | <4.6400E+02 |       |     | 464              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Chrysene                       | LIQUID |        | <6.4900E+02 |       |     | 649              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Cyclohexanone                  | LIQUID |        | <1.3020E+03 |       |     | 1.30E+03         | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Di-n-butylphthalate            | LIQUID |        | <3.7600E+02 |       |     | 376              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Di-n-octylphthalate            | LIQUID |        | <4.6600E+02 |       |     | 466              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Dibenz(a,h)anthracene          | LIQUID |        | <4.5300E+02 |       |     | 453              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Dibenzofuran                   | LIQUID |        | <1.1900E+03 |       |     | 1.19E+03         | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Diethylphthalate               | LIQUID |        | <7.2100E+02 |       |     | 721              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Dimethylphthalate              | LIQUID |        | <8.4500E+02 |       |     | 845              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Diphenylamine                  | LIQUID |        | <7.7300E+02 |       |     | 773              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Fluoranthene                   | LIQUID |        | <4.0600E+02 |       |     | 406              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Fluorene                       | LIQUID |        | <1.2720E+03 |       |     | 1.27E+03         | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Hexachlorobenzene              | LIQUID |        | <1.0830E+03 |       |     | 1.08E+03         | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Hexachlorobutadiene            | LIQUID |        | <1.5020E+03 |       |     | 1.50E+03         | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Hexachlorocyclopentadi<br>ene  | LIQUID |        | <2.6200E+02 |       |     | 262              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Hexachloroethane               | LIQUID |        | <1.4000E+03 |       |     | 1.40E+03         | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Indeno(1,2,3-cd)pyrene         | LIQUID |        | <2.6200E+02 |       |     | 262              | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Isobutanol                     | LIQUID |        | <2.1570E+03 |       |     | 2.16E+03         | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Isophorone                     | LIQUID |        | <1.3490E+03 |       |     | 1.35E+03         | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | Methylphenols, Total           | LIQUID |        | 0           |       |     |                  | ug/L |       |            |       |
| 1        | BLNK    | S1707100047   | 0 0  | O | N-Nitrosodimethylamin<br>e     | LIQUID |        | <1.2400E+03 |       |     | 1.24E+03         | ug/L |       |            |       |

Units shown for QC (BLK/BKG) may not reflect the actual units.

\* = Rejected Analyte  
C = Cancelled Analyte  
N, A = Non-reported Analyte



10/3/2017 3:02:02PM  
CompleteBatch Version 3.0.13  
batchreports 3.0.13

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## LABCORE Completed Batch Report for Batch# 00075479

| Seq Type          | Sample# | Assoc. Sample | RepR | A | * Test                       | Matrix | Actual | Found       | Blank | CTR | Limit (DL/RL/UL) | Unit | Yield  | Yield Unit | Flags |
|-------------------|---------|---------------|------|---|------------------------------|--------|--------|-------------|-------|-----|------------------|------|--------|------------|-------|
| 1                 | BLNK    | S1707100047   | 0 0  | O | N-Nitrosodipropylamine       | LIQUID |        | <1.3550E+03 |       |     | 1.36E+03         | ug/L |        |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | N-Nitrosomorpholine          | LIQUID |        | <1.0870E+03 |       |     | 1.09E+03         | ug/L |        |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | Naphthalene                  | LIQUID |        | <1.2330E+03 |       |     | 1.23E+03         | ug/L |        |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | Nitrobenzene                 | LIQUID |        | <1.2180E+03 |       |     | 1.22E+03         | ug/L |        |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | Pentachlorophenol            | LIQUID |        | <5.7000E+02 |       |     | 570              | ug/L |        |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | Phenanthrene                 | LIQUID |        | <5.9300E+02 |       |     | 593              | ug/L |        |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | Phenol                       | LIQUID |        | <1.2120E+03 |       |     | 1.21E+03         | ug/L |        |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | Pyrene                       | LIQUID |        | <3.8100E+02 |       |     | 381              | ug/L |        |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | Pyridine                     | LIQUID |        | <1.4620E+03 |       |     | 1.46E+03         | ug/L |        |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | Tri-n-butylphosphate         | LIQUID |        | <5.1300E+02 |       |     | 513              | ug/L |        |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | bis(2-Chloroethoxy)met hane  | LIQUID |        | <1.3370E+03 |       |     | 1.34E+03         | ug/L |        |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | bis(2-Ethylhexyl)phthal ate  | LIQUID |        | <4.4000E+02 |       |     | 440              | ug/L |        |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | bis-(2-Chloroethyl) ether    | LIQUID |        | <1.2970E+03 |       |     | 1.30E+03         | ug/L |        |            |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2,4,6-Tribromophenol         | LIQUID | 40000  | 3.4800E+04  |       |     | 500              | ug/L | 87     | % Recovery |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2-Fluorobiphenyl             | LIQUID | 20000  | 2.0281E+04  |       |     | 500              | ug/L | 101.4  | % Recovery |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | 2-Fluorophenol               | LIQUID | 40000  | 3.4971E+04  |       |     | 500              | ug/L | 87.428 | % Recovery |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | Nitrobenzene-d5              | LIQUID | 20000  | 2.1330E+04  |       |     | 500              | ug/L | 106.65 | % Recovery |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | Phenol-d6                    | LIQUID | 40000  | 3.5220E+04  |       |     | 500              | ug/L | 88.05  | % Recovery |       |
| 1                 | BLNK    | S1707100047   | 0 0  | O | Terphenyl-d14                | LIQUID | 20000  | 2.3408E+04  |       |     | 500              | ug/L | 117.04 | % Recovery |       |
| Sample Sequence 2 |         |               |      |   |                              |        |        |             |       |     |                  |      |        |            |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 1,2,4-Trichlorobenzene       | LIQUID | 133330 | 1.0377E+05  |       |     | 1.38E+04         | ug/L | 77.829 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 1,2-Dichlorobenzene          | LIQUID | 133330 | 1.0597E+05  |       |     | 1.35E+04         | ug/L | 79.479 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 1,4-Dichlorobenzene          | LIQUID | 133330 | 1.0557E+05  |       |     | 1.36E+04         | ug/L | 79.179 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 1-Butanol                    | LIQUID | 533330 | 3.8325E+05  |       |     | 5.55E+04         | ug/L | 71.86  | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 2,2-oxybis(1-Chloropro pane) | LIQUID | 133330 | 1.0494E+05  |       |     | 1.40E+04         | ug/L | 78.707 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 2,4,5-Trichlorophenol        | LIQUID | 133330 | 9.7900E+04  |       |     | 1.37E+04         | ug/L | 73.427 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 2,4,6-Trichlorophenol        | LIQUID | 133330 | 1.0191E+05  |       |     | 1.33E+04         | ug/L | 76.434 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 2,4-Dichlorophenol           | LIQUID | 133330 | 1.0402E+05  |       |     | 1.32E+04         | ug/L | 78.017 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 2,4-Dimethylphenol           | LIQUID | 133330 | 1.0399E+05  |       |     | 6.88E+03         | ug/L | 77.994 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 2,4-Dinitrophenol            | LIQUID | 133330 | 9.8310E+04  |       |     | 4.51E+03         | ug/L | 73.734 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 2,4-Dinitrotoluene           | LIQUID | 133330 | 1.0069E+05  |       |     | 7.29E+03         | ug/L | 75.519 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 2,6-bis-4Methylphenol        | LIQUID | 133330 | 1.0280E+05  |       |     | 6.17E+03         | ug/L | 77.102 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 2,6-Dinitrotoluene           | LIQUID | 133330 | 9.8860E+04  |       |     | 9.24E+03         | ug/L | 74.147 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 2-Butoxyethanol              | LIQUID | 266670 | 2.0568E+05  |       |     | 2.81E+04         | ug/L | 77.129 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 2-Chloronaphthalene          | LIQUID | 133330 | 1.0298E+05  |       |     | 1.40E+04         | ug/L | 77.237 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 2-Chlorophenol               | LIQUID | 133330 | 1.0596E+05  |       |     | 1.18E+04         | ug/L | 79.472 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 2-Ethoxyethanol              | LIQUID | 133330 | 1.0266E+05  |       |     | 1.86E+04         | ug/L | 76.997 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 2-Methylnaphthalene          | LIQUID | 133330 | 1.0457E+05  |       |     | 1.41E+04         | ug/L | 78.429 | % Recovery |       |

Units shown for QC (BLK/BKG) may not reflect the actual units.

\* = Rejected Analyte  
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## LABCORE Completed Batch Report for Batch# 00075479

| Seq Type | Sample# | Assoc. Sample | RepR | A | * Test                         | Matrix | Actual | Found      | Blank | CTR | Limit<br>(DL/RL/UL) | Unit | Yield  | Yield Unit | Flags |
|----------|---------|---------------|------|---|--------------------------------|--------|--------|------------|-------|-----|---------------------|------|--------|------------|-------|
| 2        | LCS     | S1707100048   | 0 0  | O | 2-Methylphenol                 | LIQUID | 133330 | 1.0764E+05 |       |     | 1.26E+04            | ug/L | 80.732 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | 2-Nitroaniline                 | LIQUID | 133330 | 1.0080E+05 |       |     | 1.00E+04            | ug/L | 75.602 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | 2-Nitrophenol                  | LIQUID | 133330 | 1.0114E+05 |       |     | 1.26E+04            | ug/L | 75.857 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | 3 & 4 Methylphenol<br>Total    | LIQUID | 133330 | 1.0614E+05 |       |     | 1.12E+04            | ug/L | 79.607 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | 3-Nitroaniline                 | LIQUID | 133330 | 9.8710E+04 |       |     | 1.21E+04            | ug/L | 74.034 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | 4,6-Dinitro-2-methylphe<br>nol | LIQUID | 133330 | 1.0087E+05 |       |     | 2.99E+03            | ug/L | 75.654 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | 4-Bromophenyl-phenyle<br>ther  | LIQUID | 133330 | 1.0093E+05 |       |     | 8.34E+03            | ug/L | 75.699 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | 4-Chloro-3-methylphen<br>ol    | LIQUID | 133330 | 1.0016E+05 |       |     | 1.27E+04            | ug/L | 75.122 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | 4-Chloroaniline                | LIQUID | 133330 | 1.0265E+05 |       |     | 1.38E+04            | ug/L | 76.989 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | 4-Chlorophenyl-phenyle<br>ther | LIQUID | 133330 | 1.0177E+05 |       |     | 1.15E+04            | ug/L | 76.329 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | 4-Methylphenol                 | LIQUID |        | 0          |       |     |                     | ug/L | N/A    |            |       |
| 2        | LCS     | S1707100048   | 0 0  | O | 4-Nitroaniline                 | LIQUID | 133330 | 9.7820E+04 |       |     | 1.08E+04            | ug/L | 73.367 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | 4-Nitrophenol                  | LIQUID | 133330 | 1.0419E+05 |       |     | 7.33E+03            | ug/L | 78.144 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Acenaphthene                   | LIQUID | 133330 | 1.0177E+05 |       |     | 1.30E+04            | ug/L | 76.329 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Acenaphthylene                 | LIQUID | 133330 | 1.0303E+05 |       |     | 1.50E+04            | ug/L | 77.274 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Anthracene                     | LIQUID | 133330 | 1.0353E+05 |       |     | 6.20E+03            | ug/L | 77.649 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Benzo(a)anthracene             | LIQUID | 133330 | 1.0268E+05 |       |     | 5.64E+03            | ug/L | 77.012 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Benzo(a)pyrene                 | LIQUID | 133330 | 1.0184E+05 |       |     | 5.42E+03            | ug/L | 76.382 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Benzo(b)fluoranthene           | LIQUID | 133330 | 1.0704E+05 |       |     | 6.22E+03            | ug/L | 80.282 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Benzo(g,h,i)perylene           | LIQUID | 133330 | 8.9980E+04 |       |     | 5.30E+03            | ug/L | 67.487 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Benzo(k)fluoranthene           | LIQUID | 133330 | 1.0531E+05 |       |     | 6.02E+03            | ug/L | 78.984 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Butylbenzylphthalate           | LIQUID | 133330 | 1.0269E+05 |       |     | 4.64E+03            | ug/L | 77.019 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Chrysene                       | LIQUID | 133330 | 1.1458E+05 |       |     | 6.49E+03            | ug/L | 85.937 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Cyclohexanone                  | LIQUID | 133330 | 1.0463E+05 |       |     | 1.30E+04            | ug/L | 78.474 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Di-n-butylphthalate            | LIQUID | 133330 | 1.0925E+05 |       |     | 3.76E+03            | ug/L | 81.94  | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Di-n-octylphthalate            | LIQUID | 133330 | 1.0849E+05 |       |     | 4.66E+03            | ug/L | 81.37  | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Dibenz(a,h)anthracene          | LIQUID | 133330 | 8.4540E+04 |       |     | 4.53E+03            | ug/L | 63.407 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Dibenzofuran                   | LIQUID | 133330 | 1.0125E+05 |       |     | 1.19E+04            | ug/L | 75.939 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Diethylphthalate               | LIQUID | 133330 | 9.9660E+04 |       |     | 7.21E+03            | ug/L | 74.747 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Dimethylphthalate              | LIQUID | 133330 | 1.0223E+05 |       |     | 8.45E+03            | ug/L | 76.674 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Diphenylamine                  | LIQUID | 133330 | 1.0344E+05 |       |     | 7.73E+03            | ug/L | 77.582 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Fluoranthene                   | LIQUID | 133330 | 1.0468E+05 |       |     | 4.06E+03            | ug/L | 78.512 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Fluorene                       | LIQUID | 133330 | 1.0207E+05 |       |     | 1.27E+04            | ug/L | 76.554 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Hexachlorobenzene              | LIQUID | 133330 | 1.0132E+05 |       |     | 1.08E+04            | ug/L | 75.992 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Hexachlorobutadiene            | LIQUID | 133330 | 1.0479E+05 |       |     | 1.50E+04            | ug/L | 78.594 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Hexachlorocyclopentadi<br>ene  | LIQUID | 133330 | 9.9650E+04 |       |     | 2.62E+03            | ug/L | 74.739 | % Recovery |       |
| 2        | LCS     | S1707100048   | 0 0  | O | Hexachloroethane               | LIQUID | 133330 | 1.0675E+05 |       |     | 1.40E+04            | ug/L | 80.065 | % Recovery |       |

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N, A = Non-reported Analyte

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## LABCORE Completed Batch Report for Batch# 00075479

| Seq Type          | Sample# | Assoc. Sample | RepR | A | * Test                  | Matrix | Actual | Found       | Blank | CTR | Limit (DL/RL/UL) | Unit | Yield  | Yield Unit | Flags |
|-------------------|---------|---------------|------|---|-------------------------|--------|--------|-------------|-------|-----|------------------|------|--------|------------|-------|
| 2                 | LCS     | S1707100048   | 0 0  | O | Indeno(1,2,3-cd)pyrene  | LIQUID | 133330 | 8.9870E+04  |       |     | 2.62E+03         | ug/L | 67.404 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | Isobutanol              | LIQUID | 266670 | 2.1692E+05  |       |     | 2.16E+04         | ug/L | 81.344 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | Isophorone              | LIQUID | 133330 | 1.0117E+05  |       |     | 1.35E+04         | ug/L | 75.879 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | Methylphenols, Total    | LIQUID |        | 0           |       |     |                  | ug/L | N/A    |            |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | N-Nitrosodimethylamin   | LIQUID | 133330 | 1.0666E+05  |       |     | 1.24E+04         | ug/L | 79.996 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | N-Nitrosodipropylamine  | LIQUID | 133330 | 1.0608E+05  |       |     | 1.36E+04         | ug/L | 79.562 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | N-Nitrosomorpholine     | LIQUID | 133330 | 1.0703E+05  |       |     | 1.09E+04         | ug/L | 80.275 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | Naphthalene             | LIQUID | 133330 | 1.0629E+05  |       |     | 1.23E+04         | ug/L | 79.719 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | Nitrobenzene            | LIQUID | 133330 | 1.0375E+05  |       |     | 1.22E+04         | ug/L | 77.814 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | Pentachlorophenol       | LIQUID | 133330 | 9.8200E+04  |       |     | 5.70E+03         | ug/L | 73.652 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | Phenanthrene            | LIQUID | 133330 | 1.0285E+05  |       |     | 5.93E+03         | ug/L | 77.139 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | Phenol                  | LIQUID | 133330 | 1.0310E+05  |       |     | 1.21E+04         | ug/L | 77.327 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | Pyrene                  | LIQUID | 133330 | 1.0636E+05  |       |     | 3.81E+03         | ug/L | 79.772 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | Pyridine                | LIQUID | 133330 | 1.0488E+05  |       |     | 1.46E+04         | ug/L | 78.662 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | Tri-n-butylphosphate    | LIQUID | 133330 | 1.0736E+05  |       |     | 5.13E+03         | ug/L | 80.522 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | bis(2-Chloroethoxy)met  | LIQUID | 133330 | 1.0385E+05  |       |     | 1.34E+04         | ug/L | 77.889 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | hane                    |        |        |             |       |     |                  |      |        |            |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | bis(2-Ethylhexyl)phthal | LIQUID | 133330 | 1.0204E+05  |       |     | 4.40E+03         | ug/L | 76.532 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | ate                     |        |        |             |       |     |                  |      |        |            |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | bis-(2-Chloroethyl)     | LIQUID | 133330 | 1.0506E+05  |       |     | 1.30E+04         | ug/L | 78.797 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | ether                   |        |        |             |       |     |                  |      |        |            |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 2,4,6-Tribromophenol    | LIQUID | 400000 | 3.2997E+05  |       |     | 5.00E+03         | ug/L | 82.492 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 2-Fluorobiphenyl        | LIQUID | 200000 | 1.7837E+05  |       |     | 5.00E+03         | ug/L | 89.185 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | 2-Fluorophenol          | LIQUID | 400000 | 3.1024E+05  |       |     | 5.00E+03         | ug/L | 77.56  | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | Nitrobenzene-d5         | LIQUID | 200000 | 1.8605E+05  |       |     | 5.00E+03         | ug/L | 93.025 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | Phenol-d6               | LIQUID | 400000 | 3.1067E+05  |       |     | 5.00E+03         | ug/L | 77.668 | % Recovery |       |
| 2                 | LCS     | S1707100048   | 0 0  | O | Terphenyl-d14           | LIQUID | 200000 | 1.9233E+05  |       |     | 5.00E+03         | ug/L | 96.165 | % Recovery |       |
| Sample Sequence 3 |         |               |      |   |                         |        |        |             |       |     |                  |      |        |            |       |
| 3                 | SAMPLE  | S17R000148    | 0 0  | O | 1,2,4-Trichlorobenzene  | LIQUID | N/A    | <1.3770E+05 |       |     | 1.38E+05         | ug/L |        |            | U     |
| 3                 | SAMPLE  | S17R000148    | 0 0  | O | 1,2-Dichlorobenzene     | LIQUID | N/A    | <1.3490E+05 |       |     | 1.35E+05         | ug/L |        |            | U     |
| 3                 | SAMPLE  | S17R000148    | 0 0  | O | 1,4-Dichlorobenzene     | LIQUID | N/A    | <1.3570E+05 |       |     | 1.36E+05         | ug/L |        |            | Ua    |
| 3                 | SAMPLE  | S17R000148    | 0 0  | O | 1-Butanol               | LIQUID | N/A    | <5.5520E+05 |       |     | 5.55E+05         | ug/L |        |            | U     |
| 3                 | SAMPLE  | S17R000148    | 0 0  | O | 2,2-oxybis(1-Chloropro  | LIQUID | N/A    | <1.3990E+05 |       |     | 1.40E+05         | ug/L |        |            | U     |
| 3                 | SAMPLE  | S17R000148    | 0 0  | O | pane)                   |        |        |             |       |     |                  |      |        |            |       |
| 3                 | SAMPLE  | S17R000148    | 0 0  | O | 2,4,5-Trichlorophenol   | LIQUID | N/A    | <1.3720E+05 |       |     | 1.37E+05         | ug/L |        |            | U     |
| 3                 | SAMPLE  | S17R000148    | 0 0  | O | 2,4,6-Trichlorophenol   | LIQUID | N/A    | <1.3270E+05 |       |     | 1.33E+05         | ug/L |        |            | U     |
| 3                 | SAMPLE  | S17R000148    | 0 0  | O | 2,4-Dichlorophenol      | LIQUID | N/A    | <1.3160E+05 |       |     | 1.32E+05         | ug/L |        |            | U     |
| 3                 | SAMPLE  | S17R000148    | 0 0  | O | 2,4-Dimethylphenol      | LIQUID | N/A    | <6.8800E+04 |       |     | 6.88E+04         | ug/L |        |            | U     |
| 3                 | SAMPLE  | S17R000148    | 0 0  | O | 2,4-Dinitrophenol       | LIQUID | N/A    | <4.5100E+04 |       |     | 4.51E+04         | ug/L |        |            | U     |
| 3                 | SAMPLE  | S17R000148    | 0 0  | O | 2,4-Dinitrotoluene      | LIQUID | N/A    | <7.2900E+04 |       |     | 7.29E+04         | ug/L |        |            | U     |
| 3                 | SAMPLE  | S17R000148    | 0 0  | O | 2,6-bis-4Methylphenol   | LIQUID | N/A    | <6.1700E+04 |       |     | 6.17E+04         | ug/L |        |            | U     |

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N, A = Non-reported Analyte

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## LABCORE Completed Batch Report for Batch# 00075479

| Seq Type | Sample# | Assoc. Sample | RepR | A | * Test                      | Matrix | Actual | Found       | Blank | CTR | Limit (DL/RL/UL) | Unit | Yield | Yield Unit | Flags |
|----------|---------|---------------|------|---|-----------------------------|--------|--------|-------------|-------|-----|------------------|------|-------|------------|-------|
| 3        | SAMPLE  | S17R000148    | 00   | O | 2,6-Dinitrotoluene          | LIQUID | N/A    | <9.2400E+04 |       |     | 9.24E+04         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 2-Butoxyethanol             | LIQUID | N/A    | <2.8090E+05 |       |     | 2.81E+05         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 2-Chloronaphthalene         | LIQUID | N/A    | <1.4000E+05 |       |     | 1.40E+05         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 2-Chlorophenol              | LIQUID | N/A    | <1.1780E+05 |       |     | 1.18E+05         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 2-Ethoxyethanol             | LIQUID | N/A    | <1.8640E+05 |       |     | 1.86E+05         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 2-Methylnaphthalene         | LIQUID | N/A    | <1.4120E+05 |       |     | 1.41E+05         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 2-Methylphenol              | LIQUID | N/A    | <1.2620E+05 |       |     | 1.26E+05         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 2-Nitroaniline              | LIQUID | N/A    | <1.0040E+05 |       |     | 1.00E+05         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 2-Nitrophenol               | LIQUID | N/A    | <1.2600E+05 |       |     | 1.26E+05         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 3 & 4 Methylphenol          | LIQUID | N/A    | <1.1240E+05 |       |     | 1.12E+05         | ug/L |       |            | U     |
|          |         |               |      |   | Total                       |        |        |             |       |     |                  |      |       |            |       |
| 3        | SAMPLE  | S17R000148    | 00   | O | 3-Nitroaniline              | LIQUID | N/A    | <1.2070E+05 |       |     | 1.21E+05         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 4,6-Dinitro-2-methylphenol  | LIQUID | N/A    | <2.9900E+04 |       |     | 2.99E+04         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 4-Bromophenyl-phenyl ether  | LIQUID | N/A    | <8.3400E+04 |       |     | 8.34E+04         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 4-Chloro-3-methylphenol     | LIQUID | N/A    | <1.2730E+05 |       |     | 1.27E+05         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 4-Chloroaniline             | LIQUID | N/A    | <1.3820E+05 |       |     | 1.38E+05         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 4-Chlorophenyl-phenyl ether | LIQUID | N/A    | <1.1520E+05 |       |     | 1.15E+05         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 4-Methylphenol              | LIQUID | N/A    | 0           |       |     |                  | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 4-Nitroaniline              | LIQUID | N/A    | <1.0800E+05 |       |     | 1.08E+05         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 4-Nitrophenol               | LIQUID | N/A    | <7.3300E+04 |       |     | 7.33E+04         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Acenaphthene                | LIQUID | N/A    | <1.2980E+05 |       |     | 1.30E+05         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Acenaphthylene              | LIQUID | N/A    | <1.5010E+05 |       |     | 1.50E+05         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Anthracene                  | LIQUID | N/A    | <6.2000E+04 |       |     | 6.20E+04         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Benzo(a)anthracene          | LIQUID | N/A    | <5.6400E+04 |       |     | 5.64E+04         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Benzo(a)pyrene              | LIQUID | N/A    | <5.4200E+04 |       |     | 5.42E+04         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Benzo(b)fluoranthene        | LIQUID | N/A    | <6.2200E+04 |       |     | 6.22E+04         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Benzo(g,h,i)perylene        | LIQUID | N/A    | <5.3000E+04 |       |     | 5.30E+04         | ug/L |       |            | Ua    |
| 3        | SAMPLE  | S17R000148    | 00   | O | Benzo(k)fluoranthene        | LIQUID | N/A    | <6.0200E+04 |       |     | 6.02E+04         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Butylbenzylphthalate        | LIQUID | N/A    | <4.6400E+04 |       |     | 4.64E+04         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Chrysene                    | LIQUID | N/A    | <6.4900E+04 |       |     | 6.49E+04         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Cyclohexanone               | LIQUID | N/A    | <1.3020E+05 |       |     | 1.30E+05         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Di-n-butylphthalate         | LIQUID | N/A    | <3.7600E+04 |       |     | 3.76E+04         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Di-n-octylphthalate         | LIQUID | N/A    | <4.6600E+04 |       |     | 4.66E+04         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Dibenz(a,h)anthracene       | LIQUID | N/A    | <4.5300E+04 |       |     | 4.53E+04         | ug/L |       |            | Ua    |
| 3        | SAMPLE  | S17R000148    | 00   | O | Dibenzofuran                | LIQUID | N/A    | <1.1900E+05 |       |     | 1.19E+05         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Diethylphthalate            | LIQUID | N/A    | <7.2100E+04 |       |     | 7.21E+04         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Dimethylphthalate           | LIQUID | N/A    | <8.4500E+04 |       |     | 8.45E+04         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Diphenylamine               | LIQUID | N/A    | <7.7300E+04 |       |     | 7.73E+04         | ug/L |       |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Fluoranthene                | LIQUID | N/A    | <4.0600E+04 |       |     | 4.06E+04         | ug/L |       |            | U     |

Units shown for QC (BLK/BKG) may not reflect the actual units.

\* = Rejected Analyte  
C = Cancelled Analyte  
N, A = Non-reported Analyte

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## LABCORE Completed Batch Report for Batch# 00075479

| Seq Type | Sample# | Assoc. Sample | RepR | A | * Test                     | Matrix | Actual | Found       | Blank | CTR | Limit (DL/RL/UL) | Unit | Yield  | Yield Unit | Flags |
|----------|---------|---------------|------|---|----------------------------|--------|--------|-------------|-------|-----|------------------|------|--------|------------|-------|
| 3        | SAMPLE  | S17R000148    | 00   | O | Fluorene                   | LIQUID | N/A    | <1.2720E+05 |       |     | 1.27E+05         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Hexachlorobenzene          | LIQUID | N/A    | <1.0830E+05 |       |     | 1.08E+05         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Hexachlorobutadiene        | LIQUID | N/A    | <1.5020E+05 |       |     | 1.50E+05         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Hexachlorocyclopentadiene  | LIQUID | N/A    | <2.6200E+04 |       |     | 2.62E+04         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Hexachloroethane           | LIQUID | N/A    | <1.4000E+05 |       |     | 1.40E+05         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Indeno(1,2,3-cd)pyrene     | LIQUID | N/A    | <2.6200E+04 |       |     | 2.62E+04         | ug/L |        |            | Ua    |
| 3        | SAMPLE  | S17R000148    | 00   | O | Isobutanol                 | LIQUID | N/A    | <2.1570E+05 |       |     | 2.16E+05         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Isophorone                 | LIQUID | N/A    | <1.3490E+05 |       |     | 1.35E+05         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Methylphenols, Total       | LIQUID | N/A    | 0           |       |     |                  | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | N-Nitrosodimethylamine     | LIQUID | N/A    | <1.2400E+05 |       |     | 1.24E+05         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | N-Nitrosodipropylamine     | LIQUID | N/A    | <1.3550E+05 |       |     | 1.36E+05         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | N-Nitrosomorpholine        | LIQUID | N/A    | <1.0870E+05 |       |     | 1.09E+05         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Naphthalene                | LIQUID | N/A    | <1.2330E+05 |       |     | 1.23E+05         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Nitrobenzene               | LIQUID | N/A    | <1.2180E+05 |       |     | 1.22E+05         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Pentachlorophenol          | LIQUID | N/A    | <5.7000E+04 |       |     | 5.70E+04         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Phenanthrene               | LIQUID | N/A    | <5.9300E+04 |       |     | 5.93E+04         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Phenol                     | LIQUID | N/A    | <1.2120E+05 |       |     | 1.21E+05         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Pyrene                     | LIQUID | N/A    | <3.8100E+04 |       |     | 3.81E+04         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Pyridine                   | LIQUID | N/A    | <1.4620E+05 |       |     | 1.46E+05         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Tri-n-butylphosphate       | LIQUID | N/A    | 1.2310E+05  |       |     | 5.13E+04         | ug/L |        |            | J     |
| 3        | SAMPLE  | S17R000148    | 00   | O | bis(2-Chloroethoxy)methane | LIQUID | N/A    | <1.3370E+05 |       |     | 1.34E+05         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | bis(2-Ethylhexyl)phthalate | LIQUID | N/A    | <4.4000E+04 |       |     | 4.40E+04         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | bis-(2-Chloroethyl) ether  | LIQUID | N/A    | <1.2970E+05 |       |     | 1.30E+05         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | 2,4,6-Tribromophenol       | LIQUID | 400000 | 6.3200E+04  |       |     | 5.00E+04         | ug/L | 15.8   | % Recovery |       |
| 3        | SAMPLE  | S17R000148    | 00   | O | 2-Fluorobiphenyl           | LIQUID | 200000 | 2.1130E+05  |       |     | 5.00E+04         | ug/L | 105.65 | % Recovery |       |
| 3        | SAMPLE  | S17R000148    | 00   | O | 2-Fluorophenol             | LIQUID | 400000 | <5.0000E+04 |       |     | 5.00E+04         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Nitrobenzene-d5            | LIQUID | 200000 | 1.9330E+05  |       |     | 5.00E+04         | ug/L | 96.65  | % Recovery |       |
| 3        | SAMPLE  | S17R000148    | 00   | O | Phenol-d6                  | LIQUID | 400000 | <5.0000E+04 |       |     | 5.00E+04         | ug/L |        |            | U     |
| 3        | SAMPLE  | S17R000148    | 00   | O | Terphenyl-d14              | LIQUID | 200000 | 2.1770E+05  |       |     | 5.00E+04         | ug/L | 108.85 | % Recovery |       |
| 3        | SAMPLE  | S17R000148    | 00   | O | Tridecane                  | LIQUID | N/A    | 220000      |       |     |                  | ug/L |        |            | JNT   |

## Comments Section:

Units shown for QC (BLK/BKG) may not reflect the actual units.

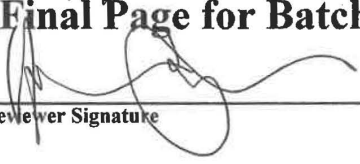
\* = Rejected Analyte  
C = Cancelled Analyte  
N, A = Non-reported Analyte

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batchreports 3.0.13

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**LABCORE Completed Batch Report for Batch# 00075479**

Data Flagger Status:  
Flagging Completed

**Final Page for Batch# 00075479**  
\_\_\_\_\_  
Reviewer Signature10/5/17  
\_\_\_\_\_  
Date

Units shown for QC (BLK/BKG) may not reflect the actual units.

\* = Rejected Analyte  
C = Cancelled Analyte  
N, A = Non-reported Analyte

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batchreports 3.0.13

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**LABCORE Completed Batch Report for Batch# 00075479**

| Seq | Sample#     | QC Type | Assoc. Sample | Sample Group | Method           | Customer Id | Specification                    | Hold Time/Expiration Date |
|-----|-------------|---------|---------------|--------------|------------------|-------------|----------------------------------|---------------------------|
| 1   | S1707100047 | BLNK    |               |              | SVOA 222S LIQUID |             |                                  |                           |
| 2   | S1707100048 | LCS     |               |              | SVOA 222S LIQUID |             |                                  |                           |
| 3   | S17R000148  | SAMPLE  |               | 20171600     | SVOA 222S LIQUID | 4AW-17-02   | 241-AW-104 Grab Sampling 2017-06 | 08/22/2017 14:15          |

Units shown for QC (BLK/BKG) may not reflect the actual units.

\* = Rejected Analyte  
C = Cancelled Analyte  
N, A = Non-reported Analyte



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batchreports 3.0.13

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**LABCORE Completed Batch Report for Batch# 00074945****Analyst:** Fabre, Martha**Book#:** *see benchshort*  
*10/6/17***Instrument:****Method:** ORGANIC DILUTION PREP #2, LA-523-149 Rev/Mod 3-2**Specification:** 241-AW-104 Grab Sampling 2017-06**Prep Batch:** N/A**Batch Comment:***NA*

| Seq Type | Sample# | Assoc. Sample | RepR | A | * Test           | Matrix | Actual | Found    | Blank | CTR | Limit<br>(DL/RL/UL) | Unit    | Yield | Yield Unit | Flags |
|----------|---------|---------------|------|---|------------------|--------|--------|----------|-------|-----|---------------------|---------|-------|------------|-------|
| 1        | BLNK    | S1707100047   |      | O | Dose Rate(1)     | LIQUID |        |          |       |     |                     |         |       |            |       |
| 1        | BLNK    | S1707100047   |      | O | Digest Factor(1) | LIQUID |        | 0.001000 |       |     |                     | uL / uL |       |            |       |
| 2        | LCS     | S1707100048   |      | O | Dose Rate(1)     | LIQUID |        |          |       |     |                     |         | N/A   |            |       |
| 2        | LCS     | S1707100048   |      | O | Digest Factor(1) | LIQUID |        | 0.000100 |       |     |                     | uL / uL | N/A   |            |       |
| 3        | SAMPLE  | S17R000148    |      | O | Dose Rate(1)     | LIQUID |        |          |       |     |                     |         |       |            |       |
| 3        | SAMPLE  | S17R000148    |      | O | Digest Factor(1) | LIQUID |        | 0.000010 |       |     |                     | uL / uL |       |            |       |

**Comments Section:**

Data Flagger Status:

**Final Page for Batch# 00074945**

Reviewer Signature

Date

Units shown for QC (BLK/BKG) may not reflect the actual units.

\* = Rejected Analyte  
C = Cancelled Analyte  
N, A = Non-reported Analyte

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LABCORE Completed Batch Report for Batch# 00074945

| Seq | Sample#    | QC Type | Assoc. Sample | Sample Group | Method           | Customer Id | Specification                    | Hold Time/Expiration Date |
|-----|------------|---------|---------------|--------------|------------------|-------------|----------------------------------|---------------------------|
| 3   | S17R000148 | SAMPLE  |               | 20171600     | ORGANIC DILUTION | 4AW-17-02   | 241-AW-104 Grab Sampling 2017-06 | 08/22/2017 14:15          |

Units shown for QC (BLK/BKG) may not reflect the actual units.

\* = Rejected Analyte  
C = Cancelled Analyte  
N, A = Non-reported Analyte

RPP-RPT-60441, Rev. 0

**APPENDIX C****REVIEW OF GAS CHROMATOGRAPHY - MASS SPECTROMETRY FILE FOR  
TENTATIVELY IDENTIFIED COMPOUNDS**

(3 pages, including cover page)

## TIC Evaluation of 170713\_AW104, file 7

The following Tentatively Identified Compounds (TICs) were evaluated using the FreeStyle program provided with the TraceFinder software. The TIC Summary report for file 7 was used to identify which peaks to evaluate. Below is a summary of the evaluation.

Retention Time (RT): 2.83 ID: Acetic Acid Evaluation: Good match, could also be ammonium acetate (spectra virtually the same).

RT: 4.65 ID: Butanoic Acid Evaluation: Good match

RT: 5.34 ID: 3-Methyl-3-nitrobut-1-ene Evaluation: ID possible match

RT: 5.50 ID: 3-Methyl-3-nitrobut-1-ene Evaluation: ID possible match, but same spectra as compound at RT 5.34. Spectra isn't unique enough to positively identify. Hydrocarbon.

RT: 5.57 ID: Phosgene oxime Evaluation: ID a good spectral match. Likely an artifact created during the extraction due to the matrix.

RT: 5.89 ID: Cyclopentane, bromo Evaluation: ID possible match, but same spectra as compound at RT 5.34 and 5.50. Spectra isn't unique enough to positively identify. Hydrocarbon. Detector may be saturated.

RT: 6.07 ID: 3-Methyl-3-nitrobut-1-ene Evaluation: ID possible match, but same spectra as compound at RT 5.34. Spectra isn't unique enough to positively identify. Hydrocarbon.

RT: 6.12 ID: 3-Methyl-3-nitrobut-1-ene Evaluation: ID possible match, but same spectra as compound at RT 5.34. Spectra isn't unique enough to positively identify. Hydrocarbon.

RT: 6.33 ID: 2-Propenoic acid, 2-methyl-, 1-methylbutyl ester Evaluation: ID not correct – missing ions. HC of some sort.

RT: 6.38 ID: 3-Methyl-3-nitrobut-1-ene Evaluation: ID possible match, similar spectra as compound at RT 5.34, but a couple of extra ions present. Spectra isn't unique enough to positively identify. Hydrocarbon.

RT: 6.54 ID: 1-Pentene, 5-nitro Evaluation: Missing ion 115. Unknown hydrocarbon.

RT: 6.79 ID: 3-Methyl-3-nitrobut-1-ene Evaluation: ID possible match, similar spectra as compound at RT 5.34, but a couple of extra ions present. Spectra isn't unique enough to positively identify. Hydrocarbon.

RT: 7.26 ID: 4-Penten-2-ol Evaluation: No - missing ions – HC of some sort.

RT: 7.40 ID: 2-Hydroxy-3-pentanone Evaluation: No - missing ions. HC of some sort.

RT: 7.98 ID: Heptane, 2-Bromo- Evaluation: No - missing ions. HC of some sort.

RT: 8.41 ID: 1-Propene, 3-propoxy- Evaluation: No - missing ions. HC of some sort.

RT: 8.52 ID: Heptane, 4-methyl- Evaluation: No – missing ions. HC of some sort.

RT: 8.63 ID: 1-Propene, 3-propoxy- Evaluation: No - missing ions. HC of some sort.

RT: 8.98 ID: 1-Propene, 3-propoxy- Evaluation: No - missing ions. Similar spectra to compound at RT 8.41, similar HC of some sort.

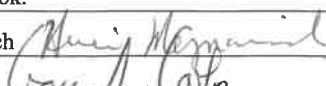
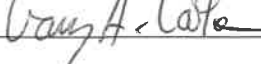
RT: 9.10 ID: Hydrazinecarboximidamine, nitrate Evaluation: No – missing ions. Some sort of HC.

RT: 10.23 ID: Dodecane Evaluation: definitely an alkane, more likely Tridecane due to MW ion 184 presence.

RT: 11.16 ID: Tetradecane Evaluation: ID is likely correct. Definitely an alkane and the MW ion is present.

## RPP-RPT-60441, Rev 0

## Calculation Checklist

|                            |                                                                                                  |       |         |
|----------------------------|--------------------------------------------------------------------------------------------------|-------|---------|
| Calculation Title/Subject: | Workbook associated with RPP-RPT-60441, Investigation of AW-104 Composite Floating Layer         |       |         |
| Scope of Review:           | Entire workbook.                                                                                 |       |         |
| Engineer/Analyst           | Huei Meznarich  | Date: | 1/18/18 |
| Organization Manager       | Gary Cooke      | Date: | 1/18/18 |

|     |     |     |
|-----|-----|-----|
| Yes | No* | NA* |
|-----|-----|-----|

- |                                     |                          |                                     |    |                                                                                                                                                                                                                         |
|-------------------------------------|--------------------------|-------------------------------------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | a. | The objective/purpose of the calculation is clearly stated and the problem is completely defined by the purpose statement.                                                                                              |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | b. | Analytical and technical approaches and results are reasonable and appropriate.                                                                                                                                         |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | c. | Input data are adequately described, referenced to their source, and checked for consistency with original source information.                                                                                          |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | d. | Necessary assumptions are reasonable, explicitly stated, and supported. Assumptions requiring verification prior to use are clearly stated and identified/tracked using TBD/HOLD numbers.                               |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | e. | For both qualitative and quantitative data, uncertainties are recognized and discussed and the data is presented in a manner to minimize design interpretations.                                                        |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | f. | Mathematical derivations were checked, including dimensional consistency of results.                                                                                                                                    |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | g. | Calculations are sufficiently detailed such that a technically qualified person can understand the analysis without requiring outside information.                                                                      |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | h. | Hand and MathCAD® calculations were verified, including review that correct input data are used, formulae correctly interpret intended expressions, correct units are used, and results are reasonable and appropriate. |

**No Hand or MathCAD calculations were used.**

- |                          |                          |                                     |    |                                                                                                                                                             |
|--------------------------|--------------------------|-------------------------------------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | i. | Software applications used are identified by the program name and version/release number as required by Attachment A (Section 7, Use of Computer Software). |
|--------------------------|--------------------------|-------------------------------------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------|

**The only software used was the Hanford site standard of Microsoft Excel.**

- |                                     |                          |                                     |    |                                                                                                                                      |
|-------------------------------------|--------------------------|-------------------------------------|----|--------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | j. | Software input data is identified and/or attached/included, the input data is correct, and consistent with the calculation document. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | k. | Software output is consistent with the input and with the results reported in the calculation document.                              |

**These workbooks are not software.**

- |                          |                          |                                     |    |                                                                                                                                                                                                                                                                                                                                            |
|--------------------------|--------------------------|-------------------------------------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | l. | Software verification and validation are addressed adequately in accordance with TFC-BSM-IRM_HS-C-01. Software verification documentation, (typically the Software Management Plan or Test Report), is included in the calculation document, or a reference is provided as required by Attachment A (Section 7, Use of Computer Software). |
|--------------------------|--------------------------|-------------------------------------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**These workbooks are not software.**

- |                                     |                          |                                     |    |                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------------|--------------------------|-------------------------------------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | m. | Software verification show that software produces correct solution for the encoded mathematical model within defined limits for each parameter employed and the software is used within its limits.                                                                                                                                                 |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | n. | The encoded mathematical model (method), produces a valid solution to the physical problem associated with the particular application (i.e., the methodology used is applicable to the problem being solved).                                                                                                                                       |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | o. | Multiple-Use spreadsheets used in the calculation are identified, verified, and documented in accordance with TFC-ENG-DESIGN-C-32. Reference to the corresponding Software Management Plan or Spreadsheet Verification Form (for legacy spreadsheets) is included in calculation as required by Attachment A (Section 7, Use of Computer Software). |

**These workbooks are single use spreadsheets.**

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|-------------------------------------|--------------------------|--------------------------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | p. | Single-Use spreadsheets used in the calculation are identified, verified, and documented as part of the calculation or other technical document as prescribed in TFC-ENG-DESIGN-C-10. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | q. | Data or results presented in tables and graphs have been checked against original source.                                                                                             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | r. | The number of significant digits is appropriate and consistent.                                                                                                                       |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | s. | Limits/criteria/guidelines applied to the analysis results are appropriate and referenced. Limits/criteria/guidelines were checked against references.                                |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | t. | Conclusions are consistent with analytical results and applicable limits.                                                                                                             |

\* If less than the entire calculation was checked, the scope of the check should be discussed. If any blocks are checked "No" or "NA", an explanation must be provided here or attached.

- ☒ ☐ ☐ u. Results and conclusions address all points in the purpose.
- ☒ ☐ ☐ v. Referenced documents are retrievable or otherwise available and the version or revision of each reference is cited.
- ☒ ☐ ☐ w. The calculation was prepared in accordance with Attachment A, "Calculation Format and Preparation Instructions," of TFC-ENG-DESIGN-C-10.
- ☒ ☐ ☐ x. Impacts on requirements have been assessed and change documentation initiated to incorporate revisions to affected documents, as appropriate.
- ☒ ☐ ☐ y. All checker comments have been dispositioned.
- ☒ ☐ ☐ z. The design media matches the calculations.

Doug Kraft



1/18/18

Checker (printed name and signature)

Date