

## **EXHIBIT J**

**[REDACTED - NON-CONFIDENTIAL VERSION]**

**EXPERT REPORT FOR**  
***Carla Marie Bartlett v. E. I. du Pont de Nemours and Company,***  
**Civil Action No. 2:13-CV-170 (S.D. Ohio)**  
**AND**  
***John M. Wolf v. E. I. du Pont de Nemours and Company,***  
**Civil Action No. 2:14-0545 (S.D.W.Va.)**

**Prepared For:**

**Plaintiffs Steering Committee in**  
***E. I. du Pont de Nemours and Company C-8 Personal Injury Liability Litigation***  
**Case No. 2:13-MD-2433 (S.D. Ohio)**

**Prepared by:**

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**November 20, 2014**



## **I. AREA OF TESTIMONY**

I expect to testify at trial for the Plaintiffs in the referenced cases above on the subjects of: 1) the precision, accuracy, representativeness, completion, and comparability (PARCC) of the methods used by DuPont to measure the concentrations of perfluorooctanoic acid (PFOA) in drinking water; 2) the extent of DuPont's knowledge of the PARCC of the reported PFOA concentrations in drinking water over time; 3) the actual error of the PFOA concentrations in drinking water over time; and 4) the accuracy of DuPont's representations to the public and others concerning the levels of PFOA concentrations in drinking water. My opinions in these areas are set forth in the following sections of this report.

## **II. SCOPE OF DUTIES**

I was retained by Taft Stettinius & Hollister LLP of Cincinnati, Ohio on behalf of the Plaintiffs' Steering Committee in this MDL to provide expert services including the review of reports, data, depositions, and pertinent documents. The work involves the preparation of an expert report and may involve deposition and trial testimony and the related preparation.

## **III. INFORMATION CONSIDERED, REVIEWED, AND/OR RELIED UPON**

See Appendix A

## **IV. PERFLUOROOCTANOIC ACID CHEMISTRY**

### **A. Nomenclature**

Ammonium perfluorooctanoate, also known as ammonium pentadecafluorooctanoate, APFO, C-8, or FC-143 is the ammonium salt of perfluorooctanoic acid (PFOA). APFO and PFOA belong to a class of compounds known as perfluorocarboxylic acids which are completely fluorinated carboxylic acids. One end of the molecule, known as the head, contains a carboxyl group ( $\text{COOH}$  or  $\text{COO}^-$ ) and the other end, known as the tail, contains the fluorocarbon. The molecular structure of the straight-chain (normal or linear) *n*-APFO and *n*-PFOA are shown in Table 1. There can be structural isomers of APFO and PFOA in which the fluorocarbon is branched both terminally, such as perfluoro-6-methylheptanoic acid (*iso*-PFOA), and internally, such as perfluoro-5-methylheptanoic acid (*5m*-PFOA) and perfluoro-4-methylheptanoic acid (*4m*-PFOA).

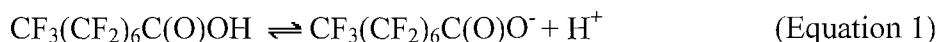


Table 1. Nomenclature

|                                                 | Ammonium Perfluorooctanoate                                                     | Perfluorooctanoic Acid                                            |
|-------------------------------------------------|---------------------------------------------------------------------------------|-------------------------------------------------------------------|
| CAS No.                                         | 3825-26-1                                                                       | 335-67-1                                                          |
| Molecular Formula                               | C <sub>8</sub> H <sub>4</sub> F <sub>15</sub> NO <sub>2</sub>                   | C <sub>8</sub> H <sub>1</sub> F <sub>15</sub> O <sub>2</sub>      |
| Condensed Structural Formula of Linear Molecule | CF <sub>3</sub> (CF <sub>2</sub> ) <sub>6</sub> CO <sub>2</sub> NH <sub>4</sub> | CF <sub>3</sub> (CF <sub>2</sub> ) <sub>6</sub> CO <sub>2</sub> H |
| Structure of Linear Molecule                    |                                                                                 |                                                                   |
| Molecular Weight                                | 431.10                                                                          | 414.07                                                            |
| Other Names                                     | ammonium<br>pentadecafluorooctanoate<br>APFO<br>C-8<br>FC-143                   | pentadecafluorooctanoic acid<br>PFOA                              |
| 3M Trade Names                                  | Fluorad™ FC-143 and FC-118                                                      | Fluorad™ Acid FC-26                                               |

## B. Physical and Chemical Properties

APFO and PFOA are known as anionic surfactants. Surfactants lower the surface tension of water and contain both a water soluble (hydrophilic) group and a water insoluble or oil soluble (hydrophobic) group. The head of the APFO and PFOA molecules contain the carboxyl group while the tail of the molecule contains the fluorocarbon. The physical properties of APFO and PFOA are influenced by both the head and the tail of the molecule. The carboxyl group at the head of the PFOA molecule is known as a "weak" acid because it is only partially ionized in water depending on the pH forming the perfluorooctanoate anion and the hydrogen cation.



The double arrows indicate that the above process can go in both the forward and in the backward direction. At equilibrium, the forward and backward rates are the same. This process for PFOA can be expressed in an equation defined as

$$K_A = [\text{H}^+][\text{CF}_3(\text{CF}_2)_6\text{C}(\text{O})\text{O}^-] \div [\text{CF}_3(\text{CF}_2)_6\text{C}(\text{O})\text{OH}] \quad (\text{Equation 2})$$

where  $K_A$  is known as the equilibrium constant (acid dissociation or ionization constant) and the brackets designate the molar concentration of each substance enclosed within the bracket. The  $\text{p}K_A$  ( $\text{p}K_A = -\text{Log}_{10}K_A$ ) for PFOA, which ranges between < 1.0 and 1.3 in the literature, Table 2, has been challenging because of the surfactant properties of PFOA.<sup>1</sup> The  $[\text{H}^+]$  in the above equation is the concentration of the hydrogen ion and is linked to the pH of the solution by

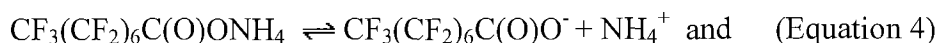
<sup>1</sup> Lena Vierke, Urs Berger, and Ian T. Cousins, Estimation of the Acid Dissociation Constant of Perfluoroalkyl Carboxylic Acids through an Experimental Investigation of their Water-to-Air Transport, *Environmental Science and Technology*, 2013, 47, pp. 11032-11039.



$$\text{pH} = -\text{Log}_{10}[\text{H}^+] \quad (\text{Equation 3})$$

By decreasing the pH (i.e., increasing the  $\text{H}^+$  concentration) the equilibrium shifts toward the left, and by increasing the pH (i.e., decreasing the  $\text{H}^+$  concentration) the equilibrium shifts to the right. Thus pH will determine through the equilibrium equation which forms of PFOA will be present in water, the un-dissociated acid  $\text{CF}_3(\text{CF}_2)_6\text{C}(\text{O})\text{OH}$  or the anion  $\text{CF}_3(\text{CF}_2)_6\text{C}(\text{O})\text{O}^-$ . The anion is more soluble in water. The un-dissociated acid is more soluble in organic solvents.

APFO is the ammonium salt of PFOA. APFO dissociates in water to form the perfluorooctanoate anion and the ammonium cation. The ammonium cation is a weak acid and has its own equilibrium.



The dissociation constant for APFO K is 4570, Table 2 and can be expressed as

$$K = [\text{NH}_4^+][\text{CF}_3(\text{CF}_2)_6\text{C}(\text{O})\text{O}^-] \div [\text{CF}_3(\text{CF}_2)_6\text{C}(\text{O})\text{ONH}_4] \quad (\text{Equation 6})$$

$$K_A = [\text{H}^+][\text{NH}_3] \div [\text{NH}_4^+] = 5.75 \times 10^{-10} @ 25^\circ\text{C} \quad (\text{Equation 7})$$

With a dissociation constant  $K = 4570$ , Table 2, when APFO is added to water (at a pH = 7) only a small fraction of APFO will be un-dissociated. However, Equation 1 will also be involved when the pH is lowered to  $< 2$  (increasing  $[\text{H}^+]$ ) forming the un-dissociated acid  $\text{CF}_3(\text{CF}_2)_6\text{C}(\text{O})\text{OH}$ . Thus, pH plays an important role in whether un-dissociated acid  $\text{CF}_3(\text{CF}_2)_6\text{C}(\text{O})\text{OH}$  or the perfluorooctanoate anion  $\text{CF}_3(\text{CF}_2)_6\text{C}(\text{O})\text{O}^-$  predominate in aqueous solutions. Thus, pH will also effect the solubility in water, volatility of APFO and PFOA in aqueous solutions (Henry's Law Constant), and the adsorption on soil. A University of Delaware study concluded

(University of Delaware C8 Study).<sup>2</sup>

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APFO and PFOA will form micelles in aqueous solutions when the concentration of APFO or PFOA reaches a certain concentration known as the critical micelle concentration (CMC), Table 2. The Krafft temperature, Table 2 is the minimum temperature at which the surfactant forms micelles. Micelles are an aggregate of APFO or PFOA molecules dispersed in the aqueous phase that form a stable complex with each other with the hydrophilic head of the molecules in contact with the water phase and the hydrophobic tail of the molecules in the center of the micelle. Micelle's are similar to a second phase within the aqueous phase which allow the concentration of APFO and PFOA to increase above their solubilities. It is also reported that these

<sup>2</sup> University of Delaware C8 Study (Bates No. EID212859-EID212872).

<sup>3</sup> <http://www.elmhurst.edu/~chm/vchembook/190acidrain.html>.

<sup>4</sup> The weighted annual mean pH of the precipitation at Caldwell, Ohio, about 36 miles from Washington Works plant site was approximately 4.1 to 4.2 in the 1980s and 4.2 to 4.3 in the 1990.

<http://nadp.isws.illinois.edu/sites/ntn/ntntrends.html?siteID=OH49>.



compounds form pre-micelles at concentrations below the CMC and stable dimeric clusters  $(\text{CF}_3(\text{CF}_2)_6\text{C}(\text{O})\text{O})_2\text{H}^-$  form at concentrations of 1 mg/L PFOA.<sup>5,6</sup>

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<sup>5</sup> Lena Vierke, Urs Berger, and Ian T. Cousins, Estimation of the Acid Dissociation Constant of Perfluoroalkyl Carboxylic Acids through an Experimental Investigation of their Water-to-Air Transport, *Environmental Science and Technology*, 2013, 47, pp. 11032-11039.

<sup>6</sup> Jie Cheng, Eleftheria Psillakis, M. R. Hoffmann, and A. J. Colussi, Acid Dissociation versus Molecular Association of Perfluoroalkyl Oxoacids: Environmental Implications, *J. Phys Chem A*, 2009, 113, pp. 8152-8156.



Table 2 Physical Properties of APFO and PFOA

| Property                                             | APFO                                                                            | PFOA                                              | Reference              |
|------------------------------------------------------|---------------------------------------------------------------------------------|---------------------------------------------------|------------------------|
| Melting Point (°C)                                   | 130<br><b>REDACTED</b>                                                          | 55<br><b>REDACTED</b><br>45-50                    | 1<br>2,3<br>7          |
| Boiling Point (°C)                                   | Sublimes                                                                        | 189<br><b>REDACTED</b><br>189-192                 | 1<br>2<br>7            |
| Vapor Pressure mm Hg                                 | $1 \times 10^{-3}$ @ 25°C<br><b>REDACTED</b><br><br>$6.1 \times 10^{-5}$ @ 20°C | 10 @ 25°C<br><br>0.04 @ 25°C<br>0.0169 @ 20°C     | 1<br>2<br>2<br>7<br>9  |
| Solubility in Water<br>5.1 g/L @ 30°C                | 20 g/L gels<br><b>REDACTED</b><br><br>>500 g/L @ 25 °C                          | 3.4 g/L<br><b>REDACTED</b><br><br>4.4 g/L @ 25 °C | 1,7<br>2,3<br>2,3<br>9 |
| Octanol Water Distribution<br>Log <sub>10</sub> D    |                                                                                 | 1.92                                              | 7<br>(experimental)    |
| Acid Dissociation Constant<br>pK <sub>A</sub>        |                                                                                 | <1.0 - 1.3<br>0.5<br>2.5                          | 5<br>5<br>8            |
| Dissociation Constant pK                             | -3.66                                                                           |                                                   | 4                      |
| Krafft Point °C                                      | 2.5                                                                             | 20                                                | 3                      |
| Critical Micelle Concentration                       | 14.2 g/L @ 2.5 °C                                                               | 3.7 g/L @ 20°C                                    | 3                      |
| Decomposition Temperature                            | 150-165 °C                                                                      |                                                   | 4                      |
| Henry's Law Constant (atm-<br>m <sup>3</sup> /gmole) | $1.2 \times 10^{-10}$ @ 25°C                                                    |                                                   | 4 (calculated)         |

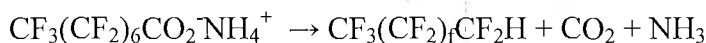
## Table References:

1. 2/20/02, USEPA Draft Hazard Assessment of Perfluorooctanoic Acid and its Salts, corrected 4/15/02.
2. 10/17/95, Interoffice Memo from Martin Schiller to Rick Brandenburg re: C-8 Properties. (Bates No. EID178612-EID178618).
3. K. Shinoda et al., Physicochemical Properties of Aqueous Solutions of Fluorinated Surfactants, *J Phys Chem* 1972, 76(6), pp 909-914.
4. 12/17/01, DuPont, Emission Modeling Data Required in Consent Order GWR-2001-019 Section VII.D. (Bates No. DJM000147-DJM000155).
5. Lena Vierke, Urs Berger, and Ian T. Cousins, Estimation of the Acid Dissociation Constant of Perfluoroalkyl Carboxylic Acids through an Experimental Investigation of their Water-to-Air Transport, *Environmental Science and Technology*, 47, pp. 11032-11039.
6. Jie Cheng, Eleftheria Psillakis,† M. R. Hoffmann, and A. J. Colussi, Acid Dissociation versus Molecular Association of Perfluoroalkyl Oxoacids: Environmental Implications, *J. Phys Chem A*, 2009, 113, pp. 8152-8156.
7. Sierra Rayne and Kaya Forest, Perfluoroalkyl Sulfonic and Carboxylic Acids: A Critical Review of Physicochemical Properties, Levels and Patterns in Waters and Wastewaters, and Treatment Methods, *J. Environ Sci & Health A*, 2009, 44, pp. 1145-1199.
8. USEPA AR-226 473.
9. Paustenbach, Dennis J., et. al., A Methodology for Estimating Human Exposure to Perfluorooctanoic Acid (PFOA): A Retrospective Exposure Assessment of a Community (1951-2003), *Journal of Toxicology and Environmental Health, Part A*, 2007, 70, pp. 28-57.



According to the USEPA, "PFOA is very persistent in the environment."<sup>7</sup> PFOA is stable under normal environmental conditions in water, soil, sediment, and sludge.<sup>8</sup> PFOA and APFO are chemically and thermally stable because of the strong fluorine carbon bond.<sup>9</sup>

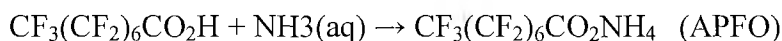
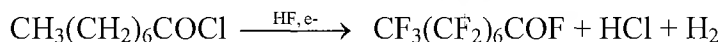
APFO when heated to 350°F in a "sintering" step loses carbon dioxide and ammonia.<sup>10</sup> This procedure is used at DuPont's Spurance Plant to destroy APFO by the following reaction:



*n*-PFOA undergoes a similar decomposition at temperatures between 355 and 385 °C to yield 1-H-perfluoroheptane and minor amounts of perfluoro-1-heptene from the loss of CO<sub>2</sub> and HF.<sup>11</sup> *n*-PFOA will also decompose by direct photolysis at certain ultraviolet wavelengths. PFOA was also reported to degrade by catalyzed H<sub>2</sub>O<sub>2</sub> propagations modified Fenton's reagent.<sup>12</sup>

### C. Synthesis of PFOA and Production of Isomers (3M v. DuPont)

There are two major synthesis paths for the production of PFOA. 3M used electrochemical fluorination (ECF) and DuPont used telomerization. In the ECF process, octanoyl chloride (H(CH<sub>2</sub>)<sub>7</sub>COCl) reacts with anhydrous hydrofluoric acid (HF) to produce octanoyl fluoride (H(CH<sub>2</sub>)<sub>7</sub>COF) which undergoes electrolysis to produce perfluorooctanoyl fluoride (F(CF<sub>2</sub>)<sub>7</sub>COF).<sup>13,14</sup> Perfluorooctanoyl fluoride undergoes hydrolysis to produce the acid PFOA. PFOA can then be converted into salts such as the ammonium salt (APFO) or the sodium salt (sodium perfluorooctanoate) by neutralization.



<sup>7</sup> Perfluorooctanoic acid (PFOA) and Fluorinated Telomers, <http://www.epa.gov/oppt/pfoa/>.

<sup>8</sup> Mark H. Russell, DuPont Haskell Laboratory for Health and Environmental Sciences, PFOA and PFOS Physical-Chemical Properties, Environmental Fate, Monitoring and Modeling, October 16, 2009, <http://www.epa.gov/oppt/pfoa/pubs/Properties%20and%20fate-%>.

<sup>9</sup> Robert C. Buck, et al., Perfluoroalkyl and Polyfluoroalkyl Substances in the Environment: Terminology, Classification, and Origins, *Integrated Environmental Assessment and Management*, 2011, 7(4), pp. 513–541.

<sup>10</sup> Letter from Gerald L. Kennedy (DuPont) to Dr. Charles M. Auer (US EPA) re: DuPont's uses of APFO, June 23, 2000 (Bates No. EID070482-EID070492).

<sup>11</sup> Sierra Rayne and Kaya Forest, Perfluoroalkyl Sulfonic and Carboxylic Acids: A Critical Review of Physicochemical Properties, Levels and Patterns in Waters and Wastewaters, and Treatment Methods, *J Environ Sci & Health A*, 2009, 44, pp. 1145-1199.

<sup>12</sup> Shannon M. Mitchell et al., Degradation of Perfluorooctanoic Acid by Reactive Species Generated through Catalyzed H<sub>2</sub>O<sub>2</sub> Propagation Reactions, *Environmental Science & Technology Letters*, 2014, 1, pp. 117-121.

<sup>13</sup> Robert C. Buck, et al., Perfluoroalkyl and Polyfluoroalkyl Substances in the Environment: Terminology, Classification, and Origins, *Integrated Environmental Assessment and Management*, 2011, 7(4), pp. 513–541.

<sup>14</sup> Voluntary Use and Exposure Information Profile for Perfluorooctanoic Acid and Salts, 3M Company. 2000. USEPA Administrative Record AR226-0595.



The conversion of octanoyl fluoride to perfluorooctanoyl fluoride is a free radical reaction which can lead to carbon chain breakage and rearrangement. The chain breakage and rearrangement produces a mixture of linear and branched perfluoroalkyl isomers and homologues.<sup>15</sup> The amount of branched-chain isomers depends on the reaction conditions but can amount to 20 to 30% of the amount of *n*-PFOA. DuPont used <sup>19</sup>F nuclear magnetic resonance (NMR) to determine the structure of several of the branched chain isomers in PFOA produced by the ECF procedure.<sup>16</sup> The NMR mole percent for each of the isomers are shown in Table 3. DuPont also reported three types of the internally branched isomers representing the different internal carbons in which the branch occurred. Similar mole percentages were reported from <sup>19</sup>F NMR analysis by 3M. The composition of 3M's PFOA was consistent year to year, one study of 18 lots over 20 years found an average composition was 78% linear and 22% branched isomers with standard deviations of 1.2%.<sup>17</sup>

3M's Product Information for Fluorad™ Fluorochemical Acid FC-26 lists a composition of > 97% PFOA by gas chromatography of which 78% was the linear PFOA, 13% was *iso*-branched, and 9% was internally branched.<sup>18</sup> The product also contained perfluorinated alkyl groups down to C<sub>5</sub>F<sub>11</sub>. The chromatogram from 3M's method for determining the composition of PFOA and its salts show one large peak (representing 75 area %) for the linear PFOA along with nine smaller peaks 3M identifies as C-8 isomers.<sup>19</sup> Of these nine isomer peaks, four peaks range between 3-9 area % and the rest are less than 0.5 area %. 3M also identified one peak as a C-6 acid and two peaks as C-7 acid.

Benskin et al. reported finding ten isomers in a lot of 3M's PFOA utilizing liquid chromatography/tandem mass spectrometry (LC/MS/MS).<sup>20</sup> Benskin et al. were able to identify and quantify the *n*-, *iso*-, 5*m*, 4*m*, 3*m* isomers where 5, 4, and 3 are the carbon number where the branching occurs (e.g., 5*m*-PFOA is perfluoro-5-methylheptanoic acid). They found that the branched isomers accounted for 17.8 % of the PFOA.

<sup>15</sup> Cyclic by-products are also formed. Lehmler H.J., Production of Fluorinated Surfactants by electrochemical Fluorination, In: Zoller U, Sosis P, editors. "Handbook of Detergents," Part F, 2009, CRC, p. 314-315.

<sup>16</sup> Memo from D. Dubois to M. Kaiser re: Analysis of Perfluoro-Octanoic Acid Samples (19F) NMR, November 15, 2000, (Bates No. EID152583-EID152593)

<sup>17</sup> Jonathan P. Benskin, Perfluorinated Acid Isomer Profiling in Water and Quantitative Assessment of Manufacturing Source, *Environmental Science & Technology*, 2010, 44, pp. 9049-9054.

<sup>18</sup> Product Information, 3M Fluorad™ Fluorochemical Acid FC-26, July 7, 2000, [http://www.3m.fr/US/mfg\\_industrial/perfchem/prodinfo/fluoroch/FC26/FC26\\_1.html](http://www.3m.fr/US/mfg_industrial/perfchem/prodinfo/fluoroch/FC26/FC26_1.html).

<sup>19</sup> Quality Control Test Method, Perfluorinated C8 Acid, its Salt or the Aqueous Salt, % Composition by GC, 3M, September 11, 1998, (Bates No. EID185895-EID185899). Note: This method GC/FID to analyze the acid derivatized to the methyl ester derivatized by BF<sub>3</sub> in methanol.

<sup>20</sup> Jonathan P. Benskin et al., Perfluorinated Acid Isomer Profiling in Water and Quantitative Assessment of Manufacturing Source, *Environmental Science & Technology*, 2010, 44, pp. 9049-9054 and supporting information at <http://pubs.acs.org/doi/suppl/10.1021/es102582x>.



Table 3. PFOA Isomers

|                           | Structure | NMR mole% |
|---------------------------|-----------|-----------|
| Linear Chain              |           | 78.9      |
| <i>iso</i> -branched      |           | 8.6       |
| Internally-branched       |           | 12.0      |
| <i>tertiary</i> -branched |           | 0.2       |

3M sold APFO under the trade name Fluorad™ FC-143 and FC-118. According to 3M's material safety data sheet (MSDS) for FC-143, the active ingredients were 95.0-100.0% APFO, < 5.0% ammonium perfluoroheptanoate, <5.0% ammonium perfluorohexanoate, and <5.0% ammonium perfluoropentanoate (<5.0%).<sup>21</sup> There was no breakdown on the isomers of APFO. 3M's product information for FC-118 states the product is a 20% aqueous solution of APFO.<sup>22</sup> The MSDS for FC-118 lists the ingredients as 80% water, 18-21% APFO, 0.1-1.0 ammonium perfluoroheptanoate, 0-0.1% ammonium perfluorohexanoate, and 0.1-1.0% ammonium perfluoropentanoate.<sup>23</sup>

3M produced PFOA and APFO by the ECF procedure from the 1950s to 2002 when production was stopped because of environmental concerns.<sup>24</sup>

DuPont developed the telomerization process in the 1970's.<sup>25</sup> In this process iodine (I<sub>2</sub>),

<sup>21</sup> MSDS for FC-143 FLUORAD Brand Fluorochemical Sulfactant, 3M, December 18, 1990, (Bates No. EID024272-EID024275).

<sup>22</sup> Product Information sheets for Fluorad™ Fluorochemical Emulsifiers FC-118 and FC-1090, 3M, September 98.

<sup>23</sup> MSDS for FC-118 Fluorad™ Brand Fluorochemical Sulfactant, 3M, February 19, 1997, (Bates No. EID008492-EID008498).

<sup>24</sup> Jonathan P. Benskin, et al., Perfluorinated Acid Isomer Profiling in Water and Quantitative Assessment of Manufacturing Source, *Environmental Science & Technology*, 2010, 44, pp. 9049-9054.

<sup>25</sup> Jonathan P. Benskin et al., Manufacturing Origin of Perfluorooctanoate (PFOA) in Atlantic and



iodine pentafluoride ( $\text{IF}_5$ ) and tetrafluoroethylene (TFE -  $\text{C}_2\text{F}_4$ ) are catalyzed by antimony pentafluoride to produce pentafluoroethyl iodide ( $\text{C}_2\text{F}_5\text{I}$ ). Pentafluoroethyl iodide is telomerized with TFE to produce a mixture of perfluoroalkyl iodides (Telomer A, AL, and AN) which are linear with even number of carbons.<sup>26,27,28</sup>

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According to Glenn R. Evers, a former DuPont employee, while discussing the degradation product from the telomere materials, DuPont "knew that PFOA was a byproduct of their process for a long, long time."<sup>30</sup>

## V. THE USES AND FATE OF AMMONIUM PERFLUOROOCCTANOATE AT THE DUPONT WASHINGTON WORKS PLANT IN WEST VIRGINIA

DuPont began using APFO in 1951 at the Washington Works facility.<sup>31</sup> Between 1951 and at least 2003<sup>32</sup> APFO was used as a surfactant in seven processes.<sup>33</sup> These processes took place in

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<sup>34</sup> DuPont purchased APFO from 3M<sup>35,36,37</sup> as a dry

Canadian Arctic Seawater, *Environmental Science & Technology*, 2012, 46, pp. 677-685.

<sup>26</sup> Robert C. Buck, et al., Perfluoroalkyl and Polyfluoroalkyl Substances in the Environment: Terminology, Classification, and Origins, *Integrated Environmental Assessment and Management*, 2011, 7(4), pp. 513-541.

<sup>27</sup> Performance Chemicals Process Technology, DuPont, (Bates No. EID138055-EID138063). The average chain length produced  $\text{C}_2\text{F}_5(\text{C}_2\text{F}_4)_n\text{I}$  where  $n = 1, 2, 3, 4, 5$ , and 6, depends on the degree of telomerization. Telomer A, AL, and AN typically contain 31, 33, and 54 % of the  $n=3$  ( $\text{C}_2\text{F}_5(\text{C}_2\text{F}_4)_3\text{I}$ ) telomer.

<sup>28</sup> Konstantinos Prevedours, et al. Sources, Fate and Transport of Perfluorocarboxylates, *Environmental Science & Technology*, 2006 40(1) pp. 32-44.

<sup>29</sup> Fluoroproducts Study Group, May 8, 2001, (Bates No. EID169284-EID169288)

<sup>30</sup> Deposition of Glenn R Evers, April 30, 2004, pp. 41, 63, and 64.

<sup>31</sup> R. J. Zipfel et al., C-8 Ammonium Perfluorooctanoate Fluorosurfactant Strategies and Plans, September 15, 1994, (Bates No. EID099864-EID099878).

<sup>32</sup> This report only refers to the information that was available as to C-8 processes and releases from DuPont's Washington Works plant through 2003.

<sup>33</sup> Paustenbach, Dennis J., et al., A Methodology for Estimating Human Exposure to Perfluorooctanoic Acid (PFOA): A Retrospective Exposure Assessment of a Community (1951-2003), *Journal of Toxicology and Environmental Health, Part A*, 2007, 70, pp. 28-57.

<sup>34</sup> Email from Daniel Weber to John Migliore re: discussion of FC143, February 9, 1998, (Bates No. EID045015).

<sup>35</sup> Letter from H.V. Bradley (DuPont) to Mr. William R. Packard (Lubeck) re: Appendix IX results from the analysis



powder (Fluorad™ FC-143) and later as a 20% aqueous solution (Fluorad™FC-118).<sup>38,39,40,41</sup> The APFO passed through the manufacturing process unchanged. The polymers produced by these processes were either sold by DuPont as an aqueous dispersion containing APFO or as a dry product in which most of the APFO was removed during processing.

The quantity of APFO used by DuPont between 1951 and 2003 at the Washington Works facility was reported by Dennis J. Paustenbach (a consultant working for and paid by DuPont) et al. in a 2007 publication in the *Journal of Toxicology and Environmental Health, Part A*.<sup>42</sup> Paustenbach et al. claims to have used purchasing records and other plant documents and graphed the annual amount of APFO used by the plant.<sup>43</sup> The quantity of APFO used at the Washington Works facility started at 29 pounds in 1951 and increased steadily during the next five decades reaching approximately 174,000 pounds at its peak consumption in 2000. Prior to 1960 under 10,000 pounds of APFO were used per year and between 1960 and 1975 the consumption of APFO varied between 10,000 and 22,000 pounds per year. By 1980 the usage was over 40,000 pounds and by 1990 it was about 65,000 pounds. DuPont's records show that in 1991, 1992, 1993, 1999, and 2000, **REDACTED** pounds of PFOA were used, respectively.<sup>44,45</sup>

The following is a history of the APFO use at the Washington Works facility up through 2003 based on information obtained from Paustenbach et al., DuPont Process Descriptions and C-8 Flow Sheets dated August 17, 2001 (Bates No. EID179289-EID179306), DuPont C-8 Flow Sheets for 1996 and 1999 (Bates No. EID185434-EID185438 and EID177167-EID177175), and Tables for 1999 and 2000 C-8 Usage and 2000 Disposal for Stacks and Surfactant Emissions (Bates No. EID180799-EID180801).

#### **A. History of APFO Use at DuPont's Washington Works Facility 1951-2003**

##### **1) 1951 - 2003 PTFE Fine Powder Process**

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of well 27, June 13, 1989, (Bates No. EID022636-EID022646).

<sup>36</sup> Other suppliers of APFO were Mitani and Hoechst. R. J. Zipfel et al., C-8 Ammonium Perfluorooctanoate Fluorosurfactant Strategies and Plans, September 15, 1994, (Bates No. EID099864-EID099878).

<sup>37</sup> Walter R Tong et al., DFS-1 (Ammonium Perfluorooctanoate) Basic Data, (Bates No. EID177566-EID177583).

<sup>38</sup> Process Description Granular, DuPont (Bates No. EID180743-EID180744).

<sup>39</sup> Gregory A. Chaplan, C-8 Program Concept Evaluation Plan, January 17, 1997, (Bates No. EID092770, EID092788--EID092092789).

<sup>40</sup> R. J. Zipfel et al., C-8 Ammonium Perfluorooctanoate Fluorosurfactant Strategies and Plans, September 15, 1994, (Bates No. EID099864-EID099878).

<sup>41</sup> FC-118 was a 20% solution used by DuPont. AIM, April 15, 1991, (Bates No. EID080798-EID-080801).

<sup>42</sup> Paustenbach, Dennis J., et al., A Methodology for Estimating Human Exposure to Perfluorooctanoic Acid (PFOA): A Retrospective Exposure Assessment of a Community (1951-2003), *Journal of Toxicology and Environmental Health, Part A*, 2007, 70, pp. 28-57.

<sup>43</sup> See Figure 6 in Paustenbach et al. showing the total amount of APFO consumed at the Washington works.

<sup>44</sup> R. J. Zipfel et al., C-8 Ammonium Perfluorooctanoate Fluorosurfactant Strategies and Plans, September 15, 1994, (Bates No. EID099864-EID099878).

<sup>45</sup> Washington Works C-8 Emissions, 1999 & 2000 C-8 Usage and Disposal, (Bates No. EID180800-EID180801)



**REDACTED**

46

**REDACTED**

From 1951 through 1989 the hot exhaust air from the dryer was sent up stacks (48 and 78 feet high) into the atmosphere where the APFO vapors cooled and condensed into small particles which were distributed by the air currents throughout the area.<sup>47</sup> In 1990 a C-8 scrubber was added to reduce APFO air emissions.<sup>48</sup> The August 17, 2001 description of the fine powder process states that,

**REDACTED**

<sup>49</sup> Thus even with

the scrubber,

**REDACTED**

Tables 4 and 5.<sup>50</sup> The APFO that was recovered in the scrubber was purportedly processed for recycling. Additional treatment was added in 2002-2003, however, details on the efficiency of removing PFOA from the air was not reported.<sup>51</sup>

**REDACTED**

According to DuPont's August 17, 2001 process description,

**REDACTED**

<sup>52</sup> Starting in 2001, the wastewater discharged into the C-8 sump was treated using an Oberlin filter to remove large solids and carbon beds to remove APFO.<sup>53</sup> The spent carbon beds were sent off-site where the carbon was regenerated and the APFO removed from the carbon was thermally destroyed. Prior to 2001, all of the wastewater was discarded directly into the Ohio River.<sup>54</sup>

## 2) 1951 - 2003 PTFE Dispersion Process

**REDACTED**

**REDACTED**

<sup>46</sup> Process Description Fine Powder, DuPont (Bates No. EID179291-EID1179292).

<sup>47</sup> Ibid. Paustenbach.

<sup>48</sup> Ibid. Paustenbach.

<sup>49</sup> August 17, 2001 Process Description Fine Powder, DuPont (Bates No. EID179291-EID179292).

<sup>50</sup> The 1996 and 1999 Fine Powder C-8 Flow Sheets also show

**REDACTED**

<sup>51</sup> Ibid. Paustenbach.

<sup>52</sup> Process Description Fine Powder, DuPont (Bates No. EID179291-EID179292).

<sup>53</sup> Ibid. Paustenbach.

<sup>54</sup> 1996 Fine Powder - C-8 Flow Sheet (Bates No. EID185437) and 1999 Fine Powder - C-8 Flow Sheet with handwritten changes for 1999. (Bates No. EID177169).



REDACTED

55,56

3) 1963 - 2003 FEP Process

REDACTED

57

REDACTED

however, between 1968 and 1997, the recovered APFO was released to the Ohio River.<sup>58</sup>

REDACTED

However, Paustenbach et al. listed these vents/stacks as being used between 1963 to 2003 for the FEP wet finishing process.<sup>59</sup>

REDACTED

Beginning in 2001,<sup>60</sup> these solutions were sent to the APFO Treatment System for APFO removal before discharge to the Ohio River. The treatment system consisted of an Oberlin filter to remove large solids and carbon beds to remove APFO. DuPont's flow sheet for FEP Process dated August 17, 2001 indicates that

REDACTED

<sup>55</sup> Process Description PTFE Dispersion, DuPont (Bates No. EID1189299-EID179300).

<sup>56</sup> It is not clear what happened to the wastewater prior to 2001. A PTFE Dispersion Flow Sheet for 1996 (Bates No. EID185438) and 1999 (Bates No. EID177172) shows two possible paths for the wastewater. One path goes to the Chambers Works and the second path goes to carbon beds. A third path is also shown in a dashed box labeled "Thermal Conv. C-8 Dest.," which probably did not occur.

<sup>57</sup> Process Description FEP, DuPont (Bates No. EID179293-EID179294).

<sup>58</sup> Ibid. Paustenbach.

<sup>59</sup> Ibid. Table 3, Paustenbach.

<sup>60</sup> Ibid. Paustenbach.



4) 1963 - 2003 FEP Dispersion Process

REDACTED

According to  
the process description for the FEP Dispersion Process dated August 17, 2001,

REDACTED

<sup>61</sup>

5) 1965 - 2003 Granular Process

REDACTED

<sup>62</sup>

REDACTED

The wastewater was not carbon treated because of the  
purportedly lower amounts of APFO from this process compared to the other processes.<sup>63</sup>  
Paustenbach et al. lists the two stacks associated with the drying step in this process,

REDACTED

<sup>64</sup>

6) 1998 - 2003 PFA Process K

REDACTED

<sup>65</sup>

REDACTED

According to  
Paustenbach et al., both the carbon bed and C-8 scrubber have been in use since the start-  
up of this process.

<sup>61</sup> Process Description FEP Dispersion, DuPont (Bates No. EID180755-EID180756).

<sup>62</sup> Process Description Granular, DuPont (Bates No. EID180743-EID180744).

<sup>63</sup> Ibid. Paustenbach.

<sup>64</sup>

REDACTED

(Bates No. EID180744).

REDACTED

Paustenbach lists the two

stacks associated with the drying process but gives no amounts for the emission from the dryers.

<sup>65</sup> Process Description PFA, DuPont (Bates No. EID180751-EID180752).



## 7) 1973 - 2003 PFA Dispersion Process

This process is similar to the PFA Process K except the product is not dried because it is sold as a liquid dispersion.<sup>66</sup> The polymerization takes place in an aqueous medium containing APFO as a dispersing agent. APFO is present in the liquid and solid wastes from the process. Information on the amount of APFO in the waste streams were not available.

## B. Quantity of APFO Released Into the Environment 1951 - 2003

Between 1951 and 2003 DuPont released APFO into the environment surrounding the Washington Works site by three main routes: 1) to the atmosphere; 2) to the Ohio River; and 3) to the land in material that was sent to on-site and off-site landfills. DuPont also released APFO to the environment from the wastewater sent to DuPont's wastewater treatment plant at Chambers Works at Deepwater, New Jersey. Prior to 1988, wastewater containing APFO was placed in unlined surface impoundments, or "pits," located along the Ohio River. When DuPont closed the surface impoundments in 1988, DuPont sent thousands of tons of soil and sludge from the impoundments for disposal at the Dry Run Landfill. DuPont also allowed Leachate containing APFO from the landfills to enter the Ohio River directly.

### 1) APFO Releases to the Atmosphere

REDACTED

<sup>67,68</sup>

REDACTED

The particle size of the condensed APFO ranged between 0.1 to 5 micrometers (0.000004 to 0.0002 inches).<sup>69,70</sup> Over half of the mass released to the atmosphere in the smallest size range, 0.1-0.3 micrometers (0.000004 to 0.00001 inches). Once in the air these particles could be distributed by the air currents into the surrounding communities.

REDACTED

<sup>66</sup> Ibid. Paustenbach.

<sup>67</sup> Ibid. Paustenbach, Table 3.

<sup>68</sup> Table listing

(Bates No. EID180799).

<sup>69</sup> Ibid. Paustenbach et al. based on 1996 DuPont emission data collected from the C-8 scrubber exhaust. No data is available before the scrubbers were installed. According to Paustenbach et al. the scrubber may have reduced the particle sizes compared to before the scrubbers were installed.

<sup>70</sup> DuPont, Emission Modeling Data Required in Consent Order GWR-2001-019 Section VII.D, December 17, 2001. (Bates No. DJM000280-DJM000320).



## REDACTED

Paustenbach et al. used mass balance calculations to estimate that over 700,000 pounds of PFOA have been released to the atmosphere from the Washington Works facility between 1951 and 2003. Paustenbach et al. published a table of the air emission for each year between 1951 and 2003 which is reproduced in this report as Table 4.<sup>71</sup>

Table 4. Paustenbach et. al. Estimated Air Emissions 1951-2003

| Year | APFO<br>(lbs) | Year | APFO<br>(lbs) | Year | APFO<br>(lbs) | Year   | APFO<br>(lbs) |
|------|---------------|------|---------------|------|---------------|--------|---------------|
| 1951 | 10            | 1965 | 7,900         | 1978 | 12,000        | 1991   | 18,000        |
| 1952 | 100           | 1966 | 12,000        | 1979 | 14,000        | 1992   | 19,000        |
| 1953 | 300           | 1967 | 10,000        | 1980 | 14,000        | 1993   | 21,000        |
| 1954 | 700           | 1968 | 8,400         | 1981 | 16,000        | 1994   | 25,000        |
| 1955 | 1,400         | 1969 | 6,900         | 1982 | 16,000        | 1995   | 27,000        |
| 1956 | 2,700         | 1970 | 4,900         | 1983 | 17,000        | 1996   | 29,000        |
| 1957 | 3,000         | 1971 | 4,200         | 1984 | 19,000        | 1997   | 26,000        |
| 1958 | 2,800         | 1972 | 5,100         | 1985 | 21,000        | 1998   | 26,000        |
| 1959 | 4,400         | 1973 | 6,400         | 1986 | 23,000        | 1999   | 34,000        |
| 1960 | 6,200         | 1974 | 6,900         | 1987 | 25,000        | 2000   | 32,000        |
| 1961 | 5,500         | 1975 | 5,400         | 1988 | 31,000        | 2001   | 23,000        |
| 1962 | 7,700         | 1976 | 7,100         | 1989 | 32,000        | 2002   | 15,000        |
| 1963 | 5,800         | 1977 | 9,500         | 1990 | 18,000        | 2003   | 7,400         |
| 1964 | 6,500         |      |               |      |               | Total: | 702,000       |

The quantity of APFO released into the atmosphere, the Ohio River and to the land are reported in several DuPont documents including:

- C-8 Flow Sheets showing 1996 Total Pounds (Bates No. EID185434-EID185438).
- C-8 Flow Sheets showing 1999 Total Pounds (Bates No. EID177167-EID177175).
- Process Descriptions and C-8 Flow Sheets Dated August 17, 2001 (Bates No. EID179289-EID179306).

<sup>71</sup> Paustenbach et al. estimate for 2000 is in agreement with DuPont's value in Table 5, however, the 1999 values are not in agreement with DuPont's values in Table 4.



- Table of 1999 C-8 Usage and Disposal (Bates No. EID180801).
- Tables of 2000 C-8 Usage and Disposal (Bates No. EID180800 and EID180802).
- DuPont, Emission Modeling Data Required in Consent Order GWR-2001-019 Section VII.D, December 17, 2001 (Bates No. DJM000280-DJM000320).
- Debbie Mulrooney, DuPont Modeling Methodology and Results, April 24, 2002 (Bates No. DJM001064-DJM001076).
- Table of **REDACTED** (Bates No. EID180799).
- Total air emissions for APFO for 2000 and November 2001 year to date. Letter from R. L. Ritchey to WVDEP re: Consent order, December 21, 2001 (Bates No. EID183431).

According to a DuPont memo, in 1984 the total APFO air emissions was 16,000 pounds per year which will increase to 25,000 pounds with implication of the fine powder expansion plan and will increase to 37,000 with the installation of a third dryer.<sup>72</sup> The total air emissions for APFO in 2000 and through November 2001 reported by DuPont to the West Virginia Department of Environmental Protection was 31,250 and 25,614 pounds respectively. These results are similar to the estimates reported by Paustenbach et al., Table 4. A breakdown of the APFO emissions by the seven DuPont processes that used APFO are summarized in Tables 5, 6, and 7 for the years 1996, 1999, and 2000. The 1996 data in Table 5 taken from the 1996 C-8 Flow Sheets show total air emission for APFO of 43,000 pounds compared to the 29,000 pounds estimated by Paustenbach et al., Table 4.<sup>73</sup>

Table 6 reports the DuPont emissions from both the 1999 Table of C-8 Usage and Disposal and the 1999 C-8 Flow Sheets. The 1999 air emissions from the three dispersion processes are probably incorrect because Paustenbach et al. reported there were no air emissions and were not included in the total air emissions in Table 6. The total APFO emissions to the atmosphere, Table 6, are 31,208 and 22,940 pounds using the 1999 Table of C-8 Usage and Disposal and the 1999 C-8 Flow Sheets, respectively, are lower than the estimated 34,000 pounds by Paustenbach et al.

<sup>72</sup> Memo from J. A. Schmid to T. M. Kemp and T. L. Schrenk, re: C-8 Meeting Summary 5/2284 - Wilmington, May 23, 1984. (Bates No. EID602999-EID602300).

<sup>73</sup> Note: The 1996 Fine Power C-8 Flow Sheet shows a filter as a dashed line box which could reduce the air emissions by 13,700 pounds. The FEP and PFA C-8 Flow Sheets show a "Thermal Conv." which could reduce the air emissions by 1,500 and 650 pounds, respectively. If all three devices were being used, the total air emissions would be reduced to 27,150 pounds APFO in Table 5. However, it is not believed that these devices were being used.



Table 7 shows the total APFO air emissions for the year 2000 (Bates No. EID180802) as

**REDACTED**

(Bates No. EID180802),<sup>74</sup>

**REDACTED**

(Bates No. DJM000280-

DJM000320).

**REDACTED**

the 31,250 pounds of total C-8 air emissions

DuPont reported to the WVDEP for the year 2000 (Bates No. EID183431) and to the 32,000 pounds estimated by Paustenbach et al. for the same year.

Although there are some differences in the exact values reported for APFO emissions to the atmosphere, the facts show that during the 1970's, 1980's, and 1990's DuPont directly released several tons of APFO into the atmosphere per year that could be deposited in the communities surrounding the Washington Works site, and these emissions generally increased during that time.

Table 5. 1996 APFO Emissions from Taken From C-8 Flow Sheets (Bates No. EID185434-EID185438).

| Process          | Total APFO Used (lbs) | Air Emissions (lbs) | Ohio River (lbs) | To Land (lbs) |
|------------------|-----------------------|---------------------|------------------|---------------|
| PTFE Fine Powder | 33,800                | 15,200              | 3,400            | 0             |
| PTFE Dispersion  | 24,600                | 0                   | 0                | 0             |
| FEP              | 40,600                | 27,100*             | 6,500            | 0             |
| FEP Dispersion   | NA                    | NA                  | NA               | NA            |
| Granular Process | 600                   | 0                   | 600              | 0             |
| PFA Process K    | 3,800                 | 700                 | NA               | NA            |
| PFA Dispersion   | NA                    | NA                  | NA               | NA            |
| Total            | 103,400**             | 43,000              | 10,500           | 0             |

\* Includes Polykettle vent, Coagulator vent and C-8 Scrubber vent.

\*\* This number may be low because there was no information on the FEP and PFA Dispersion.

NA = not available

<sup>74</sup> DuPont's data reported in Bates No. EID180800 shows

**REDACTED**

Since Paustenbach et al. report no APFO emissions from these processes, only the data from Bates No. EID180802 was used.



Table 6. 1999 APFO Usage and Disposal. Results reported are from Bates No. EID180801 and results in parenthesis are from Bates No. EID177167-EID177175.

| Process          | Total APFO Used (lbs) | Air Emissions (lbs) | To Ohio River (lbs) | To Land (lbs)   |
|------------------|-----------------------|---------------------|---------------------|-----------------|
| PTFE Fine Powder | <b>REDACTED</b>       | <b>REDACTED</b>     | <b>REDACTED</b>     | <b>REDACTED</b> |
| PTFE Dispersion  |                       |                     |                     |                 |
| FEP              |                       |                     |                     |                 |
| FEP Dispersion   |                       |                     |                     |                 |
| Granular Process |                       |                     |                     |                 |
| PFA Process K    |                       |                     |                     |                 |
| PFA Dispersion   |                       |                     |                     |                 |
| Total            |                       |                     |                     |                 |

\*Note This value may be incorrect (see text).

\*\* Assumed wastewater went to the Chamber Works.

\*\*\*Excludes air emissions from the three dispersion processes.

Table 7. 2000 APFO Usage and Disposal. Reports from Bates No. EID180802 and results in parentheses from Bates No. DJM000300 and DJM001068.

| Process          | Total APFO Used (lbs) | Air Emissions (lbs) | To Ohio River (lbs) | To Land (lbs)   |
|------------------|-----------------------|---------------------|---------------------|-----------------|
| PTFE Fine Powder | <b>REDACTED</b>       | <b>REDACTED</b>     | <b>REDACTED</b>     | <b>REDACTED</b> |
| PTFE Dispersion  |                       |                     |                     |                 |
| FEP              |                       |                     |                     |                 |
| FEP Dispersion   |                       |                     |                     |                 |
| Granular Process |                       |                     |                     |                 |
| PFA Process K    |                       |                     |                     |                 |
| PFA Dispersion** |                       |                     |                     |                 |
| Total            |                       |                     |                     |                 |

\*\*Listed in DuPont's **REDACTED** wastewater from these processes was sent

Process Description the **REDACTED**

\*\*Includes PFA to Shimizu.



## 2) APFO Releases to the Ohio River

APFO was released by DuPont directly into the Ohio River through Outfalls at the Washington Works plant located along the river. Estimated releases to the Ohio River reported in Tables 5, 6, and 7 were **REDACTED** pounds of APFO for the years 1996, 1999, and 2000. As early as 1991, DuPont detected up to 19.6 parts per billion perfluorooctanoate in the Ohio River near one of its outfalls.<sup>75</sup> Beginning in 2001, some of the wastewater was passed through carbon beds to remove APFO from the wastewater before it was released to the Ohio River. The spent carbon from the carbon beds was sent off-site for regenerating the activated carbon where the APFO was decomposed at elevated temperatures. Another DuPont document shows **REDACTED**<sup>76</sup> similar to the value reported in Table 7. DuPont also estimated releases of **REDACTED** pounds APFO in 2001, 2002, and 2003, respectively with the reduction caused by improvements in the treatment of the wastewater started in 2001.

Paustenbach et al. estimated APFO releases to the Ohio River of approximately 6,000 total pounds between 1951 and 1962, 60,000 total pounds between 1963 and 1980, 150,000 total pounds between 1981 and 1989, 340,000 total pounds between 1990 and 1999, and 71,000 total pounds between 2000 and 2003.<sup>77</sup>

Thus, as with its releases of C-8 to the air, DuPont's releases of C-8 to the Ohio River steadily increased each decade until DuPont first started treating these releases in 2001.

## 3) APFO Releases to Landfills

Waste material containing APFO was disposed by DuPont in both on-site and off-site landfills. The on-site landfills included the "Local Landfill." In addition, DuPont disposed thousands of tons of APFO contaminated soil from the closed surface impoundments in the off-site Dry Run Landfill in 1988. DuPont estimated that in 1999 and 2000, **REDACTED** pounds of APFO were landfilled. Paustenbach et al. estimated APFO disposed in landfills or the supernate ponds were approximately 12,000 total pounds between 1951 and 1962, 78,000 total pounds between 1963 and 1980, 75,000 total pounds between 1981 and 1989, 19,000 total pounds between 1990 and 1999, and 4,000 total pounds between 2000 and 2003.<sup>78</sup> The breakdown of the amount disposed at on-site landfills was not reported.

<sup>75</sup> Interoffice memo from R J Zipfel to distribution re: C-8 in Water Sample Results Ohio River, Site Test Wells, and New Lubeck Water System, October 3, 1991. (Bates No. EID79110-EID0791158, RJZ00253-RJZ009258).

<sup>76</sup> **REDACTED**. (Bates No. EID180721-EID180723).

<sup>77</sup> Ibid. Paustenbach, Figure 7.

<sup>78</sup> Ibid. Paustenbach, Figure 7.



## VI. CHRONOLOGY OF PERFLUOROOCTANOATE ANALYSIS OF GROUNDWATER AND THE METHODS USED FOR THE ANALYSIS

### A. 1984 Community Drinking Water Samples Collected by DuPont and Analyzed by the DuPont Experimental Station

The first known testing of the community water supply for perfluorooctanoate occurred on March 15 and June 4, 1984 when DuPont collected water samples in the vicinity of the Washington Works by going to gas stations or small grocery stores in the communities and asking to fill a plastic jug with water.<sup>79,80</sup> DuPont later transferred the water sample to 8 ounce glass bottles. The samples were originally analyzed at DuPont's Washington Works laboratory, however, they had problems with "high and inconsistent blanks and data." Because the analytical problems could not be resolved, the samples were then sent to DuPont's Experimental Station, Wilmington, Delaware for analysis.

The Experimental Station reported the results to the Washington Works in an analytical report dated June 25, 1984.<sup>81</sup> The water samples were analyzed by gas chromatography/electron capture detector (GC/ECD) using a modification of DuPont's Method ES-567, a method for C-8 in blood. The analytical report states that the samples were freeze dried, derivatized, and analyzed in duplicate.<sup>82</sup> Method ES-567 was modified for water analysis by 1) using a 10 gram (10mL) aliquot of the sample, 2) lyophilization (freeze drying) for 18-20 hours, and 3) reducing the amount of internal standard perfluorodecanoic acid (C-10) added.

The Experimental Station reported the analytical results in units of ng (nanograms) F (fluoride) per g (gram) water or parts per billion (ppb).<sup>83,84</sup> The report also states that, "The results are expressed as ppb fluoride where  $\text{ppb F} = 0.688 \times \text{ppb perfluorooctanoate}$ ." This conversion factor is derived from the fraction by weight of fluorine in perfluorooctanoic acid or  $15 \times 19/414 = 0.688$ . Another way of saying this is  $\text{ppb F} \times 1.45 = \text{ppb perfluorooctanoate}$  where  $1/0.688 = 1.45$  or rounded to 1.5.<sup>85</sup> A linear calibration curve was used for quantitation over a range of 0.4 to 1 ppb as fluoride (F) or 0.6 to 1.5 ppb perfluorooctanoate. No C-8 peak was detected in spiked standards at 0.1, 0.2 or 0.3 ppb F. A reproducible and detectable peak was seen

<sup>79</sup> Memo from J F Doughty to J A Schmidt re: Summary of C-8 in Water Sampling Program, August 29, 1984 (Bates No. EID079096-EID079100 and EID079098.01).

<sup>80</sup> Samples were also collected from one of the Washington Work's drinking water fountains and an employee's home.

<sup>81</sup> Experimental Station Analytical Report from S. R. Laas to J. F. Doughty, June 25, 1984. (Bates No. EID079099-EID079100).

<sup>82</sup> Details for the derivatization were not included in Laas memo. DuPont methods for the analysis of C-8 in blood derivatize the C-8 to the methyl ester using methanoic HCl (3%) followed by the extraction of the esters into hexane. Packed or capillary columns are used for the GC/ECD analysis using C-10 as the internal standard. S. S. Stafford (DuPont), Method for the Determination of Perfluorooctanoate in Blood, Water, and Other Materials, December 1982, (Bates No. EID2529536-EID252962).

<sup>83</sup> The original blood method used by DuPont was the Wickbold Torch method in which the sample was burned in a hydrogen/oxygen torch where the organic fluorine is converted to inorganic fluoride. The Wickbold Torch method reported the results as total fluoride. The Experimental Station reported the GC/ECD results on the same basis to be consistent with the Wickbold Torch method.

<sup>84</sup> This is equivalent ng/mL, ug/L, or ppb based on the density of water of 1 g/mL.

<sup>85</sup> This conversion factor for ammonium perfluorooctanoate is  $15 \times 19/431 = 0.661$  and  $1/0.661 = 1.51$ . Thus  $\text{ppb F} \times 1.51 = \text{ppb ammonium perfluorooctanoate}$ .



at 0.4 ppb F (0.6 ppb perfluorooctanoate) and this concentration was used as the detection limit.

J. F. Doughty in a June 14, 1984 memo reported the Experimental Station analytical results as "ppb C-8" after multiplying the Experimental Station's ppb fluoride results by 1.5.<sup>86</sup> The results for the Lubeck and Little Hocking Water Association samples, Table 8, are taken from Doughty's June 14, 1984 memo.<sup>87</sup> The detection limit by using the 1.5 multiplier changed from 0.4 ppb F to 0.6 ppb C-8. It must be noted that the reporting of the analytical results by the various laboratories used by DuPont changed from "F" and "C-8" in 1984 and to "FC-143" and "APFO" in subsequent years. It is assumed that "C-8" in this case refers to perfluorooctanoate based on the June 25, 1984 analytical report from the Experimental Station which refers to the conversion from ppm F to ppm perfluorooctanoate. However, the 1.5 multiplier used in Doughty's memo could be used to convert ppm fluoride to either perfluorooctanoate, perfluorooctanoic acid, or ammonium perfluorooctanoate.<sup>88</sup>

No information was provided on the quality control/quality assurance measures used by the Experimental Station.

Table 8. March and June 1984 Results for Little Hocking and Lubeck Water Samples

| Sample Location                                           | Sample Date | C-8* (ppb) |
|-----------------------------------------------------------|-------------|------------|
| Mason's Village Market - Little Hocking, OH <sup>89</sup> | 3/15/1984   | 0.6        |
| Powells General Store - Lubeck, WV                        | 3/15/1984   | 1.2        |
| Mason's Village Market - Little Hocking, OH               | 6/4/1984    | ND (0.6)   |
| Powells Store - Lubeck, WV                                | 6/4/1984    | 1.0        |
| Lubeck Pennzoil - Lubeck, WV                              | 6/4/1984    | 1.5        |

ND ( ) = not detected (detection limit)

\*Experimental Station result as ppm F x 1.5

A DuPont Report issued in December 1982 by S. S. Stafford and titled "Methods for the Determination of Perfluorooctanoate in Blood, Water, and Other Materials" lists Method ES-567 as one of the methods developed by the Experimental Station between 1979 through 1982.<sup>90</sup> This

<sup>86</sup> Memo from J. F. Doughty to J. A. Schmidt re: Update on C-8 in Water Samples, June 14, 1984 (Bates No. EID079098 and EID079098.01).

<sup>87</sup> The 1.5 multiplier used in the in Doughty's memo could be used to convert ppm fluoride to either perfluorooctanoate, perfluorooctanoic acid, or its ammonium salt since  $1/0.688$  or  $1/0.661$  both equal 1.5 when rounded to two significant figures.

<sup>88</sup> The equations for converting ppm fluoride to the various forms of perfluorooctanoate are: 1)  $\text{ppm F} \times 414 / (15 \times 19) = \text{ppm perfluorooctanoic acid}$ ; 2)  $\text{ppm F} \times 413 / (15 \times 19) = \text{ppm perfluorooctanoate}$ ; and 3)  $\text{ppm F} \times 431 / (15 \times 19) = \text{ppm ammonium perfluorooctanoate}$ . Thus,  $\text{ppm F} \times 1.45 = \text{ppm perfluorooctanoic acid}$ ,  $\text{ppm F} \times 1.45 = \text{ppm perfluorooctanoate}$ , and  $\text{ppm F} \times 1.51 = \text{ppm ammonium perfluorooctanoate}$ . Thus, the multiplier in the three equations can be rounded to the 1.5 value used in the August 29, 1984 Doughty memo to convert ppm F to any of these three forms of perfluorooctanoate.

<sup>89</sup> The result was changed from 0.8 to 0.6 on 8/28/84 in a handwritten note on the table. Memo from J. F. Doughty to J. A. Schmidt re: Summary of C-8 in Water Sampling Program, August 29, 1984 (Bates No. EID079096-EID079100 and EID079098.01).

<sup>90</sup> S. S. Stafford (DuPont), Methods for the Determination of Perfluorooctanoate in Blood, Water, and Other Materials, December 1982, (Bates No. EID252953-EID252962). A complete copy of this document including the



document states that the three steps in the current methods are:

- (1) Sample Preparation: Lyophilization of 1 mL sample aliquots.*
- (2) Derivatization: Treatment of the dried residues with methanoic HCl (3%) followed by extraction of the methyl esters into hexane.*
- (3) GC Analysis: Electron capture detector with C<sub>10</sub> internal standard for quantitation, packed or capillary columns for different applications.*

This method is sometimes referred to as the Stafford method.

Additional details on the method for the determination of C-8 in water were attached to a November 18, 1991 memo from R. J. Zipfel.<sup>91</sup> For the sample size, a 1 mL aliquot was used for ppm levels of C-8 and 10 mL was used for ppb levels. Before freeze drying, 0.05 mL of 0.05N sodium hydroxide was added. The sample was then frozen and placed in a drying flask which was attached to a lyophilizer to freeze dry the samples for 5 hours for 1 mL samples and 24 hours for 10 mL samples. To the dried residue, 1 mL of methanoic HCl and 0.1 mL internal standard (perfluorodecanoic acid [C-10]) was added and then the sample was heated for one hour at 65° C. After derivatization to the methyl ester, 1 mL hexane and 1 mL water was added and the sample was shaken. The hexane layer was removed for analysis by GC/ECD using a DB-210 capillary column. The instrument calibration used standards prepared from known concentrations of APFO in water blanks. Chromatograms accompanying the memo show one peak labeled C-8 being quantitated. Although the peak shown for C-8 is very small, there appears to be other nearby smaller peaks that may be the C-8 isomers.

#### 1) Detector Response vs. PFOA Isomer

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appendices with the methods was not available.

<sup>91</sup> Memo from R. J. Zipfel to C-8 File re: C-8 Interlaboratory Meeting, November 18, 1991, (Bates No. EID256133-EID256162).

<sup>92</sup>

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(Bates No.

EID138137-EID138158).

<sup>93</sup> The commercial PFOA also contained

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**B. 1987 Community Drinking Water Samples Collected by DuPont and Analyzed by the DuPont Experimental Station**

DuPont collected water samples near the Washington Works facility on March 13, 1987 by going to each location and asking them to fill a plastic bottle with drinking water. The Experimental Station analyzed the samples and the results were reported in an analytical report issued on May 7, 1987 as ppb fluoride.<sup>96</sup> This report states that the method used was a modification of Method ES-567 with modifications similar to that used for the 1984 samples. This time the high standard used for the calibration curve was 1.9 ppb F (2.9 ppb C-8). As before, no C-8 peak was detected below 0.4 ppb F (0.6 ppb C-8). The ppb fluoride results reported by the Experimental Station were multiplied by 1.5 to convert the results to ppb C-8, Table 9.<sup>97</sup> This appears to be the same method DuPont used for the 1984 samples including the same detection limit. No information was provided on the quality control/quality assurance measures used by the Experimental Station.

Table 9. March 1987 Sample Results.

| Sample Location                            | Sample Date | C-8* (ppb) |
|--------------------------------------------|-------------|------------|
| Powells General Store, Lubeck, WV          | 3/13/1987   | 1.9        |
| Lubeck - Lubeck Pennzoil, Lubeck, WV       | 3/13/1987   | 1.9        |
| Mason's Village Market, Little Hocking, OH | 3/13/1987   | ND (0.6)   |
| 812 20th Street, Vienna, WV                | 3/13/1987   | ND (0.6)   |

ND ( ) = not detected (detection limit)

\*Experimental Station result as ppm F x 1.5

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<sup>95</sup> Memo from R. J. Zipfel to C-8 File re: C-8 Interlaboratory Meeting, November 18, 1991, (Bates No. EID256133-EID256162).

<sup>96</sup> Experimental Station Analytical Report from M. J. Vilone and R. M. Vasta to A. J. Playtis, May 7, 1987, (Bates No. EID0790912-EID079093).

<sup>97</sup> Interoffice memo from Tony Playtis to Roger Zipfel re: C-8 in Water, May 12, 1987, (Bates No. EID079091) and interoffice memo from Tony Playtis to Roger Zipfel re: C-8 in Water, May 4, 1987, (Bates No. EID079094).



### C. 1988 and 1989 Community Water Samples Analyzed by the Experimental Station

Water samples were collected from the residences of two DuPont employees on May, 12, 1988, November 2 and 11, 1988 and on May 4 and 7, 1989.<sup>98,99,100</sup> The Playtis sample was from the Lubeck Public Service District and the Ritenour sample was from the Little Hocking Water Association. Water samples were collected from residential homes, private wells, and the new Lubeck Public Service District in 1990 and/or 1991.<sup>101</sup> The samples were analyzed by the Experimental Station. Results reported as ppb C-8 are summarized in Table 10 and are assumed to be the values after the 1.5 multiplier was applied to the Experimental Station results. The result from the Ritenour home was not reported for the November 2, 1988 and May 4, 1989 samples because it was reported that the analysis was not possible due to a contaminated sample. Further details were not given. Again, it appears DuPont used the same analytical method with the same detection limit, however, no details on the method were reported.

Table 10. 1988 and 1989 Sample Results.

| Sample Location                    | Sample Date | C-8 (ppb)     |
|------------------------------------|-------------|---------------|
| Playtis Home - Lubeck, WV          | 5/12/1988   | 2.2           |
| Ritenour Home - Little Hocking, OH | 5/12/1988   | ND (0.6)      |
| Playtis Home - Lubeck, WV          | 11/2/1988   | 1.4           |
| Ritenour Home - Little Hocking, OH | 11/7/1988   | Contaminated? |
| Playtis Home - Lubeck, WV          | 5/7/1989    | 0.73          |
| Ritenour Home - Little Hocking, OH | 5/4/1989    | Contaminated? |

ND ( ) = not detected (detection limit)

### D. 1990 and 1991 Community Water Samples Analyzed by the Experimental Station

DuPont collected water samples from two private wells (Curry and Barber) located in Lubeck, West Virginia in 1990 and 1991 and the samples were analyzed by the Experimental Station.<sup>102</sup> The results for C-8 in the private wells, Table 11, are all not detected. The reason for the increase in the detection limit for the 1991 samples was not reported. DuPont also reported results from water samples collected in 1991 from the home taps of two retired DuPont employees (McClusky and Clark) in Lubeck, West Virginia and from the New Lubeck Well,

<sup>98</sup> Interoffice memo from Tony Playtis to Roger Zipfel re: C-8 in Groundwater, August 29, 1988, (Bates No. EID079090).

<sup>99</sup> Interoffice memo from Tony Playtis to Roger Zipfel re: C-8 in Water, January 30, 1989, (Bates No. EID079089).

<sup>100</sup> Interoffice memo from Tony Playtis to William E. Crawley re: C-8 in Water Test Results From ESL, June 30, 1988, 1987, (Bates No. EID079124).

<sup>101</sup> Handwritten and typed pages with C-8 results. (Bates No. EID103018-EID103023, ASH010156, ASH010160-ASH010164).

<sup>102</sup> Handwritten and typed pages with C-8 results. (Bates No. EID103018-EID103023, ASH010156, ASH010160-ASH010164) and C-8 Sample Summary: 11/90 to Present (Updated 9/13/91). (Bates No. EID109509-EID109511).



Table 11. DuPont reported two values for each of the 1991 samples.<sup>103</sup> The second value reported, in brackets in Table 11, is the first value multiplied by 1.4 to correct the result for "FC-143." A comment accompanying the data states that, "The 1.4 correction factor is applicable to  $\leq 10$  ppb level results."<sup>104</sup> Based on this correction factor, the composition of FC-143 would contain 71% linear and 29% branched isomers.<sup>105</sup> There was no mention of multiplying the Experimental Station results by 1.5 to convert ppb fluoride to ppm C-8, however, the 0.6 and 1.0 ppb detection limits indicate that the results were reported as ppb C-8 and not as fluoride. The detection limit was raised to 1 ppb for the August 9, 1991 sample with no reason given. The increase in the detection limit occurs just two months after DuPont adopted the Community Exposure Guideline (CEG) for ammonium perfluorooctanoate (APFO) at 1 ug/L (ppb) on June 11, 1991.

A second DuPont comment accompanying the data states that, "All results  $\leq 10$  ppb prior to January 1991 are suspect because of analytical technique accuracy."<sup>106</sup> This appears to indicate that after January 1991 the accuracy of the analytical technique improved, however, there was no information on what changed to improve the accuracy nor did DuPont explain the reasons why the analytical inaccuracies were suspect. The only change appears to be multiplying the results by 1.4. No information was provided on the quality control/quality assurance measures used by the Experimental Station.

DuPont discusses the 1.4 multiplier in a November 11, 1991 memo from R. J. Zipfel.<sup>107</sup> The reason why the Washington Works facility was multiplying the Experimental Station Results by 1.4 was to "account for the isomers of C-8 that were not reported with the main C-8 peak." DuPont acknowledged that CH2M Hill, an outside laboratory, and DuPont's previously reported C-8 results in water only used the main straight chain peak for quantitation. DuPont said, "we have no knowledge of how the isomers behave in the environment [and] any attempt to correct would be misleading." "Therefore, to keep all of the data consistent and not make assumptions about unknown peaks, it was concluded that the Washington Works 1.4 factor was misleading and would not be used." "All previously reported data using the 1.4 factor will be corrected." Thus, according to DuPont, the values in the brackets in Table 11 should not be used.

It was noted with the June 23, 1991 new Lubeck Well result that another laboratory, CH2M Hill confirmed the presence of C-8 in the sample, however, additional details were not provided.<sup>108</sup>

<sup>103</sup> C-8 Sample Summary: 11/90 to Present (Updated 9/13/91) . (Bates No. EID109509-EID109511).

<sup>104</sup>  $\leq$  means less than and equal to.

<sup>105</sup> % branched isomers =  $(1.4x - x)(100)/1.4x$  where  $x$  = Concentration of linear C-8. Thus % branched isomers =  $(1.4 - 1)(100)/1.4 = 40/1.4 = 28.6\%$

<sup>106</sup> C-8 Sample Summary: 11/90 to Present (Updated 9/13/91) . (Bates No. EID109509-EID109511).

<sup>107</sup> Memo from R. J. Zipfel to C-8 File re: C-8 Interlaboratory Meeting, November 18, 1991, (Bates No. EID256133-EID256162).

<sup>108</sup> Handwritten and typed pages with C-8 results. (Bates No. EID103018-EID103023, ASH010156, ASH010160-ASH010164).



Table 11. 1990 and 1991 Sample Results

| Sample Location                  | Sample Date | C-8 (ppb)  |
|----------------------------------|-------------|------------|
| Curry Private Well - Lubeck, WV  | 11/28/1990  | ND (0.6)   |
| Barber Private Well - Lubeck, WV | 11/28/1990  | ND (0.6)   |
| McClusky Home Tap - Lubeck, WV   | 5/23/1991   | 2.7 [3.8]* |
| Clark Home Tap - Lubeck, WV      | 5/29/1991   | 2.7 [3.8]* |
| New Lubeck Well                  | 6/23/1991   | 1.7 [2.4]* |
| McClusky Home Tap - Lubeck, WV,  | 8/8/1991    | 2.8 [3.9]* |
| Curry Private Well - Lubeck, WV  | 8/9/1991    | ND (1.0)   |
| Barber Private Well - Lubeck, WV | 8/9/1991    | ND (1.0)   |

\* The numbers in "[ ]" are after multiplying the result by 1.4.

ND ( ) = not detected (detection limit)

#### E. September and October 1991 Water Samples DuPont Experimental Station and CH2M Hill, Montgomery, Alabama

In 1991, DuPont authorized CH2M Hill, Montgomery, Alabama to develop a similar GC/ECD analytical technique capable of detecting C-8 at 0.1 ppb.<sup>109</sup> DuPont began to qualify CH2M Hill as an outside laboratory by running split water samples with the Experimental Station. In September 1991, DuPont collected water samples from the Ohio River, Washington Works test wells, and the old and new Lubeck Public Service District ("LPSD") wells and sent the samples to both CH2M Hill and the Experimental Station for analysis.<sup>110</sup> The comparison of the results from the two laboratories is shown in Table 12. DuPont notes that the "Results from the Experimental Station are approximately two times higher than from CH2M Hill." DuPont reported that, "CH2M Hill experienced analytical difficulties." DuPont further notes that, "CH2M Hill experienced poor surrogate recovery," and that, "[t]hese numbers may be low on the absolute basis." According to the United States Environmental Protection Agency:

*A surrogate (i.e., a compound that is chemically similar to the analyte group but is not expected to occur in an environmental sample) should be added to each sample, blank, laboratory control sample (LCS), and matrix spike sample just prior to extraction or processing. The recovery of the surrogate standard is used to monitor for unusual matrix effects, gross sample processing errors, etc. Surrogate recovery is evaluated for acceptance by determining whether the measured concentration falls within the acceptance limits.*<sup>111</sup>

<sup>109</sup> Memorandum from Terry Vandell to Walt Stewart, Meeting Minutes of the On-Site Washington Works Meeting (September 11, 1991, 9:00 AM-11:00 AM) Regarding the September 4, 1991 Proposed C-8 Sampling Program, September 19, 1991. (Bates No. EID909790-EID909809).

<sup>110</sup> Interoffice memo from R. J. Zipfel to distribution re: C-8 in Water Sample Results Ohio River, Site Test Wells, and New Lubeck Water System, October 3, 1991 (Bates No. EID909811-EID909819).

<sup>111</sup> USEPA SW-846, Method 3500B, Organic Extraction and Sample Preparation, December 1996.



Thus, the purpose of a surrogate is to monitor the performance of the method with each sample. A low surrogate recovery indicates there is at least one systematic error affecting the results.

No information was reported on the method used by CH2M Hill, however, the method should be similar to the CH2M Hill method issued the subsequent month (October 1991) which is discussed in the next section. It is assumed that the Experimental Station was using the same method as previously discussed. The detection limit for C-8 for the Experimental Station was 1 ppb, which was higher than the 0.6 ppb previously reported (1984 through 1990). CH2M Hill's detection limit was 0.1 ppb. DuPont did not report what "multiplication factors" were applied to the data from the Experimental Station.

Table 12. Comparison of September 1991 CH2M Hill Results to the Experimental Station Results.

| Sample Location                          | Experimental Station<br>C-8 (ppb) | CH2M Hill<br>C-8 (ppb) |
|------------------------------------------|-----------------------------------|------------------------|
| Test Well #27 Washington Works           | 7.1                               | 1.2                    |
| Well #331 Washington Works               | ND (1)                            | 0.1                    |
| Well MW-4 Washington Works               | 2.7                               | 0.2                    |
| Ohio River -1 & duplicate                | ND (1) & ND (1)                   | ND (0.1) & ND (0.1)    |
| Ohio River -2 & duplicate                | ND (1) & 3.9                      | ND (0.1) & ND (0.1)    |
| Ohio River -3 (near outfall) & duplicate | 19.6 & 16.8                       | 11.0 & 12.0            |
| Ohio River -5 & duplicate                | 4.2 & 2.8                         | 1.1 & 1.1              |
| Ohio River -6 & duplicate                | ND (1) & 2.0                      | 0.5 & 0.6              |
| New Lubeck Well - F & duplicate          | ND (1) & ND (1)                   | ND (0.1) & ND (0.1)    |
| New Lubeck Well - B & duplicate          | ND (1) & ND (1)                   | 0.3 & ND (0.1)         |
| Old Lubeck Well - 1 & duplicate          | 8.8 & 4.1                         | NA & 1.1               |
| Old Lubeck Well - 4 & duplicate          | 4.2 & 2.9                         | 0.9 & 1.7              |

ND ( ) = not detected (detection limit)

NA = not available.

In the October 1991 sampling, eight samples were given to each laboratory with four of the samples being unlabeled duplicates.<sup>112</sup> The comparison of the results between the two laboratories, Table 13, show the results from the Experimental Station are approximately two times higher than CH2M Hill. The 1.4 multiplication factor was not applied to the Experimental Station Results. The Experimental Station reported a detection limit of 1 ppb which is higher than the 0.6 ppb previously used (1984 to 1990). CH2M Hill achieved the lower detection limit by using a 1000 mL sample size compared to the 10 mL used by the Experimental Station. The Experimental Station used C-10 as an internal standard and CH2M Hill used three internal standards, perfluoroheptanoic acid (C-7), 1,2-dichlorobenzene, and 1,2,4-trichlorobenzene.

<sup>112</sup> Memo from R. J. Zipfel to C-8 File re: C-8 Interlaboratory Meeting, November 18, 1991, (Bates No. EID256133-EID256162).



In this round of testing, CH2M Hill used perfluorononanoic acid (C-9) and 11H-eicosafluoroundecanoic acid (C-11) as surrogates, Table 14. The Experimental Station did not use surrogates.<sup>113</sup> According to DuPont's November 18, 1991 memo, "CH2M-Hill reported that their overall recovery of surrogates (C-9 & C-11) to be approximately 60%."<sup>114</sup> According to the same memo, "If one corrects the CH2M-Hill results for surrogate recovery, their results are close to those reported to the Experimental Station." Thus, DuPont was aware of the relationship between low surrogate recoveries and low C-8 results in the samples and that CH2M Hill's results for C-8 were biased low.

CH2M Hill did not analyze matrix spikes with the samples. The Experimental Station reported an overall recovery for C-8 spiking at 5 ppb was 95%, however, there was no indication about the type of spike this was (matrix spike or blank spike).

Table 13. Comparison of October 1991 CH2M Hill Results to the Experimental Station Results from Washington Works Test Wells.

| Sample                    | Experimental Station<br>C-8 (ppb) | CH2M Hill<br>C-8 (ppb) |
|---------------------------|-----------------------------------|------------------------|
| Test Well 27 & duplicate  | 4.7 & 4.3                         | 2.5 & 3.2              |
| Test Well M4 & duplicate  | 1.3 & 1.3                         | 0.7 & 0.6              |
| Test Well 331 & duplicate | 1.0 & 1.4                         | 0.6 & 0.6              |
| Test Well 33 & duplicate  | 94 & 100                          | 75 & 46                |

Table 14. Surrogate Recoveries from CH2M Hill October 1991 Analysis.

| Sample                    | C9<br>% Rec | C11<br>% Rec |
|---------------------------|-------------|--------------|
| Test Well 27 & duplicate  | 63 & 75     | 45 & 46      |
| Test Well M4 & duplicate  | 87 & 74     | 72 & 45      |
| Test Well 331 & duplicate | 76 & 85     | 49 & 61      |
| Test Well 33 & duplicate  | 78 & 73     | 34 & 37      |

By November 1991, DuPont stated that the Experimental Station was not capable of analyzing the volume of samples necessary to support the Resource Conservation and Recovery Act (RCRA) Verification Investigation (VI) at the Washington Works facility.<sup>115</sup> CH2M Hill was designated to analyze all future water samples for C-8 while the Experimental Station would be used to sporadically check the CH2M Hill results, however, throughout the document review no CH2M Hill results were checked by the Experimental Station. According to a November 18, 1991, DuPont memorandum, the CH2M Hill fully complies with United States Environmental Protection Agency ("EPA") protocols including "good QA/QC practices, improved sample container control, rigorous documentation of equipment calibrations, reduced ambient impurity

<sup>113</sup> Ibid. The use of surrogate compounds by the Experimental Station is questionable. A statement is made that the Experimental Station did not use surrogates is followed with the statement that their results were corrected for surrogate recovery.

<sup>114</sup> Ibid.

<sup>115</sup> Memo from R. J. Zipfel to C-8 File re: C-8 Interlaboratory Meeting, November 18, 1991, (Bates No. EID256133-EID256162).



contamination and use of control samples."<sup>116</sup> "The Experimental Station laboratory did not have the volume of work to justify the increased expense fo[r] the EPA procedure."<sup>117</sup> Details of how the Experimental Station Laboratory did not comply with EPA protocols were not reported; however, the lack of surrogates, matrix spikes, and blanks are some of the protocols that were lacking in the Experimental Station's data. DuPont cited these reasons as the rationale for switching its water analysis for C-8 to CH2M Hill even though DuPont knew that CH2M Hill was obtaining lower results than the Experimental Station and CH2M Hill's "overall recovery of surrogates (C-9 & C-11) to be approximately 60%."<sup>118</sup>

**F. October 1991 Through 1998 Water Samples Analyzed by CH2M Hill Montgomery, Alabama**

Between October 1991 and 1998 DuPont used CH2M Hill to analyze water samples using  
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<sup>116</sup> Ibid.

<sup>117</sup> Ibid.

<sup>118</sup> Ibid.

<sup>119</sup>

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October 1991, (Bates No. EID211377-EID211398).



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however, a November 18, 1991 DuPont memo points out that CH2M Hill only utilizes the "main straight chain peak."<sup>120</sup>

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The August 11, 1993 CH2M Hill laboratory report includes quantitation reports and chromatograms for the calibration and samples.<sup>121</sup> CH2M Hill's calibration used standards at 0.05, 0.1, 0.5, 1.5, and 2 ug/L. Calibration check standards at 1 ug/L were run throughout the

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<sup>120</sup>Memorandum, from R. J. Zipfel to C-8 File re: C-8 InterLaboratory Meeting and includes 8/31/92 CH2M Hill Low Level Determination of FC-143 in Soil/Sediment (Bates No. EID256133-EID256162).

<sup>121</sup> CH2M Hill Hill Laboratory Report for 7/22/93 samples, August 11, 1993. (Bates No. EID181885-EID181987).



analysis and after the last sample. Surrogates appear to be spiked at a concentration of 1 ug/L in the samples. The chromatograms indicate that the analysis was performed using one injection, which was split between two columns and recombined before entering the detector. Thus, each chromatogram contains the peaks from both columns (i.e., two C-8 peaks, one for each column). The peak identified as C-8 in the chromatograms has additional smaller peaks surrounding it which are the branched isomers of C-8 for both the standards and the samples. The peaks for the branched isomers do appear to be used in the quantitation.

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The method reports a MDL of 0.011 ppb for the separatory funnel extraction and 0.0066 ppb for the continuous extraction.<sup>122</sup> Spike recoveries for FC-143 ranged from 55-62% at 0.1-0.4 ppb for the separatory funnel extraction and from 38-45% at 0.1-0.4 ppb for the continuous extractor. CH2M Hill reported their results as FC-143 in units of ug/L (ppb).

#### 1) November 1991 Ohio River Samples Near New LPSD Well Field

DuPont collected water samples on November 19, 1991 from the Ohio River. Three samples were collected near the new LPSD Well Field along with a field blank.<sup>123</sup> The first sample was collected on the West Virginia side about 40 feet from the shore. The second sample was collected in the middle and the third sample about 40 feet from the shore on the Ohio side. The samples were collected at a depth of 8 feet below the river surface. FC-143 was present above 1 ppb in all three river samples. Results are shown in Table 15. The surrogate recoveries for the three river samples, Table 15, ranged between 45 and 66%. According to the CH2M Hill's laboratory report, the surrogate recoveries were within the acceptable QC criteria, however, the QC limits were not reported.<sup>124</sup> No matrix spikes samples were run with this set of samples.

Table 15. Results for FC-143 and Surrogates Recoveries for the November 19, 1991 Ohio River Samples.

| Sample                          | FC-143<br>(ug/L) | Surrogate<br>C-9<br>% Rec | Surrogate<br>C-10<br>% Rec | Surrogate<br>C-11<br>% Rec |
|---------------------------------|------------------|---------------------------|----------------------------|----------------------------|
| LPSD - New Wells, WV Side River | 1.4              | 62                        | 45                         | 50                         |
| LPSD - New Wells, Mid River     | 1.6              | 66                        | 53                         | 54                         |
| LPSD - New Wells, Ohio Side     | 1.7              | 58                        | 49                         | 48                         |
| Field Blank                     | ND (0.1)         | 65                        | 66                         | 70                         |

ND ( ) = not detected (detection limit)

<sup>122</sup> Low Level Determination of FC-143 in Water, CH2M Hill, October 1991, (Bates No. EID149530-EID149550).

<sup>123</sup> Memo from Daniel A Weber to distribution list re: 11/19/91 C-8 Sample Collection Summary, November 20, 1991. (Bates No. EID949490-EID949491) and Memo from Mike to Roger re: 11/19/91 results. (Bates No. EID949449).

<sup>124</sup> CH2M Hill Laboratory Report for 10/8/91 samples, November 27, 1991. (Bates No. EID949493-EID949517).



## 2) February 1992 New LPSD Well Samples

CH2M Hill analyzed water samples that DuPont collected from the new LPSD Service Division wells on February 25, 1992.<sup>125</sup> The sample results and surrogate recoveries are shown in Table 16. No results were reported for the blank spikes (LCS), matrix spike (MS), or matrix spike duplicate (MSD) for these samples. CH2M Hill used the same method as before. DuPont continued using CH2M Hill to run drinking water samples even though CH2M Hill's method previously was shown to produce low results and low surrogate recoveries.

DuPont does not sample and analyze the drinking water from the surrounding community for FC-143 for another eight years until January 2000.

Table 16. Results for FC-143 and Surrogates for the February 25, 1992 New Lubeck Public Service District Well Samples

| Sample      | FC-143<br>(ug/L) | Surrogate<br>C-9<br>% Rec | Surrogate<br>C-10<br>% Rec | Surrogate<br>C-11<br>% Rec |
|-------------|------------------|---------------------------|----------------------------|----------------------------|
| LPSD Well A | 0.2              | 78                        | 83                         | 78                         |
| LPSD Well B | 0.4              | 73                        | 77                         | 72                         |
| LPSD Well F | 0.09 J           | 82                        | 82                         | 73                         |

J = estimated

## 3) CH2M Hill FC-143 Spike Recoveries

QC data for blank spikes (LCS) and matrix spikes (MS) were available for three of the CH2M Hill laboratory reports dated June 8, 1993, August 11, 1993 and June 13, 1995. The June 8, 1993 report for water samples collected from DuPont's Local Landfill reported poor recoveries for the original FC-143 spikes for the LCS, MS and MSD, Table 17.<sup>126</sup> The spiking concentrations were 1 ug/L for the LCS and 2 ug/L for the MS/MSD while the original un-spiked value was 0.6 ug/L for the MS/MSD. Surrogates recoveries were also poor. Quality control (QC) recovery criteria were not reported. CH2M Hill re-extracted these samples and reported increased FC-143 and surrogate recoveries, Table 17.<sup>127</sup> This indicates that there is a correlation between the surrogate recoveries and the amount of FC-143 reported. Low surrogate recoveries lead to low FC-143 results.

<sup>125</sup> Letter from W M Stewart to William R Packard (Lubeck) re Feb 1992 results with attached CH2M Hill Form I, March 23, 1992 (Bates No. EID195965-EID195968).

<sup>126</sup> CH2M Hill Laboratory Report for 5/19/93 samples, June 8, 1993.

<sup>127</sup> The sample used for the re-extract for the MS/MSD was not the same as the original extraction. In addition, a smaller aliquot (50 mL vs. 1000 mL) and a higher spiking level (20 ug/L vs. 2 ug/L) was used for the MS/MSD re-extract. The original value for the un-spiked sample used for the re-extract of the MS/MSD was 37 ug/L. The re-extraction was performed beyond CH2M Hill's holding time for extractions.



Table 17. QC Sample Results from June 8, 1993 Laboratory Report

| Sample           | FC-143<br>Spike<br>% Rec | Surrogate<br>C-9<br>% Rec | Surrogate<br>C-10<br>% Rec | Surrogate<br>C-11<br>% Rec |
|------------------|--------------------------|---------------------------|----------------------------|----------------------------|
| LCS              | 21                       | 12                        | 11                         | 13                         |
| MS               | 15                       | 7                         | 7                          | 6                          |
| MSD              | 15                       | 12                        | 15                         | 10                         |
| LCS (Re-extract) | 64                       | 83                        | 91                         | 86                         |
| MS (Re-extract)  | 80                       | 70                        | 62                         | 65                         |
| MSD (Re-extract) | 96                       | 109                       | 107                        | 89                         |

The LCS and MS/MSD recoveries for the August 11, 1993<sup>128</sup> and June 13, 1995<sup>129</sup> reports are shown in Table 18. The samples used for the MS/MSD were from wells at Washington Works.

Table 18. QC Sample Results from August 11, 1993 and June 13, 1995 Laboratory Reports

| QC Sample | CH2M Hill<br>Report<br>Date | FC-143<br>Spike Added<br>(ug/L) | FC-143<br>Spike<br>% Rec | C-9<br>% Rec | C-10<br>% Rec | C-11<br>% Rec |
|-----------|-----------------------------|---------------------------------|--------------------------|--------------|---------------|---------------|
| LCS       | 8/11/93                     | 1                               | 87                       | 71           | 63            | 37            |
| MS        | 8/11/93                     | 2                               | 78                       | 68           | 39            | 33            |
| MSD       | 8/11/93                     | 2                               | 82                       | 51           | 32            | 27            |
| LCS       | 6/13/95                     | 1                               | 83                       | 67           | 81            | 60            |
| MW13A MS  | 6/13/95                     | 4                               | 89                       | 57           | 27            | 72            |
| MW13A MSD | 6/13/95                     | 4                               | 87                       | 38           | 18            | 60            |

It should be noted that the C-9 surrogate used by CH2M Hill and later by Lancaster Laboratories is also found in the environment.<sup>130</sup> In 2000, about 9% of the perfluorocarboxylic acids released into the environment was C-9 with lesser amounts of the higher carbon number analogs. The principal manufacture and use of C-9 are in Eastern Asia. The commercial C-9 produced in Japan is a mixture of linear C-7 to C-13 perfluoro ammonium salts. However, C-9 is also a by-product of 3M's electrochemical fluorination process and may contain branched-chain isomers from this process. All of this may lead to problems in using C-9 for a surrogate and questions about the purity of the surrogates.

#### G. November 1998 RCRA Facility Investigation - CH2M Hill

CH2M Hill analyzed the soil and groundwater collected for DuPont's first round of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at the Washington

<sup>128</sup> Letter from Angel Kionka (CH2M Hill) to George Woytowich (DuPont) re: Analytical Data for Dry Run, July 7, 1995, (Bates No. EIC07118-EID071207). Note: The laboratory changed its name to Quality Analytical Laboratories, Inc. (QAL).

<sup>129</sup> CH2M Hill Laboratory Report for 7/22/93 samples, August 11, 1993. (Bates No. EID181885-EID181987).

<sup>130</sup> Konstantinos Prevedours, et al. Sources, Fate and Transport of Perfluorocarboxylates, *Environmental Science & Technology*, 2006 40(1) pp. 32-44.



Works facility.<sup>131</sup> The groundwater samples were collected in November 1998. However, the data validation lists both CH2M Hill and Lancaster Laboratories, located in Lancaster, Pennsylvania as the laboratories performing the analysis.<sup>132</sup> It is not clear to what extent Lancaster Laboratories was involved with these samples. This was around the time period that CH2M Hill's Montgomery, Alabama laboratory inexplicably ceases operations. The method used for FC-143 in the first round of sampling was listed as CH2M Hill's "Low Level Determination of FC-143 in Water" described above.

Environmental Standards of Valley Forge, Pennsylvania performed the data validation on the groundwater results and issued a draft report on June 4, 1999.<sup>133</sup> The FC-143 results for nine groundwater samples (including a field duplicate) and a field blank were validated. Eight of the samples including the field blank were qualified because of low surrogate and MS/MSD recoveries or high differences in the results between field duplicates:

- Very low recoveries (<10 %) for one or more of the surrogates resulted in three samples being flagged "L" indicating that FC-143 was present and the reported value may be biased low. The actual value is expected to be higher. All samples had acceptable recoveries (QC criteria was not reported) for the C-9 surrogate.
- Very low recoveries (<10 %) for FC-143 spikes in the MS and MSD resulting in the sample that was spiked being flagged "L."
- One sample and its field duplicate were flagged "J" because of poor precision between the duplicates (RPD = 68%).
- Three samples (including the field blank) with reported FC-143 results below the PQL were flagged "R," as unusable. One or more of the surrogates had very low recoveries (<10 %).

Sometime in the Fall of 1998, CH2M Hill's Montgomery, Alabama laboratory ceases operations for unknown reasons.

#### **H. February 1999 RCRA Facility Investigation Ground Water Samples Analyzed by Lancaster Laboratories, Lancaster, Pennsylvania**

By the second round of DuPont's RFI groundwater sampling during February, 1999, Lancaster Laboratories was analyzing the samples for FC-143.<sup>134,135,136</sup> Lancaster was using the

<sup>131</sup> RCRA Facility Investigation Report DuPont Washington Works Washington, West Virginia, USEPA Permit Number WVD04-587-5291, DuPont Remediation Group, June 30, 1999, (Bates No. EID109642-EID109786).

<sup>132</sup> Draft "Quality Assurance Review of the RFI Samples Collected on September 3, 4, 22, 23, 24, 25, 28, and November 17 and 18, 1998," Environmental Standards, Inc., June 4, 1999, (Bates No. EID149626-EID149737).

<sup>133</sup> Ibid.

<sup>134</sup> Quality Assurance Review of the RFI Groundwater 2<sup>nd</sup> Round Samples Collected on February 2 and 3, 1999, for the DuPont Corporate Remediation Group, Washington Works RCRA Facility Investigation, Environmental Standards, Inc., May 20, 1999, (Bates No. EID149605-EID149625).



October 1991 CH2M Hill method.<sup>137</sup> Environmental Standards, Inc. validated the FC-143 results and issued their findings in reports dated May 20, 1999 and June 4, 1999.<sup>138,139</sup> The FC-143 results for eleven groundwater samples (including a field duplicate) were validated. Nine of the samples "should be considered biased low" because of low surrogate, LCS and MS/MSD recoveries:

- The results for two samples were flagged "B" for the presence of FC-143 in the associated laboratory blank.
- Very low recoveries (<10 %) and/or low recoveries (10 %  $\leq$  R < 50 %) for one or more of the surrogates. All positive results except for one sample "should be considered biased low and have been flagged 'L' (unless previously flagged 'B')." All samples had acceptable recoveries (QC criteria was not reported) for the C-9 surrogate.
- Very low recoveries (<10 %) for FC-143 spikes for the MS and a low recovery (10 %  $\leq$  R < 50 %) for the MSD. The sample that was spiked was flagged "L," and the result "should be considered biased low."
- A low recovery (10 %  $\leq$  R < 50 %) for FC-143 was observed for the LCS. All positive results "should be considered biased low and have been flagged 'L' (unless previously flagged 'B')." "
- The precision for one sample and its field duplicate was poor (RPD = 68%). No data was qualified because the results were previously flagged "L" due to low LCS and surrogate recoveries.

DuPont compared the results of the first and second round of groundwater sampling and stated that the FC-143 results "showed that many, but not all, second round results for FC-143 were higher than the first round results."<sup>140</sup> DuPont said that it was "investigating possible differences in the FC-143 standard used by the different laboratories for calibration and spiking in an attempt to explain the generally higher FC-143 results found during the second round of

<sup>135</sup> Quality Assurance Review of the RFI Groundwater 2<sup>nd</sup> Round Samples Collected on February 2 and 3, 1999, for the DuPont Corporate Remediation Group, Washington Works RCRA Facility Investigation, Environmental Standards, Inc., June 4, 1999, (Bates No. EID149552-EID149604).

<sup>136</sup> Letter from DuPont to EPA Region III, August 31, 2001, Response to Request for Information dated July 24, 2001, Response to Request No. 12.

<sup>137</sup> RCRA Facility Investigation Report DuPont Washington Works Washington, West Virginia, USEPA Permit Number WVD04-587-5291, DuPont Remediation Group, June 30, 1999, (Bates No. EID109642-EID109786).

<sup>138</sup> Quality Assurance Review of the RFI Groundwater 2<sup>nd</sup> Round Samples Collected on February 2 and 3, 1999, for the DuPont Corporate Remediation Group, Washington Works RCRA Facility Investigation, Environmental Standards, Inc., May 20, 1999, (Bates No. EID149605-EID149625).

<sup>139</sup> Quality Assurance Review of the RFI Groundwater 2<sup>nd</sup> Round Samples Collected on February 2 and 3, 1999, for the DuPont Corporate Remediation Group, Washington Works RCRA Facility Investigation, Environmental Standards, Inc., June 4, 1999, (Bates No. EID149552-EID149604).

<sup>140</sup> RCRA Facility Investigation Report DuPont Washington Works Washington, West Virginia, USEPA Permit Number WVD04-587-5291, DuPont Remediation Group, June 30, 1999, (Bates No. EID109642-EID109786).



groundwater analysis." DuPont also states that, "In addition, FC-143 analysis at each laboratory generally gave poor or imprecise spike recoveries as discussed in Section 4.1.3, resulting in qualification of validated FC-143 results as estimated." Two groundwater results<sup>141</sup> were qualified as unusable "primarily due to very low spike recoveries associated with non-detect FC-143 results."<sup>142</sup> A third round of sampling of the groundwater was conducted to "verify this discrepancy," however, the results were not available for review. The results of DuPont's "investigation" are not known.

#### **I. 2000 through October 2001 LPSD Water Samples Analyzed by Lancaster Laboratories, Lancaster, Pennsylvania**

Lancaster Laboratories analyzed drinking water samples collected from the new wells used by the Lubeck Public Service District (LPSD) and/or the water main from LSPD building on January 19, 2000,<sup>143</sup> August 15, 2000,<sup>144</sup> October 31, 2000,<sup>145</sup> February 28, 2001,<sup>146</sup> June 15, 2001,<sup>147</sup> and August 14, 2001.<sup>148</sup> All of these samples were analyzed by Lancaster using CH2M Hill's October 1991 "Low Level Determination of FC-143 in Water" with some revisions. During the Initial Demonstration of Capability (IDC) of the CH2M Hill method, Lancaster Laboratories reported low spike recoveries (20%) for FC-143 and the surrogates which were reported to be in agreement with historical data from CH2M Hill.<sup>149</sup> The CH2M Hill method was used even with the poor recoveries in the IDC.

Results from the six rounds of LPSD water samples analyzed by Lancaster Laboratories are reported in Table 19 along with the surrogate recoveries.<sup>150</sup> Lancaster reported the results as "FC-143" with a MDL of 0.029 ug/L in their laboratory reports. Lancaster reported results between the MDL and the reporting limit (0.1 ug/L) with a "J" qualifier (estimated). Note that one of the modifications Lancaster made to the method was the replacement of the C-10 surrogate used by CH2M Hill with perfluorododecanoic acid (C-12).<sup>151</sup> Lancaster reported the percent

<sup>141</sup> Draft "Quality Assurance Review of the RFI Samples Collected on September 3, 4, 22, 23, 24, 25, 28, and November 17 and 18, 1998," Environmental Standards, Inc., June 4, 1999, (Bates No. EID149626-EID149737).

<sup>142</sup> RCRA Facility Investigation Report DuPont Washington Works Washington, West Virginia, USEPA Permit Number WVD04-587-5291, DuPont Remediation Group, June 30, 1999, (Bates No. EID109642-EID109786).

<sup>143</sup> Letter from R L Ritchey to James C Cox (Lubeck) re LPSD Water Sample Results 1/19/2000 with attached Lancaster Form I, February 17, 2000. (Bates No. EID1959651-EID195968)

<sup>144</sup> Letter from R L Ritchey to James C Cox (Lubeck) re: LPSD Water Sample Analytical Results sampled on 8/15/00 with attached Lancaster Form I, October 4, 2000. (Bates No. EID185155-EID185160).

<sup>145</sup> Letter from R L Ritchey to James C Cox (Lubeck) re: LPSD Water Sample Analytical Results sampled on 10/31/00 with attached Lancaster Form I, April 26, 2001. (Bates No. EID185172-EID185181)

<sup>146</sup> Letter from R L Ritchey to James C Cox (Lubeck) re: LPSD Water Sample Analytical Results sampled on 2/28/01 with attached Lancaster Form I, April 2, 2001. (Bates No. EID185166-EID185171)

<sup>147</sup> Letter from R L Ritchey to James C Cox (Lubeck) re: LPSD Water Sample Analytical Results sampled on 6/15/01, with attached Lancaster Form I, July 18, 2001. (Bates No. EID718144-EID718149).

<sup>148</sup> Lancaster laboratory Form Is for Lubeck samples collected 8/14/01. (Bates No. CF016692-CF016695).

<sup>149</sup> Draft Proposal, Determination of FC-143 in Water: PBMS Method Development and Validation, Lancaster Laboratories, November 28, 2000, (Bates No. EID150093-EID150285).

<sup>150</sup> The results reported for the 10/31/00 samples are the out of hold results for the ethyl ether extraction. The results for the modified MTBE extraction were not being used by DuPont in Tables listing the Lubeck results (Bates EID195208).

<sup>151</sup> "FC-143 in Water/Wastewater," Lancaster Laboratories (Analysis #2324), August 6, 1999, (Bates No.



surrogate recoveries for the January 19, 2000 samples, however, in the subsequent rounds, Lancaster only mentioned which surrogates were outside the QC criteria ("Out" in Table 19) without disclosing the percent recoveries. Surrogates that were not mentioned by Lancaster are assumed to have met the QC criteria ("In" in Table 19). Over half of the surrogates did not meet the QC criteria. In fact, only one out of 23 samples met the QC criteria for all three surrogates. Although the percent recoveries for C-9 in the January 19, 2000 samples were poor (7, 10, and 21%), this surrogate still met the QC criteria because of the extremely low recovery minimum (1%) set by Lancaster. This extremely low recovery minimum is why all except one of the C-9 surrogate recoveries met the QC criteria, Table 19. The C-11 surrogate also had a low minimum recovery criterion, 13%, which was later lowered to 11%. C-11 recoveries were still outside the QC criteria (assumed on the low side) in 16 out of 23 samples. The C-12 surrogate with a higher recovery minimum, 50%, was outside the QC criteria in all but two samples. Such low minimum recovery criteria for the surrogates indicates that the method cannot produce results on a consistent basis. QC criteria of 1 to 50% for the recovery of the C-9 surrogate are unacceptable for an accurate analytical method.



Table 19. Results for Water Samples Collected From the LPSD Wells and Analyzed by Lancaster

| Sample           | Date     | FC-143<br>(ug/L) | Surrogate<br>C-9<br>% Rec | Surrogate<br>C-11<br>% Rec | Surrogate<br>C-12<br>% Rec |
|------------------|----------|------------------|---------------------------|----------------------------|----------------------------|
| LPSD Well A      | 1/19/00  | 0.80             | 21                        | 11                         | 9                          |
| LPSD Well B      | 1/19/00  | 0.440            | 10                        | 5                          | 3                          |
| LPSD Well F      | 1/19/00  | 0.313            | 7                         | 4                          | 3                          |
| LPSD Well A      | 8/15/00  | 0.535            | In                        | Out                        | Out                        |
| LPSD Well B      | 8/15/00  | 0.159            | In                        | Out                        | Out                        |
| LPSD Well F      | 8/15/00  | 0.073 J          | In                        | Out                        | Out                        |
| LPSD Bld Main    | 8/15/00  | 0.58             | In                        | Out                        | Out                        |
| LPSD Well A      | 10/31/00 | 0.672            | In                        | In                         | Out                        |
| LPSD Well B      | 10/31/00 | 0.492            | In                        | In                         | Out                        |
| LPSD Well F      | 10/31/00 | 0.196            | In                        | In                         | Out                        |
| LPSD Bld Main    | 10/31/00 | 0.692            | In                        | In                         | Out                        |
| LPSD Well A      | 2/28/01  | 0.648            | In                        | In                         | In                         |
| LPSD Well B      | 2/28/01  | 0.638            | Out                       | In                         | In                         |
| Lubeck Well F    | 2/28/01  | 0.212            | In                        | In                         | Out                        |
| LPSD Bld Main    | 2/28/01  | 0.499            | In                        | Out                        | Out                        |
| Lubeck Well A    | 6/15/01  | 0.220            | In                        | Out                        | Out                        |
| Lubeck Well B    | 6/15/01  | 0.555            | In                        | Out                        | Out                        |
| Lubeck Well F    | 6/15/01  | 0.065 J          | In                        | Out                        | Out                        |
| LPSD Bld Main    | 6/15/01  | 0.143            | In                        | Out                        | Out                        |
| Lubeck Well A    | 8/14/01  | 0.270            | In                        | Out                        | Out                        |
| Lubeck Well B    | 8/14/01  | 0.236            | In                        | Out                        | Out                        |
| Lubeck Well F    | 8/14/01  | 0.055 J          | In                        | Out                        | Out                        |
| LPSD Bld Main    | 8/14/01  | 0.244            | In                        | Out                        | Out                        |
| Surrogate Limits | --       | --               | 1-50                      | 13-88                      | 50-150                     |

In = within QC criteria, Out = outside QC criteria

J = estimated, NA = not available

The spike recoveries for FC-143 spiked into method blanks (LCS and LCSD) and into the Lubeck samples (MS and MSD) are shown in Table 20. Values for spike recoveries and QC recovery criteria were reported only for the January 19, 2000 samples. The spike recoveries reported in the other rounds of sampling were only reported as within, "In," or outside, "Out," of the QC criteria. None of the reported MS and MSDs met the QC spike recovery criteria. Only one of the LCS/LCSD samples failed to meet the QC spike recovery criteria.<sup>152</sup> However, the

<sup>152</sup> For the 8/15/00 samples, the FC-143 recovery for the LCS, MS, and MSD were outside the QC criteria. The samples were re-extracted past their holding time and this time the LCS met the QC criteria. However only the original results were reported.



minimum spike recovery QC criteria, of 3%, is set very low. Even though the 9% recovery for the January 19, 2000 LCS was above the minimum spike recovery QC criteria, this shows that the method yields poor FC-143 spike recoveries in laboratory blank water, a matrix in which one would expect little to no interferences. QC criteria of 3 to 55% for the recovery of FC-143 are unacceptable for an accurate analytical method. The poor FC-143 spike recoveries show that the method results are biased low.

Table 20. Lancaster's Results for QC Samples.

| Sample Date     | LCS<br>FC-143<br>% Rec | LCSD<br>FC-143<br>% Rec | MS<br>FC-143<br>% Rec | MSD<br>FC-143<br>% Rec |
|-----------------|------------------------|-------------------------|-----------------------|------------------------|
| 1/19/00         | 9                      | --                      | *                     | *                      |
| 8/15/00         | Out                    | --                      | Out                   | Out                    |
| 10/31/00        | In**                   | In**                    | --                    | --                     |
| 2/28/01         | In                     | --                      | Out**                 | Out**                  |
| 6/15/01         | In                     | --                      | Out                   | Out                    |
| 8/14/01         | --                     | --                      | Out**                 | Out**                  |
| Recovery Limits | 3-55                   | 3-55                    | 3-55                  | 3-55                   |

In = within QC criteria, Out = outside QC criteria

\* Not reported, background >4 times spike level.

\*\*RPD between MS and MSD or LCS and LCSD did not meet QC criterion (Criterion was not reported).

The method used for the above analysis is listed in the laboratory reports as No. 2324, FC-143 by GC/ECD 10/91 with the sample prepared by No. 2325, FC-143 10/91. Lancaster Laboratories tried to make "minor modifications" to the extraction procedure to improve recoveries. An August 6, 1999 method revision (Analysis #2324) adds perfluorododecanoic acid (C-12) and removes C-10 as one of the surrogates for the method.<sup>153</sup> The initial calibration included five levels of standards. The standards were made from technical APFO obtained from DuPont and were ethylated with ethanoic HCl by Lancaster. FC-143 was calibrated for each of the four major peaks (straight-chain and three isomer peaks). The concentration attributed to each peak was determined from the ratio of each peak in comparison to the total.<sup>154</sup> To quantitate FC-143, Lancaster added the concentrations for each of the four peaks. Lancaster used the average RRF for the initial calibration when the %RSD was  $\leq 20\%$ . If the %RSD exceeded 20%, then a linear or quadratic fit was used as long as the correlation coefficient was greater than 0.99. Samples were bracketed with continuing calibration verification (CCV) standards with a % drift criteria not to exceed  $\pm 20\%$ . If the CCV exceeds the criteria for one of the two columns then only the column that passes the % drift criteria is used for quantitation. To quantitate APFO in a sample, Lancaster added the concentrations for each of the four peaks to obtain a total concentration of APFO. The total APFO results for the primary column and the confirmation

<sup>153</sup> "FC-143 in Water/Wastewater," Lancaster Laboratories (Analysis #2324)," August 6, 1999, (Bates No. EID149448-EID149458).

<sup>154</sup> According to Lancaster, "The total concentration for all four components should equal the concentration for the level."



analysis were compared and if the %D between the two results were  $\leq 40\%$ , the lowest of the two results were used. The results are "flagged" if the %D exceeds 40%. The lower of the results for the surrogates were also reported. The method includes the analysis of a deionized water blank, LCS/LCSD and MS/MSD. The holding time for samples from the date of collection to the date of extraction was 14 days and extracts should be analyzed within 40 days of extraction. The reporting limit for this method was 0.1 ug/L and the MDL was 0.02 ug/L. Based on the standard used, the FC-143 results reported by Lancaster was the ammonium salt APFO. The sample preparation procedure was not included in this method, however, the method references Lancaster Laboratories Analysis #2325, "Extraction of Low-Level FC-143 in Water and Wastewater," as the sample preparation method.

As the sample preparation method for the above analysis, Lancaster Laboratories used Analysis #2325FC, "Extraction of Low-Level FC-143 in Water and Wastewater," which was first initiated on April 26, 1999 and issued on January, 6, 2000, revision 2 was issued October 20, 2000, **REDACTED**<sup>155,156</sup> Only the second and third revisions were available for review. In the second revision the extraction solvent was changed to methyl tertiary-butyl ether (MTBE) and in the third revision **REDACTED**<sup>157</sup>

**REDACTED**

The second revision of the extraction method used MTBE as a solvent and was a simpler method **REDACTED**

#### 1) Extraction Modification Using MTBE October 31, 2000 LPSD Samples

According to an October 3, 2000 DuPont email from Michael D Aucoin, Lancaster has been using the CH2M Hill method for over a year.<sup>158</sup> In addition, Lancaster was using the CH2M Hill method "as per your [DuPont's] initial instructions." The email also states that: "Due to the very involved sample preparation protocol and generally poor spike recoveries observed, Lancaster undertook an evaluation of alternatives to the CH2M Hill SOP." Lancaster proposed using MTBE **REDACTED** to perform the extraction (see October 20, 2000 extraction revision in the previous paragraph). The step involved taking the extract to dryness, which according to Lancaster may be contributing to poor spike recoveries, is eliminated using MTBE.

The October 31, 2000 LPSD samples were analyzed using the MTBE extraction

<sup>155</sup> Lancaster Labs, Extraction of Low Level FC-143 in Water and Wastewater, Analysis #2325FC Rev 2 (Bates No. EID149401-EID149411).

<sup>156</sup> -

**REDACTED**

(Bates No.

EID124578-EID124593).

<sup>157</sup> Note that the second revision states that the extraction solvent was changed from the first revision. The change was probably from ethyl ether in the CH2M Hill method to MTBE.

<sup>158</sup> Email from Michael D Aucoin to Roger J Zipfel re Laboratory Proposal FC-143, October 3, 2000. (Bates No. EID545530)



procedure.<sup>159,160</sup> The results using the MTBE extraction are shown in Table 21. At DuPont's request, Lancaster re-extracted the samples using the original ethyl ether extraction; however, the extraction was performed past the method hold time.<sup>161</sup> Comparison of the results for the LPSD samples extracted both ways show that the FC-143 results for the MTBE extraction were between 1.1 to 2 times higher than with the ethyl ether extraction, Table 21. However, surrogates recoveries continued to be outside the QC criteria. No LCS, MS, or MSD were reported for the MTBE extraction. As discussed in the previous section, the next revision of the extraction procedure

### REDACTED

Table 21. Comparison of GC/ECD Results from Ethyl Ether and MTBE Extraction

| Sample        | Sample Date | Ethyl Ether Extraction<br>FC-143 ( ug/L) | MTBE Extraction<br>FC-143 (ug/L) |
|---------------|-------------|------------------------------------------|----------------------------------|
| LPSD Well A   | 10/31/2000  | 0.672                                    | 0.79                             |
| LPSD Well B   | 10/31/2000  | 0.492                                    | 0.81                             |
| LPSD Well F   | 10/31/2000  | 0.196                                    | 0.40                             |
| LPSD Bld Main | 10/31/2000  | 0.629                                    | 0.67                             |

## 2) GC/MS Confirmation Analysis

Lancaster also developed a GC/MS method (Analysis #0495) for confirmation of FC-143 in water and wastewater in December 2000 and revised the method on February 15, 2001.<sup>162</sup> This method was used to confirm the presence of FC-143 in water and wastewater analyzed by Lancaster Laboratories Analysis #2324/2325 (GC/ECD) and used the same extract as the GC/ECD method. The initial calibration included five levels of standards. The standards were made from technical APFO obtained from DuPont and were ethylated with ethanoic HCl by Lancaster. Lancaster used the average RRF for the initial calibration when the %RSD was  $\leq 20\%$ . If the %RSD exceeded 20%, then a linear or quadratic fit was used. A CCV was run at the beginning of every 12-hour shift with a % drift criteria not to exceed  $\pm 20\%$ . The m/z 69 ion abundance was used for quantitation. Compound identification was made based on the retention time and the agreement of the abundance of all ions ( $>10\%$  of m/z 69) within 20% of the reference spectrum. The detection limit for this method was 0.1 ug/L.

The GC/MS method (Analysis # 0495) was used for confirmation for the February 28,<sup>163</sup> June 15,<sup>164</sup> and August 14, 2001<sup>165</sup> Lubeck samples, Table 22.

<sup>159</sup> Letter from R L Ritchey to James C Cox (Lubeck) re: LPSD Water Sample Analytical Results sampled on 10/31/00, April 26, 2001, (Bates No. EID185172-EID185181).

<sup>160</sup> Letter from R L Ritchey to James C Cox (Lubeck) re: LPSD Water Sample Analytical Results sampled on 10/31/00 with attached Lancaster Form I, April 26, 2001. (Bates No. EID185172-EID185181).

<sup>161</sup> Although DuPont reported both the MTBE extraction and ethyl ether extraction results to the LPSD on April 26, 2001, DuPont generally only used the ethyl ether extraction data in their data tables (Bates No. EID195208).

<sup>162</sup> "GC/MS Confirmation of FC-143 in Water/Wastewater (Analysis #0495)," . Lancaster Laboratories, February 15, 2001, (Bates No. EID149417-EID149429).

<sup>163</sup> Letter from R L Ritchey to James C Cox (Lubeck) re: LPSD Water Sample Analytical Results sampled on 2/28/00, April 2, 2001, (Bates No. EID185166-EID185171).



Table 22. Comparison of GC/ECD Results to GC/MS Confirmation (Ethyl Ether Extraction) for 2001 LPSD Samples

| Sample        | Sample Date | GC/ECD<br>FC-143 (ug/L) | GC/MS<br>Confirmation<br>FC-143 (ug/L) |
|---------------|-------------|-------------------------|----------------------------------------|
| LPSD Well A   | 2/28/2001   | 0.648                   | 0.22                                   |
| LPSD Well B   | 2/28/2001   | 0.638                   | 0.45                                   |
| LPSD Well F   | 2/28/2001   | 0.212                   | 0.100                                  |
| LPSD Bld Main | 2/28/2001   | 0.499                   | 0.32                                   |
| LPSD Well A   | 6/15/2001   | 0.220                   | 0.431                                  |
| LPSD Well B   | 6/15/2001   | 0.555                   | 0.321                                  |
| LPSD Well F   | 6/15/2001   | 0.065 J                 | ND (0.09)                              |
| LPSD Bld Main | 6/15/2001   | 0.143                   | ND (0.09)                              |
| LPSD Well A   | 8/14/2001   | 0.270                   | 0.21                                   |
| LPSD Well B   | 8/14/2001   | 0.236                   | 0.171                                  |
| LPSD Well F   | 8/14/2001   | 0.055 J                 | ND (0.09)                              |
| LPSD Bld Main | 8/14/2001   | 0.224                   | 0.206                                  |

ND ( ) = not detected (detection limit)

J = estimated

#### J. 1999 - 2001 Lancaster Laboratories FC-143 Method Development To Improve Recoveries

Starting in October 1999, Lancaster Laboratories attempted to develop a method to analyze FC-143 based on the EPA 552.2, a method for haloacetic acids by GC/ECD.<sup>166</sup> This is discussed in a series of emails between Lancaster Laboratories and DuPont between October 1999 and October 2000. The method is similar to EPA 552.2 and uses MTBE as the extraction solvent; however, the Lancaster procedure derivatized the acid to the ethyl ester instead of the methyl ester in EPA 552.2. Studies conducted in October 1999 showed FC-143 spike recoveries averaging 98% (RSD = 8%) based on four spiked samples with good surrogate recoveries (80 to 120%). However, the MDL was too high and Lancaster continued to refine the method to obtain a lower detection limit. By April 2001, Lancaster had submitted two methods for the analysis of FC-143 in water with improved surrogate and FC-143 spike recoveries over the CH2M Hill procedure. The first method known as the "low-level method" was a GC/MS procedure using MTBE as the extraction solvent. The second method, known as the "high-level method" used solid phase microextraction, (SPME) followed by analysis by GC/MS. In both methods, FC-143 was derivatized to the ethyl ester.

<sup>164</sup> Letter from R L Ritchey to James C Cox (Lubeck) re: LPSD Water Sample Analytical Results sampled on 6/15/01, July 18, 2001, (Bates No. EID718144-EID718149).

<sup>165</sup> Lancaster Laboratories Form Is for LPSD samples collected 8/14/01. (Bates No. CF016692-CF016695).

<sup>166</sup> Email from N. J. Bornholm (Lancaster) to Michael D Aucoin re: FC143, October 4, 1999. (Bates No. EID150418).



## 1) Low-Level Method

For the low-level method, the sample was extracted by "Extraction of Low Level FC-143 in Water and Wastewater (Analysis #0813FC)"<sup>167</sup> and analyzed by GC/MS by "FC-143 in Water and Wastewater by GC/MS (Analysis # 0616)".<sup>168</sup> One liter of sample was placed in a separatory funnel, and the surrogate was added. The pH was adjusted to greater than 12 with sodium hydroxide. The aqueous solution was extracted with methylene chloride, and the methylene chloride was discarded. The pH was then adjusted to less than 1.5 with sulfuric acid and extracted with MTBE. The MTBE layer was filtered through sodium sulfate and placed in a K-D apparatus. The aqueous phase was extracted two more times with MTBE, and the MTBE portions were filtered through sodium sulfate and added to the K-D apparatus. The MTBE was concentrated at 80-85°C to less than four milliliters. Ethanol was added to the MTBE and nitrogen evaporated at 35°C to one milliliter. The sample was then placed in a vial with sulfuric acid. The vial was capped, and placed in an oven at 63-67°C for one hour to derivatize the FC-143. The sample was removed from the oven and mixed with 1 mL methylene chloride and 1 mL water. The methylene chloride layer was removed and washed by mixing with water. The methylene chloride layer was removed and filtered through glass wool and sodium sulfate. The volume was made up to one milliliter with methylene chloride and placed in a vial for analysis. The initial calibration is achieved using six concentration levels made from ethyl perfluorooctanoate.<sup>169</sup> The reported MDL (seven spikes) was 0.078 ppb when spiked at 0.25 ppb.<sup>170</sup> The LOQ was 0.1 ppb.

The average spike recovery from the accuracy and precision study (quad study) for the low-level method was 78% with a standard deviation of 0.1012 ug/L based on a spike level of 2.5 ppb - 25 times greater than the reported method detection limit. The surrogate compound, perfluorononanoic acid, had an average recovery of 92% at this same concentration. Studies also showed that spikes of FC-143 at 0.1 ppb into a sample from the Washington Works site (unspiked result 0.14 ug/L) had recoveries ranging from 50-90% with an average of 63% recovery. At 1 ppb, recoveries ranged from 61-78% with an average of 68%. At 10 ppb, the range was from 65-68% with an average of 68%. The variation in the recoveries (%RSD) decreased from 36% to 2% as the concentration increased from 0.1 ppb to 10 ppb.

The Washington Works groundwater quarterly samples collected April 11, 2001 were analyzed by both the traditional (CH2M Hill) GC/ECD method and the proposed low-level GC/MS method (Analysis # 0616).<sup>171</sup> The data generated by the GC/MS method

<sup>167</sup> "Extraction of Low Level FC-143 in Water and Wastewater (Analysis #0813FC)," Lancaster Laboratories, April 3, 2001, (Bates No. EID150103-EID150113).

<sup>168</sup> "FC-143 in Water and Wastewater by GC/MS (Analysis # 0616)," Lancaster Laboratories April 3, 2001, (Bates No. EID150114-EID1501126).

<sup>169</sup> Sigma-Aldrich, 99% or equivalent.

<sup>170</sup> FC-143 in Water/Wastewater by GC/MS Quad/MDL Studies (Bates No. EID149381-EID149396).

<sup>171</sup> FC-143 Comparison Results from historic SOP and proposed SOP 1Q01, May 17, 2001, (Bates No. EDD0074006).



yielded concentrations 2.6 to 5.6 times higher than the traditional GC/ECD method, Table 23. The recoveries for the C-9 surrogate by the proposed low-level method, Table 24, are much higher than the traditional method. The surrogate C-9, having comparable properties to APFO, would be expected to behave in a similar manner to APFO in the analysis. Thus, the low recoveries of C-9 when using the traditional CH2M Hill method indicates that the APFO results are biased low. This can also be seen in the low matrix spike recoveries for FC-143 in the LCS, MS, and MSD of 9, 15, and 23% respectively by the CH2M Hill method.<sup>172</sup> There was not enough sample to run MS/MSD for the proposed method so a LCS and LCSD were run on a blank spiked with FC-143.

DuPont decided to continue use the CH2M Hill 10/91 method even though there is a significant difference in the results compared to the GC/MS method proposed by Lancaster Laboratories as shown in Table 23.

Table 23. Comparison of the Traditional GC/ECD Low-Level Method to the Proposed Low Level GC/MS Method.

| Sample            | Sample Date | Traditional GC/ECD ug/L | Proposed Low Level GC/MS ug/L |
|-------------------|-------------|-------------------------|-------------------------------|
| Gallery           | 4/11/2001   | 3.99                    | 18.3                          |
| Ranney            | 4/11/2001   | 5.48                    | 30.9                          |
| West Wellfield #1 | 4/11/2001   | 1.58                    | 4.15                          |

Table 24. Surrogate Recoveries for the Traditional GC/ECD Method to the Proposed Low-Level GC/MS Method.

| Sample            | Traditional GC/ECD % C-9 Recovery | Proposed Low Level GC/MS % C-9 Recovery |
|-------------------|-----------------------------------|-----------------------------------------|
| Gallery           | 18                                | 97                                      |
| Ranney            | 16                                | 101                                     |
| West Wellfield #1 | 18                                | 80                                      |
| Blank             | 12                                | 110                                     |
| LCS               | 9                                 | 96                                      |
| LCSD              | NA                                | 91                                      |
| MS                | 16                                | NA                                      |
| MSD               | 19                                | NA                                      |
| QC Limits         | 1-50                              | 70-130                                  |

NA = sample not included

<sup>172</sup> Letter from R L Ritchey to WV-DEP re: Quarterly Sampling Results sampled on 4/11/01, May 25, 2001. (Bates No. EID185166-EID185171).



## 2) High-Level Method

The high-level method was based on a paper by M. N. Sarrión, F. J. Santos, and M. T. Galceran, titled "In Situ Derivatization/Solid-Phase Microextraction for the Determination of Haloacetic Acids in Water."<sup>173</sup> The high-level method "FC-143 in Water/Wastewater by SPME/GCMS (Analysis # 0615)," Revision 1, was issued April 9, 2001.<sup>174</sup> Five milliliters of sample were placed into a vial and acidified with hydrochloric acid. The surrogate, C-9, was added. Bromofluorobenzene (BFB) used as an internal standard but was also added at this time. Tetrabutylammonium hydrogen sulfate was added as an ion pairing reagent. Diethyl sulfate, ethanol, and sulfuric acid were then added. The solution was stirred for 30 minutes to derivatize the FC-143. After derivatization, the SPME fiber was inserted into the vial for ten minutes. The fiber was then inserted into the GC/MS and analyzed. The calibrated range was 1-25 parts per million (ppm) made from APFO prepared through the extraction/ethylation procedure. The reported MDL (from seven spikes) was 0.44 ppm when spiked at 1.0 ppm.<sup>175</sup> The LOQ in the Scope of the method was 1.0 ppm. Based on the data from accuracy and precision studies (quad studies) submitted by Lancaster Laboratories,<sup>176,177</sup> the average recovery of spiked FC-143 was reported to be 98% for the high-level method with a standard deviation of 1.0344 ppm. However, this was based on a spike concentration of 12.5 ppm - over twelve times higher than the reported method detection limit.

The FC-143 results by the high-level method for two water samples, 23.2 and 15.8 ppm were slightly less than twice the concentration found when compared to the conventional GC/ECD method, 12.6 and 9.2 ppm respectively.<sup>178</sup>

According to Lancaster, the FC-143 used for the GC/ECD analysis was a technical grade supplied by DuPont that contained other components (APFO isomers).<sup>179</sup> Lancaster was also using an ethylated FC-143 standard (ethyl perfluorooctanoate) for some development work (FC-143 in Water and Wastewater by GC/MS (proposed low-level GC/MS Analysis # 0616)) which was purchased from Sigma-Aldrich. Lancaster compared the results run by the proposed low-level GC/MS method of a 1 ug/L standard of FC-143 prepared from FC-143 obtained from Fluka and from DuPont against the calibration curve made from ethylated Sigma-Aldrich standard. The average result obtained for the Fluka 1 ppm standard was 0.80 ug/L and for the DuPont FC-143

<sup>173</sup> M. N. Sarrión, F. J. Santos, and M. T. Galceran, In Situ Derivatization/Solid-Phase Microextraction for the Determination of Haloacetic Acids in Water, *Analytical Chemistry*, 72 (20), pages 4865-4873, 2000. (Bates No. EID150145-EID150173).

<sup>174</sup> Lancaster Labs, FC-143 in Water/Wastewater by SPME/GCMS, (Analysis #0615)" Rev 1, April 9, 2001 (Bates No. EID150131-EID150147).

<sup>175</sup> FC-143 in Water/Wastewater by GC/MS Quad/MDL Studies (Bates No. EID149381-EID149396).

<sup>176</sup> FC-143 in Water/Wastewater by GC/MS Quad/MDL Studies (Bates No. EID149381-EID149396).

<sup>177</sup> Email from Michael D Aucoin to Harry L Gearhart re: FC-143 exec summary, April 25, 2001, (Bates No. EID150414-EID150415) and Lancaster Labs, FC-143 Method & Evaluation: Executive Summary, May 23, 2001, (Bates No. EID149336).

<sup>178</sup> FC-143 in Water/Wastewater by GC/MS Quad/MDL Studies (Bates No. EID149381-EID149396).

<sup>179</sup> Email from J S Kauffman (Lancaster) to Michael D Aucoin re FC-143 Standards. February 15, 2001 (Bates No. EID150286).



0.72 ug/L.<sup>180</sup> Lancaster states the low bias in the Fluka and DuPont supplied FC-143 is due to "inherent losses during the ethylation and extraction process for the FC-143."<sup>181,182</sup>

DuPont continued sending drinking water samples to Lancaster Laboratories until October 2001 even though DuPont was aware that the CH2M Hill method that Lancaster was using had poor surrogate and FC-143 spike recoveries as reported in Lancaster's data reports. Michael D. Aucoin, a DuPont employee even talks about the problems with the recoveries in an October 3, 2000 DuPont email.<sup>183</sup> Low surrogate and FC-143 spike recoveries indicate that the drinking water results reported by Lancaster are all biased low.

#### **K. October 2001: Exygen Research, State College, Pennsylvania**

Exygen Research, Inc., (Exygen) located in State College, Pennsylvania, developed a new method for the analysis of FC-143 utilizing liquid chromatography/tandem mass spectrometry (LC/MS/MS) in the negative ion mode. Exygen first used this method on the LPSD well samples collected October 11, 2001.<sup>184</sup> The method was published on January 11, 2002.<sup>185,186</sup> Samples were collected in plastic containers. Any residual chlorine was removed with sodium thiosulfate. A 40 mL aliquot of the sample was exposed to a C18 solid phase extraction (SPE) cartridge. The SPE cartridge was then eluted with 40% methanol in water, and the eluant was discarded. The cartridge was then eluted with 100% methanol. A five milliliter portion of the eluant was collected for analysis by LC/MS/MS monitoring the 413 (parent) to 369 (daughter) transition. The limit of quantitation (LOQ) for this method was reported to be 0.050 ug/L. No internal standards or surrogates were used in the analysis.

Calibration of the LC/MS/MS system was performed by analyzing concentrations at 0, 0.025, 0.050, 0.10, 0.25, 0.5, and 1.0 ug/L. Calibration standards were spikes of PFOA (Fluorochem USA) in water and carried through the entire analytical process. The concentration of the PFOA in the standard was corrected for the purity of the standard. Linear regression was used with 1/X weighting; the zero concentration was not included in the calculation. Calibration was considered acceptable if the correlation coefficient (R) was  $\geq 0.992$  ( $R^2 \geq 0.985$ ). The reported limit of quantitation was 0.050 ug/L. Percent recoveries at 0.1 and 0.5 ug/L ranged from

<sup>180</sup> FC-143 in Water/Wastewater by GC/MS Quad/MDL Studies (Bates No. EID149381-EID149396).

<sup>181</sup> FC-143 Method & Evaluation: Executive Summary, Lancaster Laboratories, May 23, 2001 (Bates No. EID149336-EID149354).

<sup>182</sup> Using the ethylated Sigma-Aldrich standard in DuPont's Low-Level GC/MS method without converting the concentration to the ammonia salt (1 ppm ethyl perfluorooctanoate = 0.98 ppm APFO) will result in slightly higher numerical value (about 2% higher).

<sup>183</sup> Email from Michael D Aucoin to Roger J Zipfel re Laboratory Proposal FC-143, October 3, 2000. (Bates No. EID545530)

<sup>184</sup> Analytical Report for 10/11/01 samples, Exygen Research, Inc., November 15, 2001. (Bates No. EID185019-EID185152).

<sup>185</sup> "Method of Analysis for the Determination of Ammonium Perfluorooctanoate (APFO) in Water," Exygen Research, January 11, 2002, (Bates No. EID546037-EID546063).

<sup>186</sup> -

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(Bates No. EID525770-EID525801 and EID525935-EID525971).



104-112% in tap water, well water, stream water, and drinking water.

A calibration check standard (second source) at 0.25 ug/L was to be analyzed with each set of samples. The response from the check standard must fall with  $\pm 15\%$  of the average response of the 0.25 ug/L calibration standards to be considered acceptable. In addition, injections of the entire set of calibration standards were to be interspersed with the samples in a set so that a second complete set of calibration standards was analyzed with each set of samples.

Laboratory control samples (LCS) consisting of Milli-Q water spiked with PFOA at 0.050 and 0.50 ug/L were to be included with each set of samples. The PFOA must be from a different source than the PFOA used for the calibration standards. Recoveries must fall between 70 and 130% to be considered acceptable.

Under the conditions used in the method, one peak was reported for PFOA. The 413 parent ion is due to the perfluorooctanoic acid anion while the 369 ion is due to the loss of carbon dioxide from this anion. Since the instrument is set up to monitor the 369 daughter ion from the parent 413 ion, any molecule producing a 413 ion and fragmenting further to yield a 369 ion would be detected using this analytical method. Any branched isomers of C-8 should be observed using this method if the isomers produce a 369 ion from a 413 parent ion. However, no studies were included in any of the documents reviewed to determine the fragmentation pattern of C-8 isomers. The single peak observed in the chromatograms of field samples indicate either that no isomers are present in the samples or that all isomers elute at the same time as the straight-chain C-8. Since the analytical setup was designed to monitor just the 369 ion resulting from a parent 413 ion, any shorter or longer chain perfluoroalkyl compounds (other telomerization products) in the sample would not be detected.

The concentration of PFOA was calculated from the calibration curve (linear regression parameters). The concentration of APFO was determined by multiplying the PFOA result by 431/414. Samples with responses less than the minimum detection limit (MDL) were to be reported as "ND." Samples with responses less than the LOQ and equal to or greater than the MDL were to be reported as "NQ" (not quantifiable).

The LPSD samples were collected in plastic containers on October 11, 2001, and analyzed by Exygen using this method. Exygen reported duplicate results as APFO, Table 25. The relative percent difference (RPD) between the replicate samples were less than ten percent. The reported LOQ was 0.05 ug/L and the MDL was (approximately) 0.0075 ug/L. The field blank was reported as ND.

Matrix spikes were run on each of the samples (0.5 ug/L PFOA spike added) and percentage recoveries reported, Table 25. Acceptable QC criteria for the MS recoveries reported by Exygen was 70-130%.



Table 25. Exygen Results for October 11, 2001 samples

| Sample        | APFO<br>(ug/L) | Duplicate<br>APFO<br>(ug/L) | MS<br>(% Rec.) |
|---------------|----------------|-----------------------------|----------------|
| LPSD Well A   | 0.703          | 0.684                       | 86.0           |
| LPSD Well B   | 0.581          | 0.568                       | 84.2           |
| LPSD Well F   | 0.288          | 0.264                       | 87.6           |
| LPSD Bld Main | 0.621          | 0.605                       | 96.6           |
| QC Limits     |                |                             | 70-130         |

The chromatograms included with the Exygen report monitor the 369 daughter ion and generally display a single, symmetrical peak just after five minutes. Background noise was observable in the blanks and methanol washes. The chromatogram for the 0.05 ug/L standard provided a strong signal at an amplitude an order of magnitude above that used for the blanks and washes. Any noise in the 0.05 ug/L standard chromatogram was lost in the baseline.

In subsequent laboratory reports, Exygen reported the results below the limit of detection (LOD) as "ND."<sup>187</sup> Results between the LOD and the limit of quantitation (LOQ) were reported as not quantifiable "NQ." Results above the LOQ are reported as APFO with a numerical value in units of ug/L. Exygen's APFO results from the LPSD and Little Hocking Water Association production wells are shown in Tables 26 and 27.<sup>188</sup> The reported LOD and LOQ for the March 28, 2002 LPSD samples were 0.010 and 0.050 ug/L respectively.<sup>189</sup> Exygen's report for the March 28, 2002 samples states that all samples were analyzed in duplicate. Exygen reported the average of the duplicate results if both results were greater than five times the LOQ and the RPD was less than 20%. If the RPD was greater than 20%, the higher value was reported.<sup>190</sup> If both results were less than the five times the LOQ (and above the LOQ), the average was reported if the difference between the two results was less than 50 ug/L. Otherwise the higher value was reported.

<sup>187</sup> The MDL is comparable to the LOD. DuPont Corporate Remediation Group, Data Assessment DuPont Washington Works (OPPT-2004-0113 PFOA Site-Related Environmental Assessment Program), October 2, 2008. (Bates No. ROWE039818-ROWE039969B).

<sup>188</sup> Letter from Andrew S Hartten to WV-DEP re: Public Water Supply Results, West Virginia, and Ohio, July 31, 2002. (Bates No. OEPA2766-OEPA2770).

<sup>189</sup> Letter from Andrew S Hartten to WV-DEP re: Lubeck, Belpre, and Tupper's Public Service District Sampling Results sampled in March 2002, April 16, 2002 (Bates No. EID598321-EID598343). The reported MDL was approximately 0.01 ug/L.

<sup>190</sup> Ibid.



Table 26. Exygen's Results for LPSD Production Wells

| Sample               | 1/3/02<br>APFO<br>(ug/L) | 2/21/02<br>APFO<br>(ug/L) | 3/28/02<br>APFO<br>(ug/L) | 4/26/02<br>APFO<br>(ug/L) |
|----------------------|--------------------------|---------------------------|---------------------------|---------------------------|
| LPSD Well A          | 0.764                    | 0.683                     | 0.796                     | 0.938                     |
| LPSD Well B          | NA                       | 0.61                      | 0.551                     | 0.532                     |
| LPSD Well C          | 0.592                    | 0.479                     | 0.491                     | 0.471                     |
| LPSD Well D          | 0.758                    | 0.725                     | 0.692                     | 0.406                     |
| LPSD Well E          | 0.332                    | 1                         | 1.09                      | 1.11                      |
| LPSD Well F          | 1.04                     | 0.313                     | 0.358 & 0.352             | 0.332                     |
| LPSD After Treatment | NA                       | NA                        | 0.69                      | 0.652                     |

NA = not available

Table 27. Exygen's Results for Little Hocking Production Wells

| Sample           | 12/20/01<br>APFO<br>(ug/L) | 1/21/02<br>APFO<br>(ug/L) | 2/22/02<br>APFO<br>(ug/L) | 3/26/02<br>APFO<br>(ug/L) | 4/23/02<br>APFO<br>(ug/L) |
|------------------|----------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| Little Hocking 1 | 1.82                       | 1.72                      | 2.37                      | 2.99                      | 2.02                      |
| Little Hocking 2 | 3.72 & 3.52                | 2.97                      | 2.03 & 2.07               | 3.31                      | 3.4                       |
| Little Hocking 3 | 0.844                      | 0.744                     | 0.42                      | 0.827                     | 0.783                     |
| Little Hocking 5 | 7.66                       | 6.22                      | 6.14                      | 5.69                      | 6.57                      |

The LC/MS/MS method used by Exygen depends on the electrospray ionization of PFOA to be consistent between the standards and the samples. In the Exygen method the straight-chain PFOA and the branched-chain isomers elute as one peak. According to Jonathan W. Martin et al. in a 2004 paper co-authored by Mary Kaiser of DuPont, "Isomers respond to electrospray ionization (ESI) differently, and thus the relative areas in the chromatogram do not necessarily reflect the relative amounts in the standard."<sup>191</sup> Thus, the isomers content in the standards should match isomer ratio of the samples. Martin et al. also state that "coeluting matrix components can either suppress or enhance ionization, which must be controlled to achieve maximum accuracy." Procedures to control the matrix effects can include matching the standard matrix to the samples, the method of standard additions, and isotope dilution. Martin et al. write: "Standard addition quantitation, which involves spiking successive known quantities of a standard into the sample and reanalyzing, is common in atomic absorption spectroscopy and an acceptable technique to use when matrix effects are unavoidable." However, Martin et al. also state, "Isotopically labeled perfluoroalkyl internal standards (isotope dilution) are probably the most appropriate approach for negating ionization effects because they will have the same retention times as their natural analogues (excluding any isomeric separation)." Exygen did not use any of these procedures for the water samples collected from the community drinking water systems. Therefore, it raises questions about the accuracy of Exygen's water analysis for PFOA.

<sup>191</sup> Jonathan W. Martin et al., Analytical Challenges Hamper Perfluoroalkyl Research, *Environmental Science and Technology*, 2004, 38 (13), pp. 248A-255A.



In a 2007 paper published by Barbara S. Larsen and Mary A. Kaiser, DuPont's Corporate Center for Analytical Science, they wrote:<sup>192</sup>

*Because perfluorinated compounds are so different from their hydrocarbon analogs, additional care must be taken to ensure that a valid method is demonstrated. Adequate methods include "the usual" good precision and accuracy as well as spike recovery, linearity, internal standards, surrogates, and a variety of blanks" for the analysis of PFOA.*

Larsen and Kaiser also wrote:

*One major consideration is the effect of coeluting peaks on the analyte signal. Coeluting peaks can affect the ionization efficiency of the PFC [perfluorocarboxylate] either positively or negatively, giving either an apparently higher or lower concentration result, depending on the nature and concentration of the coeluant. An isotopically enriched internal standard added before the LC analysis will have the same retention time as the analyte, so the signal of the isotopically enriched standard can be monitored to determine whether the analyte signal is suppressed or enhanced (33). If a second isotopically enriched standard is available, it can be added early in the sampling or sample preparation process as a surrogate to elucidate any problems caused by these procedures.*

Larsen and Kaiser also state, "If available, the best surrogate is an isotopically enriched version of the analyte." DuPont chose Exygen in October 2001 to perform the LC/MS/MS analysis on drinking water from the community instead of Lancaster Laboratories even though Exygen did not use internal standards or surrogates to monitor if the method was performing properly.

Exygen was one of the laboratories involved in the analysis of human blood for PFOA in 2005 and 2006 as part of The C-8 Health Project.<sup>193</sup> As part of the quality-assurance measures for the medical monitoring of the participants in the study, a second laboratory Axys of Vancouver, Canada analyzed split samples of blood (that of participants and spiked rabbit serum standards). The results for the split samples analyzed by Axys were consistently lower than the results from Exygen. In fact, Axys analyzed samples obtained from participants up to December 7, 2005 were 30% lower than the split samples from Exygen. This trend did not continue after December 8, 2005. In order to determine if the difference was real, selected splits were retested by both laboratories after December 7, 2005. After December 2005 Exygen's retest results were lower than Exygen's original results and Exygen's retest results were closer to the Axys' results (i.e., 25 % different before December and -2% after December). There was no information if this laboratory discrepancy was investigated. Something apparently changed at Exygen to cause the abrupt change in the results. This change most likely has to do with calibration and the standards used for calibration. It is not known if this anomaly in the blood data also affected the results for

<sup>192</sup> Barbara S. Larsen and Mary A. Kaiser, Challenges in Perfluorocarboxylic Acid Measurements, *Analytical Chemistry*, 2007, 79 (11), pp. 3966-3973.

<sup>193</sup> Kevin M. Leyden and Alan Ducatman, West Virginia University, "Chronicle of the C8 Health Project".



the above water samples. Therefore, it raises questions about the accuracy of Exygen's water results.

Exygen's method is not the first LC/MS/MS method for PFOA. **REDACTED**

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The US EPA published a LC/MS/MS method for PFOA in drinking water, Method 537, in September 2009.<sup>195</sup> In contrast to the Exygen method, the US EPA method used isotopically labeled compounds for internal standards and surrogates including perfluoro-[1,2-<sup>13</sup>C<sub>2</sub>]octanoic acid. The US EPA Method uses a range between 70-130% as the QC criteria for recovery of PFOA spikes in laboratory fortified blanks, MS/MSD, and for surrogate recoveries.

#### **L. Summary of Methods Used by DuPont and Its Contract Laboratories for Drinking Water Analysis**

In 1984 DuPont was aware that APFO was present in the drinking water system served by the LPSD and in Little Hocking Water Association by virtue of its own sampling and analysis. These samples were analyzed by GC/ECD by DuPont's own laboratory at the Experimental Station, Wilmington, Delaware. Although DuPont questions the analytical accuracy of their results prior to January 1991, the detection of this substance in the community drinking water occurred on more than one occasion between 1984 and 1991. These results are probably biased low because DuPont only measured the main straight-chain isomer. However, because of the lack of quality assurance/quality control with the Experimental Station results such as surrogates and matrix spiking, the accuracy and precision of this data are not known. From September 1991 through November 1998 DuPont used CH2M Hill to analyze the drinking water samples by GC/ECD. CH2M Hill's method included internal standards, surrogates, and matrix spikes. CH2M Hill only measured the main straight-chain isomer of PFOA. DuPont intentionally chose CH2M Hill to analyze the drinking water samples for a period of seven years even though DuPont knew that CH2M Hill's results were significantly lower than the Experimental Station's results for split samples and "CH2M Hill experienced poor surrogate recovery."<sup>196</sup> DuPont was aware that CH2M Hill's "numbers may be low on the absolute basis."<sup>197</sup> DuPont did not voluntarily stop using CH2M Hill for C-8 water analysis but only switched laboratories after CH2M Hill's laboratory went out of business in the Fall of 1998.

194

**REDACTED**

(Bates No.

EID213799-EID212872).

<sup>195</sup> EPA/600/R-08/092 Method 537, Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS), in September 2009.

<sup>196</sup> Memorandum from Terry Vandell to Walt Stewart, Meeting Minutes of the On-Site Washington Works Meeting (September 11, 1991, 9:00 AM-11:00 AM) Regarding the September 4, 1991 Proposed C-8 Sampling Program, September 19, 1991. (Bates No. EID909790-EID909809).

<sup>197</sup> Ibid.



At DuPont's direction, Lancaster Laboratories used the CH2M Hill method with some minor changes to analyze drinking water samples submitted by DuPont from February 1999 through October 2001. Lancaster experienced poor surrogate recoveries and poor recoveries of FC-143 spiked into samples and blanks. DuPont was aware of the poor recoveries<sup>198</sup> and continued having Lancaster analyze the samples using the CH2M Hill method even though DuPont knew the results were biased low. Lancaster proposed an improved method using GC/MS with good surrogate recoveries and good FC-143 spike recoveries. Preliminary results from Lancaster's proposed method yielded higher results than the traditional CH2M Hill method but DuPont never authorized use of this improved method on any of the drinking water samples from LPSD or Little Hocking. Instead DuPont intentionally chose Exygen's LC/MS/MS method that DuPont knew did not include surrogates to monitor if the method was performing properly.

A summary of PFOA methods used by DuPont and its contract laboratories between 1984 to 2004 is shown in Table 28.

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<sup>198</sup> Email from Michael D. Aucoin to Roger J. Zipfel re Laboratory Proposal FC-143, October 3, 2000. (Bates No. EID545530)



Table 28. Summary of PFOA Methods Used by DuPont and It's Contract Laboratories for PFOA in Drinking Water 1984 to 2004

| Dates Used                      | Laboratory                | Method   | Sample Preparation                                                     | Sample Size (mL) | Internal Standard                                                  | Surrogate         | Comments                                                                                   |
|---------------------------------|---------------------------|----------|------------------------------------------------------------------------|------------------|--------------------------------------------------------------------|-------------------|--------------------------------------------------------------------------------------------|
| 1984 to 1991                    | DuPont Experiment Station | GC/ECD   | Freeze dry, derivatize with methanoic HCl                              | 10               | C-10                                                               | None              | Reported as F and multiplied by 1.5 to obtain perfluorooctanoate. Reported main PFOA peak. |
| September 1991 to November 1998 | CH2M Hill                 | GC/ECD   | Extraction with organic solvent, cleanup, derivatize with ethanoic HCl | 1000             | C-7<br>1,2-Dichlorobenzene<br>1,2,4-Trichlorobenzene               | C-9, C-10, & C-11 | Low surrogate & MS/MSD recoveries. Reported main PFOA peak                                 |
| February 1999 to ~October 2001  | Lancaster Laboratories    | GC/ECD   | Extraction with organic solvent, cleanup, derivatize with ethanoic HCl | 1000             | C-7 (ethyl ester)<br>1,2-Dichlorobenzene<br>1,2,4-Trichlorobenzene | C-9, C-11, & C-12 | Low surrogate, LCS, MS/MSD recoveries. Added main APFO peak and 3 isomers.                 |
| October 2001 to 2004+           | Exygen Research, Inc.     | LC/MS/MS | C18 SPE cartridge                                                      | 40               | None                                                               | None              | One Peak. Calculated result as APFO. Replicates and MS. No surrogates                      |



## VII. OVERVIEW

In the early 1980s DuPont was measuring the concentration of PFOA in blood from its Washington Works plant in West Virginia employees and their newborn children.<sup>199</sup> This type of sampling and analysis is not undertaken unless it is extremely important and very serious. The concern about these results require the best sampling and analysis planning to obtain reliable PFOA measurements for all of the various media that define the PFOA exposure to humans and the environment. This includes the PFOA sources, transport, and fate.

At this same time, DuPont was steadily increasing the amount of APFO used at the Washington Works plant in the production of its fluoropolymers. With the increase in APFO usage, DuPont knew that APFO releases into the environment surrounding the plant were also increasing. This includes APFO releases into the atmosphere, releases to the Ohio River, and disposal in landfills.

Experimental data come from a measurement process. The data obtained consist of numbers that are used to provide a basis for a decision. Experimental factors influence the results. Variability is inevitable in a measurement process. A good measurement process results from an effort to control the sources of variability. By effort, the process can be improved and, conversely, lack of attention can lead to inaccurate and imprecise results. Reliable data production requires planning. The first step is to define the problem to be investigated by the measurement. A sampling and analysis plan needs to be adopted. The samples and the analytical method must accomplish what is required of the measurement process. Data quality objectives are an integral portion of the planning process. The quality of the results depend on the analytical method, sampling process, and the quality assurance adopted from the data quality objectives. In the case of PFOA in blood, the seriousness of the investigation requires the most stringent data quality objectives possible.

Excluding blatant mistakes in the production of measurement data, there are two sources of error: random error and systematic error. Random error is the uncertainty or variability in the process of making a measurement. If there are enough samples analyzed this random error statistic will average out to zero. The error in any given measurement can be of a different magnitude and sign (plus or minus) from the true value. Systematic error always has the same sign (always plus or always minus) and the magnitude. This error is persistent for a given methodology. When a systematic error is suspected or indicated, then there must be an effort made to eliminate the error. This is the fundamental precept in analytical chemistry and especially true if there are serious consequences for the decision process using the data generated by the measurement.

From the mid-1980s, the USEPA was formulating their data quality objectives.<sup>200</sup> The analytical chemistry both qualitative and quantitative would be governed by the criteria placed on the data use or level of concern. EPA suggests that the end use of the quality of the data developed by the measurement should be indicated by the following five parameters:

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<sup>199</sup> EID079375.

<sup>200</sup> November 5, 1985, USEPA Draft Data Quality Objectives for RI/FS Process.



- precision
- accuracy
- representativeness
- completeness
- comparability

The acronym for these parameters is PARCC. They come from the general knowledge basic to analytical chemistry.

**a) Precision**

Precision is the quantitative evaluation of the reproducibility of a measurement. There is analytical precision measured by running a sample by the method two or more times. There is sampling and analytical precision by obtaining two or more samples from the same location at the same time and running the analytical method on these samples. Analytical precision plus sampling precision equals the precision of the entire variability of the measurement. Thus, it is not how close you come to the bullseye, but how well you group your shots.

**b) Accuracy**

Accuracy is the quantitative assessment of how close the result is to the true or actual value. Since the true value is not known, the accuracy is judged by the lack of interferences and the ability to calibrate the analytical methodology with the target analyte. There are numerous quality control (QC) samples and techniques used to measure a bias in the analytical result. Two techniques are used to reduce the bias in an analytical methodology's results: isotope dilution<sup>201</sup> and method of standard additions.<sup>202</sup> Thus, accuracy is the measurement of how close your shot or shots come to the bullseye.

**c) Representativeness**

Representativeness is the measure of how close the analytical result comes to the actual result for the sample media. In other words, a good or useable measurement can not come from a bad sample. Gain or loss of the analyte during the sampling, transport, and storage of the sample will affect the analytical accuracy and/or precision, thus the answer will not represent the sampled media for the analyte of interest.

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<sup>201</sup> See USEPA SW-846, Method 8290, Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS), September 1994.

<sup>202</sup> See USEPA SW-846, Chapter One Quality Control, July 1991.



**d) Completeness**

Completeness is defined as the goal in obtaining the critical valid data for the intended use of the measurement. If the data are not accurate and/or precise enough for the intended use, then the sample must be re-sampled and/or reanalyzed to obtain a valid result.

**e) Comparability**

Comparability is the confidence the user has in the comparability of one result to another. This can be results obtained by a single analytical method, a single analytical method by another chemist and/or laboratory, or by two different methods. The best result would be a measurement with accuracy and precision, which is the same for different analytical methods, chemists, and laboratories.

Using PARCC as a guide and the importance of the analytical methodology to achieve the accurate concentration of PFOA in drinking water, there are several facts that need to be addressed.

**The Chronology of DuPont's C-8 Water Analysis**

**1982 - 1991**

The S. S. Stafford method was used by the DuPont Experimental Station for the qualitative and quantitative analysis of PFOA in water. The PFOA was concentrated as a salt by freeze drying and derivatized to a methyl ester prior to capillary column gas chromatography analysis utilizing an electron capture detector. (GC/ECD). The PFOA was quantified using an internal standard.

Systematic errors that either did occur or might have occurred are:

- Accounting for the isomers of perfluorooctanoate.
- Accounting for the reporting difference between PFOA and APFO.
- Purity of the PFOA in the calibration.
- Purity of the internal standard perfluorodecanoate.
- Percent methylation of PFOA and PFDA (internal standard).

Drinking water samples analyzed for PFOA in 1984 had a detection of 0.6 ug/L (ppb) for a 10 mL sample size. Quality control measurements were not given with this methodology. Even though the reported results for PFOA in drinking water was greater than 1 ppb, there was no



sampling and analysis planned or initiated at the Washington Works to develop reliable data for PFOA in drinking water starting with sampling and analysis to obtain accuracy, precision, and representativeness of the results. After a decade of PFOA measurements in water by DuPont, and after the establishment of an 1 ppb drinking water standard, DuPont attempted to discredit its own, earlier results by stating: "All results less than or equal to 10 ppb prior to 1991 are suspect because of analytical technique accuracy."<sup>203</sup> Yet, there was no effort to determine the error in the PFOA measurements in water, if there indeed was one.

The analytical method accuracy could have been easily fortified with available changes in the methodology well known to DuPont's analytical chemists. These are:

- Isotope dilution methodology using either  $^{14}\text{C}$  or  $^{13}\text{C}$  PFOA.
- The method of standard additions (MSA).
- Determining the appropriate adjustments in order to report the concentrations of linear PFOA and the branched isomers of PFOA.

### Isotope Dilution Methods

The stable isotope carbon-13 can be used to "tag" PFOA with carbon-13 atoms that will change the molecular weight from 414 daltons to 422 daltons.<sup>204</sup> This isotopically labeled linear PFOA thus serves as a tracer for the linear PFOA in the analytical method. Any concentration changes in the analytical protocol will affect both the regular PFOA and the isotopically labeled PFOA alike because their chemistry is identical. The isotopically labeled PFOA is the internal standard for PFOA in the sample. Therefore, if the concentration of both types of PFOA are similar, then adsorption to glass or plastic, losses due to sample manipulation, etc. are automatically adjusted since the changes occur to both the isotopically labeled linear PFPA and the linear sample PFOA.

This analytical methodology has been used for 2,3,7,8-tetrachlorodibenzo-p-dioxin at parts per billion levels since the mid-1980s<sup>205</sup> by the US EPA. Also a general method using isotope dilution GC/MS was published by the US EPA in the Federal Register in 1984 as a method to quantitatively analyze semi-volatile organic compounds in water. This was called Method 1625 and had target analytes that were the same as in Method 8270 of SW-846. As these methods were all publically available, DuPont had access to this information.

The main advantage of the isotopic dilution methodology is its ability to give accurate measurements at very low concentrations in difficult matrices. The method works equally well for the tandem mass spectrometry methodologies such as GC/MS/MS<sup>206</sup> or LC/MS/MS. This

<sup>203</sup> C-8 Sample Summary: 11/90 to Present (Updated 9/13/91) . (Bates No. EID109509-EID109511).

<sup>204</sup> Perfluoro-n- $^{13}\text{C}_8$ octanoic acid. This compound was introduced in 2008 by Wellington Laboratories LLC. Other  $^{13}\text{C}$  labeled compounds such as perfluoro-n-[1,2,3,4- $^{13}\text{C}_4$ ]octanoic acid was available in 2005. Personal communication.

<sup>205</sup> December 14, 1984.

<sup>206</sup> J. S. Smith, D. Ben-Hur, R. Pavlick, M. Urban, J. LaFornara, R. D. Kleopfer, K. T. Yue, C. J. Kirchmer, W. A.



analytical methodology addresses systematic errors and improves the accuracy and precision of the results. The isotope dilution method was proposed for PFOA analysis of drinking water by Dr. Larsen of DuPont in 2007 in a feature article in the *Journal of Analytical Chemistry*.<sup>207</sup>

Isotopically labeled PFOA was first used by DuPont in the early 1980s in a report published in 1982 titled "Placental Transfer of <sup>14</sup>C-labelled C-8 in the Rat, Haskell Laboratory Report' No. 61-82."<sup>208</sup> Thus, DuPont could have developed an isotope dilution method with carbon-14 in the early 1980's when the Experimental Station started to analyze PFOA in water. While carbon-14 is the radioactive isotope of carbon and carbon-13 is the stable isotope of carbon, the synthesis of the labeled PFOA would be the same. Thus, DuPont could have developed an isotope dilution method using isotopically labeled PFOA in the early 1980's but chose not to.

### Method of Standard Additions

The method of standard additions is very useful for quantitative analysis of low concentrations of an analyte. A calibration curve is generated using varying amounts of the analyte placed into the sample using the sample itself as a blank for the calibration curve. The detector response should be linear with a slope similar to a calibration curve without the sample but with a pure matrix substance. The sample concentration can be determined from the graphical representation of the calibration curve generated with the sample matrix.<sup>209</sup> According to an article on the analysis of PFOA published in 2004 in the *Journal of Environmental Science and Technology* and co-authored by Mary Kaiser of DuPont, the method of standard additions is an "acceptable technique to use when matrix effects are unavoidable."<sup>210</sup>

### Isomer Content of PFOA

The isomer content of the 3M PFOA is mostly the straight chain isomer with several branched chain compounds. The telomer manufactured by DuPont is the straight chain isomer of PFOA. The difficulty in the comparability of analytical methods is the nature of the calibration standard and whether the analytical methodology can and does differentiate between the isomers in the FC-143 produced by 3M. The analytical methodology will be affected by the calibration standard and the moiety reaching the detector.

- Are all of the isomers equally detected by the mass spectrometer or electron capture detector?
- Are all the isomers derivatized by the techniques used in the method?

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Smith and S. Viswanathan, "Comparison of a New Rapid Extraction GC/MS/MS and the Contract Laboratory Program GC/MS/MS Methodologies for the Analysis of 2,3,7,8-Tetrachlorodibenzo-p-dioxin," 189th National Meeting of the American Chemical Society, Miami Beach, Florida, April 28-May 3, 1985.

<sup>207</sup> Barbara S. Larsen and Mary A. Kaiser, Challenges in Perfluorocarboxylic Acid Measurements, *Analytical Chemistry*, 2007, 79 (11), pp. 3966-3973.

<sup>208</sup> Affidavit of David Gray, Ph.D., December 13, 2004 [Bates No. USEPA19401-USEPA19423]).

<sup>209</sup> Presentation on mercury analysis at the parts per trillion level by MSA and US EPA SW-846.

<sup>210</sup> Jonathan W. Martin et al., Analytical Challenges Hamper Perfluoroalkyl Research, *Environmental Science and Technology*, 2004, 38 (13), pp. 248A-255A.



- Some GC chromatograms separate some of the isomers whereas others do not. How does this affect the resulting PFOA concentration?

### **Concentration Adjustment Factors**

There have been several calculated C-8 concentrations from the analytical results.

- C-8 from a GC/ECD method calculated as fluoride and then recalculated as perfluorooctanoate by multiplying the fluoride results by 1.5.
- The PFOA isomers that were observed in some of the GC/ECD analysis were sometimes included in the quantitation and sometimes only the straight chain isomer of PFOA was included.
- Multiplying C-8 results by a factor of 1.4 to account for the isomers of C-8 that were not reported with the main C-8 peak.
- Inconsistency in the form of the compound that was reported to represent C-8 and FC-143. C-8 and FC-143 were reported to represent either perfluorooctanoate, perfluorooctanoic acid (PFOA), or ammonium perfluorooctanoate (APFO).
- Corrections made for surrogate recoveries to the PFOA concentrations.
- DuPont's statement that their results were corrected for surrogate recovery.<sup>211</sup>

### **1991 - 2001**

The year 1991 brought changes to the analysis program of the DuPont Washington Works plant and the surrounding vicinity. By June 11, 1991 DuPont had formally approved a Community Exposure Guideline (CEG) for ammonium perfluorooctanoate (APFO) at 1 ug/L (ppb). Therefore, it would be advantageous to have an analytical method for APFO that has a detection limit close to 0.1 ug/L. This would provide for random error levels at or near the 1 ug/L level to be numerated.

Also in June of 1991, PFOA was found in the new LPSD well water above 1 ppb. It was not until this point in time that DuPont suddenly looked to an outside lab to start handling any of its C-8 water analysis. In September of 1991, DuPont asked a new outside laboratory, CH2M Hill of Montgomery, Alabama to analyze water samples obtained from the Ohio River and the new Lubeck Public Service District wells. The comparison of the results with samples analyzed by DuPont's Experimental Station using DuPont's C-8 method revealed a systematic error because the Experimental Station's results were approximately twice the results reported by CH2M Hill's analysis (see Table 12). This systematic error was verified by statistical methods using the

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<sup>211</sup> Memorandum, from R. J Zipfel to C-8 File re: C-8 InterLaboratory Meeting, November 18, 1991 (Bates No. EID256133-EID256162).



Student t Distribution test<sup>212</sup> for the differences between paired values from the two laboratories. If the calculated t value is greater than the confidence limit values in Student t Distribution tables then there is a high probability of a systematic error. The calculated t value<sup>213</sup> for this set of data is greater than the t value for both the 95% and 99% probability indicating that there is a strong probability of at least one systematic error, Table 29. This initial review comparison was also tested in October of 1991. Four split samples of water were sent to both laboratories with each sample having a blind duplicate. The reported answers to these four water samples are given in Table 13. The Student t test was applied to the differences between the two laboratory's results that were in the drinking water range.<sup>214</sup> The calculated t value for this set of data is greater than the t value for 95% confidence indicating that there is a strong probability of at least one systematic error, Table 30.

Table 29. Calculation of the Student t Distribution for the September 1991 Paired Result Differences between the Experimental Station and CH2M Hill.

| Sample Location               | Experimental Station C-8 (ppb) | CH2M Hill C-8 (ppb) | Difference |
|-------------------------------|--------------------------------|---------------------|------------|
| Test Well #27                 | 7.1                            | 1.2                 | 5.9        |
| Well MW-4                     | 2.7                            | 0.2                 | 2.5        |
| Ohio River -3 (near outfall)  | 19.6                           | 11                  | 8.6        |
| Ohio River -3 (duplicate)     | 16.8                           | 12                  | 4.8        |
| Ohio River -5                 | 4.2                            | 1.1                 | 3.1        |
| Ohio River -5(duplicate)      | 2.8                            | 1.1                 | 1.7        |
| Ohio River -6 (duplicate)     | 2                              | 0.6                 | 1.4        |
| Old LPSD Well - 1 (duplicate) | 4.1                            | 1.1                 | 3.0        |
| Old LPSD Well - 4             | 4.2                            | 0.9                 | 3.3        |
| Old LPSD Well - 4 (duplicate) | 2.9                            | 1.7                 | 1.2        |

Average = 3.6  
 Standard Dev = 2.3  
 Calculated t = 4.9\*

\*For 9 degrees of freedom,  $t_{0.975} = 2.26$  (95 % probability) and  $t_{0.995} = 3.25$  (99 % probability) from Student t Distribution tables.

<sup>212</sup> John A. Dean, "Analytical Chemistry Handbook," 1995, McGraw-Hill, Inc., Section 20.4.1 Student's Distribution or t Test.

<sup>213</sup>  $t = \frac{\overline{\text{Diff}}}{\text{Std Dev}} \sqrt{N}$  where  $\overline{\text{Diff}}$  = average difference, Std Div = standard deviation of the differences, and N = number of pairs of data.

<sup>214</sup> The t test was applied to the group values less than 10 ppb which were within the range of the drinking water results.



Table 30. Calculation of the Student t Distribution for the October 1991 Paired Result Differences between the Experimental Station and CH2M Hill

| Sample Location           | Experimental Station<br>C-8 (ppb) | CH2M Hill<br>C-8 (ppb) | Difference |
|---------------------------|-----------------------------------|------------------------|------------|
| Test Well #27             | 4.7                               | 2.5                    | 2.2        |
| Test Well #27 (duplicate) | 4.3                               | 3.2                    | 1.1        |
| TW-M4                     | 1.3                               | 0.7                    | 0.6        |
| TW-M4 (duplicate)         | 1.7                               | 0.6                    | 1.1        |
| TW-331                    | 1.0                               | 0.6                    | 0.4        |
| TW-331 (duplicate)        | 1.4                               | 0.6                    | 0.8        |

Average = 1.03  
Standard Dev = 0.63  
Calculated t = 4.0\*

\*For 5 degrees of freedom,  $t_{0.975} = 2.57$  (95 % probability) and  $t_{0.995} = 4.03$  (99 % probability) from Student t Distribution tables.

The CH2M Hill laboratory's method included a concentration step of solvent extraction of 1000 mL of water sample followed by making the PFOA ethyl ester and GC/ECD. CH2M Hill's MDL was 0.1 ug/L (ppb). They used surrogates in order to determine the efficiency of the analytical method to be quantitative. These surrogate compounds were perfluoroalkyl acids like PFOA and were added to the sample prior to extraction. The surrogate recoveries for the October 1991 analysis by CH2M Hill are shown in Table 14. If the PFOA results are corrected for the surrogate C-9 recoveries, the Student t test indicates there is still a systematic error (95% probability) and the systematic error in the CH2M Hill PFOA analysis gives low values, Table 31. In spite of the acknowledgement of the low results for PFOA, DuPont purposely chose to contract CH2M Hill in November of 1991 to analyze water samples going forward and did not require surrogate correction when reporting results.<sup>215</sup>

<sup>215</sup> Memo from R. J. Zipfel to C-8 File re: C-8 Interlaboratory Meeting, November 18, 1991, (Bates No. EID256133-EID256162).



Table 31. Calculation of the Student t Distribution for the October 1991 Paired Result Differences between the Experimental Station and CH2M Hill After Correcting the CH2M Hill Results for the C-9 Surrogate Recovery.

| Sample Location           | Experimental Station<br>C-8 (ppb) | CH2M Hill<br>Surrogate Rec<br>Corrected<br>C-8 (ppb) | Difference |
|---------------------------|-----------------------------------|------------------------------------------------------|------------|
| Test Well #27             | 4.7                               | 4.0                                                  | 0.7        |
| Test Well #27 (duplicate) | 4.3                               | 4.3                                                  | 0.0        |
| TW-M4                     | 1.3                               | 0.8                                                  | 0.5        |
| TW-M4 (duplicate)         | 1.7                               | 0.8                                                  | 0.9        |
| TW-331                    | 1.0                               | 0.8                                                  | 0.2        |
| TW-331 (duplicate)        | 1.4                               | 0.7                                                  | 0.7        |
| Average =                 |                                   |                                                      | 0.5        |
| Standard Dev =            |                                   |                                                      | 0.33       |
| Calculated t =            |                                   |                                                      | 3.8*       |

\*For 5 degrees of freedom,  $t_{0.975} = 2.57$  (95 % probability) and  $t_{0.995} = 4.03$  (99 % probability) from Student t Distribution tables.

If the objective is to produce reliable, useful, and accurate measurements of PFOA, then it would be imperative to eliminate systematic errors and reduce the measurement scatter at the concentration levels approaching the MDL. Yet on June 8, 1993 the CH2M Hill Laboratory sent water sample results to DuPont's Washington Works concerning the water samples that were run twice. The Student t test for significance between the first analysis and the re-analysis indicates a systematic error at the 90% confidence level. In addition, there is no explanation of the cause for the improvement in the C-9 surrogate recovery due to the smaller sample volume extraction. Both of these facts revealed to DuPont that the CH2M Hill PFOA results are lower than the actual amount in the sample. Thus, there is a negative bias.

DuPont's Verification Investigation Washington Works April 1992 report to the US EPA states on Page 27 that there are PFOA groundwater data that are highly variable but were better when there was re-sampling due to improved surrogate recoveries. Thus, DuPont was well aware of this analytical problem with the PFOA measurement in a water matrix. Region III of the US EPA Item 5 of their comments on the VI also believe this problem should be addressed and explained.

Despite knowledge of the surrogate recovery problem of the CH2M Hill method, DuPont never switched away from that laboratory for its water analysis, even though it knew that it would be submitting that laboratory's results to the Federal government as part of its RCRA Facility Investigation of the DuPont Washington Works. DuPont was forced to make a change, however, when the CH2M Hill laboratory in Montgomery, Alabama ceased operations in the fall of 1998. At that point, DuPont contracted with Lancaster Laboratories of Pennsylvania to analyze PFOA in water and asked Lancaster to use the same method CH2M Hill had been using. DuPont's RCRA report dated June 30, 1999 states that DuPont provided the analytical SOP to Lancaster



Laboratories.<sup>216</sup> The RCRA report also notes that the Lancaster PFOA results were higher than the CH2M Hill results for the previous round of analysis of groundwater noting that both laboratories "gave poor or imprecise spike recoveries."<sup>217</sup> The data validation process of the groundwater results were judged to be "unusable (flagged R) primarily due to very low spike recoveries associated with the non-detect FC-143 results."<sup>218</sup>

Nevertheless, DuPont asked Lancaster Laboratories to continue to analyze PFOA in water samples using the CH2M Hill method. During the time frame from the Fall of 1998 until the Fall of 2001, Lancaster Laboratories made several attempts to improve the accuracy of the PFOA methodology by numerous analytical techniques including changing solvents, clean-ups, concentration methods, and instrumentation. By April of 2001, Lancaster had told DuPont about a new GC/MS method that had better surrogate recoveries but would yield C-8 levels 2.6 to 5.6 times higher than the CH2M Hill method. In response, none of the Lancaster Laboratories PFOA method improvements were accepted by DuPont.

## 2001 - Present

In October 2001 rather than use the improved methods recommended by Lancaster, DuPont decided to start using a completely different laboratory, MPI (Now Exygen Research, Inc.) of State College, Pennsylvania to analyze PFOA in water samples, claiming that Exygen Research was using the "state of the art" SPE/LC/MS/MS methodology to measure the concentration of PFOA in water samples. The sample concentration step is solid phase extraction (SPE) followed by elution of PFOA that was separated by liquid chromatography (LC) and qualitatively and quantitatively analyzed by negative ion mass spectrometry, a collision cell and mass spectrometry of a fragment ion. Electrospray sample introduction was used between the liquid chromatograph and the tandem mass spectrometer. The method limit of quantitation was 0.05 ug/L (ppb). Yet this was not a new method, **REDACTED** had been utilizing LC/MS/MS on water samples since 1991. The Exygen Research method did not include a surrogate. The Severn Trent Laboratory (STL) in Denver, Colorado was designing a LC/MS/MS method for PFOA in water for DuPont in 2001 as well as Exygen Research. However, the Severn Trent Laboratory was including PFNA (C-9) as a surrogate. Rather than yield C-8 water results 2.6 to 5.6 times higher than CH2M Hill had been reporting, as would have been the case if the improved Lancaster Laboratories method were used, the new Exygen method yielded C-8 results much more similar to CH2M Hill's. The ability to verify the accuracy of Exygen's new results was hindered, however, as there was were no longer any surrogate recovery rates that would have revealed such problems.

PFNA is an excellent surrogate for the LC/MS/MS analysis if it is of known purity. Dr. Larsen<sup>219</sup> brings the purity issue into question in her 2007 feature article in *Analytical Chemistry*.

<sup>216</sup> RCRA Facility Investigation Report DuPont Washington Works Washington, West Virginia, USEPA Permit Number WVD04-587-5291, DuPont Remediation Group, June 30, 1999, (Bates No, EID109642-EID109786).

<sup>217</sup> Ibid. Section 4.1.2.1 FC-143 Analysis.

<sup>218</sup> Ibid. Section 4.1.3 RFI Data Usability Review and Data Validation.

<sup>219</sup> Barbara S. Larsen and Mary A. Kaiser, Challenges in Perfluorocarboxylic Acid Measurements, *Analytical Chemistry*, 2007, 79 (11), pp. 3966-3973.



STL performed a study of the stability of PFOA at concentrations of 0.1 to 50 ug/L in water in glass and plastic containers. There was no noticeable decline in PFOA after over two months of storage in either glass or plastic containers. They remained stable.

The LC/MS/MS method does not separate the isomers of PFOA. In addition, MS/MS is not consistent for each isomer of PFOA, as shown by Dr. Larsen.<sup>220</sup> This strongly implies that the 2001 methodology of SPE LC/MS/MS is not measuring PFOA accurately and precisely due to the unknown factors that have not been resolved.

The Data Assessment DuPont Washington Works Report dated October 2, 2008 does not include any public drinking water data prior to the 2001 LC/MS/MS method.<sup>221</sup> The previous water PFOA analytical data is ignored without a reason implied or given. Measurement data cannot be dismissed without giving a logical reason for its dismissal. The data cannot be "cherry picked" due to its advantage to the picker.

Data validation of the LC/MS/MS measurements was done on two groundwater data packages by Environmental Standards, Inc. of Valley Forge, Pennsylvania. These samples were taken in 2005 and 2006 and consisted of about 36 samples. No residential nor public water samples were included. The data assessment process was not comprehensive.

### **Poor Surrogate Recoveries**

CH2M Hill's laboratory analyzed water samples for PFOA by GC/ECD. In late 1991 DuPont gave the analytical analysis of PFOA to the CH2M Hill laboratory in spite of their known lower results on split samples with the DuPont Experimental Station. The CH2M Hill surrogate recoveries were low ranging from 34 to 87%, strongly implying that the results were less than the actual concentration in the samples (see Tables 12 and 13), belying DuPont's representation in November of 1991, that CH2M Hill laboratory was complying with the US EPA data quality protocols.

It is interesting to note that there was no third party data validation of this PFOA data even though the US EPA "Functional Guidelines for Evaluating Organic Analysis" was published on February 1, 1988. This flawed CH2M Hill analytical method remained in use until October, 2001.

Lancaster Laboratories proposed to DuPont a modification of US EPA Method 552.5 for haloacetic acids in drinking water to analyze PFOA in water samples. They reported spike recoveries that averaged 94% and greatly improved surrogate recoveries. Water samples from the Washington Works production wells were analyzed by both the CH2M Hill method and the proposed method. DuPont knew that the Lancaster method showed consistently higher results by a factor of 2.6 to 5.6 (see Table 19) and surrogate recoveries between 80 and 110% (see Table 20). Yet DuPont purposely chose not to use this apparently improved method and more accurate methodology which included mass spectrometry confirmation for use in the analysis of water

<sup>220</sup> Ibid.

<sup>221</sup> Data Assessment DuPont Washington Works (OPPT-2004-0113 PFOA Site-Related Environmental Assessment Program), DuPont Corporate Remediation Group, October 2, 2008, (Bates No. ROWE039818-ROWE039969B).



samples by DuPont.

### **No Surrogate Method**

After learning of the improved Lancaster method that improved recoveries but yielded much higher drinking water results, DuPont contracted with a new laboratory Exygen Research, Inc. of State College, Pennsylvania to develop a LC/MS/MS method to analyze PFOA in water which need not include any surrogate spikes. This is a critical factor when there is a non-detect for the analysis of analyte PFOA. The question becomes whether or not the entire analytical system functions as per the methodology. For instance, if the injection of the sample into the LC or the desorption of the PFOA from the C18 solid phase extraction (SPE) cartridge goes haywire there is no quality control measure that something went wrong and/or by how much. How does one prove that the LC/MS/MS methodology truly provided a result that is a non-detect when there is no surrogate in the method? Thus, DuPont knowingly switched to Exygen in 2001 and asked them to use a C-8 water method the accuracy of which would be much harder to verify.

#### **A. Representativeness**

No data are available from a drinking water system that give a reasonable estimate of the representativeness of the sample water. There is approximately four years of data for three pumping wells of the LPSD system between January 2000 and December 2003 (See Figures 2, 3, and 4). This data does not indicate a consistent concentration of PFOA in these wells which one would expect from the source and the Ohio River mixing and transport downstream to this well field. The analytical system's variability appears to supersede the precision and representativeness of the sampling and analysis.

#### **B. Completeness**

Completeness was not a concern of DuPont's until 1998. This was the time when a third party was first employed by DuPont to assess the usability of the PFOA analytical results. This data validation was accomplished by Environmental Standards of Valley Forge, Pennsylvania because of DuPont's need to use the data for a US EPA RCRA investigation. They based their data validation on the US EPA 1994 National Functional Guidelines for Organic Data Review and the Quality Assurance Project Plan (QAPP). The standard operating procedure (SOP) for this data validation and a drinking water QAPP were not available to review.

Data validation of the CH2M Hill and Lancaster Laboratory results for PFOA from 1998 - 2001 was qualified as estimated, biased low, or rejected. Most of the qualification of the results was due to the low percent recovery of surrogate, matrix, and/or laboratory control samples.

#### **C. Comparability**

DuPont's Washington Work's project director, Andrew Hartten, a hydrogeologist was concerned about the comparability of the data (lines 3 and 4, page 174 of the 2009 deposition and Exhibit #40) by at least early 2000 when he was first considering this in a C-8 lawsuit. From Mr. Hartten's



e-mail,<sup>222</sup> it appears that DuPont needed to "pursue an advanced analytical method that provides accurate results." This is 16 years after DuPont first started PFOA analysis in a water matrix. There are two points in this memo that are very important. First, DuPont does not consider the data obtained in the previous 16 years of PFOA in water to be accurate with a high level of confidence. Second, DuPont is worried that someone will find out that this is true if the comparability of the old and new data change by a factor of 3-5 times, which would become apparent if DuPont switched to the new, improved method Lancaster Laboratories was recommending at the time.<sup>223</sup> Thus, DuPont was clearly worried about third parties learning of its underreported C-8 water levels if it switched to the method proposed by Lancaster Laboratories. This concern by DuPont is misplaced if their "objectives are always to try to use the best method available."<sup>224</sup>

#### **D. The October 2000 Letter to the LPSD Customers.**

In October 2000, a letter was sent to the LPSD customers noting that C-8 was in their drinking water but assuring them it was safe because the levels found were all below DuPont's Community Exposure Guideline at 1 ppb. Yet the levels reported to be 0.2, 0.5 and 0.1 ppb were those provided by DuPont from August 2000 samples from three wells. The concentrations of PFOA are shown in Figures 2, 3, and 4. The question is about the accuracy, precision, and representativeness of the PFOA results shown in the figures and the office building (Figure 5), which is supposed to represent the drinking water of the system. However, the precision measurements were never made on the LPSD wells or system. The representativeness of the sampling was never tested as well. The accuracy of these analytical values is suspect because of the poor surrogate recoveries for the CH2M Hill method (see Table 19) as well as the lack of quality control for the calibration of the methods due to isomer amounts in the standard. The underestimation of PFOA values during this time frame have a high probability of being reported several times less than the actual values in the drinking water. Thus, DuPont knew that these results likely underrepresented the true concentration of C-8 and was worried about third party lawsuits if DuPont switched to Lancaster.

On the same day that the water samples were obtained from the LPSD wells A, B, and F there was a sample taken from the main. This drinking water sample had a concentration for PFOA of 0.6 ppb. It is not possible to mix water containing 0.1, 0.2, and 0.5 ppb PFOA to obtain a concentration of 0.6 ppb. As shown in Figures 2, 3, and 4, the 99.5 confidence interval for PFOA in wells A, B, and F strongly imply that these values are under reported.

#### **E. Summary of Opinions**

1. Methods used by DuPont to measure the concentration of PFOA in water are not accurate and have led to reported levels of PFOA in drinking water supplies that are lower than the true value.

<sup>222</sup> Deposition of Andrew Hartten Vol. II, November 6, 2009, Exhibit #40.

<sup>223</sup> E-mail from Michelle J. Kolodziejki to Tara M. Spaide, October 1, 1999 (Bates No, P000016209, EID072379, & GW007427).

<sup>224</sup> Andrew Hartenn 2009 deposition page 268 lines 2 and 3.



2. DuPont was aware that the PFOA levels in drinking water were reported lower than the true concentration values, and DuPont had the knowledge and expertise to correct the discrepancy in the data.
3. Prior to the water analysis performed by Exygen in 2001, the PFOA concentrations in drinking water were higher than reported by DuPont and exceeded 1 ppb on numerous occasions.
4. The information concerning the October letter to the LPSD water customers about PFOA concentrations in drinking water was not accurate and PFOA concentrations were underreported.
5. Forensic techniques to age date the PFOA using the isomers of PFOA were not performed. The FC-143 produced by 3M and used by DuPont at the Washington Works plant prior to 2002

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which was used by DuPont after 2002. According to Hyeong-Moo Shin et al., PFOA entered the municipal water supplies via air transport and deposition of PFOA from the Washington Works plant.<sup>225,226</sup> It is unknown whether this PFOA is from the use of FC-143 from 3M by the Washington Works facility, or C-8 from the PFOA made by DuPont and used after 2002 when the 3M PFOA was no longer available. Isomer analysis could be of forensic aid in the transport mechanism as well as making the analytical results more reliable.

6. Three decades of qualitative and quantitative analysis of PFOA for the health and safety of employees and the Washington Works plant community by one of the world's major chemical companies shows that the analytical sampling and analysis are still questionable due to accuracy, precision, representativeness, completeness, and comparability concerns. None of these analytical chemistry concerns apply to other chemicals of considerable and probable health concerns, such as dioxin, or polynuclear aromatic hydrocarbons (PAHs), or polychlorinated biphenyls (PCBs). All of these substances are semi-volatile compounds like PFOA and their sampling and analysis can be accomplished to very low concentrations accurately and precisely. There is a disconnect in the approach to accurate and precise analytical chemistry of PFOA. This disconnect has led to DuPont's underestimation and underreporting of PFOA concentrations and the reluctance to correct the analytical system.

When the analytical data is questionable it causes the users of the results to make corrections that assume the worst case scenarios. This is exactly the sentiment portrayed by Bernard J. Reilly, DuPont's lawyer, in an email to his son on May 7, 2001:<sup>227</sup>

*Got a call about 2130 when in bed last night from one of our engineers worrying about our technique for measuring surfactant at Parkersburg. We learned recently that our analytical technique has very poor recovery, often 25%, so any results we*

<sup>225</sup> Hyeong-Moo Shin, et al., Environmental Fate and Transport Modeling for Perfluorooctanoic Acid Emitted from the Washington Works Facility in West Virginia, *Environmental Science and Technology*, 2011, 45, pp. 1435-1432.

<sup>226</sup> Hyeong-Moo Shin, et al., Modeling the Air-Soil Transport Pathway of Perfluorooctanoic acid in the Mid-Ohio Valley Using Linked Air Dispersion and Vadose Zone Models, *Atmospheric Environment* 2012, 51, pp. 67-74.

<sup>227</sup> Andrew Hartenn 2009 deposition page 279 and Exhibit #45 (Bates No. EDD0073970).



*get should be multiplied by a factor of 4 or even 5. However, that has not been the practice, so we have been telling the agencies results that surely are low. Not a pretty situation, especially since we have been telling the drinking water folks not to worry, results have been under the level we deem 'safe' of 1 ppb. We now fear we will get data from a better technique that will exceed the number we have touted as safe, Ugh.*

The real essence of the e-mail is that DuPont grew concerned about the percent recovery problem of its PFOA underreporting analytical methods only after being sued over such issues even though DuPont was fully aware of and had been authorizing the use of these methods. This analytical work had been going on for 17 years. The word at the end of the paragraph is "Ugh," and there is the truth.

## VIII. QUALIFICATIONS/EXPERIENCE/PUBLICATIONS

**James S. Smith, Ph.D., CPC**

### Credentials

- Ph.D. Organic Chemistry - Iowa State University (1964)
- B.A. Chemistry, with honors thesis - Williams College (1960)
- N.I.H. Postdoctoral Fellowship, Organic Chemistry - University of Illinois (1965-66)
- Visiting Lecturer, General and Organic Chemistry - University of Illinois (1966)
- Assistant Professor, Organic and Analytical Chemistry - Eastern Michigan University (1966-68)
- N.I.H. Postdoctoral Fellowship, Organic Mass Spectrometry - Cornell University (1968-69)
- American Chemical Society (1960 to present)
  - Chairman of the Mass Spectrometry discussion group, 1970-71
- American Society for Testing and Materials
  - Committee D-19 on Water (1979 to present)
  - Committee D-18 on Soil and Rock (1993 to present)
- American Society of Mass Spectroscopists
- Association of Official Analytical Chemists
  - Technical Division on Reference Materials
- National Ground Water Association
- The American Institute of Chemists (AIC) (1992 to present)
  - Fellow, American Institute of Chemists (FAIC)
  - Certified Professional Chemist (CPC)
  - Board of Directors (2002 - 2004)
  - American Academy of Forensic Sciences (1997 to present)
  - Fellow - Engineering Sciences Section
  - Chairman of the Engineering Sciences Section (2003)
  - Recipient of the Engineering Sciences Section Andrew Payne, Jr. Special Achievement Award (2002)



## **Experience Summary**

### **Consulting**

1987 to Present - President/Chemist, Trillium, Inc., Coatesville, PA

1985 to 1987 - Chemistry Manager, Walter B. Satterthwaite Associates, Inc., West Chester, PA

1981 to 1985 - Laboratory Director, Roy F. Weston, Inc., West Chester, PA

### **Industrial**

1969 to 1981 - Manager, Corporate Research Center, Analytical Department, Allied Chemical Corporation (Now Honeywell), Morristown, NJ

### **Academic**

1968 to 1969 - N.I.H. Postdoctoral Fellow, Cornell University - Mass Spectrometry

1966 to 1968 - Assistant Professor, Eastern Michigan University

1964 to 1966 - Visiting Lecturer and N.I.H. Postdoctoral Fellow, University of Illinois

### **Publications And Presentations For The Last 10 Years**

- Smith, J.S., "*Is Your Analytical Result Accurate?*," 57th Annual Meeting, American Academy of Forensic Sciences, New Orleans, Louisiana, February 21-26, 2005.
- Smith, J.S., "*Forensic Science*," Presented at the Harford County Teachers Inservice Day, Bel Air, Maryland, April 7, 2005.
- Smith, J.S., "*Is Your Analytical Result Accurate?*," GSA North-Central Section 39th Annual Meeting, Minneapolis, Minnesota, May 20, 2005.
- Smith, J.S. and C. McLane, "*Environmental Forensics: Methods and Applications*," National Ground Water Association Seminar, Baltimore, Maryland, July 19-20, 2005.
- Smith, J.S., "*Is Your Analytical Result Accurate?*," 2005 National Ground Water and Environmental Law Conference, Baltimore, Maryland, July 22, 2005.
- Smith, J.S. and C. McLane, "*Environmental Forensics: Concepts and Applications*," National Ground Water Association Course, Columbus, Ohio, June 20-21, 2006.
- Smith, J.S., "*Daubert Rules Challenge Scientists*," 2006 National Ground Water and Environmental Law Conference, Chicago, Illinois, July 6, 2006.



- Lane, V.A. and J.S. Smith, "*Fact or Fiction: The Source of Perchloroethylene Contamination in Groundwater is a Manufacturing Impurity in Chlorinated Solvents*," 2006 National Ground Water and Environmental Law Conference, Chicago, Illinois, July 6, 2006.
- Smith, J.S. and G.W. DeWitt, "*Released Hydrocarbons - Aerobically or Anerobically Biodegraded*," 2006 National Ground Water and Environmental Law Conference, Chicago, Illinois, July 7, 2006.
- DeWitt, G.W. and J.S. Smith, "*First-Order Exponential Regression of Ethylbenzene/Xylenes Ratios for Estimating Release Date*," 2006 National Ground Water and Environmental Law Conference, Chicago, Illinois, July 7, 2006.
- Smith, J.S. and C. McLane, "*Environmental Forensics: Methods and Applications*," National Ground Water Association Seminar, Houston, Texas, November 8-9, 2006.
- Smith, J.S. and G.W. DeWitt, "*Released Petroleum Products Containing BTEX - Aerobic or Anaerobic Biodegradation*," 59<sup>th</sup> Annual Meeting, American Academy of Forensic Sciences, San Antonio, Texas, February 22, 2007.
- Smith, J.S. and C. McLane, "*Environmental Forensics: Methods and Applications*," National Ground Water Association Course, Fair Lawn, New Jersey, June 26-27, 2007.
- Peale, James G.D., M. French, and J.S. Smith, "*Perception vs. Reality: Countering Claims of Co-solvency Effects Using Good Science*," NGWA Ground Water and Environmental Law Conference, Dublin, Ohio, July 24, 2007.
- Smith, J.S. and K.L. Shoop, "*ESI: Environmental Scene Investigation, Who are You?*," NGWA Ground Water and Environmental Law Conference, Dublin, Ohio, July 25, 2007.
- Smith, J.S., B.L. Jolin, and C.A. Erikson, "*Automobile Shredder Residue: Waste or Wasted Resource?*," NGWA Ground Water and Environmental Law Conference, Dublin, Ohio, July 25, 2007.
- Lane, V.A. and J.S. Smith, "*Fact or Fiction: The Source of Perchloroethylene Contamination in Groundwater is a Manufacturing Impurity in Chlorinated Solvents*," The 23<sup>rd</sup> Annual International Conference on Soils, Sediments and Water, Amherst, Massachusetts, October 15-18, 2007.
- Smith, J.S. and C.A. Erikson, "*Automobile Shredder Residue: Waste or Wasted Resource?*," 60<sup>th</sup> Annual Meeting, American Academy of Forensic Sciences, Washington, D.C., February 21, 2008.
- Peale, James G.D., M. French, and J.S. Smith, "*Perception vs. Reality: Countering Claims*



*of Co-solvency Effects Using Good Science,* " 60<sup>th</sup> Annual Meeting, American Academy of Forensic Sciences, Washington, D.C., February 22, 2008.

- Smith, J.S. and M. Zdepski, "*New Jersey Hillbillies,*" 60<sup>th</sup> Annual Meeting, American Academy of Forensic Sciences, Washington, D.C., February 22, 2008.
- DeWitt, G.W., J.S. Smith, and F.J. Hoitash, "*Determination of Free-Phase Conditions Using Ethylbenzene/Xylenes Ratios,*" NGWA 2008 Ground Water Summit, Memphis, Tennessee, March 31, 2008.
- Smith, J.S. and S. Pitkin, "*Environmental Forensics: Methods and Applications,*" National Ground Water Association Course, Denver, Colorado, June 9-10, 2008.
- DeWitt, G.W., J.S. Smith, and F.J. Hoitash, "*Determination of Free-Phase Conditions Using Ethylbenzene/Xylenes Ratios,*" 61<sup>st</sup> Annual Meeting, American Academy of Forensic Sciences, Denver, Colorado, February 20, 2009.
- Smith, J.S. and S. Pitkin, "*Environmental Forensics: Methods and Applications,*" National Ground Water Association Course, Pittsburgh, Pennsylvania, June 15-16, 2009.
- Adamus, G.M., K.S. Murray, G.W. DeWitt, and J.S. Smith, "*Review of Groundwater Ethylbenzene/Xylenes Model to Estimate Petroleum Release Date,*" Air and Waste Management Association 102 Annual Conference, Detroit, Michigan, June 17, 2009.
- Smith, J.S., "*Some Chemistry Concerning Vapor Intrusion,*" Association of Environmental and Engineering Geologists, New York - Philadelphia Section Meeting, Somerset, New Jersey, January 19, 2011.
- Smith, J.S., "*Environmental Forensics: A Repository For Junk Science,*" 63<sup>rd</sup> Annual Meeting, American Academy of Forensic Sciences, Chicago, Illinois, February 24, 2011.
- Hadka, M.C. and J.S. Smith, "*Finding the Genie in a Bottle,*" 64<sup>th</sup> Annual Meeting, American Academy of Forensic Sciences, Atlanta, Georgia, February 23, 2012.
- Erikson, C.A. and J.S. Smith, "*Chemistry Ignored-A Case Study,*" 64<sup>th</sup> Annual Meeting, American Academy of Forensic Sciences, Atlanta, Georgia, February 23, 2012.
- DeWitt, G.W. and J.S. Smith, "*Free Product Determination Using Ethylbenzene to Total Xylenes Ratio,*" 64<sup>th</sup> Annual Meeting, American Academy of Forensic Sciences, Atlanta, Georgia, February 23, 2012.
- Smith, J.S., "*The Road to the Supreme Court,*" 64<sup>th</sup> Annual Meeting, American Academy of Forensic Sciences, Atlanta, Georgia, February 23, 2012.
- Smith, J.S., "*Attorneys, Journalists, Environmental Forensic Scientists, and Four*



*Words*, " 64<sup>th</sup> Annual Meeting, American Academy of Forensic Sciences, Atlanta, Georgia, February 23, 2012.

- Smith, J.S., "*Environmental Site Forensic Investigations: Where Junk Science in Litigation is King*," The American Institute of Chemists Annual Meeting, E. Carmichael Members & Fellows Lecture, Philadelphia, Pennsylvania, April 13, 2012.
- Smith, J.S., "*Environmental Chemistry*," 65<sup>th</sup> Annual Meeting, American Academy of Forensic Sciences, Washington, D.C., February 21, 2013.
- Smith, J.S., "*Nothing Has Changed in Environmental Forensics*," Guest Editorial, The Chemist, Vol. 86, No. 2, pp. 33-34, April 2014.

## **IX. PRIOR TESTIMONY FOR THE LAST FOUR YEARS**

### **Deposition Testimony**

Dattilo Realty v. Chevron U.S.A. Inc., United States District Court for the District of New Jersey, Civil Action No. 2:09-CV-02278

Expert for Plaintiff

David R. Forrey, Esquire  
Lewis & Forrey, L.L.C.  
34 Chambers Street  
Princeton, NJ 08542  
(609) 924-0180

*Date of Deposition Testimony:* January 11, 2011

James V. Atria, Jr. And Margaret Mary Atria v. Cumberland Farms, Inc., Tiger Claw, Inc. D/b/a Exxon; Exxon Mobil; New Jersey Department of Transportation; John Doe 1-10; GHI, Co. 1-10 (said names being fictitious, and Cumberland Farms, Inc., v. Sunoco, Inc.; Barker Bus Company. Martha's Cleaners and Launderers, Inc. And John Does 1-10 (said names being fictitious, Superior Court of New Jersey Law Division - Somerset County, Docket No. SOM-L-1647-04

Expert for Defendant/Third-Party Plaintiff - Cumberland Farms, Inc.

Martha N. Donovan, Esquire  
Norris McLaughlin & Marcus, P.A.  
721 Route 202-206, Suite 200  
P.O. Box 5933  
Bridgewater, NJ 08807  
(908) 722-0700

*Date of Deposition Testimony:* November 8, 2011



The Newark Group, Inc. v. Crown Beverage Packaging, Inc. and Continental Holdings, Inc.,  
Commonwealth of Massachusetts - Middlesex - Superior Court, Docket No. C.A. 09-4552

Expert for Plaintiff

Amy E. Boyd, Esquire  
Jonathan M. Ettinger, Esquire  
Foley Hoag LLP  
Seaport World Trade Center West  
155 Seaport Boulevard  
Boston, MA 02210  
(617) 832-1000

*Dates of Deposition Testimony:* July 24, 2012 and April 24, 2013

Richard Catena v. Raytheon Company, etc., et als., Superior Court of New Jersey Law Division:  
Bergen County, Docket No. BER-L-1267-11

Expert for Defendant - Raytheon Company

Dennis Krumholz, Esquire  
Michele Glass, Esquire  
Riker Danzig Scherer Hyland & Perretti, LLP  
Headquarters Plaza  
One Speedwell Avenue  
Morristown, NJ 07962  
(973) 538-0800

*Dates of Deposition Testimony:* March 5, 2013, March 6, 2013, March 12, 2013, and  
March 28, 2013

Tri-Realty Company v. Ursinus College, United States District Court for the Eastern District of  
Pennsylvania, Case No. 2:11-05885

Expert for Plaintiff

Scott J. Etish, Esquire  
Gibbons, P.C.  
1700 Two Logan Square  
18<sup>th</sup> & Arch Streets  
Philadelphia, PA 19103  
(215) 446-6261

*Date of Deposition Testimony:* July 22, 2014



## **Trial Testimony**

Before the Corporation Commission of Oklahoma, Applicant: Michelin North America, Inc.,  
Respondent: Gary S. Walker, Director, Petroleum Storage Tank Division, Oklahoma Corporation  
Commission, Relief Sought: Determination of Jurisdiction, Cause No. PSD 200800004

Expert for Applicant - Michelin North America, Inc.

Connie M. Bryan, Esquire  
Rubenstein McCormick & Pitts, P.L.L.C.  
1503 East 19<sup>th</sup> Street  
Edmond, OK 73013  
(405) 340-1900

*Date of Hearing Testimony:* April 22, 2010 and March 2 and 3, 2011

James V. Atria, Jr. And Margaret Mary Atria v. Cumberland Farms, Inc., Tiger Claw, Inc. D/b/a  
Exxon; Exxon Mobil; New Jersey Department of Transportation; John Doe 1-10; GHI, Co. 1-10  
(said names being fictitious, and Cumberland Farms, Inc., v. Sunoco, Inc.; Barker Bus Company,  
Martha's Cleaners and Launderers, Inc. And John Does 1-10 (said names being fictitious,  
Superior Court of New Jersey Law Division - Somerset County, Docket No. SOM-L-1647-04

Expert for Defendant/Third-Party Plaintiff - Cumberland Farms, Inc.

Martha N. Donovan, Esquire  
Norris McLaughlin & Marcus, P.A.  
721 Route 202-206, Suite 200  
P.O. Box 5933  
Bridgewater, NJ 08807  
(908) 722-0700

*Date of Trial Testimony:* February 28, 2012

## **X. COMPENSATION**

The basis of compensation for James S. Smith, Ph.D. is an hourly rate of \$250.00, including deposition testimony and plus expenses, per Trillium, Inc.'s January 6, 2014, Professional Fee Schedule.



## **XI. SIGNATORY**

The preceding report includes opinions that I hold to a reasonable degree of scientific certainty and represents my best professional judgment based on the documents and facts with which I have been presented, and my training and experience. I reserve the right to update this report based on additional information that comes to my attention.

*November 20, 2014*

Date

*James S. Smith*

James S. Smith, Ph.D., CPC  
President/Chemist

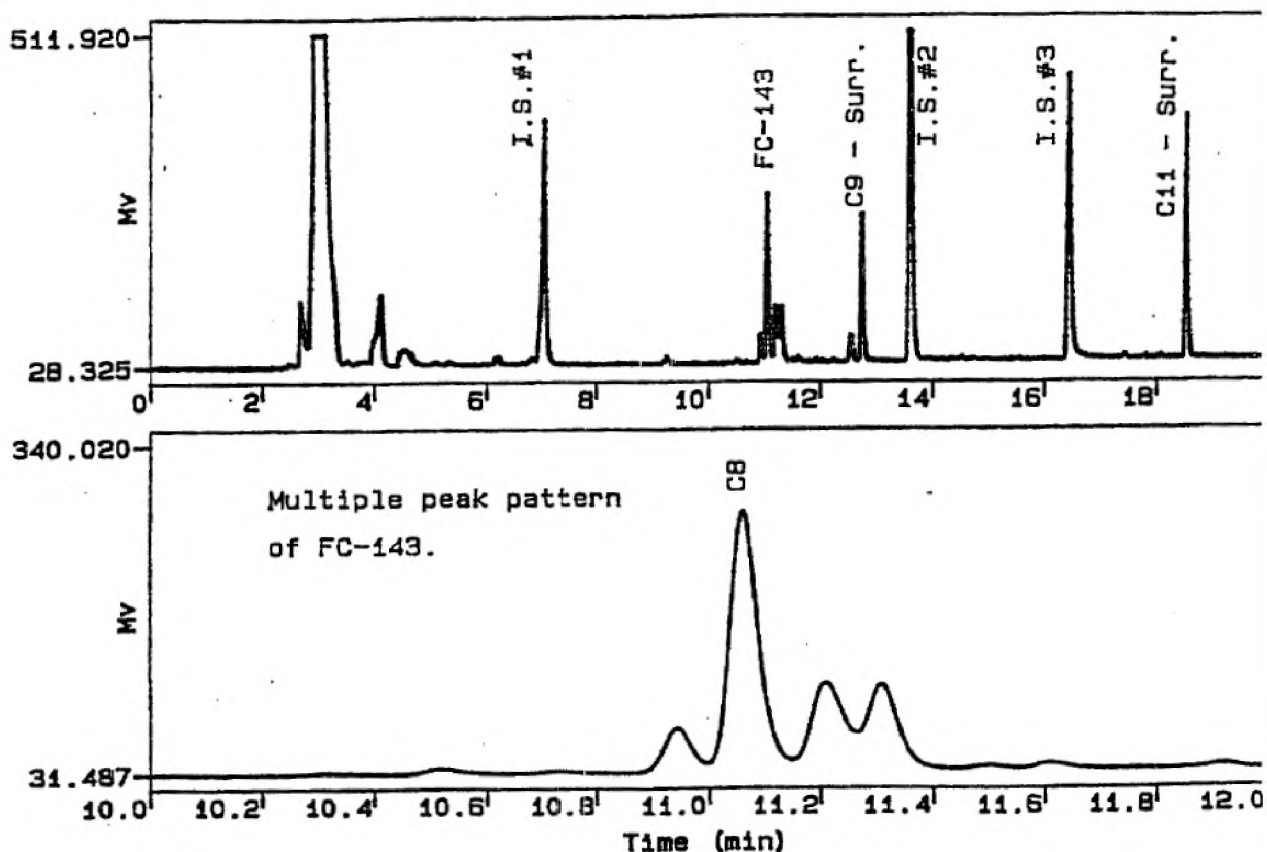


Figure 3. GC/ECD chromatogram of instrument standard at 1 ug/mL and multiple peak pattern of FC-143. Fused silica capillary column: Rtx-200 (Restek Corporation), 30m x 0.32mm I.D., 0.5um film thickness. Column program: 50°C for 2 minutes to 90°C at 5°C/minute then to 280°C at 10°C/minute and hold 2 minutes. Injector zone: 200°C. Detector zone: 320°C. Helium carrier inlet pressure = 5.5psig. 1uL splitless injection, split on at 0.5 minutes.

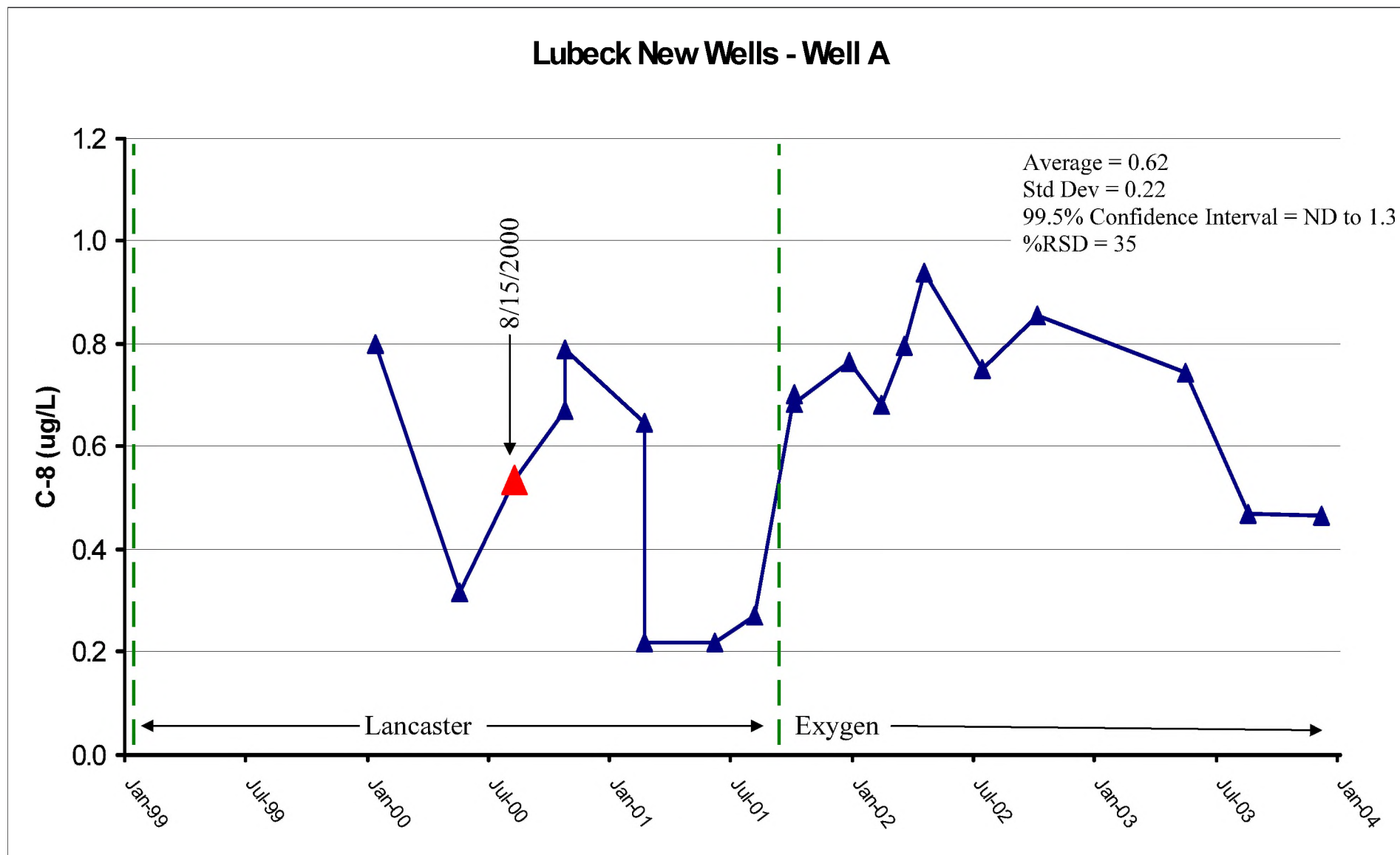


Figure 2. C-8 Results for LPSD Well A.

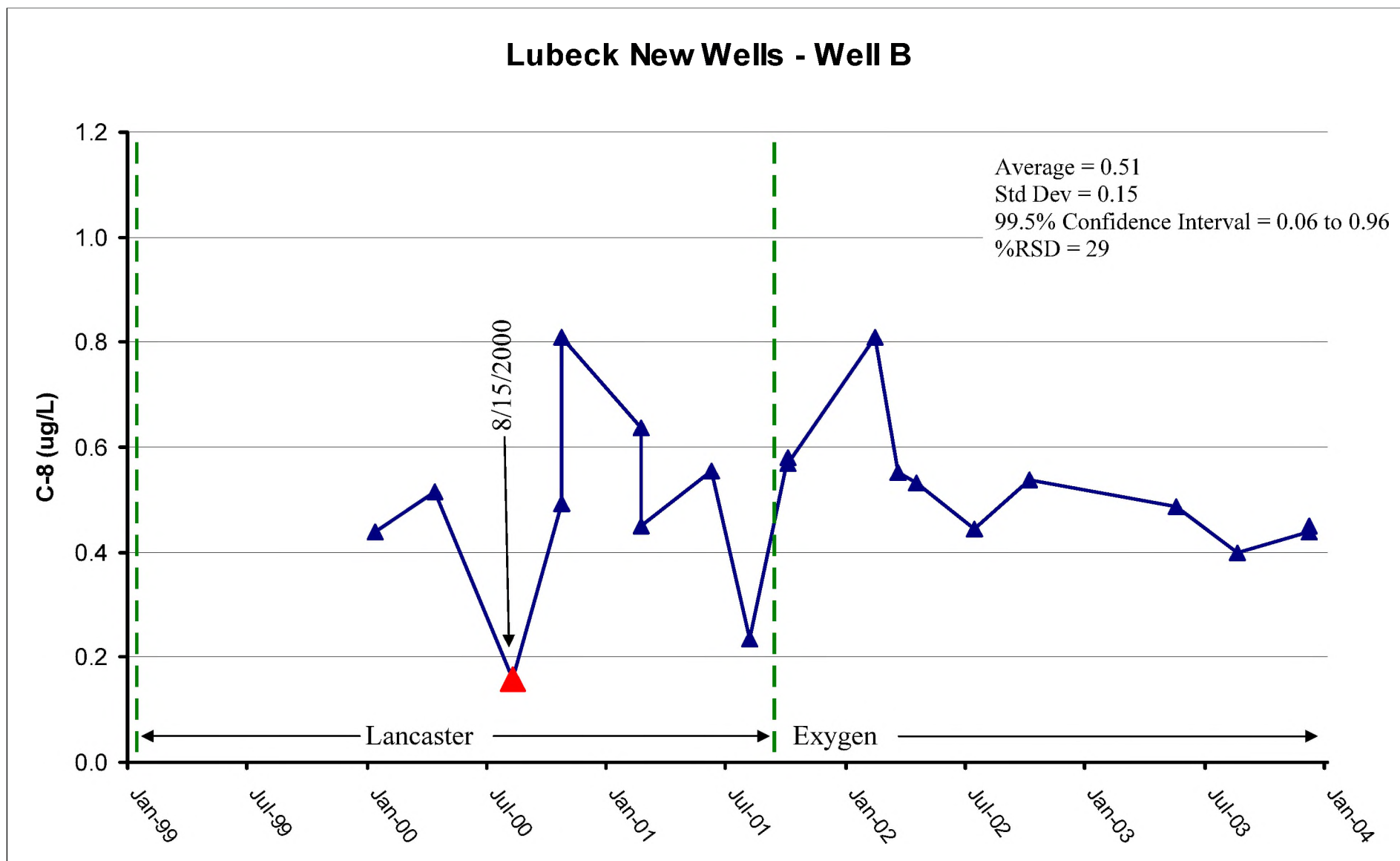


Figure 3. C-8 Results for LPSD Well B.

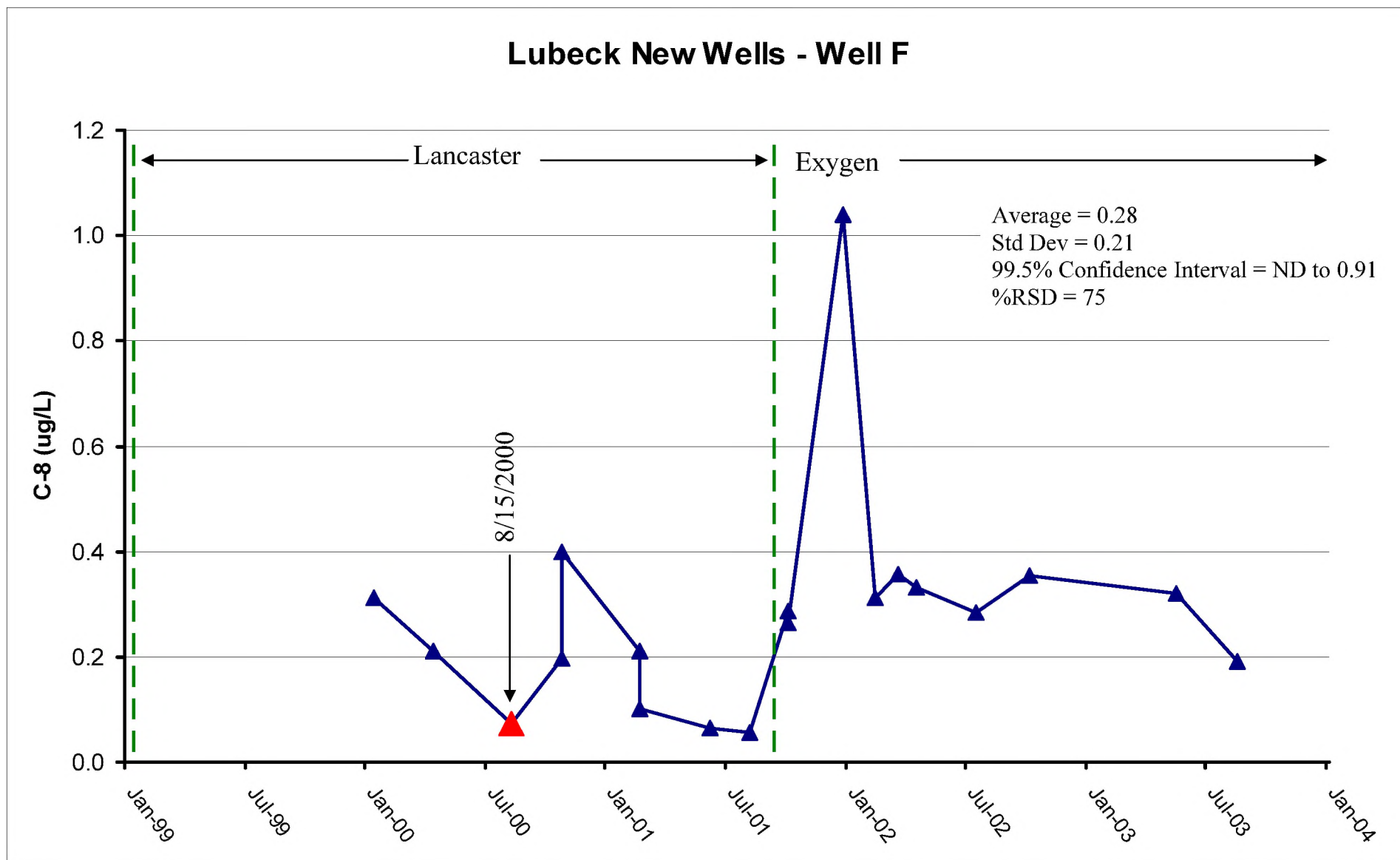


Figure 4. C-8 Results for LPSD Well F.

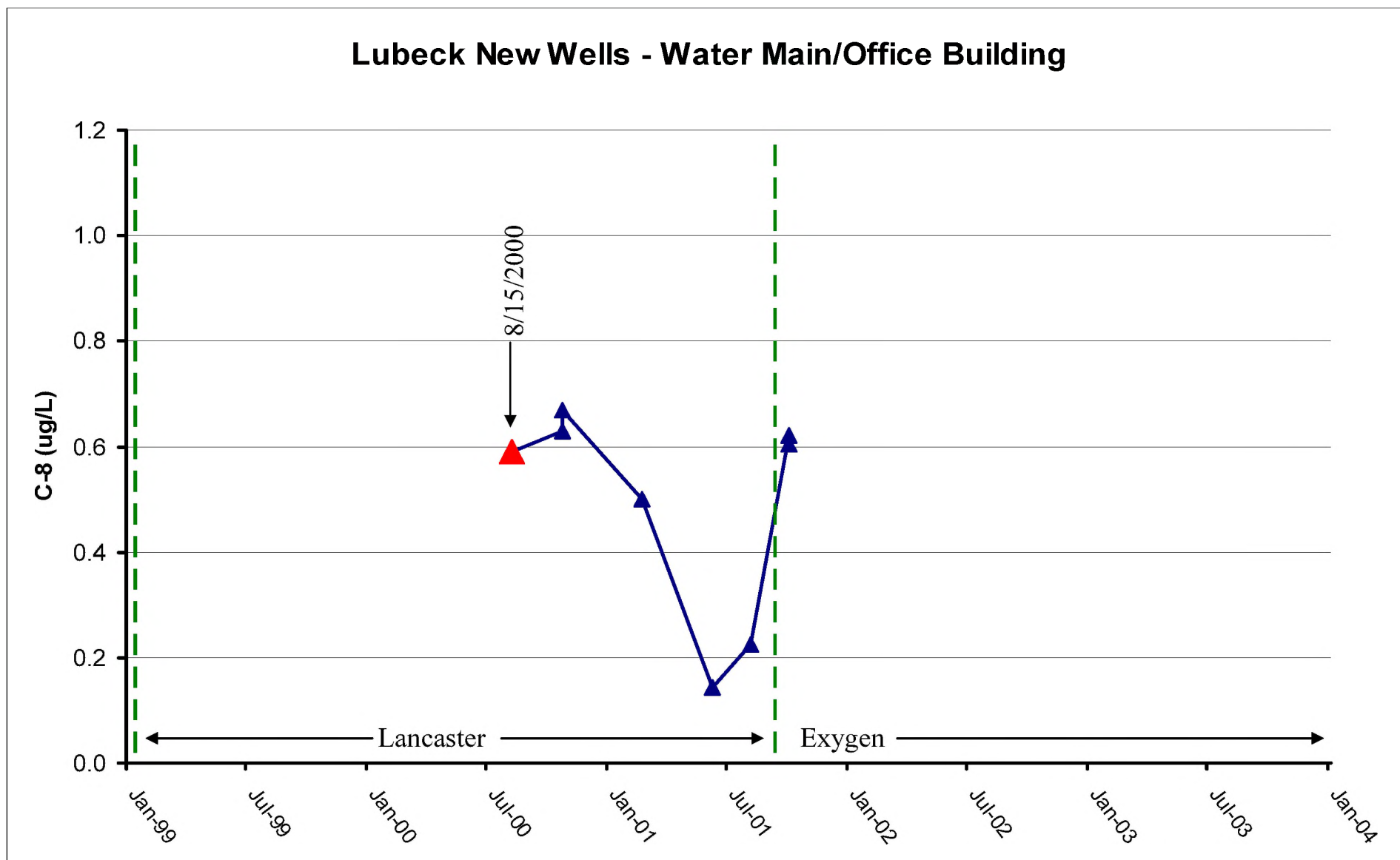


Figure 5. C-8 Results for LPSD Water Main/Office Building.



## PROFESSIONAL FEE SCHEDULE

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| PERSONNEL                                        | TITLE                      | HOURLY RATE |
|--------------------------------------------------|----------------------------|-------------|
| James S. Smith, Ph.D.<br>(Includes Deposition)   | President/Chemist          | \$250.00    |
| James S. Smith, Ph.D.<br>(Trial Testimony)       | President/Chemist          | \$500.00    |
| Michael C. Hadka, Ph.D.<br>(Includes Deposition) | Chemist                    | \$150.00    |
| Michael C. Hadka, Ph.D.<br>(Trial Testimony)     | Chemist                    | \$300.00    |
| Carol A. Erikson                                 | Quality Assessment Manager | \$125.00*   |
| Elizabeth K. Dickinson                           | Quality Assessment Manager | \$125.00*   |
| Patricia A. Cochran                              | Quality Assessment Manager | \$125.00*   |
| All Staff**                                      | Data Validation Services   | \$ 90.00    |
| <hr style="border-top: 1px dashed black;"/>      |                            |             |
|                                                  | Technical Assistant        | \$ 75.00    |
|                                                  | Administrative Assistant   | \$ 40.00    |

\* Trial Testimony billed at two times normal hourly fee, per the above rate schedule.

\*\* All Staff- Services for rush turnaround time requirements (required turnaround times of one week or less) billed at two times the normal hourly fee, per the above rate schedule.

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Rates Effective January 06, 2014



## **APPENDIX A**

### **INFORMATION CONSIDERED, REVIEWED, AND/OR RELIED UPON**



|            |                                                      |
|------------|------------------------------------------------------|
| 2/14/2001  | Deposition of Robert Ritchey.                        |
| 5/2/2001   | Deposition of Andrew Hartten Vol. I, with exhibits.  |
| 6/6/2002   | Deposition of Dee Ann Staats Vol. I, with exhibits.  |
| 6/7/2002   | Deposition of Dee Ann Staats Vol. II, with exhibits. |
| 11/15/2002 | Deposition of Herbert David Ramsey with exhibits.    |
| 4/30/2004  | Deposition of Glenn R. Evers with exhibits.          |
| 11/19/2004 | Deposition of Timothy Bingman with exhibits.         |
| 6/4/2009   | Deposition of Shane Snyder with exhibits.            |
| 11/6/2009  | Deposition of Andrew Hartten Vol. II, with exhibits  |



Procedures for landfill monitoring and sampling. Pages 26-70. (Bates No. EID070739-EID070776, GW007141-GW007185).

Table of Bottom Ash and Fly ash results. (Bates No. EID035100, JMM005733).

List of groundwater monitoring wells at Dry Run Landfill (Bates No. EID018019-EID-018021).

Mass spectra for F-113 and F-11, and comparative plot of F-11 and F113 mass ions. (Bates No. EID009800-EID009802, RLR00736-RLR00738).

Table 1: Sludge Test Results and EP Toxicity Test results (Bates No. EID034753-EID034754).

Table 1: Sludge Test Results and EP Toxicity Test results [Same as document listed above.] (Bates No. EID008656, RLR000150).

Hand written "Michigan Report" w/ fluoride concentrations in urine and bone. (Bates No. EID017257, RAK007392).

Appendix F-Pages 23-52. (Bates No. EID034693-EID034722, JMM005831-JMM005859).

Fluoride Sources to Dry Run Landfill. (Bates No. EID067263, JMM002370).

Note to Dry Run Landfill Team Members. Summary of Kemron results for split samples. (Bates No. EID034884, DDJ001231).

EPA suspicion of TIC and Freon 13. (Bates No. EID066106, GPS000607).

Hand written notes of fly ash, filter press, supernatant pond, and bio-waste activities. (Bates No. EID066107-EID066108, RV000433&RV000437).

News release questions and answers. (Bates No. EID063140-EID063143, DDJ000960-DDJ000963).

Aerial photograph (Bates No. EID021516.01).

5/1979

Article Grout-Induced Temperature Rise Surrounding Wells, Molz, Fred J. and Carl E. Kurt, Groundwater, Vol. 17, No. 3, May-June 1979.



04/20/1980 - Waste Classification forms including some MSDS (Bates No. 05/12/199 EID035852-EID035961, JMM005456-JMM005565).

08/12/1980 - RCRA Waste Classification forms. (Bates No. EID036030-EID036042, 12/04/1980 JMM005634-JMM005646).

11/12/1980 Memo from C.J. Babcock and C.F. Nelson to H. Moncure and R.L. Hall re: extraction of heavy metals from structural polymers. (Bates No. EID036034-EID036035, JMM005638-JMM005639).

9/21/1981 Memo from D.H. Snyder to J.J. Di Nicola re: copy of landfill information sheet. (Bates No. EID022224-EID022225, CF001293-CF001294).

10/23/1981 Memo from C.F. Nelson to A.R. Stoltenberg and W.T. Darnell re: operations involved during the start-up phase of Krolor pigments. (Bates No. EID036038-EID036040, JMM005642-JMM005644).

10/28/1981 Hand written memo from Dan to CWK re: required to notify EPA if "new" hazardous waste is introduced. (Bates No. EID036037, JMM005641).

12/16/1981 Kemron chromium and lead results for three samples collected 12/8/81. (Bates No. EID036044).

12/21/1981 Memo from from C.F. Nelson to R.L. Tewksbury re: amounts of lead and chromate extracted from RYNITE Homelite Red are below RCRA limits. (Bates No. EID036043, JMM005647).

3/8/1982 Memo from J.B. Armitage to D.H. Snyder re: acute oral toxicity levels. (Bates No. EID030008, CF001285).

4/30/1982 Kemron EP Tox. metals results for one bottom ash sample. (Bates No. EID035180-EID035181, JMM005813-JMM005814).

6/18/1982 Application for Water Pollution Control Permit for Disposal of Industrial Waste by Landfill. Includes cover letter from A.C. Huston to David Robinson re: application for new landfill site. (Bates No. EID051410-EID051490, CF001891-CF001971).

10/26/1982 Letter from James J. McKenna to A.C. Huston re: Water Pollution Control Permit. (Bates No. EID050965-EID050999, CF001224-CF001258).

5/1/1984 Initial, Quarterly, and Monthly Sampling results. Includes sampling requirements and memo from T.J. Fortenberry to F.W. Fly. (Bates No.



EID022602-EID022631, RAK003776-RAK003805).

- 5/16/1984 Memo from Helen to Ach re: phenolics results for monitoring well samples.
- 5/18/1984 Initial Comprehensive Well Report Form. Includes cover letter from A.C. Huston to Heidi Kammer. (Bates No. EID018183-EID018192, CF001827-CF001836).
- 5/23/1984 Memo from J. A. Schmid to T. M. Kemp and T. L. Schrenk, re: C-8 Meeting Summary 5/2284 - Wilmington. (Bates No. EID602999-EID602300).
- 9/20/1984 Kemron, EP Tox metals results for two polyvinyl butyral samples. (Bates No. EID035105, JMM005738).
- 2/15/1985 Technical Testing ash mineral results for Bottom Ash No. 6 Boiler. (Bates No. EID035104, JMM005737).
- 2/20/1985 Technical Testing results for ash mineral and bottom ash. (Bates No. EID031332-EID031333).
- 5/9/1985 Washington Works Ash and Coal Constituents. (Bates No. EID035164-EID035165, JMM005797-JMM005798).
- 8/14/1985 Memo from L.B. Dahl to A.J. Playtis re: Triton levels in upstream supernate pond sludge (Bates No. EID007978, RAK002874).
- 9/6/1985 Memo from M. Kruempelman to L.B. Dahl re: analysis of supernate sludge sample for C8. (Bates No. EID007979-EID007980, RAK002875-RAK002876).
- 9/12/1985 Memo from L.B. Dahl to A.C. Huston and J.J. Di Nicola re: C-8 and Triton levels in supernate pond sludge analysis. (Bates No. EID007976-EID007977, RAK002872-RAK002873).
- 9/12/1985 Memo from L.B. Dahl to A.C. Huston and J.J. Di Nicola re: C-8 and Triton levels in supernate pond sludge analysis. [Same as above docuemt.] (Bates No. EID034755-EID034759).
- 9/16/1985 Memo from John Doughty to Art Huston re: identified material found at landfill as Delrin fluff. (Bates No. EID039584, RLR002117).
- 10/10/1985 Letter from A.C. Huston to Heidi Kammer (WVDNR). re: proposed construction of sediment basin at Industrial Waste Landfill. (Bates No.



EID018230-EID018243, CF001813-CF001826).

- 10/11/1985      Vegetation survey report from Charles E. Anderson (Pollution Solutions, Inc.). (EID070493-EID070589).
- 10/25/1985      Letter from A.C. Huston to R.M. Sovic (WVDWR). re: propose to dispose of truck which was contaminated with antimony pentachloride in Dry Run landfill. (Bates No. EID050951-EID050952, CF001811-CF001812).
- 1/21/1986      Letter from Carlo Castaldini (Acurex Corp.) to Art Huston (DuPont) re: EP Tox. results for ash streams. [Includes analytical results from Environmental Research Group, Inc.]. (Bates No. EID035106-EID035108, JMM005739-JMM005741).
- 4/29/1986      Memo from Linda H. Hall to H.E. Bumgarner re: extraction of water samples produced an oily residue identified as Santicizer 8. Includes TOC results and IR scans. (Bates No. EID039580-EID039582, RLR002113-RLR002115).
- 12/3/1986      NUS metals results for concentrated sludge sample collected 10/20/86. (Bates No. EID035646, JMM006946).
- Jan-87          Metal Content of Sludge in ppm - 1986 data. (Bates No. EID035632, JMM006962).
- 6/22/1987      Memo from R.L. Carlsen to A.C. Huston re: codisposal of bio-sludge and powerhouse fly ash. (Bates No. EID029686-EID029687, GW000038-GW000039).
- 6/29/1987      ETC Technical Report for water sample collected 6/4/87. (Bates No. EID034911-EID034927, CF001525-CF001541).
- 7/27/1987      Fuel Engineering Company of New York results for dried bio pond sludge sample received 7/7/87. (Bates No. EID035615, JMM006945).
- 7/30/1987      Letter from A.C. Huston to David Robinson (WVDWR). re: planned physical change at plant resulting in minor change in the waste material disposed on in Dry Run Landfill and results of sludge test. (EID007534-EID007535, JMM003564-JMM003565).
- 7/30/1987      Letter from A.C. Huston to David Robinson (WVDWR). re: planned physical change at plant resulting in minor change in the waste material disposed on in Dry Run Landfill and results of sludge test. [Same as document above] (EID051927-EID051928, GW006726-GW006727).



8/10/1987 Letter from A.C. Huston to David W. Robinson re: request modification of landfill permit to include activated sludge wastewater treatment plant waste sludge. (Bates No. EID051100-EID051103, JMM0070270-JMM007030).

8/19/1987 NPDES Permit Application. Includes cover letter from A.C. Huston to David Robinson. (Bates No. EID052236-EID052346, CF001690-CF001799).

9/15/1987 Letter from A.C. Huston to David W. Robinson (DNR). re: expected annual volume of mixed flyash and activated sludge and expected amounts of TOC, COD, MBAS, and Zn in EP Tox analysis of sludge. (Bates No. WVDEP 0093-WVDEP 0095).

9/15/1987 Letter from A.C. Huston to David W. Robinson (DNR). re: expected annual volume of mixed flyash and activated sludge and expected amounts of TOC, COD, MBAS, and Zn in EP Tox analysis of sludge. [Same as document listed above] (Bates No. EID051929-EID051931, GW006728-GW006730).

9/18/1987 Letter from John Britvec to A.C. Huston re: agency concurs with modification discussed in 7/30/87 letter. (Bates No. EID051095-EID051096, CF001564-CF001565).

9/28/1987 Letter from D.W. Robinson to A.C. Huston re: request to include wastewater treatment plant waste sludge in Dry Run Landfill granted. (Bates No. EID051104, CF001562).

10/15/1987 Memo from Chris Amick to John Britvec re: results and notes from compliance monitoring sample performed 7/29/87. Includes cover letter from John Britvec to A.C. Huston dated 11/12/87. (Bates No. EID022649-EID022657, CF001542-CF001550).

11/20/1987 Kemron EP Tox results for one Emergency Tank sample received 11/9/87. (Bates No. EID036084, JMM005688).

12/15/1987 Kemron results for total and TCLP metals for #2 Incinerator Ash. (Bates No. EID034686-EID034687, CF001523-CD001524).

12/15/1987 Kemron results for total and TCLP metals for #2 Incinerator Ash. (Bates No. EID035965-EID035966, JMM005569-JMM005570).

12/17/1987 Letter from D.W. Robinson to A.C. Huston re: modification granted to dispose of 7,100 tons of non-hazardous sludge and dirt. (Bates No.



EID051114, CF001520).

- 12/17/1987 Letter from D.W. Robinson to A.C. Huston re: modification granted to dispose of 7,100 tons of non-hazardous sludge and dirt. [Same as document listed above] (Bates No. EID051926, GW006725).
- 12/17/1987 Letter from D.W. Robinson to A.C. Huston re: modification granted to dispose of 7,100 tons of non-hazardous sludge and dirt. [Same as document listed above] (Bates No. EID034760, JMM005900).
- 2/3/1988 EOD No. P-0085 Closing Report. [Includes inorganics data] (Bates No. EID015230-EID015248, RAK005992-RAK006010).
- 3/1/1988 Report of flyash-bipond sludge codisposal test. Includes letter from A.C. Huston to John Britvec re: request to modify permit to landfill activated sludge and flyash mixture. (Bates No. EID051139-EID051143, JMM003919-JMM003923).
- 3/14/1988 Letter from D.W. Robinson (WVDEP) to A.C. Huston re: NPDES permit extended because contract laboratory may not have run leachability test correctly; test will be rerun. (Bates No. EID007481, CF001511).
- 4/14/1988 Letter from A.C. Huston to John Britvec re: results for leachability tests. (Bates No. EID051135-EID051138, JMM003772-JMM003775).
- 5/12/1988 Memo from C.J. Babcock to D.H. Snyder re: results for sludge/fly ash testing. (Bates No. EID029688-EID029694, GW000040-GW000046).
- 8/29/1988 NUS metals results for concentrated sludge sample received 7/21/88. (Bates No. EID035643, JMM006973).
- 12/1/1988 Kemron mercury result for one fluorescent bulb received 11/18/88. (Bates No. EID035109, JMM005742).
- 12/29/1988 Technical Testing laboratory analysis report for two ash samples (Bates No. EID034689-EID034692).
- 1/25/1989 NUS metals results for bio pond sludge sample collected 10/12/88. (Bates No. EID035642, JMM006972).
- 2/2/1989 NUS metals results for bio pond sludge sample collected 1/10/89. (Bates No. EID035641, JMM006971).
- 3/9/1989 NUS metals results for bio pond sludge sample collected 1/10/89. (Bates No. EID035636, JMM006966).



3/9/1989 NUS metals results for bio pond sludge sample collected 1/10/89. [Same as above document] (Bates No. EID035637, JMM006967).

3/9/1989 NUS metals results for bio pond sludge sample collected 10/12/88. (Bates No. EID035638, JMM006968).

3/9/1989 NUS metals results for bio pond sludge sample collected 10/12/88. [Same as above document] (Bates No. EID035639, JMM006969).

3/9/1989 NUS metals results for bio pond sludge sample collected 10/12/88. [Same as above document] (Bates No. EID035640, JMM006970).

3/10/1989 Letter from Laidely Eli McCoy (WVDEP) to A.C. Huston re: authorization to operate under permits until formal permit action are necessary. (Bates No. EID051115-EID051116, GW004177-GW004178).

3/30/89 Kemron EP Tox. metals results for bio pond sludge collected 3/13/89. (Bates No. EID035605-EID035606, JMM006935-JMM006936).

3/30/1989 Kemron EP Tox. metals results for bio pond sludge collected 3/13/89. [Same as above document.] (Bates No. EID035629-EID035630, JMM006959-JMM006960).

5/9/1989 Letter from A.C. Huston to John Britvec re: map of five new monitoring wells. (Bates No. EID007491-EID007492, CF002338-CF002339).

5/10/1989 Kemron TCLP results for bio pond sludge collected 4/24/89. (Bates No. EID035602-EID035604, JMM006932-JMM006934).

5/10/1989 Kemron TCLP results for bio pond sludge collected 4/24/89. [Same as above document.] (Bates No. EID035626-EID035628, JMM006956-JMM006958).

5/11/1989 NUS metals results for bio pond sludge sample collected 4/18/89. (Bates No. EID035635, JMM006965).

5/17/1989 Memo from W.B. West to A.C. Huston, W.M. Stewart, and R.J. Yoak re: test well sampling (performed 5/11/89). for Appendix IX. (Bates No. EID022647-EID022648, GW000065-GW000066).

6/13/1989 Letter from H.V. Bradley to Mr. William R. Packard re: Appendix IX results from the analysis of well 27. (Bates No. EID022636-EID022646, GW000054-GW000064).



6/21/1989 Letter from Laidley Eli McCoy to A.C. Huston re: modifications necessary to landfill as a result of new Solid Waste Management Regulations. (Bates No. EID007493-EID007494, CF002326-CF002327).

6/23/1989 Kemron results for eight water samples collected 5/19/89. (Bates No. EID036157-EID036174, GW006345-GW006362).

7/17/1989 Interoffice memo from Arthur C. Huston, Jr. To Gerald A. Ploeger re: PCBs all ND. (Bates No. EID022635, GW000053).

8/3/1989 Interoffice Memo from Harold Bumgarner to distribution re: repair to leak in Lower Pond of Dry Run. (Bates No. EID014083, CF001177).

8/8/1989 NUS metals results for bio pond sludge sample collected 7/17/89. (Bates No. EID035633, JMM006963).

8/8/1989 NUS metals results for bio pond sludge sample collected 7/17/89. [Same as above document] (Bates No. EID035634, JMM006964).

9/29/1989 Interoffice memo from Billy d. Garner to distribution re: installation of new wells at Dry Run. (Bates No. EID014114, GW001074).

Oct-89 Monitoring Well Installation Program prepared by Tetra Tech Richardson, Inc. (Bates No. EID070639-EID070694, ASH000192-ASH000245, RJZ000002).

12/6/1989 Letter from Laidley Eli McCoy to A.C. Huston re: groundwater sample collected from specified monitoring wells and analyzed for total metals. (Bates No. EID051983-EID051984, CF002204-CF002205).

1/2/1990 Letter from A.C. Huston to Laidley Eli McCoy re: permits require sampling of Dry Run wells only. Sampling of Letart wells will also be performed. (Bates No. EID051122-EID051123, CF002198-CF002199).

1/12/1990 Letter from Laidley Eli McCoy to A.C. Huston re: response to comments in 10/20/89 letter. (Bates No. EID051932-EID051933, GW004299-GW004300).

1/12/1990 Water Pollution Control Permit (Bates No. EID051509-EID051550, JMM001092-JMM001133).

2/16/1990 Notice of Appeal. Includes cover letters from David Yaussy (Robinson & McElwee to Arthur C. Huston, Jr. (DuPont) and Frances E. Hunter (State Water Resources Board). (Bates No. EID051858-EID051875, JRM000773-JRM000790).



3/14/1990 Memo from L.C. Diaz (Engineering Services Div.) to W.M. Stewart (Washington Works). re: replacement of Dry Run Well 14. (Bates No. EID015127-EID015128).

3/14/1990 Letter from Christopher Burns to Lisa Diaz re: restoration/replacement of Well #14. (Bates No. EID015129-EID015130).

3/14/1990 Letter from Christopher Burns to Lisa Diaz re: pros and cons of restoration of Well #14. (Bates No. EID015131-EID015135).

Apr-90 Construction of Monitoring Well #14 Dry Run Landfill, prepared by Tetra Tech Richardson, Inc. (Bates No. EID015142-EID015153).

4/18/1990 Kemron Appendix IX results for four samples collected 3/27/90. (Bates No. EID034990-EID035055, GW001160-GW001225).

4/23/1990 Kemron Appendix IX results for three samples collected 3/27/90. (Bates No. EID034928-EID034989, GW001098-GW001159).

4/24/1990 Kemron TCLP metals results for one incinerator ash sample collected 4/23/90. (Bates No. EID012554, JMM006203).

4/30/1990 TCLP results for one fly ash sample collected 4/23/90. Work Order # N0-04-276. (Bates No. EID030508, JMM005817).

5/11/1990 Operations Manual for Dry Run. [Includes cover letter from W.M. Stewart to L. Eli McCoy.] (Bates No. EID007495-EID007428, CF002037-CF002070).

5/23/1990 Kemron TCLP results for six samples collected 4/23/90. [Metals results only] (Bates No. EID035056-EID035057, EID035163, EID035182-EID035184, JMM005689-JMM005690, JMM005796, JMM003965-JMM003968).

6/12/1990 Dry Run Quarterly Monitoring Well Report and Monitoring Well Construction Information. Includes cover letter from H. Verlon Bradley to L. Eli McCoy. [Hand written note on letter "see corrected report"]. (Bates No. EID022658-EID022695, JMM003350-JMM003386).

6/13/1990 Letter from W.M. Stewart to Paul Rader (WV Air Pollution Control Commission) re: Asbestos Removal Notification form. (Bates No. EID007529-EID007532, RAK005764-RAK005767).

7/26/1990 C-8 in ppm. Dry Run Landfill quarterly Routine Samples. (Bates No.



EID035186, JMM003702).

- 7/27/1990 Interoffice memo from Penny C. Mahoney to distribution list re: Dry Run Landfill slope. (Bates No. EID018035, CF001175).
- 8/15/1990 Interoffice memo from Penny C. Mahoney to distribution list re: minutes of meeting held on 8/14/90. (Bates No. EID008308, CF001157).
- 8/17/1990 Interoffice memo from Penny C. Mahoney to Billy D. Garner re: supernate sludge removal strategy. (Bates No. EID005686-EID005687, CF001155-CF001156).
- 8/23/1990 Letter from W.M. Stewart to Max Robertson (WVDNR) re: intent to relocate fluoropolymer contaminated sludge from Dry Run landfill to Letart landfill. (Bates No. EID051924-EID051925, GW006723-GW006724).
- 9/4/1990 Kemron Appendix XI results for one Dry Run sludge sample collected 8/23/90. WO# NO-08-282. (Bates No. EID035141-EID035148, JMM005774-JMM005781).
- 10/8/1990 Kemron TCLP metals preliminary results for three samples collected 9/12/90. WO# NO-09-173. (Bates No. EID035060-EID035061, JMM003988-JMM003991).
- 10/8/1990 Kemron TCLP metals results for three samples collected 9/12/90. WO# NO-09-173. (Bates No. EID035221-EID035224, JMM005693-JMM005694).
- 10/8/1990 Kemron TCLP metals results for three samples. (Bates No. EID034890-EID034893, RAK006044-RAK006047).
- 10/8/1990 Kemron TCLP metals results for three samples. [Same as document listed above] (Bates No. EID012532-EID012535).
- 10/8/1990 Kemron EP Tox metals results for bio pond sludge collected 10/8/90. (Bates No. EID035599-EID035601, JMM006929-JMM006931).
- 10/8/1990 Interoffice Memo from Penny C. Mahoney to distribution list re: concerns with wells at Dry Run. (Bates No. EID010895-EID010896, CF001143-CF001144).
- 10/17/1990 Kemron TCLP and EP Tox metals preliminary results for one incinerator bag ash sample collected 10/10/90. WO# NO-10-146. (Bates No. EID035225-EID035231, CF002011-CF002017).



10/17/1990 Kemron report of TCLP and EP Tox. metals results for one sample. (Bates No. EID012529-EID012531, JMM006178-JMM006180).

10/17/1990 Kemron report of TCLP and EP Tox. metals results for one sample. [Same as document listed above] (Bates No. EID012550-EID012552, JMM006199-JMM006201).

10/18/1990 Kemron TCLP and EP Tox. metals results for one sample. (Bates No. EID012543-EID012548, JMM006192-JMM006197).

10/30/1990 Results for MW-6, MW-12, and MW-13 for samples collected 5/22/90, 8/7/90, and 10/23/90. (Bates No. EID036164-EID036156, GW006342-GW006343).

11/2/1990 Letter from W.M. Stewart to L. Eli McCoy re: metals results appear to make fly ash a hazardous waste. [Only Attachment 4 included] (Bates No. EID051657-EID051660, CF002018-CF002021).

11/5/1990 Kemron TCLP metals results for eight samples collected 8/6/90. WO# N0-10-181. (Bates No. EID035990-EID036000, JMM005595-JMM005604).

11/15/1990 PSI TCLP metals results for one incinerator ash sample. (Bates No. EID012542, JMM006191).

11/26/1990 Kemron TCLP metals results for four samples received 10/29/90. WO# N0-10-382. (Bates No. EID036045-EID036052, JMM005649-JMM005656).

11/29/1990 Interoffice memo from P.C. Mahoney to distribution re: notice of violation for the DNR 10/22/90 audit. (Bates No. EID012555-EID012556, JRM000766-JMM000767).

1/9/1991 Letter from Charles A. Moses to Jon Hundertmark (USEPA). re: report of permit compliance sampling inspection conducted on 8/7/90. (Bates No. CA 232-CA 238).

1/11/1991 Letter from Thomas R. Copeland (Enseco) to Penny Mahoney (DuPont) re: volatiles results (624 and DAI). for one sample collected 12/27/90. [Includes results and COC] (Bates No. EID039559-EID039577, RLR002092-RLR002110).

1/11/1991 Letter from Thomas R. Copeland (Enseco) to Penny Mahoney (DuPont) re: volatiles results (624 and DAI). for one sample collected 12/27/90.



[Same as above document. Includes results and COC] (Bates No. EID035236-EID035254, GW000121-GW000139).

- 1/16/1991 Letter from Laidley Eli McCoy to Walter M. Stewart re: Draft Order Number 2904 in response to permit non-compliance. (Bates No. EID051830-EID051833, JRM000714-JRM000717).
- 1/31/1991 Washington Works, 1990 Annual Landfill Report. Permits WV0076244, WV0076538, WV1176066. (Bates No. EID037225-EID053433, JMM007365-JMM007478, GW002713-GW002716).
- 2/1/1991 Kemron TCLP metals results for bio pond sludge collected 1/14/91. (Bates No. EID035623-EID035625, JMM006953-JMM006955).
- 2/1/1991 Kemron TCLP metals results for bio pond sludge collected 1/14/91. [Same as above document] (Bates No. EID035595-EID035598, JMM006925-JMM006928).
- 2/4/1991 Letter from W.M. Stewart to L. Eli McCoy re: meeting on 2/15/91 to discuss Draft Order 2904. [Includes letter from Laidley Eli McCoy to Walter M. Stewart dated 1/16/91 re: Draft Order Number 2904 in response to permit non-compliance.] (Bates No. EID051814-EID051819, CF002703-CF002708).
- 3/12/1991 Notice of Appeal, DuPont (appellant) v. L. Eli McCoy, Water Resources (appellee) (Bates No. WVDEP 0154-WVDEP 0157).
- 3/15/1991 Memo from P.C. Mahoney to C.F. Muska re: groundwater flow rate and direction. Includes maps indicating flow in bedrock and overburden aquifers. (Bates No. EID018026-EID018028, CF001139-CF001141).
- 3/21/1991 Letter from W.M. Stewart to Laidley Eli McCoy re: written confirmation of cover placed on cells after cessation of the fly ash disposal. (Bates No. EID010782-EID010784, CF002645-CF002647).
- 4/2/1991 Kemron metals results for one Tote Bin Wash Water collected 3/21/91. WO# N1-03-217. Includes memo from G. Woytowich to J.L. Marlow re: source of heavy metals. (Bates No. EID036059-EID036060, JMM005663-JMM005664).
- 4/19/1991 Letter from W.M. Stewart to Laidley Eli McCoy re: request for permission to run biopond sludge/flyash test. [Includes Attachment 1 and 2.] (Bates No. EID051574-EID051598, RAK006011-RAK006035).
- 4/19/1991 Kemron TCLP metals results for one Oberlin filter cake collected 4/11/91.



WO# N1-04-227. (Bates No. EID036061-EID036063, JMM005665-JMM005667).

4/19/1991 Kemron TCLP metals results for one Oberlin filter cake collected 4/11/91. WO# N1-04-227. [Same as above document.] (Bates No. EID036055-EID036057, JMM005659-JMM005661).

4/22/1991 Kemron results for one fly ash collected 4/5/91. WO# N1-04-137. [Includes COC.] (Bates No. EID035256-EID035263, JMM004043-JMM004046).

4/22/1991 Kemron results for one fly ash collected 4/8/91. [Includes COC.] (Bates No. EID034894-EID034901, RAK006036-RAK006043).

4/22/1991 Kemron results for one bio pond/fly ash collected 4/8/91. [Includes COC.] (Bates No. EID035607-EID035614, JMM006937-JMM006944).

5/20/1991 Kemron results for one fly ash and bio pond mixture collected 4/22/91. [Includes COC.] (Bates No. EID035644-EID035662, JMM006974-JMM006992).

5/30/1991 Fax from G.L. Kreil (Consolidation Coal Company) to R. Nefta (DuPont) re comprehensive analysis of the equity of coals delivered to Washington Works. (Bates No. EID035101-EID035103, JMM0005734-JMM005736).

7/22/1991 Kemron results for one bio pond sludge collected 7/1/91. (Bates No. EID035591-EID035594, JMM006921-JMM006924).

7/29/1991 Kemron TCLP results for one Rags A&B sample collected 7/11/91. WO# N1-07-165. [Includes COC.] (Bates No. EID035115-EID035135, JMM005748-JMM005768).

9/20/1991 Temporary Operating Instructions. (Bates No. EID024267-EID024285, JIG000309-JIG000327).

9/20/1991 Letter from David L. Yaussy to Walter M. Stewart re: Appeal No. 427 was dismissed. [Includes copy of Appeal] (Bates No. EID051778-EID051780, JMM003849-JMM003851).

10/3/1991 Letter from David L. Yaussy to Walter M. Stewart re: conditions appealed to Water Resources Board and resolution to each. (Bates No. EID051773-EID051777, CF002635-CF002639).

10/25/1991 Memo from W.M. Stewart to H.D. Ramsey re: appeal was settled and



dismissed. [Includes letter from David L. Yaussy to Walter M. Stewart dated 10/3/91 re: conditions appealed to Water Resources Board and resolution to each. (Bates No. EID051772-EID051777, CF002634-CF002639).

- 11/18/1991 Memo from R J Zipfel to C-8 File re: C-8 InterLaboratory Meeting and includes 8/31/92 CH2M Hill Low Level Determination of FC-143 in Soil/Sediment (Bates No. EID256133-EID256162).
- 1/21/1992 Kemron metals results for bio pond sludge collected 1/06/92. [Includes COC.] (Bates No. EID035585-EID035590, JMM006915-JMM006920).
- 3/2/1992 C-8 results for 14 site samples collected 2/18/92. [Includes COC and transmittal letter from Wanda L. Hall (CH2M Hill) to Dan Weber (DuPont)] (Bates No. EID071327-EID071352, AC002920-AC002945).
- 3/27/1992 Email from Helen Wright to Robert Ritchey re: Communications with Regulatory Agencies disclosing FC-143. (Bates No. EID009472-EID009474, RLR002052-RLR002054).
- 4/15/1992 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, First Quarter, 1992. Includes cover letter from W.M. Stewart to L. Eli McCoy. (Bates No. EID022696-EID022706, JMM006648-JMM006658).
- 5/8/1992 Standard Laboratories, Inc. TCLP metals results for 14 ash samples collected 4/22-24/92. (Bates No. EID035085-EID035098, JMM005718-JMM005731).
- 5/8/1992 Standard Laboratories, Inc. TCLP metals results for 14 ash samples collected 4/22-24/92. (Bates No. EID035166-EID035179, JMM005799-JMM005812).
- 6/5/1992 Kemron TCLP results for one Tank sludge sample collected 5/15/92. WO#N2-05-268. [Includes COC.] (Bates No. EID036064-EID036082, JMM005668-JMM005686).
- 6/10/1992 Handwritten results for % volatiles for EQ Tank Sludge Off Bottom Off Tank. (Bates No. EID036083, JMM005687).
- 6/24/1992 C-8 results for two site samples collected 6/12/92. [Includes COC and transmittal letter from Wanda L. Hall (CH2M Hill) to Dan Weber (DuPont)] (Bates No. EID071314-EID071326, AC002907-AC002919).
- 7/15/1992 Washington Works Monitoring Report, Dry Run Landfill Permit



WV0076244, Second Quarter, 1992. Includes cover letter from W.M. Stewart to L. Eli McCoy. (Bates No. EID022707-EID022717, JMM006637-JMM006647).

8/25/1992 Tabulated metals results for bottom ash and fly ash collected 4/23-24/92. (Bates No. EID030509-EID030510, JMM005818-JMM005819).

8/25/1992 Tire Derived Fuel and Coal Experimental Burn, Leachate test results of Bottom and Fly Ash samples for samples collected 4/23-23/92, metals results. (Bates No. EID035058-EID035059).

9/15/1992 Letter from W.M. Stewart to Eli McCoy re: original asbestos disposal area filled and new area selected and put into use. (Bates No. EID010813-EID010815, CF002612-CF002614).

10/15/1992 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Third Quarter, 1992. Includes cover letter from W.M. Stewart to L. Eli McCoy. (Bates No. EID022718-EID022727, JMM006628-JMM006636).

12/17/1992 Analytical results for fly ash and bottom ash sampled collected 10/27-30/92. (Bates No. EID030511-EID030514, JMM005820-JMM005823).

1/15/1993 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Fourth Quarter, 1992. Includes cover letter from W.M. Stewart to L. Eli McCoy. (Bates No. EID022728-EID022738, JMM006616-JMM006626).

1/29/1993 Washington Works, 1992 Annual Landfill Report. Permits WV0076244, WV0076538, WV1176066. (Bates No. EID037342-EID037381, JMM007488-JMM07523).

2/5/1993 Interoffice memo from Ross S. Hefta to distribution list re: changes in coal to CONSOL blend may be contributing to the increased pH levels. (Bates No. EID017105, CF001025).

2/16/1993 Kemron TCLP metals results for bio pond sludge collected 1/25/93. (Bates No. EID035580-EID035584, JMM006910-JMM006914).

2/16/1993 Kemron TCLP metals results for bio pond sludge collected 1/25/93. (Bates No. EID035617-EID035620, JMM006947-JMM006950).

2/24/1993 Hand written tables of select metals results in bottom ash, fly ash, biosludge, and supernate from biosludge. (Bates No. EID034877-EID034878, RAK006173-RAK006174).



- 2/24/1993 Hand written tables of select metals results in bottom ash, fly ash, biosludge, and supernate from biosludge. (Bates No. EID035074-EID035075).
- 3/26/1993 Interoffice memo from George Waytowich to Thomas R. Waldron re: using ash as a cover material at the Dry Run Landfill. (Bates No. EID010897, CF001024).
- 4/15/1993 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, First Quarter, 1993. Includes cover letter from W.M. Stewart to L. Eli McCoy. (Bates No. EID022739-EID022748, JMM006606-JMM006615).
- 4/30/1993 C-8 results for 12 site samples collected 4/15-16/93. [Includes COC and transmittal letter from Wanda L. Hall (QAL Labs) to Dan Weber (DuPont)] (Bates No. EID071291-EID071313, AC002884-AC002906).
- 5/28/1993 Kemron TCLP results for bio pond sludge collected 5/10/93. (Bates No. EID035578-EID035579, JMM006908-JMM006909).
- 5/28/1993 Kemron TCLP results for bio pond sludge collected 5/10/93. [Same as above document] (Bates No. EID035559-EID035560, JMM006889-JMM006890).
- 5/28/1993 Kemron TCLP results for bio pond sludge collected 5/10/93. [Same as above document] (Bates No. EID035557-EID035558, JMM003714-JMM003715).
- 5/28/1993 Kemron TCLP results for bio pond sludge collected 5/10/93. [Same as above document] (Bates No. EID035621-EID035622, JMM006951-JMM006952).
- 6/2/1993 Density, pH, and % moisture results for one fly ash sample collected 6/2/93. (Bates No. EID030516, JMM005824).
- 6/3/1993 Power House Consol Coal Flyash/Bottom Ash Constituents. [Tabulated results] (Bates No. EID030507, JMM005816).
- 6/11/1993 Letter from W.M. Stewart (DuPont) to Dr. L. Eli McCoy (WVDEP) re: updates estimates of the amount of each type of waste disposed in Dry Run Lanfill. [Includes table of major constituents.] (Bates No. EID015296-EID015297, GW004414-GW004415).
- 7/8/1993 Letter from John G. Britvec (WVDEP) to W.M. Stewart (DuPont) re:



excessive sediment in lower sedimentation pond, upper sedimentation pond not being operated in compliance due to excessive sediment accumulation, and discharge from the lower pond is causing discoloration of the receiving stream. (Bates No. EID012563-EID012564, JMM003331-JMM003332).

- 7/8/1993 Interoffice memo from Gerge Woytowich to Thomas R. Waldron re: cleaning out the sedimentation pond. [Includes procedure]. (Bates No. EID017106-EID017106, JMM003346-JMM003347).
- 7/12/1993 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Second Quarter, 1993. Includes cover letter from W.M. Stewart to L. Eli McCoy. (Bates No. EID022749-EID022758, JMM006596-JMM006604).
- 7/14/1993 Interoffice Memo from Eduardo G. Ramos to distribution re: special samples required at landfill as a result of the visit from WVDEP personnel on 6/28/93. (Bates No. EID017112-EID017113, RAK003509-RAK003510).
- 7/16/1993 Washington Works State Required Water Sample Quarterly Dry Run Samples. (Bates No. EID036088-EID036096, GW006429-GW006448).
- 7/22/1993 Kemron preliminary results for one Dry Run 001 Outlet sample collected 7/15/93. WO# N3-07-251. (Bates No. EID036107-EID036109, CF001010-CF001012).
- 7/22/1993 Kemron results for one Dry Run 001 Outlet sample collected 7/15/93. WO# N3-07-251. [Includes COC]. (Bates No. EID036105-EID036106, EID036087, CF001013-CF001014, GW006473).
- 7/22/1993 Kemron results for one Dry Run 001 Outlet sample collected 7/15/93. WO# N3-07-251. [Includes COC]. (Bates No. EID036101-EID036104, EID036110-EID036115, CF002571-CF002573, GW006475, GW006487).
- 7/28/1993 Kemron cover sheet for sample results. WO# N3-07-134. No results attached. [Includes COC.] (Bates No. EID036085-EID036086, GW006497-GW006498).
- 7/30/1993 Kemron metals results for eight water samples collected 7/16/93. WO# N3-07-282. (Bates No. EID036116-EID036122, GW006430-GW006436).
- 8/4/1993 Letter form W.M. Stewart (DuPont) to Dr. L. Eli McCoy re: response to



report of agency's field review conducted 6/28/93. (Bates No. EID012567-EID012574, RAK003424-RAK003431).

- 8/5/1993 Interoffice memo from Eduardo G. Ramos to distribution re: Dry Run Pond Drainage observations by Cindy Musser. (Bates No. EID010898, RAK003496).
- 8/5/1993 Calculation of Dry Run Sedimentation (J. Ramos) (Bates No. EID036123-EID036126, GW006476-GW006779).
- 8/5/1993 Interoffice memo from Richard A. Kirschner to Thomas R. Waldron re: open discharge value all the way. (Bates No. EID017129, RAK003482).
- 8/12/1993 Kemron cover sheet for sample results. WO# N3-08-004. No results attached. [Includes COC.] (Bates No. EID036127-EID036128, GW006492-GW006493).
- 8/26/1993 Letter from W.M. Stewart (DuPont) to Dr. L. Eli McCoy (WVDEP) cleaning of the sedimentation pond at Dry Run was completed on 8/20. (Bates No. EID010816-EID010819, CF002575-CF002578).
- 9/9/1993 Notes on conversation with Dr. Parker discussing possible algae control at Dry Run Landfill. (Bates No. EID017146, RAK003485).
- 9/30/1993 Kemron results for one Dry Run Pond sample collected 9/20/93. WO# N3-09-361. [Includes COC.] (Bates No. EID036129-EID036133, RAK003419-RAK003423).
- 9/30/1993 Kemron results for one Dry Run Pond sample collected 9/20/93. WO# N3-09-361. [Includes COC] (Bates No. EID036134-EID036138, JMM003128-JMM003132).
- 10/8/1993 Letter from W.M. Stewart to Dr. L. Eli McCoy re: maximum daily TSS permit limit and schedule for performing and submitting bioassay. (Bates No. EID051712-EID051714, CF002568-CF002570).
- 10/11/1993 Interoffice memo from Richard A. Kirsahner, Jr. to distribution re: sampling of Dry Run pond for nutrient content. (Bates No. EID030457-EID030458, RAK003411-RAK003412).
- 10/11/1993 Interoffice memo from Carl F. Muska to Richard A. Kirschner, Jr. re: questions concerning nutrient testing and results. (Bates No. EID017188, RAK003414).
- 10/13/1993 Kemron cover sheet for results for two samples. WO# N3-10-013. [No



COC]. (Bates No. EID036139-EID036140, GW006505-GW006506).

- 10/14/1993 Letter from John G. Britvec (WVDEP) to W.M. Stewart (DuPont) re: request to delay acute toxicity testing is granted. (Bates No. EID010822, CF002565).
- 10/14/1993 Letter from W.M. Stewart (DuPont) to Dr. L. Eli McCoy (WVDEP) re: acceptable to dispose of 50/50 mixture of sludge and sawdust/woodchips in landfill. (Bates No. EID010821, GW006844).
- 10/15/1993 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Third Quarter, 1993. Includes cover letter from W.M. Stewart to L. Eli McCoy. (Bates No. EID022759-EID022769, JMM006585-JMM006595).
- 10/18/1993 Hand written results sheet for pH, DO, and temp. [Includes COC.] (Bates No. EID036141-EID036144, RAK003404, GW006542-GW006544).
- 10/26/1993 Interoffice memo from George Woytowich to distribution re: "fludging" at Dry Run Landfill. (Bates No. EID010825, CF001007).
- 10/27/1993 Kemron results for one Dry Run Pond sample collected 10/18/93. WO# N3-10-300. (Bates No. EID036145-EID036149, RAK003399-RAK003403).
- 10/29/1993 Letter from Emily Williams (CH2M Hill) to Dan Weber (DuPont) re: acknowledgement of sample set (Lab No. 25939). [Includes COC] (Bates No. EID036150-EID036151, GW006507-GW006508).
- 11/10/1993 C-8 results for six site samples collected 10/22/93. [Includes COC and transmittal letter from Wanda L. Hall (CH2M Hill) to Dan Weber (DuPont)] (Bates No. EID071250-EID071271, AC002842-AC002863).
- 11/10/1993 C-8 results for six site samples collected 10/21-22/93. [Includes COC and transmittal letter from Wanda L. Hall (CH2M Hill) to Dan Weber (DuPont)] (Bates No. EID071272-EID071290, AC002864-AC002883).
- 11/11/1993 Interoffice memo from Richard A. Kirschner to Bharat O. Desai re: results of nutrient analysis. (Bates No. EID030471, RAK003397).
- 11/11/1993 Interoffice memo from Bharat O. Desai to Richard Kirschner re: nutrient levels are OK. [Includes memo 11/11/93 from above.] (Bates No. EID030472, RAK003398).
- 11/15/1993 Interoffice memo from Richard A. Kirschner to George Woytowich re:



Dry Run Pond Nutrients and bioassay set for late November/early December. [Includes two memo dated 11/11/93 from above.] (Bates No. EID030470, RAK003396).

11/22/1993      Kemron results cover sheet for two water samples. WO# N3-11-175. [Includes COC.] (Bates No. EID036152-EID036153).

12/6/1993      Hand written results for pH for Dry Run Pond sample. (Bates No. EID036180, RAK003386).

12/8/1993      Interoffice memo from Richard A. Kirschner to distribution list re: high nutrient levels. [Includes tabulated data.] (Bates No. EID030473-EID030474, CF000994-CF000995).

12/08-10/93      AH&M Environmental, Inc. Bioassay report. (Bates No. WVDEP 0290-WVDEP 0319).

12/20/1993      Kemron results for one Dry Run Pond sample collected 12/6/93. WO# N3-12-106. (Bates No. EID036184-EID036188, RAK003376-RAK003380).

12/20/1993      AH&M Environmental bioassay laboratory bench sheets. (Bates No. EID036189-EID036192, RAK003382-RAK003385).

12/29/1993      Letter from Eric Gillespie (AH&M Environmental). to Jim Yoak (DuPont) re: delayed bioassay reports. (Bates No. EID036193, CF000962).

1994              Dry Run Landfill Fluoride Data attached to one page of article entitled "Groundwater Resources of the Ohio River Valley in WV". (Bates No. EID018024-EID018025, LKI000592-LKI000593).

1/14/1994      Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Fourth Quarter, 1993. Includes cover letter from W.M. Stewart to L. Eli McCoy. (Bates No. EID022770-EID022788, CF003241-CF003259).

1/26/1994      Kemron results for Outlet 001 sample received 12/21/93. WO# N3-12-456. (Bates No. IED036176, EID036178-EID036179, GW001913, RAK003387).

1/28/1994      Washington Works, 1993 Annual Landfill Report. Permits WV0076244, WV0076538, WV1176066. (Bates No. EID037382-EID037463, JMM007524-JMM007604).



2/4/1994 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, January 2000. (Bates No. EID023934-EID023942, JMM004525-JMM004533).

2/11/1994 Kemron results for four samples collected 1/31/94. WO# N4-01-362. [Includes COC.] (Bates No. EID035111-EID035114, JMM005746-JMM005747).

3/4/1994 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, February 2000. (Bates No. EID023943-EID023952, JMM004508-JMM004517).

3/17/1994 C-8 results for 11 site samples collected 2/21-22/94. [Includes COC and transmittal letter from Wanda L. Hall (QAL Labs) to George Woytowich (DuPont)] (Bates No. EID071228-EID071249, AC002820-AC002841).

4/14/1994 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, March 1994 (Bates No. EID023953-EID023962, JMM004483-JMM004492).

4/14/1994 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, First Quarter 1994. (Bates No. EID022789-EID022799, JMM004644-JMM004656).

4/18/1994 Kemron TCLP VOA results for one Fire Pit sample collected 3/29/94. WO# N4-03-608. [Includes COC.] (Bates No. EID035158-EID035162, JMM005791-JMM005795).

5/6/1994 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, April 1994 (Bates No. EID023963-EID023972, JMM004458-JMM004467).

5/25/1994 Interoffice memo from John Britvec (WVDEP) to file re: field review of Dry Run Landfill and Local Landfills performed by John Britvec and Cindy Musser (WVDEP) performed on 5/16/94. (Bates No. EID012611-EID012619, GW004785-GW004793).

5/25/1994 Interoffice memo from John Britvec (WVDEP) to file re: field review of Dry Run Landfill and Local Landfills performed by John Britvec and Cindy Musser (WVDEP) performed on 5/16/94. [Same as above document.] (Bates No. EID070210-EID070218, LKI001692-LKI001700).

6/9/1994 Letter from Deborah Hill (Kemron) to George Woytowich (DuPont) re: formaldehyde analysis of 001 outlet missed holding time. (Bates No.



EID030482, GW006403).

- 6/15/1994 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, May 1994 (Bates No. EID023973-EID023979, JMM004437-JMM004443).
- 7/8/1994 Renewal application for WV Solids Waste/NPDES permit. [Includes cover letter from W.M. Stewart (DuPont) to Mark A. Scott (WVDEP)]. (Bates No. EID053308-EID53772, GW002549-GW003053).
- 7/14/1994 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Second Quarter 1994. (Bates No. EID022800-EID022811, JMM004617-JMM004628).
- 7/14/1994 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, June 1994. (Bates No. EID023980-EID023989, JMM004420-JMM004429).
- 8/12/1994 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, July 1994 (Bates No. EID023990-EID023999, JMM004403-JMM004412).
- 8/16/1994 Consol, Inc. Coal Quality Statistical Evaluation of metals results. (Bates No. EID035099, JMM005732).
- 8/18/1994 C-8 results for 11 site samples collected 7/29/94 and 8/1/94. [Includes COC and transmittal letter from Angel Kionka (QAL Labs) to George Woytowich (DuPont)] (Bates No. EID071208-EID071227, AC002800-AC002819).
- 9/9/1994 Letter from W.M. Stewart to Mark A. Scott re: information to complete permit application submitted 7/8/94. [Includes revisions.] (Bates No. EID020862-EID020877, CF000545-CF000562).
- 9/12/1994 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, August 1994. (Bates No. EID024000-EID024009, JMM004386-JMM004395).
- 9/14/1994 Letter from W.M. Stewart (DuPont) to Mark A. Scott (WVDEP) re: filter press used to dewater sludge. Enclosed revised list of major constituents going to landfill. (Bates No. EID010828-EID010830, JMM003658-JMM003660).
- 10/5/1994 Kemron TCLP metals results for bio pond press filter cake received 9/19/94. (Bates No. EID035574-EID035577, JMM006904-JMM006907).



10/10/1994 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, September 1994. (Bates No. EID02010-EID024019, JMM004366-JMM004375).

10/14/1994 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Third Quarter 1994. (Bates No. EID022812-EID022824).

10/17/1994 Kemron TCLP results for bio pond press filter cake received 10/10/94. (Bates No. EID035569-EID035573, JMM006899-JMM006903).

10/17/1994 Kemron TCLP VOA results for Kiln Ash sample collected 9/29/94. WO# N4-10-034. (Bates No. EID035062-EID035067, JMM005695-JMM005700).

11/10/1994 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, October 1994. (Bates No. EID024020-EID024029, JMM004349-JMM004358).

11/28/1994 Interoffice Memo from Ross S. Hefta to Daniel A. Weber re: tabulated results for flyash. (Bates No. EID030506, JMM005815).

12/14/1994 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, November 1994 (Bates No. EID024030-EID024039, JMM004332-JMM004341).

01/95-07/95 Report of Investigation. (Bates No. EID070219-EID070231).

1/6/1995 Letter from Terry Hofmann to Hopewell Water Project Residents re: completion of attached survey. (Bates No. EID070233-EID070234, LKI001716-LKI001717).

1/10/1995 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, December 1994. (Bates No. EID024040-EID024041.10, JMM004312-JMM004323).

1/13/1995 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Fourth Quarter 1994. (Bates No. EID022825-EID022842).

1/30/1995 Washington Works, 1994 Annual Landfill Report. Permits WV0076244, WV0076538, WV1176066. Includes cover letter from W.M. Stewart to Mark A. Scott. (Bates No. EID037475-EID037503, JMM007124-JMM007152).

2/14/1995 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit



WV0076244, January 1995. (Bates No. EID023782-EID023792, SDB000749-SDB000759).

2/20/1995 Letter from H.D. Ramsey (DuPont) to distribution re: landfill is not contaminating water supply. (Bates No. EID013171, LKI000745).

3/1/1995 Interoffice Memo from John F. Doughty to distribution list re: black color of water is caused by iron sulfide. (Bates No. EID016749-EID01757, JMM003013-JMM003021).

3/2/1995 Interoffice Memo from Daniel A. Weber to H. David Ramsey, Jr., Walter M. Stewart, Gerald A. Ploeger, and Lynwood K. Ireland re: bis-(2-ethylhexyl). phthalate summary. (Bates No. EID030517-EID030519, JMM001051-JMM001053).

3/6/1995 Interoffice memo from H. David Ramsey, Jr. to distribution re: proposed vist by Hopewell citizens. (Bates No. EID070235, LKI001718).

3/14/1995 Interoffice Memo from John F. Doughty to Alison A. Crane re: review chemical compositions and MSDS for four materials. Can be burned in incinerator. (Bates No. EID015625, RAK006190).

3/15/1995 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, February 1995. (Bates No. EID023793-EID023803, SDB000730-SDB000740).

3/15/1995 Interoffice Memo from David E. Ellis to Richard A. Kirschner, Jr. re: black water possibly caused by weight of the material in the new lifts may be compressing the old pre-sedimentation pond. (Bates No. EID016764, JMM003711).

3/15/1995 Interoffice Memo from Richard A. Kirschner, Jr. to David E. Ellis , Robert A. Reich and J. Martin Odom re: water exiting sedimentation pond was black and smelled of sulfides. In addition, experienced large amounts of foam. (Bates No. EID016758-EID016859, JMM003712-JMM003713).

3/15/1995 Interoffice Memo from J. Martin Odom to Richard A. Kirschner, Jr. re: Sulf Control used for suppressing sulfide emissions from waste treatment systems. (Bates No. EID016763, JMM003712).

3/16/1995 Interoffice Memo from Ralph E. Beeman to David E. Ellis re: nitric acid used to treat the sulfide problem ex situ. (EID0168766, RAK006479).

3/22/1995 Self Control Field Test Proposal. [Includes fax transmission from Robert F. Knauer, Jr. (EBI) to Rich Kirschner (DuPont)]. (Bates No.



EID016855-EID016861, CF000911-CF000917).

- 3/22/1995 Interoffice memo from Lynwood K. Ireland to H. David Ramsey, Jr. and Gerald A. Ploeger re: points of interest concerning Hopewell-Lubeck citizens and DuPont. (Bates No. EID070236, LKI001719).
- 3/23/1995 WVDEP Landfill Inspection Report (Bates No. WVDEP 0694).
- 3/23/1995 WVDEP Landfill Inspection Report (Bates No. EID012628, CF000947).
- 3/23/1995 WVDEP Landfill Inspection Report (Bates No. EID070208-EID070209, LKI001690-LKI001691).
- 3/27/1995 Memo from Richard A. Kirschner, Jr. re: introduction of chemical not currently in use -Sulf Control SC-103. (Bates No. EID016795, RAK006489).
- 3/30/1995 Interoffice memo from Lynwood K. Ireland to Ronald W. Meloan and H. David Ramsey re: draft letter to be sent to Hopewell citizens to obtain a water service for the community. (Bates No. EID070237, LKI001720).
- 3/30/1995 Kemron TCLP metals results for two Slag samples collected 3/27/95. WO# N5-03-482. [Includes COC.] (Bates No. EID035081-EID035084, JMM005714-JMM5714).
- 4/6/1995 Interoffice memo from George Woytowich (DuPont) to distribution re: disposal of heat stabilizer in Dry Run Landfill. (Bates No. EID015626-EID015627, GW001326-GW001327).
- 4/13/1995 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, March 1995. (Bates No. EID023804-EID023814, SDB000711-SDB000721).
- 4/13/1995 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, First Quarter 1995. (Bates No. EID022843-EID022853).
- 4/16/1995 Interoffice memo from Roger Duff to distribution list re: call from Mr. Tennant about a fish kill in the stream feeding off the settling pond at Dry Run. (Bates No. EID007451, CF000953).
- 4/18/1995 QA Lab Work Request. [Includes results for surfactants, COD, and TSS.] Bates No. CA 002-CA 003).
- 4/25/1995 Interoffice memo from Richard A. Kirschner, Jr. to Ronald W. Meloan, Lynwood K Ireland, Walter M. Stewart, George Woytowich, and Thomas



R. Waldron re: two geologists from DER visited site and indicated that they felt the measures taken should improve the color and flow from the landfill. (Bates No. EID016649, CF000952).

- 4/26/1995 Interoffice memo from D. Chris Koelsch to Gerald A. Ploeger and H. David Ramsey, Jr. re: report of foam coming from run off from farmer who owns 200 acres near the landfill. Forwarded to Water M. Stewart, George Woytowich, Lynwood Ireland, and Richard A. Kirshner, Jr. by Gerald a. Ploeger. (Bates No. EID007456-EID007457, GW001370-GW001371).
- 5/3/1995 WVDEP Landfill Inspection Report (Bates No. EID012627, CF000946).
- 5/4/1995 Report from Robert M. Crowley to D.A. Weber, statistical review of first quarter data. (Bates No. EID030532-EID030543, GW000707-GW000718).
- 5/8/1995 Interoffice Memo from Lynwood K. Ireland to John F. Doughty, George Woytowich, Richard A. Kirschner, Jr. and Thomas R. Waldon re: return of black water. (Bates No. EID016652, RAK006451).
- 5/12/1995 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, April 1995. (Bates No. EID023815-EID023825, SDB000688-SDB000698).
- 5/24/1995 Dry Run Special Weekly Samples; tabulated TOC, COD, DO, and flow results for Outlet 001 and 1000 feet downstream. (Bates No. EID016653, RAK006448).
- 5/26/1995 Kemron TCLP metals results for one sample collected 5/8/95. WO# N5-05-152. (Bates No. EID035110, JMM005743).
- 5/26/1995 Kemron TCLP metals results for one sample collected 5/8/95. WO# N5-05-152. [Same as above document.] (Bates No. EID035974, JMM005578).
- Jun-95 Remove Efficiency of Leachate/Sediment Pond @ Dry Run Landfill. [Includes results for COD, BOD, TOC, T-Fe, Sulfate, TDS, TSS, Mn for three quarters] (Bates No. WVDEP 0655).
- Jun-95 Dry Run Pond "Black" water. Includes activities performed during 1994, future programs, and tabulated data for 1994 and January through May 1995. (Bates No. EID016709-EID016715, LKI000076-LKI000082).
- 6/1/1995 Interoffice memo from David E. Ellis to distribution re: conversation with



Prof. Perry McCarty (Stanford). re: ways to treat black water problem. (Bates No. EID016654-EID016655, LK1000122-LK1000123).

- 6/1/1995 Tabulated inorganic results for Outlet 001 and 1000 feet downstream samples collected January through June, 1995. (Bates No. EID016737, LK1000083).
- 6/7/1995 Memo from Cindy Musser (WVDEP) to Mike Zeto re: issues pertaining to the increase in COD, BOD, TOC, and sulfate, and "black water". [Attachments and photos referenced in document not included] (Bates No. WVDEP 0640-WVDEP 0647).
- 6/9/1995 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, May 1995. (Bates No. EID023826-EID023836, SDB000669-SDB000679).
- 6/9/1995 Interoffice memo from John F. Doughty to distribution list re; test on Dry Run water and solids. (Bates No. EID016664-EID016666, CF000940-CF000942).
- 6/12/1995 Kemron TCLP SVOC and VOA results for one sample received 5/24/95. WO# N5-05-474. (Bates No. EID035076-EID035080, JMM005709-JMM005713).
- 6/14/1995 Interoffice memo from John Doughty to distribution list re: activated carbon not successful treatment for black water problem. (Bates No. EID016667, CF000943).
- 6/15/1995 Interoffice Memo from Richard A. Kirschner, Jr. to distribution list re: "black" water problem still exists. Activated carbon worked for first day. [No notes included although indicated in memo to be present.] (Bates No. EID016663, CF000939).
- 6/15/1995 Kemron TKN results for three water samples collected 6/1/95. [Includes COC]. (Bates No. EID016670-EID016674, RAK006421-RAK006425).
- 6/17/1995 Interoffice memo from Ralph E. Beeman to George Woytowich re: questions concerning treatment of black water. (Bates No. EID016668-EID016669, GW001368-GW001369).
- Jul-95 Report of Investigation (Bates No. EID012642-EID012656, CF000404-CF000418).
- Jul-95 DMR 1995 [Tabulated results for monthly monitoring parameters] (Bates No. WVDEP 0691).



Jul-95 Quarterly Leachate Analysis (Bates No. WVDEP 0690).

Jul-95 June activities and future programs for black water problem, treatment study using activated carbon, and began 24 hr. aeration. [Includes tabulated inorganic results for Outlet 001 and 1000 feet downstream samples collected January through June, 1995 and Dry Run Special Weekly Samples; tabulated TOC, COD, DO and flow results for Outlet 001 and 1000 feet downstream] (Bates No. EID016726-EID016728, LKI001377-LKI001379).

7/7/1995 C-8 results for nine site samples collected 6/13/95. [Includes COC and transmittal letter from Angel Kionka (QAL Labs). to George Woytowich (DuPont)] (Bates No. EID071188-EID071207, AC002780-AC002799).

7/12/1995 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, June 1995. (Bates No. EID023837-EID023849, SDB000638-SDB000650).

7/12/1995 Report from Robert M. Crowley to George Woytowich, statistical review of second quarter data. (Bates No. EID030580-EID030590, GW000737-GW000747).

7/14/1995 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Second Quarter 1995. (Bates No. EID022854-EID022864).

7/25/1995 Interoffice Memo from Alison A. Crane to distribution list re: aeration of upper pond has cleared appearance. (Bates No. EID016707, CF000938).

8/14/1995 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, July 1995. (Bates No. EID023850-EID023866, SDB000610-SDB626).

9/14/1995 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, August 1995. (Bates No. EID023867-EID023878, SDB000590-SDB000601).

9/25/1995 Letter from John G. Britvec (WVDEP) to W.M. Stewart re: deficiencies found at field investigations on May 16, 1994 were not addressed as seen in the March 23, 1995 and May 3, 1995 investigations. (Bats No. EID012672-EID012685, LKI000830-LKI000843).

10/1995 Response to comments detailed in letter from WVDEP dated September 25, 1995. (Bates No. EID039514-EID039544, DAW000578-



DAW000608).

- 10/11/1995 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, September 1995. (Bates No. EID023879-EID023890, SDB000570-SDB000581).
- 10/12/1995 Report from Robert M. Crowley to D.A. Weber, statistical review of third quarter data. (Bates No. EID030580-EID030590, GW000737-GW000747).
- 10/13/1995 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Third Quarter 1995. (Bates No. EID022865-EID022881).
- 10/20/1995 Treatment of Dry Run Landfill ponds from 3/13/95-10/20/95. (Bates No EID039286-EID039288, TRW001295-TRW001297).
- 10/24/1995 Kemron TCLP results for one soil sample collected 10/12/95. WO# N5-10-310. [Includes COC.] (Bates No. EID036001-EID036008, JMM005605-JMM005612).
- 10/26/1995 Letter from W.M. Stewart (DuPont) to John G. Britvec (WVDEP) re: confirmation of conversation that reference permit application is incomplete. (Bates No. EID020817, GW004426).
- 11/6/1995 Kemron TCLP results for two railroad debris samples collected 10/17/95. WO# N5-10-457. [Includes COC.] (Bates No. EID03581-EID035989, JMM005585-JMM005589).
- 11/6/1995 Kemron TCLP results for two railroad debris samples collected 10/17/95. WO# N5-10-457. [Includes COC. Same as above document.] (Bates No. EID03549-EID035957, JMM005782-JMM005790).
- 11/9/1995 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, October 1995. (Bates No. EID023891-EID023905, SDB000547-SDB000561).
- 11/17/1995 SOP for Leeman Inductively Coupled Plasma Atomic Emission Spectroscopy (EID067544-EID067565).
- 12/5/1995 Letter from John Britvec (WVDEP) to W.M. Stewart re: deficiencies observed in May 1994 and March 1995 field reviews have been addressed; November 2, 1995 field review revealed some deficiencies that must be addressed. (Bates No. EID012688-EID012690, CF000383-CF000385).



12/5/1995 Interoffice memo from Craig K. Dillon to distribution list re: meeting notes on the disposal of FC-143 at Dry Run. (Bates No. EID016730-EID016731, GW000841-GW000842).

12/11/1995 Document signed by A.E. James re: non C-8 waste to be shipped to Dry Run Landfill. [Includes procedures for packaging] (Bates No. EID009068-EID009084, GW000845-GW000861).

12/12/1995 Report from Robert M. Crowley to D.A. Weber, statistical review of fourth quarter data. (Bates No. EID030591-EID030609, GW000748-GW000766).

12/13/1995 Notes from Dawn Jackson documenting call from Jim Crum (DNR). re: deer Mr. Tennant found dead was near Dry Run and DuPont's treatment practices of ponds. (Bates No. EID010289, DDJ001308).

12/15/1995 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, November 1995. (Bates No. EID023906-EID023916, SDB000824-SDB000834).

12/28/1995 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Fourth Quarter 1995. (Bates No. EID022882-EID022893).

1/5/1996 Memo from Marilyn Zumbro to DuPont Sampling Personnel re: DuPont to audit Kemron's sampling during first quarter sampling effort. (Bates No. EID067536-EID067539).

1/8/1996 Quarterly Statistical Review of Groundwater Monitoring Results, Dry Run Landfill, First Quarter 1996. (Bates No. EID 022960-EID022969, GW000643-GW000652).

1/12/1996 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, December 1995. (Bates No. EID023917-EID023927, SDB000512-SDB000522).

1/12/1996 Revised Data Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, for August, September, and October. (Bates No. EID023928-EID023933, SDB000523-SDB000528).

1/16/1996 National Testing Laboratories Watercheck Report of B.J. Well. (Bates No. CA 001,CA 055-CA057).

1/16/1996 National Testing Laboratories Watercheck Report of Dry Run center pipe. (Bates No. CA 052-CA054).



1/29/1996 Washington Works, 1995 Annual Landfill Report. Permits WV0076244, WV1176066. Includes cover letter from W.M. Stewart to Barbara S. Taylor. (Bates No. EID037475-EID037503, JMM007124-JMM007152).

1/29/1996 Washington Works, 1995 Annual Landfill Report. Permits WV0076244, WV1176066. Includes cover letter from W.M. Stewart to Barbara S. Taylor. [Same as above w/ different Bates Nos.] (Bates No. EID037717-EID037725, RAK006401-RAK006409).

2/5/1996 Letter report from Charles Anderson re: results of vegetation survey performed on August 9-10, 1995. Visible effects of air pollution at top of ridge near the Telfon facility. [Includes tables of observations] (Bates No. EID014065-EID014075, LKI000887-LKI000897).

2/6/1996 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, January 1996. (Bates No. EID023661-EID023671, SDB000491-SDB000501).

2/21/1996 Typed notes from "Dan" re: site visit by Michael Zeto, Donald Hill and Cindy Musser all from WVDEP. (Bates No. EID012694, DDJ001307).

3/6/1996 Kemron metals and TCLP metals results for one bottom ash sample collected 2/21/96. WO# N6-02-457

3/7/1996 Interoffice memo from Daniel A. Weber to distribution re: landfill waste totals and projected years remaining on utilization. (Bates No. EID031514-EID031515, LKI000255-LKI000256).

3/14/1996 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, February 1995. (Bates No. EID023672-EID023681, SDB000466-SDB000475).

3/22/1996 Kemron results for paint booth filters 3/8/96. WO# N6-03-163. [Includes COC.] (Bates No. EID035136-EID035140, JMM005769-JMM005773).

4/2/1996 Quarterly Statistical Review of Groundwater Monitoring Results, Dry Run Landfill, First Quarter 1996. (Bates No. EID022944-EID022959, GW000411-GW000426).

4/4/1996 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, First Quarter 1996. (Bates No. EID022894-EID022906).

4/4/1996 State of WV Quarterly Leachate Analysis Report Form (EID022970-EID02273, GW002185-GW002188).



4/11/1996 Letter from Spencer Hamil (QAL Labs). to Dan Weber (DuPont) acknowledging sample receipt on 4/10/96. (Bates No. EID071179-EID071181, AC002766-AC002768).

4/12/1996 Letter from Spencer Hamil (QAL Labs). to Dan Weber (DuPont) acknowledging sample receipt on 4/12/96. (Bates No. EID071182-EID071184, AC002769-AC002771).

4/12/1996 Letter from Spencer Hamil (QAL Labs). to Dan Weber (DuPont) acknowledging sample receipt on 4/12/96. (Bates No. EID071185-EID071187, AC002772-AC002774).

4/12/1996 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, March 1996. (Bates No. EID023682-EID023691, SDB000442-SDB000451).

4/18/1996 Interoffice memo from Walter M. Stewart to Daniel Weber re: aquashade OK for use in sedimentation pond. (Bates No. EID017723, DAW000468).

4/22/1996 Interoffice memo from George Woytowich to Daniel Weber and Walter M. Stewart re: error in Dry Run NPDES Permit Application. (Bates No. EID029734, JMM003562).

4/25/1996 Kemron TCLP results for bio pond press filter cake received 4/17/96. (Bates No. EID035561-EID035568, JMM006891-JMM006898).

4/30/1996 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, April 1996. (Bates No. EID023692-EID023701, SDB000424-SDB000433).

4/30/1996 C-8 results for four site samples collected 4/10/96. [Includes COC and case narrative from CH2M Hill.] (Bates No. EID071136-EID071146, AC002722-AC002732).

5/1/1996 C-8 results for three site samples collected 4/9/96. [Includes COC and transmittal letter from Jennifer Boone (QAL Labs). to Dan Weber (DuPont) Laboratory sheets indicates CH2M Hill.] (Bates No. EID071164-EID071178, AC002750-AC002765).

5/1/1996 C-8 results for three site samples collected 4/10/96. [Includes COC and transmittal letter from Jennifer Boone (QAL Labs). to Dan Weber (DuPont) Laboratory sheets indicates CH2M Hill.] (Bates No. EID071147-EID071163, AC002733-AC002749).



5/1/1996 Letter from W.M. Stewart to Barbara S. Taylor re: revised permit application for continued operation of Dry Run Landfill. [Includes supporting documentation] (Bates No. EID020749-EID021462, CF000537-CF000538, RAK001406-RAK002575).

5/30/1996 Kemron SOP for Sampling Groundwater Monitoring Wells (Bates NO. EID067515-EID067535).

6/4/1996 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, May 1996. (Bates No. EID023702-EID023711, GW005074-GW005083).

6/10/1996 Kemron TCLP results for one asphalt sample collected 5/28/96. WO# 96-05-520. [Includes COC.] (Bates No. EID035975-EID035980, JMM005579-JMM005584).

6/18/1996 Letter from W.M. Stewart to Barbara Taylor re: additional information for Dry Run permit renewal application. (Bates No. EID020696-EID020748, RAK001136-RAK001188).

6/20/1996 Quarterly Statistical Review of Groundwater Monitoring Results, Dry Run Landfill, Second Quarter 1996. (Bates No. EID022974-EID022989, GW000427-GW000442).

6/28/1996 Letter from W.M. Stewart to Barbara S. Taylor re: intention to land apply filter cake sludge generated from filter press at Dry Run Landfill. (Bates No. EID010831-EID010836, CF000354-CF000359).

7/8/1996 Interoffice memo from Richard A. Kirschner, Jr. to Water M. Stewart re: request for copy of OWR approval letter for the application of industrial sludge. (Bates No. EID070777, GW007186).

7/10/1996 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Second Quarter 1996. (Bates No. EID022907-EID022918).

7/11/1996 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, June 1996. (Bates No. EID023712-EID023721, SDB000387-SDB000396).

8/7/1996 Memo from R.W. Meloan to R.A. Kirschner re: Project Objectives Letter, Washington Works Power & Services, Dry Run Landfill Stormwater Diversion and Pond Modifications. (Bates No. EID070250-EID070252, LKI001733-LKI001735).



8/13/1996 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, July 1996. (Bates No. EID023722-EID023731, SDB000348-SDB000357).

8/13/1996 WVDEP Landfill Inspection Report (Bates No. EID012696, GW004160).

8/16/1996 Interoffice memo from Thomas R. Waldron to Lynwood K. Ireland re: efforts made to address items identified by Cindy Musser during audit. (Bates No. EID039285, TRW001294).

8/28/1996 Interoffice memo from Thomas R. Waldron to Brenda C. Sams re: list of materials that can be landfilled without second opinion. (Bates No. EID017773-EID017774, DAW000437-DAW000438).

9/10/1996 Interoffice memo from Walter M. Stewart to distribution re: complaint from Earl Tenant that 150 cattle died as a result of fluoride exposure to water from landfill. (Bates No. EID010291, LKI000126).

9/10/1996 Letter from W.N. Stewart to Cynthia J. Musser re: steps taken to address items noted in compliance inspection report. (Bates No. EID012699-EID012701, GW000151-GW000153).

9/11/1996 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, August 1996. (Bates No. EID023732-EID023741, GW005045-GW005054).

9/16/1996 Interoffice memo from Thomas R. Waldron to Ronald W. Meloon and Lynwood K. Ireland re: observations at landfill. (Bates No. EID024378, JMM002726).

9/24/1996 Letter from Mike Zickler (Weston) to Deborah Eble re: possible conflict of interest. (Bates No. EID009470-EID009471, JMM001634-JMM001635).

9/24/1996 Quarterly Statistical Review of Groundwater Monitoring Results, Dry Run Landfill, Third Quarter 1996. (Bates EID022990-EID023005, GW000443-GW000458).

9/25/1996 Letter from John G. Britvec (WVDEP) to W.M. Stewart (DuPont) re: need for additional information in order to review permit application. (Bates No. EID020647-EID020650, LKI000632-LKI000635).

Oct-96 Data Evaluation of fluoride, aluminum, iron, and manganese. (Bates No. EID034639, RAK004315).



10/2/1996 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Third Quarter 1996. (Bates No. EID022919-EID022931).

10/7/1996 Interoffice memo from Thomas R. Waldron to Ronald W. Meloon and Lynwood K. Ireland re: foam at outfall and exposed track on the face of the active field. (Bates No. EID039381, TRW001290).

10/9/1996 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, September 1996. (Bates No. EID023742-EID023751, GW005035-GW0005044).

10/15/1996 Interoffice memo from Walter M. Stewart to distribution re: inspection of landfill to be performed as a result of Mr. Tennant's complaint. (Bates No. EID024318, JMM001782).

10/15/1996 Letter from Laidley Eli McCoy to W.M. Stewart re: intent to file civil action against DuPont due to continuous discharge and disposal violations. [Includes complaint] (Bates No. EID012733-EID012756, LKI000594-LKI000617).

10/16/1996 EPA sampling at Dry Run Landfill Summary of Split Sample Results Analyzed by Kemron Environmental Services. [Includes results for metals, formaldehyde, acetone, benzene, and di-n-butylphthalate] (Bates No. EID034874, JMM001722).

10/17/1996 Interoffice Memo from Edward J. Lutz to 9 addresses re: technical arguments in defense of Dry Run conceptual design. (Bates No. EID017801-EID017803, DAW000430-DAW000432).

10/22/1996 State of WV Quarterly Well Report Form (Bates No. EID023006-EID023020, SDB000039-SDB000053).

10/23/1996 TIC summary forms for water samples received 10/18/96. (Bates No. EID034830-EID034834, JMM001480-JMM001483).

10/24/1996 Kemron Organic QA/QC (Bates No. EID034835-EID034846, JMM001409-JMM001420).

10/28/1996 Kemron Inorganic QA/QC (Bates No. EID034808-EID034829, JMM001387-JMM001408).

11/1/1996 Interoffice memo from Thomas R. Waldron to Lynwood K. Ireland and Richard A. Kirschner, Jr. re: exposed trash and truck unloading in the asbestos disposal area. (Bates No. EID039260, TRW001269).



- 11/4/1996 Letter from W.M. Stewart to Ron Levine (Northwestern Disposal Sanitary Landfill) re: would like to begin disposing of 330 tons per month of non-hazardous filter cake. [Includes Solid Waste Profile form]. (Bates No. EID010872-EID010785, RAK007630-RAK007643).
- 11/4/1996 Interoffice memo from Richard A. Kirschner, Jr. to Sharon S. Adams re: biopond filtercake shipments to Northwestern Landfill on Rt. 50. (Bates No. EID010886, RAK007625).
- 11/7/1996 Letter from Richard P. Cooke (EPA). to Ronald Levine (Northern Disposal, Co.). re: approval granted to dispose of filter cake. (Bates No. EID010888, RAK007623).
- 11/8/1996 Letter from W.M. Stewart (DuPont) to Barbara S. Taylor (WVDEP) re: plans to collect leachate generated at Dry Run Landfill and transport it to Washington Works for treatment. (Bates No. EID010842-EID010864, RAK007672-RAK007676).
- 11/11/1996 Talking Points-For Use Only Upon Media Inquiry. [Includes draft dated 11/8/96 and memo from Gerald Ploeger to Walter Stewart, Daniel Weber, and Dawn Jackson requesting review.] (Bates No. EID017805-EID017807, DAW000411-DAW000413).
- 11/12/1996 Letter from W.M. Stewart (DuPont) to Barbara S. Taylor (EPA). re: request modification to permit to treat leachate from Dry Run in the wastewater treatment plant. (Bates No. EID021472-EID021516, LKI000465-LKI000508).
- 11/13/1996 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, October 1996. (Bates No. EID023752-EID023761, SDB000283-SDB000292).
- 11/14/1996 Kemron results for samples collected 10/16/96. [Includes cover letter from W.M. Stewart (DuPont) to Barbara Taylor (WVDEP) (Bates No. EID012759- EID012811, JMM001674-JMM001721).
- 11/18/1996 Kemron TCLP metals results for one solid waste collected 10/24/96. Login # 96-11-040. (Bates No. EID035972-EID035973, JMM005576-JMM005577).
- 11/20/1996 Letter from John Britvec (WVDEP) to W.M. Stewart (DuPont) re: requests 1 foot clay berm be installed around the entire perimeter of the leachate holding tank. (Bates No. EID031608-EID031609, HDR000754-HDR000755).



11/20/1996 Lubeck PSD Findings for EPA's Inquiry. [Includes cover letter from David P Watkins (WVDEP) to Sarah Caspar (EPA Region III).]. (Bates No. EID012815-EID012823, JMM001637-JMM001645).

11/20/1996 Minutes of ECC Meeting. (Bates No. EID070290, GW007088).

11/25/1996 Letter from Richard P. Cooke (EPA). to Ronald Levine (Northern Disposal, Co.) Re: approval granted to dispose of increased volume of filter cake. (Bates No. EID010894, RAK007613).

12/2/1996 Letter from W. M. Stewart (DuPont) to Barbara Taylor (WVDEP) re: proposed revision to the system which will be used to collect leachate generated at the Dry Run Landfill and transport it to Washington Works for treatment. (Bates No. EID010849-EID010860, CF000316-CF000327).

12/3/1996 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, November 1996. (Bates No. EID023762-EID023771, GW005016-GW005024).

12/3/1996 Letter (unsigned). from W.M. Stewart (DuPont) to Barbara S. Taylor (WVDEP) re: additional information concerning operation of the holding tank pump used in the Dry Run Landfill leachate collection system. [Same as signed letter dated 12/4/96] (Bates No. EID017708-EID017710, DAW000407-DAW000409).

12/4/1996 Letter from W.M. Stewart (DuPont) to Barbara S. Taylor (WVDEP) re: additional information concerning operation of the holding tank pump used in the Dry Run Landfill leachate collection system. [Same as unsigned letter dated 12/3/96] (Bates No. EID010862, RAK007656).

12/4/1996 Letter from John Britvec (WVDEP) to W. M. Stewart (DuPont) re: revised interim system appears to be acceptable. (Bates No. EID010863-EID010864, CF000305-CF000306).

12/4/1996 Quarterly Statistical Review of Groundwater Monitoring Results, Dry Run Landfill, Fourth Quarter 1996. (Bates No. EID023021-EID023040, GW0000459-GW000478).

12/12/1996 Letter from Barbara S. Taylor to Walt M. Stewart re: modification to WV/NPDES permit. Revised pages enclosed. (Bates No. EID021464-EID021471, HDR000673-HDR000680).

12/12/1996 Consent Decree, Circuit Court of Wood County, WV; Laidley Eli McCoy, Director WV Division of Environmental Protection, Plaintiff v. E.I.



DuPont de Nemours & Co., Inc. (Bates No. EID029970-EID029985, RLR001485-RLR001500).

- 12/13/1996 Field Trip Report Preliminary Assessment for Dry Run/N. Fork Lee Creek Bovine Site, by PRC Environmental Mgmt for USEPA Region 3 (Bates No. USFW 0157-USFW 0350).
- 12/19/1996 Interoffice memo from Hayden Lancaster to Waldrotr re: rejected load and itemization of various Teflons to be disposed. (Bates No. EID031616-EID031617, CF000806-CF000807).
- 12/19/1996 Interoffice memo from Thomas R. Waldron to Alison A. Crane, Richard A. Kirschner, Jr., and Daniel A. Weber re: able to dispose of pelletized stuff in Dry Run but have no idea where powders and raw materials will end up. (Bates No. EID 031615, CF00805).
- 12/19/1996 Interoffice memo from Hayden Lancaster to Thomas R. Waldron re: disposal of material. (Bates No. EID039248-EID039249, TRW001240-TRW001241).
- 12/20/1996 Interoffice memo from Daniel A. Weber to distribution list re: teflon/tefzel/halar wates OK for Dry Run providing they are extruded material. Hold on calcium tetraborate. (Bates No. EID031614, CF000804).
- 12/20/1996 Interoffice memo from Thomas R. Waldron to Hayden E. Lancaster re: returned shipment. (Bates No. EID031618, JMM004019).
- 12/23/1996 Letter from W.M. Stewart to Barbara S. Taylor re; submission of additional information to supplement Dry Run Landfill permit renewal application. (Bates No. EID020596-EID020641, RAK001035-RAK001080).
- 12/30/1996 Interoffice memo from Richard A. Kirschner to Leonard W. Hall re: Dry Run Landfill project update. (Bates No. EID070239-EID070246, LKI001722-LKI001729).
- 12/31/1996 Fax from Matthew Crown to David Ramsey re: requesting signature to Order Issued Under the Water Pollution Control Act. Includes handwritten note also dated 12/31/96. (Bates No. EID024188-EID024189, HDR000661-HDR000662).
- 12/31/1996 Signed Order Issued Under the Water Pollution Control Act.
- 1997 Dry Run Landfill Task Team Anticipated Questions. (Bates No.



EID029797-EID029801, LKI001047-LKI001047).

- 1997 Hand written notes of Tennant farm Review of video tape. (Bates No. EID067268-EID067271, GPS000561-GPS000564).
- 1/2/1997 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Fourth Quarter 1996. (Bates No. EID022932-EID022943).
- 1/3/1997 Interoffice Memo from Ronald Meloan to distribution list re: first load of leachate from Dry Run back to the new dewatering facility. (Bates No. EID029946, CF000801).
- 1/6/1997 Appendix E-Support Documentation. Narrative and QC data for soil and water samples collected 10/96. Analysis performed by AATSLA. Also includes COC and copies of sample tags. (Bates No. EID034848-EID034864, JMM001493-JMM001509).
- 1/6/1997 Appendix D CADRE Qualification Reports (Bates No. EID034865-EID034873, JMM001484-JMM001492).
- 1/6/1997 Kemron TCLP metals results for one Monomer Stillhouse sample collected 12/31/96. Login # 97-01-009. [Includes COC.] (Bates No. EID035967-EID035971, JMM005571-JMM005575).
- 1/7/1997 Inorganic Data Validation (IM2 Level) prepared by Lockheed Martin. [Includes transmittal memo from Cynthia E. Caporale to Sarah Caspar] (Bates No. USEPA 0400-USEPA 0454).
- 1/13/1997 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, December 1996. (Bates No. EID023772-EID023781, GW005005-GW005014).
- 1/19/1998 Memo from Andrew Hartten to Dan Weber re: Comments on EPA's Dry Run Landfill Summary Report Geology and Hydrogeology Related Issues. (Bates No. EID067091-EID067096, RAK004335-RAK004340).
- 1/19/1998 Table of results from memo from Andrew Hartten to Dan Weber re: Comments on EPA's Dry Run Landfill Summary Report Geology and Hydrogeology Related Issues. (Bates No. EID067091-EID067096, RAK004335-RAK004340).
- 1/20/1997 Interoffice memo from Daniel A. Weber to distribution re: monitoring well maintenance/issue list. (Bates No. EID024361).
- 2/7/1997 Kemron TCLP results for six samples collected 1/17/97. Login # 97-01-



459. (Bates No. EID036009-EID036029).

- 1/22/1997 Interoffice memo from Thomas R. Waldron to D. Lew Westermeyer re: 30 boxed of material to landfill at Dry Run. (Bates No. EID039928, TRW000388).
- 1/23/1997 Interoffice memo from Thomas R. Waldron to Hayden E. Lancaster re: disposition of material to landfill. (Bates No. EID039247, TRW001239).
- 1/24/1997 NPDES Incident Summary (EID029936, RLR001326).
- 1/27/1997 Interoffice memo from Alison A. Crane to Daniel A. Weber re: request to landfill melamine cyanurate and elvamide. (Bates No. EID031838).
- 1/27/1997 Letter from W.M. Stewart to Barbara Taylor re: signed copy of Order Number 3850 for settlement of findings resulting from inspections conducted at Dry Run. (Bates No. EID024243-EID024248, DDJ000065-DDJ000070).
- 1/29/1997 Interoffice memo from Harley D. Bickerstaff to Ronald W. Meloon & Lynwood K. Ireland re: pH, TSS, and T-Fe results for sample taken from Outlet 001. (Bates No. EID039240, TRW001220).
- 1/30/1997 Washington Works, 1996 Annual Landfill Report. Permit WV0076244. Includes cover letter from W.M. Stewart to Barbara S. Taylor. (Bates No. EID037734-EID037743, RAK006382-RAK006391).
- 1/30/1997 Hand drawn map of existing leachate collection system, upper pond, lower pond, and Outlet 001. (Bates No. EID029921, GW004751).
- 1/31/1997 Table of TSS and total iron results for Outlet 001 and Outlet 002. (Bates No. EID011553, RAK000264).
- 1/31/1997 Interoffice memo from John F. Doughty to 5 addressees re: iron and manganese in water samples from landfill. Memo forwarded to Thomas R. Waldron and Alison A. Crane from Richard A. Kirschner, Jr. (Bates No. EID039242-EID039243, TRW001224-TRW001225).
- 2/3/1997 State of WV Quarterly Well Report Form. Includes Groundwater Sampling Field Data Sheets (Bates No. EID023116-EID023013, GW000393-GW000403, SDB00105-SDB001059).
- 2/7/1997 Interoffice memo from Richard A. Kirschner, Jr. to 5 addressees re: iron content in Outlet 001 sample. (Bates No. EID039239, TRW001219).



2/11/1997 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, January 1997. (Bates No. EID023538-EID023546, SDB000982-SDB000990).

2/13/1997 Letter from Dennis P. Carney (EPA Region III) to Walt Stewart (DuPont) re: seeking information concerning a release at Dry Run Landfill. [Includes Interoffice memo from W.M. Stewart to H.D. Ramsey.] (Bates No. EID009021-EID009029, RAK003232-RAK003240).

2/14/1997 Interoffice Memo from Richard A. Kirschner, Jr. to distribution list re: investigation meeting to discuss iron exceedances. (Bates No. EID029916, HDR000477).

2/16/1997 Email from Carl Berryman to Alloyra A. Marrs re: Mr. Tennant's cattle deaths. (Bates No. EID010297, JMM000996).

2/19/1997 MSDS for FC-118. [Includes fax form from Les Eng to Dr. William Edwards. (Bates No. EID008492-EID008498, GW001400-GW001406).

2/19/1997 Interoffice memo from Richard A. Kirschner, Jr. to distribution list re: elevated iron levels in landfill. (Bates No. EID011551-EID011553, RAK000262-RAK000263).

2/20/1997 Incident Report (Washington Works)., monthly average for iron exceeded NPDES permit limit. (Bates No. EID024385-EID024387, JRM000282-JRM000284).

2/21/1997 Washington Works Dry Run Landfill Additional Information. (Bates No. EID020434-EID020571, RAK000859-RAK000996).

2/27/1997 Interoffice Memo from Daniel A. Weber to Alison A. Crane re: disposal of creosoted wood. (Bates No. EID031849, GW000839).

2/27/1997 Letter from Charles A. Moses (Div. Environmental Protection). to Anthony Meadows (NPDES/EPA). re: report of groundwater sampling performed 1/14-16/97. Includes tabulated analytical results (Bates No. EID046428-EID046438, RAK007425-RAK007435).

2/27/1997 Letter from Jack Cotrell to Todd Carden (Public Service Commission of WV) re: object to permit being issued to Boso Equipment. (Bates No. EID020432, DDJ000387).

3/3/1997 Interoffice memo from Daniel Weber to Walter M. Stewart re: disposal of deer bones at Dry Run Landfill approved by WVDEP. (Bates No. EID031850, JMM001815).



3/6/1997 Interoffice Memo from Walter M. Stewart to distribution list re: tissue samples collected from deceased cow. (Bates No. EID017283, JMM001778).

3/7/1997 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, February 1997. (Bates No. EID023547-EID023556, SDB001046-SDB001054).

3/7/1997 Letter from W.M. Stewart to Barbara S. Taylor (WVDEP) re: narrative description and Groundwater Protection Plan required for Dry Run Landfill. Includes plan. (Bates No. EID020415-EID020431, CF000269-CF000285).

3/10/1997 Report form Shelia Grimes (Animal Disease Diagnostic Laboratory) to Belpre Animal Clinic of necropsy findings of dead 6-month bull cow. (Bates No. B 001-B 005).

3/10/1997 Report form Shelia Grimes (Animal Disease Diagnostic Laboratory) to Belpre Animal Clinic of necropsy findings of dead 6-month bull cow. (Bates No. USEPA 145-USEPA 148).

3/10/1997 Interoffice memo from Richard A. Kirschner, Jr. to Daniel Weber re: disposal of materials from Washington Works. (Bates No. EID031851-EID03153, GW000829-GW000831).

3/10/1997 Interoffice memo from Daniel Weber to distribution list re: issuance of formal response to FOIA request and samples taken from dead cow, and submitted for analysis. (Bates No. EID009486, JMM001903).

3/17/1997 Interoffice memo from Charles T. Abel to Richard A. Kirschner, Jr. re: Hartley Manufacturing sending waste to Dry Run since operations began in 1984. (Bates No. EID031855, GW000790).

3/19/1997 Notes of phone call to Dr. Thomas. (Bates No. EID010433).

3/19/1997 Update: 3 meetings on Dry Run. (Bates No. EID009785, JMM000971).

3/20/1997 Update to Dry Run. (Bates No. EID009785, JMM000971).

3/20/1997 Letter from W.M. Stewart (DuPont) to Sarah Caspar (EPA) re: response to Dry Run Landfill information request received 2/19/97. (Bates No. EID009048-EID009067, JMM002825-JMM002844).

3/20/1997 Letter from W.M. Stewart (DuPont) to Sarah Caspar (EPA) re: response



to Dry Run Landfill information request received 2/19/97. (Bates No. EID009085-EID009114, JMM002845-JMM002874).

- 3/28/1997 Report from Jon S. Patterson (Animal Health Diagnostic Laboratory) to Sarah Caspar (EPA Region 3). of necropsy findings of two cows. (Bates No. USEPA 130-USEPA 134).
- 3/31/1997 Quarterly Statistical Review of Groundwater Monitoring Results, Local Landfill, First Quarter 1997. (Bates No. EID023106-EID023115, GW000496-GW000505).
- 4/3/1997 Letter from John G. Britvec (WVDEP) to W.M. Stewart re: forms for Permit Application found to be complete. Includes draft copy of permit and copy of memo from W.M. Stewart to H.D. Ramsey dated 4/3/97 asking for comments (Bates No. EID020222-EID020262, RAK007280-RAK007326).
- 4/4/1997 Report of Laboratory Examination (Animal Health Diagnostic Laboratory) feed analysis. (Bates No. WVDEP 0857-WVDEP 0858).
- 4/15/1997 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, First Quarter 1997. (Bates No. EID023041-EID023052).
- 4/15/1997 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, March 1997. (Bates No. EID023557-EID023566, SDB001073-SDB001082).
- 4/17/1997 Spreadsheet of Outlet 001 data and comparison with various standards. (Bates No. EID034640-EID034641, RAK004316-RAK004317).
- 4/17/1997 Interoffice memo from Neil Krivanek to Anthony J. Playtis re: review of pathology report for dead bull calf performed by Krivanek and one vet. Animal death was emaciation caused by parasite and that organic and inorganic material from Outfall 001 did not contribute to death. (Bates No. EID017415, GW002280).
- 4/26/1997 Interoffice memo from Thomas R. Waldron to Lynwood K. Ireland re: water leaching from three areas of Dry Run Landfill. (Bates No. EDI039223-EID039224, TRW001183-TRW001184).
- 5/2/1997 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, April 1997. (Bates No. EID023567-EID023576, SDB001090-SDB001099).
- 5/7/1997 Letter from W.M. Stewart (DuPont) to Barbara Taylor (WVDEP) re:



comments regarding NPDES permit for Dry Run Landfill. (EID020191-EID020206, DDJ000271-DDJ000286).

- 5/7/1997 Letter from George Woytowich (DuPont) to Sheryl Chesnutt (Kemron) re: additional samples collected during quarterly July sampling to be analyzed for FC-143. (Bates No. EID008995-EID008997, GW006830-GW006832).
- 5/19/1997 Interoffice memo from Daniel A. Weber to distribution re: copy of WVDEP groundwater sampling inspection report. (Bates No. EID017996-EID017997, RAK007436-RAK007437).
- 5/29/1997 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, May 1997. (Bates No. EID023577-EID023586, SDB001107-SDB001116).
- 5/29/1997 Interoffice memo from Lynwood K. Ireland to 3 addressees re: need to remove Mr. Tennant from property. (EID017784, DAW000247).
- 5/29/1997 Interoffice memo from Richard A. Kirschner to 6 addressees re: cow(s) tried drinking the water exiting the lower pond discharge at Outfall 001. (Bates No. EID017681, DAW000245).
- 5/30/1997 Interoffice memo from Daniel Weber to distribution list re: Kemron and WVDEP use Method No. 340.2 for fluoride analysis. (Bates No. EID030653, CF000763).
- 5/30/1997 Memo re: Kemron and WVDEP use Method No. 340.2 for fluoride analysis. (Bates No. EID034883, DDJ001227).
- 6/1997 Draft Conceptual Work Plan prepared by Roy F. Weston. (Bates No. EID034650-EID034668, CF001317-CF001335).
- 6/6/1997 Quarterly Statistical Review of Groundwater Monitoring Results, Dry Run Landfill, Second Quarter 1997. (Bates No. EID023123-EID023151, CF003086-CF003105).
- 6/6/1997 Letter from W.M. Stewart (DuPont) to Barbara Taylor (WVDEP) re: design information to use high density polypropylene drainage net material in leachate collection system. (Bates No. EID020175-EID020189, RAK001101-RAK001115).
- 6/9/1997 Interoffice memo from Daniel A. Weber to 7 addressees re: EPA Region III re: EPA to take samples to conduct an ecological risk assessment. (EID017890-EID017891, DAW000243-DAW000244).



- 6/11/1997 Small Mammal Sampling and Processing and Veterinary Pathology worksheets. (Bates No. EID038355-038454, JMM000863-JMM000962).
- 6/11/1997 Small Mammal Sampling and Processing and Veterinary Pathology worksheets. Similar to document above with the addition of some handwritten notes. (Bates No. EID038455-038554, RAK004498-RAK005071).
- 6/11/1997 Interoffice memo from Richard Kirschner, Jr. to Lynwood K. Ireland re: status of mammal sampling. (Bates No. EID017255-EID017256, DAW000240-DAW000241).
- 6/12/1997 C-8 results for three site samples collected 5/22/97. [Includes COC and transmittal letter from Spencer Hamil (CH2M Hill) to George Woytowich (DuPont)] (Bates No. EID071101-EID071114, AC002652-AC002665).
- 6/23/1997 Dry Run Landfill 1997 Groundwater/Surface water: additional monitoring results. (Bates No. EID037761-EID037765, RAK006515-RAK006519).
- 6/30/1997 Memo from W.M. Stewart to L.K. Ireland re: report summarizing toxicology results indicate the only significant toxicological finding was low copper concentration. [Includes necropsy report dated 3/28/97.] (Bates No. EID017416-EID017427, JRM000135-JRM000145).
- 7/1997 Final Report: Toxicity Assessment of Soil Samples from the Dry Run Creek Site with the Lumbricid Earthworm, Eisenia Foetida [Includes cover letter from Joe Owusu-Yaw (QST) to Mike Horne (Weston). dated 6/24/97.] (Bates No. EID038266-EID038030391, RAK004995-RAK005032).
- 7/1997 Final Report: Toxicity Assessment of Sediments from the Dry Run Creek Site with the Freshwater Invertebrate, Hyalella Azteca [Includes cover letter from Joe Owusu-Yaw (QST) to Mike Horne (Weston). dated 7/23/97.] (Bates No. EID038041-EID038091, JMM000762-JMM000813).
- 7/1997 Final Report: Chronic Toxicity of Surface Water Samples from the Dry Run Creek Site with the Fathead Minnow. (Bates No. EID038150-EID038198, JMM000814-JMM000862).
- 7/2/1997 C-8 results for 11 site samples collected 5/29/97 and 6/02/97. [Includes COC and transmittal letter from Spencer Hamil (CH2M Hill) to George Woytowich (DuPont)] (Bates No. EID071115-EID071135, AC002666-AC002685).



7/11/1997 Interoffice memo from Roger W. Duff to Dawn D. Jackson re: odor complaint from resident by Dry Run Landfill. (Bates No. EID013185, RAK007220).

7/14/1997 Interoffice memo from Dawn D. Jackson to distribution re: response to odor complaint. (Bates No. EID013186-EID013188, RAK007217-RAK007219).

7/14/1997 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Second Quarter 1997. (Bates No. EID023053-EID023064).

7/14/1997 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, June 1997. (Bates No. EID023587-EID023596, SDB001126-SDB001135).

7/14/1997 Interoffice memo from Thomas R. Waldron to Ronald W. Meloon, Linwood K. Ireland, and Richard A. Kirschner, Jr., re: algae bloom and smell of rotten eggs coming from two collection ponds. (Bates No. EID039196, TRW001149).

7/17/1997 Interoffice memo from Neil Krivanek to Anthony J. Playtis re: report summarizing toxicology results indicate the only significant toxicological finding was low copper concentration. (Bates No. EID017810-EID017811, DAW00229-DAW000231).

7/17/1997 Interoffice memo from Neil Krivanek to Anthony J. Playtis re: report summarizing toxicology results indicate the only significant toxicological finding was low copper concentration. [Same as above with the addition of a hand written note] (Bates No. EID017430, DDJ00827).

7/17/1997 Interoffice memo from Roger Duff to Dawn D. Jackson re: aerator turned on at landfill. (Bates No. EID039190, TRW001143).

7/23/1997 Email from John Little to many addressees re: fact sheet for distribution which addresses concerns about Dry Run landfill. (Bates No. EID070696-EID070698, RJZ000004-RJZ000006).

7/28/1997 Letter from Laidley Eli McCoy (Potesta) to Daniel Weber (DuPont) re: thoughts on four comments made by Affiliated Construction Trades Foundation regarding draft permit. (Bates No. EID052803-EID052805, CF000720-CF000722).

7/29/1997 Interoffice memo from Thomas R. Waldron to Lynwood K. Ireland re: no



leachate entered upper pond during power outage. (Bates No. EID017787, DAW000211).

- 7/29/1997 Interoffice memo from Lynwood K. Ireland to Daniel A. Weber re: electricity at Dry Run landfill -FYI. (Bates No. EID017786, DAW000210).
- 8/6/1997 Interoffice memo from Daniel A. Weber to Jeremy S. Bruno re: first half 1997 waste to landfills. (Bates No. EID067473, CF004839).
- 8/8/1997 Memo from Mike McClusky re: plans to move to using recyclable drums for Teflon shipment. (Bates No. EID009796, DDJ001167).
- 8/8/1997 Letter from Ronald R. Potesta (Potesta) to Dan Weber (DuPont) re: proposal for surface and groundwater survey and testing. (Bates No. EID018013-EID018017, JRM000478-JRM000482).
- 8/11/1997 Interoffice Memo from Dawn D. Jackson to distribution re: notes from meeting with five citizens living on Pine Run Road. (Bates No. EID013156-EID013158, RAK007468-RAK007470).
- 8/12/1997 Interoffice memo from Richard A. Kirschner, Jr. to Dawn D. Jackson re: oily sheen on sample from 001 outlet disappeared. (Bates No. EID039176, TRW001126).
- 8/13/1997 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, July 1997. (Bates No. EID023597-EID023606, SDB001145-SDB001154).
- 8/16/1997 Letter report form Charles Anderson re: results of vegetation survey performed on July 29-30, 1997. [Includes tables of observations] (Bates No. EID014065-EID014075, LKI000887-LKI000897).
- 8/19/1997 C-8 results for eight site samples collected 7/21-22/97. [Includes COC and transmittal letter from Spencer Hamil (CH2M Hill). to George Woytowich (DuPont)] (Bates No. EID071081-EID071100, AC002632-AC002651).
- 8/28/1997 Project Procurement Plan. (Bates No. EID070253-EID070259, LKI001736-LKI001741).
- 9/10/1997 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, August 1997. (Bates No. EID023607-EID023616, SDB001167-SDB001176).



9/12/1997 Quarterly Statistical Review of Groundwater Monitoring Results, Dry Run Landfill, Third Quarter 1997. (Bates No. EID023152-EID023172, GW000526-GW000546).

9/25/1997 Interoffice memo from Thomas R. Waldron to Lynwood K. Ireland and Richard A. Kirschner, Jr. re: notes from Public Service Commission meeting and discussion of individuals attending hearing protesting DuPont's operation. (Bates No. EID017703-EID017705, DAW000201-DAW000203).

9/25/1997 Interoffice memo from H. David Ramsey, Jr. to 10 addressees re: sensitive information. (Bates No. EID017702, DAW000200).

9/26/1997 Letter from Dawn Jackson to Lyn Westbrook re: list of substances from operating permit that might be in Dry Run landfill.

9/29/1997 Memo from V. Kansal to R. Singhvi re: analytical results and COCs for samples collected in June 97. (Bates No. EID038821-EID038972, RAK004742-RAK004890).

10/7/1997 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Third Quarter 1997. (Bates No. EID023065-EID023076).

10/8/1997 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, September 1997. (Bates No. EID023617-EID023626, SDB001192-SDB001201).

10/9/1997 Interoffice memo from David F. Eggleston to Daniel A. Weber re: asbestos waste going to Meadowfill Landfill. (Bates No. EID037650, JMM007652).

10/15/1997 Interoffice memo from Richard A. Kirschner to David F. Eggleston re: asbestos waste to Dry Run Landfill between '95 and '97. (Bates No. EID037650, JMM007652).

10/17/1997 Interoffice memo from Daniel A. Weber to 2 addressees re: responses to comments during permit renewal process and comment about carpet from manufacturer being dumped at Dry Run. (Bates No. EID017884, DAW000197).

10/31/1997 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, October 1997. (Bates No. EID023627-EID023636, SDB001217-SDB001226).

10/31/1997 Letter from R.L. Ritchey to David Chaney (WVDEP) re: transmittal of



computer disk containing all available waster analysis results from samples taken at Letart Landfill. (Bates No. EID069704-EID069705, CF005158-CF005159).

- Nov-97 Results of histopathology for the meadow vole and analytical results of several water samples (Bates No. EID038092-EID038149, RAK005171-RAK005228).
- Nov-97 Draft Report prepared by Mark D. Sprenger, Ph.D. and Michael T. Horne, Ph.D. (Bates No. USFW 0579-USFW 1244).
- Nov-97 Operations plan prepared by Potesta & Associates, Inc. for DuPont Polymers, Project No. 97016. (Bates No. EID020149-EID020167, JRM000303-JRM000322).
- 11/7/1997 Email from Roger to Jim re: disposal costs for C-8 containing wastes and non-C-8 containing wastes. (Bates No. EID070699, RJZ000007).
- 11/21/1997 Fax from Rich Kirschner to Pat Lane (Kemron) re: sampling changes. (Bates No. EID030656, RAK004155).
- 12/1/1997 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, November 1997. (Bates No. EID023641-EID023650, SDB001245-SDB001254).
- 12/5/1997 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, October 1997 Revision. (Bates No. EID023637-EID023640, SDB001241-SDB001244).
- 12/23/1997 Interoffice memo from Dan Weber to distribution list re: key findings and comments from EPA's draft report on Dry Run Creek. (Bates No. EID039437-EID039443, JMM002201-JMM002207).
- 1998 Dry Run Landfill Usage by Fluoroproducts in 1997. (Bates No. EID015222, RLR001145).
- 1998 Natural Fluoride Levels in Soil, GW, and SW. (Bates No. EID045511-EID045518, ASH000050-ASH000057).
- Jan-98 Fluoride sources to Dry Run Landfill (Bates No. EID016853-EID016854, JMM000049-JMM000050).
- 1/5/1998 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, December 1997. (Bates No. EID023651-EID023660, SDB001272-SDB001281).



1/6/1998 Quarterly Statistical Review of Groundwater Monitoring Results, Dry Run Landfill, Fourth Quarter 1997. (Bates No. EID023252-EID02371, GW000567-GW000586).

1/9/1998 Interoffice memo from Robert L. Ritchey to distribution re: formation of the Team to develop a scientific response to the EPA draft report on Dry Run Landfill. (Bates No. EID067081-EID067082, RLR001276-RLR001277).

1/13/1998 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Fourth Quarter 1997. (Bates No. EID023077-EID023088).

1/13/1998 Interoffice memo from Daniel A. Weber to distribution re: review of Dry Run Landfill draft report. (Bates No. EID067085-EID067086, RAK004496-RAK004497).

1/13/1998 Interoffice memo from Mary Jenkins to Robert L. Ritchey re: have not seen materials for review. (Bates No. EID067087, RAK004490).

1/13/1998 Interoffice memo from Robert L. Ritchey to Mary Jenkins re: copy of report being sent ASAP. (Bates No. EID067088, RAK004491).

1/14/1998 Interoffice memo from Daniel A. Weber to Richard A. Kirschner, Jr. re: include Oct. '96 data, monthly sampling data summaries for 1996 and 1997, and statistical comparisons of Mn and other data. (Bates No. EID067089, RAK004492).

1/16/1998 Interoffice memo from J. Bart Ruiter to Richard Kirschner, Jr. re: draft report does not need NPDES review. (Bates No. EID067090, RAK004458).

1/20/1998 Title blocks from topographic map of site. (Bates No. EID037766-EID037767, RAK006520-RAK006521).

1/20/1998 Memo from Timothy S. Bingman to Daniel Weber re: several symptoms found in cattle are not attributable to fluoride. (Bates EID039503-EID039505, DAW000533-DAW000535).

1/20/1998 Interoffice memo from Timothy S. Bingman to Daniel Weber re: effects of fluoride in cattle references (Bates No. EID017440, JMM002167).

1/22/1998 Interoffice memo from Matthew S. Bogdanffy to Richard Kirschner, Jr. and Daniel Weber re: due to poor procedures, inferences drawn in the Dry Run report with regard to mammalian species at risk are not supported by



the experimental data presented in the report. (Bates No. EID067154-EID067156, DAW000158-DAW000160).

- 1/23/1998 Interoffice memo from Daniel A. Weber to Robert L. Ritchey re: response to three questions asked by John Britvec. (Bates No. EID017880-EID017881, DAW000152-DAW000153).
- 1/23/1998 Interoffice memo from Richard A. Kirschner, Jr. to Daniel A. Weber re: Comments on EPA draft report. (Bates No. EID067076-EID067079, DAW000154-DAW000158).
- 1/27/1998 Interoffice memo from Daniel A. Weber to distribution re: Technical Review Summary of EPA's Dry Run Creek Draft Report. (Bates No. EID067025-EID067031, RAK004360-RAK004366).
- 1/27/1998 Technical Review Summary of EPA's Dry Run Creek Draft Report. (Bates No. EID067466-EID067470, JMM002365-JMM002369).
- 1/28/1998 Email from H. David Ramsey to Roger J. Zipfel re: involvement in helping to prepare for Dry Run landfill meeting with EPA. (Bates No. EID070704, RJZ000033).
- 1/28/1998 Interoffice memo from Keith B. Pierson to Robert L. Ritchey re: summary of technical issues discussed during conference call. (Bates No. EID067198-EID067199, DAW000138-DAW000139).
- 1/30/1998 Washington Works, 1997 Annual Landfill Report. Permit WV0076244. Includes cover letter from R.L. Ritchey to Barbara S. Taylor. (Bates No. EID037754-EID037760, RAK006508-RAK006514).
- 2/2/1998 Kemron report for formaldehyde (OUTLET 001) (Bates No. EID023466-EID023472, SDB001878-SDB001884).
- 2/2/1998 Interoffice memo from Andrew S. Hartten to Richard A. Kirchner, Jr. re: pump to use for sampling MW-14. (Bates No. EID030695, RAK004309).
- 2/2/1998 Kemron report for samples Outlet 001 and 1000 Ft Downstream. (Bates No. EID023403-EID023417, SDB001895-SDB001909).
- 2/2/1998 Email from Carey to Zipfel re: items sent to Dry Run on an annual basis from Granular. (Bates No. EID070700, RJZ000008).
- 2/3/1998 Memo from Roger Zipfel to Bob Ritchey re: information requested concerning the types and amounts of materials sent to Dry Run Landfill



by Fluoroproducts BTO. (Bates No. EID031870-EID031907, JMM001895-JMM001205).

- 2/5/1998 Email from Roger to George re: polymeric material being sent to Dry Run. (Bates No. EID070701, RJZ000009).
- 2/6/1998 Interoffice memo from Robert L. Ritchey to Daniel A. Weber re: non-standard polymer due to molecular weight or particle size still inherently stable fluoropolymer. (Bates No. EID015217, RLR001140).
- 2/6/1998 Email from Daniel A. Weber to Robert L. Ritchey re: Fluorides Sources to Dry Run Landfill (slide) (Bates No. EID015202-EID015203, RLR001975-RLR001976).
- 2/9/1998 Email from Dan Weber to Ritcherl, Ramsey, and Zipfel re: movement and disposal of FC-143. (Bates No. EID070702, RJZ000010).
- 2/9/1998 Email from Daniel Weber to John Migliore re: discussion of FC143 (Bates No. EID045015, JMM007804).
- 2/10/1998 Interoffice memo from Robert L. Ritchey to distribution list re: re: call from Mr. Mike Torrino, Region III, new person on Dry Run project. (Bates No. EID024340, JMM002156).
- 2/10/1998 Email from George Woytowich to distribution re: call from Mr. Mike Torrino, Region III, new person on Dry Run project. (Bates No. EID070289, GW007087).
- 2/13/1998 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, January 1998. (Bates No. EID023383-EID023392, SDB001910-SDB001919).
- 2/16/1998 Interoffice memo from John F. Doughty to Daniel A. Weber re: search done on fluoropolymers, analytical methods, and environmental samples. (Bates No. EID017815, DAW000123).
- 2/17/1998 Interoffice memo from Robert L. Ritchey to distribution re: visit to landfill by Mike Taurino. (Bates No. EID067732-EID067734, RLR001724-RLR001726).
- 2/17/1998 Interoffice memo from Daniel A. Weber re: Fluoride Sources to Dry Run Landfill. Bates No. EID008651-EID008652, JMM002105-JMM002106).
- 2/17/1998 Interoffice memo from Daniel A. Weber re: Technical Review Summary on EPA Dry Run Report. (Bates No. EID067032-EID067037,



JMM002111-JMM002116).

- 2/17/1998      Technical Review Summary on EPA Dry Run Report. [Same as document listed above w/o interoffice memo.] (Bates No. EID067038-EID067042, DDJ000528-DDJ000532).
  
- 2/19/1998      Interoffice memo from Daniel A. Weber to Richard A. Kirschner, Jr. and Thomas R. Waldron re: asbestos disposal contract in place and as of 1/1/98 asbestos was no longer sent to Dry Run. (Bates No. EID031912, CF000719).
  
- 2/19/1998      Interoffice memo from Robert L. Ritchey to Matthew S. Bogdanffy, Daniel A. Weber, and Richard A. Kirschner, Jr. re: phenols detected in cattle feces. (Bates No. EID067476, RAK004303).
  
- 2/19/1998      Interoffice memo from Daniel A. Weber to Robert L. Ritchey re: Technical Review Summary on EPA Dry Run Report. (Bates No. EID067062-EID067068, RLR001114-RLR001120).
  
- 2/23/1998      Agenda with hand written notes. (Bates No. EID067280, RLR001107).
  
- 3/4/1998      Kemron report for Outlet 001 and 1000 Ft Downstream. (Bates No. EID023444-EID023460, SDB001856-SDB001872).
  
- 3/5/1998      Interoffice memo from John G. Britvec to Pravin Sangani re: disk copy of draft letter revised to address DuPont concerns and comments raised by the public. (Bates No. WVDEP 0989).
  
- 3/10/1998      Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, February 1998. (Bates No. EID023393-EID023402, SDB001885-SDB001894).
  
- 3/27/1998      Cattle Expert discussion w/ M Bogdanffy [hand written notes] (Bates No. EID017441, RLR001046).
  
- 3/30/1998      Table 4: Concentrations of Metals in Water, Dry Run Creek, Washington, Wood County, WV, November 1997. (Bates No. EID067478).
  
- 4/1/1998      Kemron report for samples Outlet 001 and 1000 Ft Downstream. (Bates No. EID023519-EID023525, SDB001823-SDB001829).
  
- 4/2/1998      Hand written notes of call from Carl Muska. (Bates No. EID017442, RLR001045).
  
- 4/6/1998      Quarterly Statistical Review of Groundwater Monitoring Results, Dry



Run Landfill, First Quarter 1998. (Bates No. EID023201-EID023221, GW000587-GW000607).

- 4/8/1998 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, March 1998. (Bates No. EID023418-EID023427, SDB001830-SDB001839).
- 4/8/1998 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, First Quarter 1998. (Bates No. EID023173-EID023200).
- 4/9/1998 Memo from Paul E. Ross to Carl Muska re: Alleged Effects on Cattle Near the Dry Run Landfill. (Bates No. EID017444-EID017445, RLR001042-RLR001043).
- 4/14/1998 WVDEP OWR NPDES Water Pollution Control permit. (Bates No. USEPA 1196-USEPA 1225).
- 4/14/1998 Letter from Barbara S. Taylor to Robert L. Ritchey. Order of Compliance. (Bates No. USEPA 1226-USEPA 1231).
- 4/14/1998 Interoffice memo from Lydia R. Cox to Carl F. Muska re: possible chromosomal damage in the cattle herd. (Bates No. EID017446-EID017447, RLR001040-RLR001041).
- 4/14/1998 Response to Public Comments. (Bates No. WVDEP 1002-WVDEP 1006).
- 4/14/1998 Letter from Barbara S. Taylor to Robert L. Ritchey re: DuPont's responses to draft permit. (Bates No. USEPA 1188-USEPA1195).
- 4/14/1998 Letter from Barbara S. Taylor to Shirley A. Skaggs, Esq. re: comments of the Affiliated Construction Trades Foundation regarding the draft permit. (Bates No. WVDEP 1089-WVDEP 1090).
- 4/15/1998 Lancaster Laboratories formaldehyde results for Outfall 001. (Bates No. EID023461-EID023465, SDB001873-SDB001877).
- 4/21/1998 Field logs of 1998 Deer Reproduction study. (Bates No. USFW 0526-USFW 0566).
- 4/22/1998 Kemron report for Outfall 001 and 1000 Ft Downstream. (Bates No. EID023438-EID023443, SDB001850-SDB001855).
- 4/27/1998 Letter from Melvin H. Boso (Boso Equipment) to Ton Waldron re: dead deer on landfill property. (Bates No. EID005585, JRM000022).



4/30/1998 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, April 1998. (Bates No. EID023428-EID023437, SDB001840-SDB001849).

5/5/1998 Interoffice memo from Daniel A. Weber to Robert L. Ritchey and Linwood K. Ireland re: analysis frequency for C-8. (Bates No. EID007938, HDR000385).

5/6/1998 Interoffice memo from John F. Doughty to Harry L. Gearhart II re: methods for fluorocarbons and fluorochlorocarbons. (Bates No. EID009806, RLR000742).

5/7/1998 Faxed copy of memo from Richard Kirschener to Pat Lane (Kemron). re: changes in Dry Run Sampling. [One page attached discussing water levels and stagnant water removal.] (Bates No. EID067540-EID067541).

5/12/1998 Hand written note from Bob Ritchey to Dave Ramsey attached to first draft of 2 page summary. (Bates No. EID010364-EID010366, JMM000659-JMM000661).

5/14/1998 Letter from Robert L. Ritchey to Sarah L. Caspar re: documentation and detailed discussion of concerns. (Bates No. USEPA 0620-USEPA 0636).

5/14/1998 Faxed letter from Laidley Eli McCoy to Daniel Weber re: observations on Dry Run Landfill Permit. [Includes suggested draft letter from Potesta to Barbara Taylor requesting a permit modification.] (Bates No. EID052957-EID052962, RAK000819-RAK000824).

5/15/1998 Interoffice memo from Harry L. Gearhart to John F. Doughty re: methods for fluorocarbons and fluorochlorocarbons. (Bates No. EID009806, RLR000742).

5/20/1998 Letter from Spencer Hamil (CH2M Hill) to George Woytowich (DuPont) re: acknowledges receipt of samples collected 5/19/98 for C-8 analysis. [Includes COC and login documentation] (Bates No. EID008298-EID008302, GW006742-GW006746).

5/26/1998 Interoffice memo from Bharat O. Desai to Richard A. Kirschner re: TSS , Al, and Fe results for fabric filter lab test on landfill leachate. Forwarded by Richard A. Kirschner to Thomas R. Waldron and Jon F. Moore on 5/27/99. (Bates No. EID039317, TRW000907).

5/28/1998 Letter from Spencer Hamil (CH2M Hill) to Dan Weber (DuPont) re: acknowledges receipt of samples collected 5/26/98 for C-8 analysis.



- [Includes COC and login documentation] (Bates No. EID008304-EID008307, SDB002324-SDB002327).
- 6/1/1998 Letter from Barbara S. Taylor (WVDEP) to Robert L. Ritchey re: correction of typographical errors. [Includes copies of corrected pages.] (Bates No. WVDEP 1161-WVDEP 1163).
- 6/2/1998 Kemron report for sample 001 Outlett (Bates No. EID023519-EID023525, SDB001823-SDB001829).
- 6/2/1998 REI Consultants Acute Toxicity Bioassay Report for samples collected 5/19/98. [Includes interoffice memo from Daniel Weber to distribution.] (Bates No. EID030698-EID030705, CF000695-CF000702).
- 6/8/1998 Interoffice memo from Robert Pinchot to DuPont personnel re: F-11 analytical/effects help. (Bates No. EID009807, RLR000743).
- 6/8/1998 CH2M Hill results for samples collected 5/19/98 for C-8 analysis. Includes transmittal letter from Spencer Hamil (CH2M Hill) to George Woytowich (DuPont) (Bates No. EID018766-EID018782, GW006801-GW006817).
- 6/9/1998 CH2M Hill results for samples collected 5/26/98 for C-8 analysis. Includes transmittal letter from Spencer Hamil (CH2M Hill) to George Woytowich (DuPont) (Bates No. EID018060-EID018076, GW006768-GW006884).
- 6/9/1998 CH2M Hill results for samples collected 5/27/98 for C-8 analysis. Includes transmittal letter from Spencer Hamil (CH2M Hill) to Dan Weber (DuPont) (Bates No. EID018552-EID018567, GW006785-GW006800).
- 6/11/1998 Interoffice Memo from Daniel A. Weber to Robert L. Ritchey re: EPA uses Modified 524.2 for VOCs in soil and Emron uses Method 624. (Bates No. EID017850, DAW000115).
- 6/15/1998 Revised Kemron report for samples 001 OUTLET, STREAM 1, and STREAM 2. [Includes results for 001 OUTLET from 6/2/98 report.] (Bates No. EID023486-EID0235202, SDB001790-SDB001806).
- 6/15/1998 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, May 1998. (Bates No. EID023473-EID023485, SDB001777-SDB001789).
- 6/15/1998 Interoffice memo from John F. Doughty to Daniel A. Weber re: unlikely



that F-113 could be misidentified as F-11. (Bates No. EID009803).

- 6/15/1998 Interoffice memo from John F. Doughty to Daniel A. Weber re: would like confirmation that other peaks were not present. (Bates No. EID009803).
- 6/16/1998 Dry Run Landfill Groundwater/surface Water Monitoring Summary of 1998 FC-143 Analytical Results. (Bates No. EID016804, RLR000245).
- 6/22/1998 Hand written notes re: 1) deformity in doe fetus, 2) two tank trucks of formaldehyde, 3) Walt's credibility. (Bates No. EID017448, RLR001050).
- 6/24/1998 Interoffice memo from Daneil A. Weber to H. David Ramsey, Robert L. Ritchey, and Lynwood K. Ireland re: box van disposal at Dry Run Landfill. (Bates No. EID017851, DAW000114).
- 6/24/1998 Email from Vera L. Wigal (DuPont) to DuPont personnel; tabulated FC-143 results. (Bates No. EID009493-EID009494, RLR002057-RLR002058).
- 6/24/1998 FC-143 sample data from CH2M Hill. Samples collected 5/19/98. (Bates No. EID071078, AC002581).
- 6/24/1998 Handwritten notes of call from Ron Potesta and Eli McCoy re: issue with deer fetus and deer harvest. (Bates No. EID017449, RLR001048).
- 6/25/1998 Interoffice memo from Michael D. Aucoin to Daniel A. Weber re: use of modified 524.2 for soils and the use of methanol by the lab. [Includes 8260A compound list with soil and water LOQs. (Bates No. EID024410-EID024413, JMM002633-JMM002636).
- 6/26/1998 Handwritten notes from call from Potesta re: discussion of deer harvest and visual findings. (Bates No. EID017451, RLR001047).
- 7/8/1998 Dry Run Landfill Soil Sampling Data Summary. (Bates No. WVDEP 1164-WVDEP 1166).
- 7/9/1998 CH2M Hill results for samples collected 6/16/98 for C-8 analysis. Includes transmittal letter from Spencer Hamil (CH2M Hill) to George Woytowich (DuPont) (Bates No. EID007598-EID007611, GW003750-GW003763).
- 7/10/1998 Interoffice memo from H. David Ramsey, Jr. to distribution re: summary of meeting with Office of Water Resources. (Bates No. EID017707,



RLR002061).

- 7/13/1998 Memo from R. Valentine to C.A. Muska re: comments on Dry Creek Run situation. (Bates No. EID017452-EID017454, RLR001006-RLR001008).
- 7/13/1998 Letter from R. L. Ritchey to Michael A. Zeto (Office of Water Resources) re: sign-in sheet for 2/23/98 meeting between DuPont and Region III. [Includes sign-in sheet.] (Bates No. EID001819-EID001820, CF000117-CF000118).
- 7/14/1998 Handwritten notes of 7/14/98 meeting. (Bates No. EID010435-EID010437, RLR000929-RLR000931).
- 7/15/1998 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, June 1998. (Bates No. EID023526-EID023537, RAK0007940-RAK000805).
- 7/15/1998 Interoffice memo from Daniel A. Weber to distribution list re: TSS exceedance in June. (Bates EID030713, JMM000364).
- 7/15/1998 Interoffice memo from Daniel A. Weber to H. David Ramsey, Jr. re: ways to address discharge exceedances. (Bates No. EID030714-EID030716, HDR000361-HDR000363).
- 7/17/1998 Quarterly Statistical Review of Groundwater Monitoring Results, Dry Run Landfill, Second Quarter 1998. (Bates No. EID023222-EID023231, GW003891-GW003900).
- 7/20/1998 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Second Quarter 1998. (Bates No. EID001275-EID001298).
- 7/20/1998 Handwritten notes of conference call to Sarah Caspar. (Bates No. EID067295-EID067297, RLR000961-RLR000963).
- 7/20/1998 Handwritten notes of EPA conference call. (Bates No. EID067298-EID067303, JMM002520-JMM002525).
- 7/21/1998 Group 2 List of compounds which may be present at the Dry Run Landfill. (Bates No. EID015204-EID015205, RLR001967-RLR001968).
- 7/22/1998 EPA Sampling at Dry Run Landfill: Sediment/Soil Split Sample Results. (Bates No. WVDEP 1167).



7/23/1998 Interoffice memo from Daniel A. Weber to distribution re: samples collected. (Bates No. EID030717-EID030719, RLR000825-RLR000827).

7/28/1998 Handwritten notes of conference call (Bates No. EID067304, RGS000797).

7/29/1998 Interoffice memo from Thomas R. Waldron to Lynwood K. Ireland re: tour of landfill with resident. (Bates No. EID039427, TRW001035).

8/4/1998 Group 1 List of compounds which may be present at the Dry Run Landfill. (Bates No. EID015206, RLR001966).

8/4/1998 Draft Group 1 and Group 2 lists of compounds which may be present at the Dry Run Landfill. (Bates No. EID047116-EID047117, RGS000818-RGS000819).

8/6/1998 Bioassay report for sample collected from 001 outlet Dry Run on 8/3/98. Same as 8/13/98 document except missing "Test Results" page and includes additional data sheet. (Bates No. EID001366-EID001372, GW003947-GW003953).

8/7/1998 Interoffice memo from Michael D. Aucoin to Daniel Weber re: weighting factor applied to PAHs to determine total B(a)P equivalent. (Bates No. EID024440, HDR000264).

8/7/1998 Toxicity of trichlorofluoromethane and trichlorotrifluoroethene. (Bates No. EID009808, RLR000744).

8/8/1998 Interoffice Memo from Thomas Waldron to Lynwood K. Ireland and John Mathews re: observations of silt and turbid water at Dry Run Landfill. (Bates No. EID030998).

8/9/1998 Interoffice Memo from Thomas Waldron to Lynwood K. Ireland and John Mathews re: observations of silt and turbid water at Dry Run Landfill. (Bates No. EID017500).

8/11/1998 Summary of cattle findings. (Bates No. EID017457-EID017458, RLR000818-RLR000819).

8/11/1998 Handwritten notes of EPA meeting. (Bates No. EID067314-EID067316, GW002104-GW002106).

8/11/1998 Handwritten notes of meeting between EPA, DEP, and DuPont. (Bates No. EID067310-EID067312, RLR000814-RLR000816).



8/11/1998 Purpose Statement for collaborative effort between EPA and DuPont. (Bates No. EID017942, JMM002629).

8/11/1998 Lists of Group 1 (materials known to be present at Dry Run) and Group 2 (materials which may be present at Dry Run). Includes hand written notes. (Bates No. USEPA 0822-USEPA 0824).

8/11/1998 Dry Run Creek Landfill: Considerations for Further Study (Bates No. EID017459-EID017466, JMM002658-JMM002665).

8/11/1998 Agenda Dry Run Landfill Meeting. Includes hand written notes. (Bates No. EID067313, RLR000817).

8/11/1998 Hand written notes of "Action Items 8/11/98 Dry Run LF 'Next Steps' Mtg." (Bates No. WVDEP 1169-WVDEP 1172).

8/13/1998 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, July 1998. (Bates No. EID001335-EID001344, GW003955-GW003964).

8/13/1998 Bioassay report for sample collected from 001 outlet Dry Run on 8/3/98. (Bates No. WVDEP 1207-WVDEP 1212).

8/14/1998 Interoffice memo from Robert L. Ritchey to John F. Doughty, Daniel A. Weber, and Lou Bedekovick re: Butacite sent to Dry Run was made with 4G7. (Bates No. EID015170, RLR000144).

8/14/1998 Interoffice memo from Robert L. Ritchey to distribution re: EPA needs list of degradation products of major polymers and resins landfilled at Dry Run since it began operation. (Bates No. EID066109-EID066111, CF000641-CF000643).

8/14/1998 Qualitative Benthic Survey Report for Satation in Fry Run Creek, Wood County, WV. August 1998. (Bates No. EID001347-EID001357, GW004043-GW004053).

8/17/1998 Interoffice memo from Robert Ritchey to distribution re: EPAs approval to proceed with collaborative program. [Second page identical to first page except different font.] (Bates No. EID067317-EID067318, RLR001776, RLR000813).

8/18/1998 Letter from Ralph G. Stahl to Sarah Caspar re: draft proposal for collaborative effort. [Includes cover email dated 8/18/98 discussing availability.] (Bates No. EID001822-EID001824, RLR001786-



RLR001788).

- 8/18/1998 Email from Thomas R. Waldron to Lynwood K. Ireland and John R. Mathews re: dead deer found in vicinity of MW-13 and MW-13A. Appears that deer was dead for a few days and dragged to that location. (Bates No. EID008018, RLR001999).
- 8/18/1998 Interoffice memo from Robert L. Ritchey to Sarah Caspar re: names for Collaborative Program Teams. (Bates No. EID041650-EID041651, GPS000608-GPS000609).
- 8/18/1998 Interoffice memo from Robert L. Ritchey to 6 addressees re: transmittal Collaborative Program Teams memo to Sarah Caspar and EPA to fill role of wildlife biologist. (Bates No. EID041652-EID041651, GPS000610-GPS000609).
- 8/18/1998 Email from Richard Kirschner to John R. Mathews, H. David Ramsey, Jr., Robert L. Ritchey, Daniel A. Weber, and Dawn D. Jackson re: inspection of dead deer by Jeff McCrady (DNR). Email forwarded by Robert L. Ritchey to Rudolph Valentine, Lydia R. Cox, Paul e. Ross, and Lynwood K. Ireland. (Bates No. EID008654-EID008655, RLR001995-RLR001996).
- 8/19/1998 Interoffice memo from Robert L. Ritchey to 4 addressees re: procedures to take for the next time a dead deer is found and input on blue tongue. (Bates No. IED067319-EID061320, GPS000554-GPS000555).
- 8/19/1998 Typed note re: "Jeff" unwilling to fill our report or sign anything since he could not definitively say why the animal died. (Bates No. EID008658, HDR000281).
- 8/20/1998 Interoffice memo from Ralph G. Stahl, Jr., to Mark Sprenger and Sarah Caspar re: resources for implementing small animal work at Dry Run and adjacent areas. (Bates No. EID000236-EID000237, RLR000750-RLR000751).
- 8/22/1998 Interoffice memo from Thomas R. Waldron to Lynwood K. Ireland and John R. Mathews re: observations of dead deer made by Jeff McCraddy (DNR). (Bates No. EID039417-EID039418, TRW001023-TRW001024).
- 8/22/1998 Field notes of Dennis Stottlemeyer (Potesta & Associates). (Bates No. EID007939, RLR000764).
- 8/24/1998 Letter report from Charles Anderson re: results of vegetation survey performed on July 20-21, 1998. [Includes tables of observations and



mineral results on grasses, and interoffice memo of transmittal.] (Bates No. EID048279-EID048297, CF003985-CF004003).

- 8/25/1998 Interoffice memo from Sarah Caspar to Robert L. Ritchey re: EPA approves DuPont's proposal for Collaborative Program Teams and provides EPA members in program. (Bates No. EID001827, RLR000749).
- 8/26/1998 Interoffice memo from Robert L. Ritchey to 6 addressees re: informed Sarah Caspar of dead deer inspection. (Bates No. EID014143, DAW000085).
- 8/26/1998 Interoffice memo from Daniel Weber to Robert L. Ritchey, H. David Ramsey, Jr., and Lynwood K. Ireland re: difficulty in taking benthic sample due to little or no stream flow. (Bates No. EID030739, RAK008832).
- 8/26/1998 Interoffice memo from Robert L. Ritchey to distribution re: EPAs approval of collaborative process. (Bates No. EID067321-EID067322, RLR001792-RLR001793).
- 8/27/1998 Interoffice memo from Robert L. Ritchey to distribution re: call with Mike Zeto (WVDEP) discussing dead deer found and DuPont's protocol for responding to future deer found. (Bates No. EID008022-EID008023, RLR000756-RLR000757).
- 8/27/1998 CH2M Hill results for samples collected 7/15/98 for C-8 analysis. Includes transmittal letter from Spencer Hamil (CH2M Hill) to George Woytowich (DuPont) (Bates No. EID024230-EID024242, GW006751-GW006763).
- 8/27/1998 Interoffice memo from Robert L. Ritchey to Charles L. Mullins, Cheryl S. Fisher, and Walt Lively re: TCLP may provide information about degradation of materials landfilled at Dry Run. (Bates No. EID066145, CF000646).
- 8/28/1998 Letter from R.L. Ritchey to Barbara S. Taylor (WVDEP) re: Office of Water Resources participation in Dry Run Landfill discussions. (Bates No. EID000227, RLR000747).
- 8/28/1998 Interoffice memo from Robert L. Ritchey to 6 addressees re: discussion with Mike Zeto about deer harvest and citizen concern about eating deer from Dry Run area. (Bates No. EID067325, GPS000553).
- 8/28/1998 Interoffice memo from Robert L. Ritchey to 6 addressees re: discussion



with Mike Zeto about deer harvest and citizen concern about eating deer from Dry Run area. [Same as above document] (Bates No. EID067326, GPS000554).

- 8/31/1998 Interoffice memo from Robert L. Ritchey to John F. Doughty and Daniel A. Weber re: propose to remove polyacrylic acid from major constituent list and add n-butyl methacrylate and ethyl methacrylate. (Bates No. EID015175, RLR000152).
- 8/31/1998 Interoffice memo from Charles L. Mullins to Robert L. Ritchey re: can not come up with anything that would be a significant change in waste streams to Dry Run. (Bates No. EID066143).
- 8/31/1998 Memo from Robert Ritchey to distribution list re: minutes of 8/11/98 Dry Run Landfill meeting. (Bates No. EID097327-EID067328, RV000449-RV000450).
- Sep-98 Product Information sheets for Fluorad<sup>TM</sup> Fluorochemical Emulsifiers FC-118 and FC-1090.
- 9/1/1998 Interoffice memo from Cheryl s. Fisher to Robert L. Ritchey re: no TCLP results for fluoropolymer wastes that would be sent to Dry Run. (Bates No. EID066144, CF000645).
- 9/1/1998 Interoffice memo from Lou Bedekovich to Robert L. Ritchey re: incineration and disposal of Butacite. (Bates No. EID066146).
- 9/1/1998 Interoffice memo from Robert L. Ritchey to Rudolph Valentine, Ralph G. Stahl, Jr., Michael D. Aucoin, and Daniel A. Weber re: Appendix 1 list has been revised to remove polyacrylic acid from major constituent list and add n-butyl methacrylate and ethyl methacrylate. (Bates No. EID015174, RLR000151).
- 9/1/1998 Email from Dawn D. Jackson to Rudolph Valentine re: memo dated 12/13/95 concerning a conversation between Jim Crum and Mr. Tennant. (Bates No. EID044737-EID044738, RV000447-RV000448).
- 9/1/1998 Group 1 Appendix: Major monomers and constituents of Group 1 resins. (Bates No. EID067329, RLR001799).
- 9/8/1998 Interoffice memo from Richard L. Johnson to distribution list re: Polymer/Resin Decomposition Information-Acrylic Polymers in a Landfill Environment. (Bates No. EID066150-EID066152, CF000666-CF000668).



9/8/1998 Interoffice memo from Daniel A. Weber to 6 addressees re: 9/8/98 WVDEP Inspection at Dry Run Landfill. (Bates No. EID017835, DAW000079).

9/10/1998 Memo from Robert L. Ritchey to distribution re: minutes of 8/11/98 Dry Run Landfill Meeting. (USEPA 0832-USEPA 0857).

9/10/1998 Hand written notes of conference call with Steering Team. (Bates No. EID067330-EID067333, RLR000616-RLR000619).

9/11/1998 Letter from Robert L. Ritchey to John G. Britvec re: changes made in the 1993-1994 timeframe. (Bates No. EID000228-000229, RLR000613-RLR000614).

9/11/1998 Interoffice memo from Robert L. Ritchey to 23 addressees re: conference call held on 9/10/98 between DuPont, WV-OWR and EPA. Discussed plans for next round of small mammal sampling. (Bates No. EID041715-EID041717, GPS000707-GPS000709).

9/14/1998 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, August 1998. (Bates No. EID001358-EID001369, GW003939-GW3946).

9/14/1998 Hand written notes of phone call with Paul Ross. (Bates No. EID008021, RLR000608).

9/16/1998 Interoffice memo from Thomas R. Waldron to Ronald W. Meloon and Lynwood K. Ireland re: observations made during tour of landfill on 9/16/98. (Bates No. EID016848, CF000694).

9/22/1998 Hand written notes of talking points for John Sieg visit. (Bates No. EID009810-EID009812, RLR000597-RLR000599).

9/22/1998 Interoffice memo from Dawn D. Jackson to distribution re: update of Washington Works Responsible Care Team meeting. (Bates No. EID066086-EID066088, RLR000591-RLR000593).

9/22/1998 Interoffice memo from Robert L. Ritchey to distribution list re: Ceil Mancini and EPA personnel to visit site. (Bates No. EID067334, HDR000200).

9/30/1998 Interoffice memo from Robert L. Ritchey to distribution re: contents of Mr. Tennant's videotapes. (Bates No. EID010392-EID010393, RLR000576-RLR000577).



9/30/1998 Email from Daniel A. Weber to Daniel A. Weber re: C-8 info slides for RLR meeting 10/5/98. (Bates No. EID045003-EID045004, JMM007792-JMM007793).

10/7/1998 Quarterly Statistical Review of Groundwater Monitoring Results, Dry Run Landfill, Third Quarter 1998. (Bates No. EID023232-EID023241, GW003865-GW003874).

10/8/1998 Email from Michael D. Aucoin to Robert L. Ritchey re: identification of materials landfilled. (Bates No. EID009747-EID009748, RLR001969-RLR001970).

10/8/1998 Email from Robert L. Ritchey to distribution re: DNR not planning deer report. (Bates No. EID005586, RLR001987).

10/9/1998 Letter report from D. Mark Kiser (Potesta) to Dan Weber (DuPont) re: completion of hydrologic and hydraulic analysis of receiving stream. (Bates No. EID070621-EID070622, ASH000174-ASH000175).

10/9/1998 Letter report from D. Mark Kiser (Potesta) to Dan Weber (DuPont) re: completion of hydrologic and hydraulic analysis of receiving stream. [Same as above document.] (Bates No. EID030282-EID030284, JMM002801-JMM002803).

10/12/1998 Interoffice memo from Gary W. Klesel to Daniel A. Weber re: status of landfill improvements. (Bates No. EID031011, RAK008801).

10/12/1998 Email from Allison A. Crane to Daniel A. Weber re: results indicate that the material is acceptable to send to Dry Run. (Bates No. EID070327, AC002422).

10/12/1998 Response to email from Allison A. Crane to Daniel A. Weber re: results indicate that the material is acceptable to send to Dry Run. Email from Daniel A. Weber to Allison a. Crane re: OK as long as not in 55 gal. drums and no free liquids. (Bates No. EID070328, AC002423).

10/13/1998 Interoffice memo from Daniel A. Weber re: potential foaming material at Dry Run Landfill. (Bates No. EID016841, JMM002711).

10/13/1998 Interoffice memo from Daniel A. Weber re: known foaming material at Dry Run Landfill. (Bates No. EID017854-EID017855, DAW000072-DAW000073).

10/14/1998 Interoffice memo from Gary W. Klesel to Daniel A. Weber re: Outlet 002 put into service on 8/11/98. (Bates No. EID017821, DAW000071).



10/14/1998 Interoffice memo from Daniel A. Weber to Lynwood K. Ireland re: use of "Aquashade" (triphenylmethane) for plant growth control. (Bates No. EID016835, JMM002751).

10/14/1998 Interoffice memo from Daniel A. Weber to distribution re: Aquashade OK for use in sedimentation pond. (Bates No. EID016833-EID016835, CF000682-CF000683).

10/14/1998 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, September 1998. (Bates No. EID001419, GW003937).

10/14/1998 Dry Run Landfill Sedimentation Pond Additives. [Includes Group 2 list.] (Bates No. EID063176-EID063179, JMM002797-JMM002798).

10/14/1998 Interoffice memo from Ralph G. Stahl to distribution re: incorporate comments into draft of scope of work for small animal trapping. (Bates No. EID067340, RLR000543).

10/20/1998 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Third Quarter 1998. (Bates No. EID001373-EID001398).

10/21/1998 Interoffice memo from Robert L. Ritchey to distribution re: allegations of health effects in Mr. Tennant's family. (Bates No. EID066098, LKI001230).

10/21/1998 Interoffice memo from Robert L. Ritchey to distribution re: allegations of health effects in Mr. Tennant's family. [Same as above document.] (Bates No. EID010448, RLR000536).

10/21/1998 Interoffice memo from Ralph G. Stahl to distribution re: proposed agenda for Technical Work Group Meeting. (Bates No. EID040412-EID040414).

10/23/1998 Interoffice memo from Robert L. Ritchey to distribution re: deer fetus studies file review at DNR. (Bates No. EID008027-EID008028, RLR000530-RLR000531).

10/23/1998 Interoffice memo from Robert L. Ritchey to David E. Overton re: need molecular weights for polymers and resins. (Bates No. EID066176, CF000644).

10/23/1998 Interoffice memo from Robert L. Ritchey to John Gannon re: molecular weights. (Bates No. EID066177, JMM002757).



10/23/1998 Interoffice memo from James R. Lawson to Robert L. Ritchey re: molecular weights of Delrin. (Bates No. EID066180).

10/23/1998 Transmittal letter from Ronald R. Potesta (Potesta & Associates) to Mr. Robert L. Ritchey re: raw data sheets for 1998 doe fetus study. (Bates No. EID007941-EIDEID007958, RLR000501-RLR000518).

10/27/1998 Handwritten note construction phase status. (Bates No. EID031167, HDR000161).

10/28/1998 Email from Roger J. Zipfel to Robert L. Ritchey re: molecular weight of various resins. (Bates No. EID070703, RJZ000013).

10/28/1998 Email from Robert L. Ritchey to John Gannon re: molecular weight ranges and characteristics of fluoropolymers. (Bates No. EID070705-EID070706, RJZ000037-RJZ000038).

10/28/1998 Interoffice memo from fluoropolymer molecular weight ranges. (Bates No. EID014118-EID014119, DAW000047-DAW000048).

10/28/1998 Interoffice memo from Roger J. Zipfel to Robert L. Ritchey re: molecular weights for specific resins. (Bates No. EID066186, CF000623).

10/29/1998 Interoffice memo from Daniel A. Weber to distribution re: foam forming in lower pond. (Bates No. EID030763, RAK008791).

10/29/1998 Interoffice memo from Richard A. Morgan to Roger J. Zipfel re: molecular weight range for irradiated PTFE micropowder ranges. (Bates No. EID066192).

10/29/1998 Email from Ralph G. Stahl, Jr. to distribution re: keys points for discussion at meeting. (Bates No. EID066185, RGS000231).

10/30/1998 Interoffice memo from Daniel A. Weber to distribution re: Dry Run Landfill leachate management. (Bates No. EID030767-EID030768, RAK008787-RAK008788).

10/30/1998 Letter from Sarah Caspar (EPA) to Ceil Mancini (Woodward-Clyde) re: comments on draft work plan for small mammal trapping investigation in Dry Run Landfill. (Bates No. EID040423- EID040425, JMM002700-JMM002702).

11/3/1998 Memo from Robert Ritchey to 7 addressees re: update to event timeline. (Bates No. EID037485-EID039480, DAW000499-DAW000504).



11/3/1998 Dry Run Landfill Sedimentation Pond Additives. (Bates No. EID031974, JMM002800).

11/3/1998 Interoffice memo from David E. Overton to Robert L. Ritchey re: molecular weights for polyesters. (Bates No. EID066195, CF000600).

11/4/1998 Email from John F. Doughty (DuPont) to DuPont personnel re: foam sample collected from lower pond was found to be the sodium salt of an acrylic polymer with a high acid content. (Bates No. EID016811-EID016812, RLR002031-RLR002032).

11/4/1998 Interoffice memo from John F. Doughty (DuPont) to DuPont personnel re: foam sample collected from lower pond was found to be the sodium salt of an acrylic polymer with a high acid content. [Same as email from John F. Doughty dated 11/4/98] (Bates No. EID030773-EID030775, RLR000108-RLR000110).

11/4/1998 Email from Robert Ritchey to John Gannon and Michael Aucoin (response to 11/4/98 email from John Doughty re: additional work on degradation products. (Bates No. EID016811-EID016812, RLR002031-RLR002032).

11/4/1998 Email from Robert Ritchey to DuPont personnel (response to 11/4/98 email from John Doughty). re: Tennant's video tapes show foaming and have identified to EPA several materials known to be foamers that have been landfilled over the years. (Bates No. EID016818-EID016819, RLR002029-RLR002030).

11/4/1998 Notes of Employee Response Case Team. Includes site maps. (Bates EID067253-EID067265, RLR000053-RLR000062, JMM002370-JMM002372).

11/4/1998 Interoffice memo from Robert L. Ritchey to Lynwood K. Ireland re: need to identify local vet acceptable to DuPont and Mr. Tennant. (Bates No. EID014129, DAW000033).

11/4/1998 Letter from Ronald R. Potesta (Potesta & Associates) to Robert L. Ritchey (DuPont) re: copies of two report one of which discusses an overbite condition in deer. (Bates No. EID007691-EID008012, LKI001274-LKI001305).

11/4/1998 Interoffice memo from Mark H. Gaston to Robert L. Ritchey re: molecular weight of Butacite sheeting. (Bates No. EID066196).

11/4/1998 Interoffice memo from Robert L. Ritchey to distribution re: not



recommended that Butacite be landfilled. [Includes interoffice memo from Mark H. Gaston to Robert L. Ritchey re: molecular weight of Butacite sheeting.] (Bates No. EID066197-EID066199).

- 11/4/1998 Letter from Ceil Mancini to Sarah Caspar re: revised work plan for Small Mammal Trapping Investigation. Includes work plan. (Bates No. USFW 0351-USFW 0409).
- 11/5/1998 Fax from Kevin Scott (Tetra Tech) to Ralph Stahl transmitting COCs and analytical data summary tables for samples collected 7/22/98. (Bates No. EID000287-EID000303, JMM002887-JMM002903).
- 11/5/1998 Memo from Ralph G. Stahl to Rudolph Valentine re: notes of major points from Dry Run Technical Work Group Meeting. (Bates No. USEPA 0860-USEPA 0863).
- 11/5/1998 Interoffice memo from Robert L. Ritchey to distribution re: call from EPA indicating degradation studies would not be helpful. (Bates No. EID066200-EID066201).
- 11/5/1998 Interoffice memo from Robert L. Ritchey to David E. Overton re: call from EPA indicating degradation studies would not be helpful. (Bates No. EID066202, CF000595).
- 11/9/1998 Interoffice memo from Robert L. Ritchey to distribution re: Sarah Caspar fell back into step on allowing the collaborative process to play out. (Bates No. EID066203-EID066204, HDR000120-HDR000121).
- 11/11-13/98 Field Data Sheets from Areas I, II, V, and Ref. Area. Includes letter of transmittal dated 11/23/98. (Bates No. USFW 0424-USFW 0478).
- 11/12/1998 Letter from R.L. Ritchey (DuPont) to Barbara Taylor (WVDEP) re: could not determine if attached letter had been sent. Includes September 1998 Monthly Monitoring Report dated 10/14/98. (Bates No. EID001418-EID001419, GW003936-GW003937).
- 11/12/1998 Letter from Peter G. Moisan to Dr. Paul Ross re: submission of CV for review. (Bates No. EID041588-EID041603, GPS000521-GPS000536).
- 11/17/1998 Interoffice memo from Robert L. Ritchey to 2 addressees re: monitoring well closure. (Bates No. EID014130, DAW000032).
- 11/17/1998 Letter from Ellen Rae Herndon (WVDEP) to Roderic E. Moore (Potesta). re: variance request granted for the abandonment of MW-10 and MW-11. (Bates No. EID053058, CF000672).



- 11/20/1998 Interoffice memo from Robert L. Ritchey to remote addressee re: transmittal of compounds lists. [Includes Group 1: Materials known or suspected to have been sent to Dry Run (dated 8/11/98), Group 1 Appendix: Major monomers and constituents of Group 1 resins (dated 9/1/98), and Group 2: Low and trace volume chemicals of interest (dated 10/14/98)]. (Bates No. EID015162-EID015165, RLR000131-RLR000134).
- 11/24/1998 Letter from D. Mark Kiser (Potesta & Associates) to Dan Weber re: list of differences between permit drawings and as-constructed conditions. (Bates No. EID031055-EID031057, CF000673-CF000675).
- 11/24/1998 Letter from D. Mark Kiser (Potesta) to Gary Klesel re: discussions held with WVDEP concerning well abandonment. Includes letter from Ellen Rae Herndon (WVDEP) to Roderic E. Moore (Potesta) re: variance request granted for the abandonment of MW-10 and MW-11. (Bates No. EID053056-EID053058, CF000670-CF000672).
- 11/24/1998 Fax transmission from Paul E. Ross (DuPont) to Peter G. Moisan. Includes "example of Proposal to Consult". (Bates No. EID041585-EID041587, GPS000518-GPS000520).
- 11/24/1998 Interoffice memo from Larry D. Butler to Kathleen A. Lodge Brennan re: confidential information agreement for Peter G. Moisan. (Bates No. EID041584, GPS000517).
- 11/24/1998 Interoffice memo from Kathleen A. Lodge Brennan to Larry D. Butler re: confidential information agreement for Peter G. Moisan. (Bates No. EID041583, GPS000516).
- 11/25/1998 Letter from Peter G. Moisan to Dr. Paul Ross re: proposal to provide consulting services for the cattle disease problem. (Bates No. EID041590, GPS000523).
- 11/25/1998 Faxed copy of letter from Peter G. Moisan to Dr. Paul Ross re: proposal to provide consulting services for the cattle disease problem. (Bates No. EID017334, LKI001309).
- 11/25/1998 Interoffice memo from Robert L. Ritchey to Isidoros J. Zankos re: need to move forward with monitoring well closure. (Bates No. EID031058, RAK008753).
- 11/25/1998 Interoffice memo from Gary W. Klesel to Robert L. Ritchey re: the 7 existing wells have been closed. (Bates No. EID031059, RAK008752).



11/30/1998 Letter from Frank A. Borsuk, Jr. (Potesta) to Mr. Dan Weber (DuPont) re: unable to perform microinvertebrate sampling due to low rainfall. (Bates No. EID001420-EID001421, GW003915-GW003916).

11/30/1998 Letter from Frank A. Borsuk, Jr. (Potesta) to Mr. Dan Weber (DuPont) re: unable to perform microinvertebrate sampling due to low rainfall. (Bates No. EID030288-EID030289, CF001432-CF001433).

12/2/1998 Interoffice memo from Larry D. Butler to Kathleen A. Lodge Brennan re: faxed confidential information agreement to Peter G. Moisan for his signature. (Bates No. EID041589, GPS000522).

12/3/1998 Letter report from Ceil Mancini (Woodward-Clyde) to Sarah Caspar (EPA) re: summarizing the findings of the small mammal trapping investigation. (Bates No. USEPA 1026-USEPA 1039).

12/3/1998 Summary of Small Mammal Trapping Report from R.L. Ritchey to distribution. [Includes letter report from Ceil Mancini (Woodward-Clyde) to Sarah Caspar (EPA) re: summarizing the findings of the small mammal trapping investigation.] (Bates No. EID040469-EID040476, DDJ000650-DDJ000657).

12/4/1998 Email from Robert L. Ritchey to Ron Potesta re: foam at Dry Run and information to be used to compile "talking points". (Bates No. EID024283-EID024285, EID031990-EID031998, RLR002008-RLR002010, RAK006152-RAK006159).

12/8/1998 Kemron results for one GW Seep Collector Drain collected 11/20/98. Login # L9811381. (Bates No. WVDEP 1277-WVDEP 1288).

12/10/1998 Attendee list of Dry Run Team meeting. (Bates No. EID041724, GPS000735).

12/10/1998 Letter report from Peter G. Moisan to Dr. Paul Ross re: preliminary observations from examination of two cattle tapes. (Bates No. EID041721-EID041720, GPS000729, GPS000732-GPS000734).

12/15/1998 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, November 1998. (Bates No. EID001422-EID001436, GW003918-GW003932).

12/17/1998 Letter from Laidley E. McCoy (Potesta) to Mid Ohio Valley Health Department re: FOIA request. (Bates No. EID000486, CF000474).



12/17/1998 Letter from Laidley E. McCoy (Potesta). to Mr. Russel Rader (Office of Env. Health). re: FOIA request. (Bates No. EID000488, CF000476).

12/22/1998 Letter from William S. Herold, Jr., to Laidley E. McCoy re: response of FOIA request. (Bates No. EID000489, CF000477).

12/22/1998 Letter from Gary Hamilton to Laidley E. McCoy re: response of FOIA request. (Bates No. EID000487, CF000475).

1999 Dry Run Landfill: C-8 Summary. (Bates No. EID066094, ASH000144).

1/4/1999 Memo from Paul E. Ross (DuPont) to Mark D. Sprenger (USEPA/ERT) re: examined 45 slides and found no gross abnormalities in the small mammals trap on the site. (Bates No. USEPA 1040-USEPA 1041).

1/5/1999 Email from Chuck Anderson to George Woytowich re: fluoride results (Bates No. EID037707, JMM007772).

1/5/1999 Letter from Peter G. Moisan, DVM to Dr. Paul Ross re: comments on two laboratory reports from cattle examined at the Ohio Department of Agriculture and the Michigan State University Animal Health Diagnostic Laboratory and the list of materials disposed of at Dry Run Landfill. (Bates No. EID041744-EID041745, GPS000755-GPS000756).

1/6/1999 Email from Georg Woytowich to Robert L. Ritchey. Forwarded email from Chuck Anderson to George Woytowich re: fluoride results [Same as 01/05/99 document above] (Bates No. EID037707, JMM007772).

1/13/1999 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, December 1998. [No samples taken] (Bates No. EID001437, GW003914).

1/13/1999 Interoffice memo from Thomas R. Waldron to Jon F. Moore re: high solids visible in stream. (Bates No. EID030784, JFM0000400).

1/18/1999 Call to Ralph Stahl (connected in Rudy Valentine and Paul Russ). re: 1) update on project, 2) cattle team, 3) EPA and mapping "hot-spots" of on-site chemicals, 4) EPA and deer study, 5) strategy team meeting. (Bates No. EID017486-EID017488, RLR000041-RLR000043).

1/20/1999 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Fourth Quarter 1998. (Bates No. EID001438-EID001457).

1/20/1999 Memo from Mark Huston to Mark D. Sprenger and Michael Horne re: white tail deer samples. (Bates No. USFW 0573-USFW 0578).



1/20/1999 Email from Sarah Caspar to Ralph G. Stahl, Jr. re: sampling of Tennant's cattle and deer harvesting. (Bates No. EID017337, RLR001863).

1/20/1999 Forwarded email from Ralph G. Stahl, Jr. to Paul Ross, Ritcherl, and Valent. Email from Sarah Caspar to Ralph G. Stahl, Jr. dated 1/20/99 re: sampling of Tennant's cattle and deer harvesting. (Bates No. EID017337, RLR001863).

1/22/1999 Interoffice Memo from Ralph G. Stahl, Jr. to distribution re: minutes of meeting held on 12/10/98. (Bates No. EID040480-EID040482).

1/24/1999 Email from Ralph G. Stahl, Jr. to DuPont personnel re: symptoms in Mr. Tennant's cattle. (Bates No. EID045552).

1/28/1999 1998 Dry Run Landfill Operational Report. Includes letter from R.L. Ritchey to Barbara S. Taylor. (Bates No. WVDEP 1300-WVDEP-1305).

1/28/1999 Letter report from Charles Anderson (NCSU) to George Woytowich (DuPont) re: fluoride results in Bermuda grass. [Includes interoffice memo transmitting data.] (Bates No. EID048277-EID048278, CF03983-CF003984).

1/28/1999 Letter report form Charles E. Anderson, Ph. D. to George Woytowich re: fluoride in Bermuda grasses collected from Dry Run landfill. [Includes DuPont transmittal memo] (Bates No. EID017357-EID017358, DDJ000684-DDJ000685).

1/28/1999 Letter from R.L. Ritchey to Barbara S. Taylor re: request permit modification. [Includes signed certification and copy of \$500 check.] (Bates No. EID000483-EID000485, EID000490, CF000471-CF000473, CF000478).

1/28/1999 DuPont contract order with Peter G. Moisan. [Includes letters form Peter G. Moisan dated 11/25/98, 1/7/99, and 1/19/99, and executed confidentially agreement. (Bates No. EID067719- EID067730).

1/29/1999 Interoffice memo from Thomas R. Waldron to Daniel A. Weber and Richard A. Kirschner, Jr. re: using water from containment pond for dust control. (Bates No. EID039385, TRW000984).

2/2/1999 Interoffice memo from Robert L. Ritchey to distribution list re: EPA's request for analytical information on streams going to WWTP and the biosolids that are landfilled at Dry Run. (Bates No. EID024444, HDR000107).



2/2/1999 Interoffice memo from Jon F. Moore to Daniel Weber re: meeting iron and aluminum discharge limits. (Bates No. EID053082, LKI001608).

2/5/1999 Email from Ralph G. Stahl, Jr. to distribution re: kick off meeting for the cattle expert team. (Bates No. EID067489, HDR001160).

2/11/1999 Letter from Mavis L. Lucas (WVDEP) to R.L. Ritchey re: papers constituting a modification application for NPDES permit. (Bates No. EID000494-EID000497, CF000466-CF000470).

2/12/1999 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, January 1999. Includes bioassay report. (Bates No. WVDEP 1306-WVDEP 1322).

2/12/1999 Interoffice memo from Lou Bedekovich to 4 addressees re: disposal of wastes directly to landfill. (Bates No. EID039368, TRW000967).

2/15/1999 Interoffice memo from Daniel A. Weber to Jon F. Moore and Richard A. Kirschner, Jr. re: January monitoring results. (Bates No. EID053091, JFM000418).

2/18/1999 Letter from R.L. Ritchey to Office of Water Resources re: copies of completed forms requested in letter dated February 11, 1999. (Bates No. EID000498-EID000510).

2/19/1999 Washington Works Semi-annual Stormwater Monitoring Report, Dry Run Landfill: Permit WV0076244. (Bates No. EID001486-EID001553).

2/22/1999 Interoffice memo from Rudolph Valentine to Robert L. Ritchey re: Greg Syke's involvement in cattle issue. (Bates No. EID042165, GPS000977).

2/24/1999 Email from Richard A. Kirschner, Jr. to H. David Ramsey re: location of Stream Sampling Point No. 1. (Bates No. EID058055-HDR001161).

Mar-99 March 1999 Environmental Performance Summary Historical Regulatory Exceedances and Reportable Releases. (Bates No. EID067438, CF004502).

3/1/1999 Interoffice memo from Lou Bedekovich to Hayden E. Lancaster re: waste disposal. (Bates No. EID039367, TRW000966).

3/1/1999 Interoffice memo from Lynwood K. Ireland to H. David Ramsey, Jr., Robert L. Ritchey and Greg P. Sykes re: availability of Dr. Lisa Davis-Heller for cattle team meeting. (Bates No. EID017359, HDR000027).



- 3/1/1999 Letter report from Frank A. Borsuk, Jr., Ph.D (Potesta) to Daniel Weber (DuPont) re: summary of field activities and associated lab analyses for samples collected January 27, 1999. [Includes COC and results for alkalinity and hardness] (Bates No. EID053098-EID053103, JFM000184-JFM000189).
- 3/8/1999 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, February 1999. (Bates No. EID001554-EID001563, GW003558-GW003567).
- 3/8/1999 Email from Daniel A. Weber to Robert L. Ritchey re: phone call to John Britvec concerning permitting and the installation of the leachate collection system. (Bates No. EID021613, RLR002124).
- 3/8/1999 Interoffice memo from Andrew S. Hartten to Robert L. Ritchey re: RFI groundwater data. (Bates No. EID071080, AC002583).
- 3/8/1999 Email from Hayden E. Lancaster to Mike E. Goodwin re: new waste disposal procedures. (Bates No. EID070325-EID070326, AC002420-AC002421).
- 3/9/1999 Email from Hayden E. Lancaster to Thomas R. Waldron re: waste disposal. (Bates No. EID070325-EID070326, AC002420-AC002421).
- 3/9/1999 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Benthic Macroinvertebrate Survey: August 1998. Includes copy of monthly monitoring report for January 1999 and biosassay report. (Bates No. EID001564-EID001587, CF002904-CF002927).
- 3/9/1999 Cattle Team Kickoff Meeting Summary (EID042172-EID042175, GPS000986-GPS000989).
- 3/9/1999 List of Problems and Differential Diagnoses for the Tenant Farm. (Bates No. EID042188-EID042189, GPS001003-GPS001004).
- 3/11/1999 Email from James A. Dyer to Richard A. Kirschner re: Fe and Lal levels in leachate pond. (Bates No. EID053113-EID053115, RAK008561-RAK008563).
- 3/12/1999 Email from Richard A. Kirschner to James A. Dyer re: Fe and Al levels in leachate pond. (Bates No. EID053116, RAK008564).
- 3/12/1999 Email from Richard A. Kirschner to James A. Dyer re: waste streams going to landfill are inert plastic wastes from the plant, scrap metal, wood



etc. that can't be reclaimed. (Bates No. EID053118, RAK008566).

- 3/12/1999 Email from James A. Dyer to Richard A. Kirschner re: Fe and Al levels in leachate pond. (Bates No. EID053117, RAK008565).
- 3/15/1999 Interoffice memo from Greg P. Sykes to Patrick J. Haley and Paul C. Meunier re: meeting with EPA regarding Dry Run landfill and cattle cases (EID042184-EID042185, GPS000999-GPS001000).
- 3/15/1999 Application Request for Approval for Phases II-Leachate Collection System includes interoffice memo from Richard A. Kirschner, Jr. to W. David Shoaf and Daniel A. Weber. (EID005062- EID005078, JFM000448-JFM000464).
- 3/16/1999 Memo from Bob Ritchey to Roger Zipfel, Tony Playtis, John Migliore, Alison Crane, and Dan Weber re: second round of results expected shortly. (Bates No. EID071079, AC002582).
- 3/16/1999 Email from James A. Dyer to Richard A. Kirschner re: discussion of Fe and Al concerns. (Bates No. EID053133, RAK008567).
- 3/22/1999 Interoffice memo from Richard a. Kirschner to distribution re: meeting to discuss now permitting limits. (Bates No. EID039359, TRW000954).
- 3/23/1999 Interoffice memo from Bharat O. Desai to distribution re: potential options for permit compliance at Dry Run. (Bates No. EID030797-EID030798, RAK000111-RAK000112).
- 3/23/1999 Email from Greg P. Sykes to distribution re: cattle team meeting minutes. (Bates No. EID017367-EID017368, RLR001941-RLR001942).
- 3/23/1999 Email from Daniel A. Weber to distribution re: phone call with John Britvec (WVOWM) concerning Fe and Al discharge limits (Bates No. EID037701, JMM007766).
- 3/24/1999 Interoffice memo from Daniel Weber to Jon F. Moore re: water acceptable for use for dust control. (Bates No. EID01868, DAW000014).
- 3/25/1999 Interoffice memo from J. Bart Ruiter to Dan Weber re: if discharge strictly stormwater would limits be applied to discharge. (Bates No. EID053147-EID053148, JFM000481-JFM000482).
- 3/26/1999 Email from J. Bart Ruiter to Bharat O. Desai re: discharge limits for Fe and Al. (Bates No. EID030802-EID030804, RAK000094-RAK000096).



- 3/29/1999 Report prepared by Protesta & Associates for DuPont Washington Works. Monitoring Wells MW-1, MW-1A, MW-4, MW-4A, MW-6, MW-10, and MW-11 Abandonment Report . (Bates No. EID030290-EID030322, CF002863-CF002895).
- 3/29/1999 Analytical information requested by EPA on the wastewater streams which feed into the WWTP and the resulting biosolids. [Includes letter from Robert Ritchey (DuPont) to Sarah Caspar (EPA). discussing dates biosolids were landfilled in Dry Run.] (Bates No. EID009452-EID009469, RLR000004-RLR000021).
- 3/29/1999 Potesta Monitoring Well MW-15 Installation Report Dry Run Landfill DuPont Washington Works, prepared for DuPont Washington Works, Project No. 98016. (Bates No. EID030323-EID030341, CF002844-CF002862).
- 3/30/1999 Interoffice memo from Robert L. Ritchey (DuPont) to Richard a. Kirschner, Jr. re: visit from Sarah Caspar to obtain split sample of biopond filter cake and the wasterwaster stream that feeds the filter press. (Bates No. EID017371-EID017372, RLR000002-RLR000003).
- 3/30/1999 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, First Quarter 1998. (Revised quarterly well report forms). (Bates No. WVDEP 1357-WVDEP 1363).
- 3/31/1999 Fax transmission from Sarah L. Caspar to Robert Ritchie re: list of analytical parameters. (Bates No. 000342, RLR000456).
- 3/31/1999 Email from James A. Dyer to Richard A. Kirschner re: dissolved Fe and Al. (Bates No. EID030805-EID030806, RAK000092-RAK000093).
- 4/6/1999 Quarterly Statistical Review of Groundwater Monitoring Results, Dry Run Landfill, First Quarter 1999. (Bates No. WVDEP 1418-WVDEP 1428).
- 4/6/1999 Terms and Conditions from DuPont to Saint Marys Veterinary Clinic (attn: Dr. Lisa Davis-Heller).; Contract Order No. LPW5135. (Bates No. EID067666-EID067668).
- 4/7/1999 Interoffice memo from Dawn Jackson to distribution re: standby statement and questions and answers in anticipation of media contact due to EPA site visits. (Bates No. EID063144-EID063151, HDR000007-HDR000014).
- 4/7/1999 Email from Robert Ritchey to distribution re: visit by EPA to plant went



well. EPA meeting with cattle vets at Tennant farm to prepare for planned cattle testing. (Bates No. EID017377, HDR000022).

- 4/9/1999 Memo from Greg P. Sykes to 6 addressees, report of Dry Run site visit, April 8-9, 1999. (Bates No. EID042206-EID0042208, GPS001021-GPS001023).
- 4/9/1999 Notes of phone conversation with Dr. Heller. (Bates No. EID017379-EID017381, RLR000447-RLR000449).
- 4/9/1999 Email from Robert Ritchey to distribution re: phone conversation with Dr. Heller (cattle team) discussing the visit from Dr. Heller's perspective and deer harvest. (Bates No. EID017384-EID017385).
- 4/10/1999 Email from Greg P. Sykes to distribution. Trip Report: Dry Run Visit by the Cattle Team on April 7 & 8, 1999. (Bates No. EID017390-EID017391, RLR001937-RLR001938).
- 4/12/1999 Letter from Barbara Taylor (WVDEP) to R.L. Ritchey (DuPont) re: Modification No. 1 of NPDES Permit. (Bates No. EID000516-EID000524, CF000441-CF000449).
- 4/13/1999 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, First Quarter 1999. (Bates No. WVDEP 1429-WVDEP 1444).
- 4/14/1999 Email from Greg P. Sykes to Sarah Caspar and Ralph G. Stahl, Jr. Forwarded Trip Report: Dry Run Visit by the Cattle Team on April 7 & 8, 1999. (Bates No. EID017389-EID017391, RLR001936-RLR001938).
- 4/14/1999 Email from Ralph G. Stahl, Jr. to distribution re: results and "final" conclusion of Tennant's herd available in 2-4 weeks. Forwarded Trip Report: Dry Run Visit by the Cattle Team on April 7 & 8, 1999. (Bates No. EID017389-EID017391, RLR001936-RLR001938).
- 4/15/1999 Email memo from Ralph G. Stahl, Jr. to Robert L. Ritchey, minutes from Cattle Team Meeting, March 9, 1999. (Bates No. EID017398-EID017401, RLR001931-RLR001931).
- 4/15/1999 Interoffice memo from Daniel A. Weber to distribution re: discussions concerning high pH in Dry Run Landfill lower pond. (Bates No. EID030807-EID030808, RAK000082-RAK000083).
- 4/16/1999 Email from Dawn D. Jackson to distribution re: standby statement which incorporates upgrades. (Bates No. EID058072-EID058075,



HDR001193-HDR001196).

- 4/16/1999 Standby statement. Same as text from above email. (Bates No. EID063152-EID063158, DDJ000676-DJD000682).
- 4/19/1999 Email from Bharat O. Desai to Daniel A. Weber re: high pH will precipitate out metals. (Bates No. EID058076, HDR001197).
- 4/20/1999 Email from Richard A. Kirschner to Bharat O. Desai re: mixed pond water and leachate water in 40/60 ratio to ensure that both TSS and Fe/Al were present for the filtration study. (Bates No. EID030813, RAK000078).
- 4/20/1999 Email from Bharat O. Desai to Richard A. Kirschner re: filtration will remove iron. (Bates No. EID030812, RAK000079).
- 4/26/1999 Letter from D. Mark Kiser (Potesta) to Richard Kirschner (DuPont) re: repairs to made at the lower pond of the landfill. (Bates No. EID015940-EID015942, RAK007823-RAK007825).
- 4/29/1999 Email from Ralph Stahl, Jr. to Robert Ritchey re: cattle team involvement in deer harvest. (Bates No. EID037693-EID037694, JMM007725-JMM007726).
- 5/7/1999 Email from Chuck Anderson (NCSU).to George Woytowich (DuPont) re: fluoride method to be used for grasses. [Email message forwarded to Robert L. Ritchey (DuPont) by George Woytowich (DuPont)] (Bates EID017403-EID017404, RLR000441-RLR000442).
- 5/11/1999 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, April 1999. (Bates No. EID001652-EID00161661, GW006377-GW006386).
- 5/19/1999 Roy F. Weston Analytical Report for samples collected 4/7/99. (Bates No. EID030353-EID030400, RLR000350-RLR000395).
- 5/25/1999 Interoffice memo from Bharat O. Desai to Richard A. Kirschner re: TSS , Al, and Fe results for the filtration test on landfill leachate. (Bates No. EID039318-EID039320, TRW000908-TRW000910).
- 5/25/1999 Email from Chris E. Shoop to Anil Shahak re: solid waste must have no free liquids. Supersacks must be liquid free. (Bates No. EID070368, AC002463).
- 5/27/1999 Email from Richard A. Kirschner to Bharat E. Desai re: sample collection



for filtration study. (Bates No. EID070182, JFM000763).

- 5/27/1999 Email from Bharat E. Desai to Richard A. Kirschner re: rental for field filtration unit. (Bates No. EID070183, JFM000764).
- 6/1/1999 Analytical results for split sludge samples collected 4/7/99. [Includes cover letter from R.L. Ritchey (DuPont) to Sarah L. Caspar (EPA). (Bates No. USEPA 1059-USEPA 1080).
- 6/2/1999 Email from Alison a. Crane to Janet Y. Villers re: confirmation the TE7043, TE9423, TE9423D, and FPD9382 do not contain C-8. (Bates No. EID070369, AC002464).
- 6/4/1999 Email memo from Dr. Perry Habecker to Greg P. Sykes forwarded email from Sarah Caspar to Perry Habecker discussing fluorides in animal tissues (Bates No. EID042282, GPS001103).
- 6/4/1999 Email memo from Dr. Perry Habecker to Greg P. Sykes forwarded email from Dr. Robert Poppenga re: response to Sarah Caspar email on fluorides.(Bates No. EID042283, GPS001104).
- 6/11/1999 Tennant Farm Herd Health Investigation: Cattle Team Data Workbook. [Includes Herd Investigation Report (dated 4/18/99), pathology reports, copied photographs, Draft Report Dry Run Creek (dated 11/97), veterinary pathology report (dated 12/22/97), letter report of Small Mammal Trapping Effort (dated 12/3/98)]. (Bates No. EID042286-EID042287, GPS001107-GPS001108, DUP 002-DUP 240).
- 6/16/1999 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, May 1999. [Includes bioassay report.] (Bates No. WVDEP 1499-WVDEP 1514).
- 6/16/1999 Washington Works-NPDES Permit WV0001279 Monthly Monitoring Report for May 1999. [Includes bioassay report.] (Bates No. EID001684-EID001740, GW006217-GW006273).
- 6/17/1999 Standby statement to be used in the event of media inquiries. DuPont has received a "Notice of Intent to Sue" regarding Dry Run Landfill. Confident that the site does not present any risk to the community. (Bates No. EID067514, HDR001202).
- 6/21/1999 Quarterly Statistical Review of Groundwater Monitoring Results, Dry Run Landfill, Second Quarter 1999. (Bates No. EID023272-EID023282, CF002805-CF002815).



6/24/1999 Email from Robert L. Ritchey to DuPont personnel re: F11 detected slightly above MDL and acrolein detected at 1.99 ppm. Concerned that EPA will maintain their focus on F11. (Bates No. EID030828, RLR001884).

6/24/1999 Email from Alison A. Crane to Louis J. Bedekovich re: cleanup in diesel tank, sandblasting, and paint and solvent storage areas. (Bates No. EID070406, AC002503).

6/24/1999 Email from Michael D. Aucoin to Robert L. Ritchey re: detection of acrolein at 1.99 ppm not significant since RBS is 1600 mg/kg. (Bates No. EID030828, RLR001884).

7/1/1999 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244. Quarterly Leachate Analysis Report, Second Quarter 1999. (Bates No. WVDEP 1515-WVDEP 1521).

7/1/1999 Press Release Draft: detailed version #1, DuPont Washington Works: Dry Run Landfill Civil Action. (Bates No. EID067503, HDR000531).

7/1/1999 Press Release Draft: short version #1, DuPont Washington Works: Dry Run Landfill Civil Action. (Bates No. EID067504, HDR000532).

7/2/1999 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Second Quarter 1999. (Bates No. WVDEP 1522-WVDEP 1531).

7/14/1999 Interoffice memo from Greg P. Sykes to 6 addressees re: Dry Run Litigation Record hold order. (Bates No. EID042293-EID042294, GPS001124-GPS001125).

7/14/1999 Email from Greg P. Sykes to 6 addressees re: Dry Run Litigation Record hold order. (Bates No. EID042295-EID042296, GPS001126-GPS001127).

7/14/1999 Interoffice memo from Greg P. Sykes to Patrick J. Haley re: FYI-Dry Run Litigation Record Hold Order. (Bates NO. EID042297, GPS001128).

7/14/1999 Interoffice memo from Greg P. Sykes to 4 addressees re: apology to Mike for error in name. (Bates No. EID042298, GPS001129).

7/15/1999 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, June 1999. No samples taken. (Bates No. EID001759-EID001767, GW006321-GW006329).



7/16/1999 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Quarterly Pond Underdrain Analysis Report, Second Quarter 1999. (Bates No. EID001786-EID001769).

7/20/1999 Email from Daniel Weber to John M. Migliore (DuPont); forwarded email from Ralph Stahl, Jr. to Robert Ritchey [dated 4/29/99] re: cattle team involvement in deer harvest. (Bates No. EID037693-EID037694, JMM007725-JMM007726).

7/20/1999 Email from Bharat O. Desai (DuPont) to Richard A. Kirschner (DuPont) re: sample shipment to Oberlin for analysis. (Bates No. EID030830, RAK000004).

7/22/1999 Email from Bharat O. Desai (DuPont) to Richard A. Kirschner re: keep leachate out of pond at this time and discussion of sample to be submitted to Oberlin for testing. (Bates No. EID030831, RAK000002).

7/27/1999 Email from George Woytowich to distribution re: Annual Vegetation Survey by Dr. Charles Anderson. (Bates No. EID070260, LK1001749).

7/29/1999 Proposed agenda for EPA/DuPont Cattle Team Meeting. (Bates No. EID042303, GPS001134).

7/30/1999 Email from Robert L. Ritchey to Ralph G. Stahl re: speaking with Dr. Moisan concerning his vegetation survey efforts and his input to cattle team. (Bates No. EID017410, RLR000340).

8/4/1999 Email from Daniel Weber to Robert Ritchey. Forwarded email from Chuck Anderson to George Woytowich re: fluoride results (Bates No. EID037707, JMM007772).

8/4/1999 Letter report from Charles Anderson re: results of vegetation survey performed on July 19-20, 1999. [Includes tables of observations and DuPont interoffice memo dated 8/11/99 transmitting information] (Bates No. EID048261-EID0048276, CF003967-CF003982).

8/9/1999 Email from Dr. Perry Habecker to Sarah Caspar re: preliminary report of cattle team study. (Bates No. DUP 001).

8/12/1999 Email memo from Greg P. Sykes to 6 addressees re: responding to specific questions should be avoided until report is final (Bates No. EID042321-EID042321, GPS001158-GPS001159).

8/13/1999 Email memo from Greg P. Sykes to Patrick H. Haley & James A. Popp re: brief chronology of cattle team activities. (Bates No. EID042323-



EID042324, GPS001161-GPS001162).

- 8/13/1999 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, July 1999. No samples taken. (Bates No. EID001770-EID001778, GW006573-GW006580).
- 8/13/1999 Email memo from Sarah Caspar to Greg P. Sykes re: may be jumping to conclusions on the cause of cattle problems. (Bates No. EID042325-EID042326, GPS001163-GPS001164).
- 8/13/1999 Interoffice memo from Dr. Perry Habecker (U Penn). to Peter Moisan, Lisa Davis-Heller, Greg P. Sykes (DuPont), Bob Poppenga (U Penn)., and Bob Munson (U Penn). re: contact with Mr. Tennant is to be through attorney. Any contact from Mr. Billott should be through DuPont counsel. (Bates No. EID042328, GPS001166).
- 8/18/1999 Email from Jon F. Moore (DuPont) to Lynwood K. Ireland (DuPont) and Dawn D. Jackson (DuPont) re: per DNR loss of hair in deer attributable to ring worm. (Bates No. EID008500, RLR001911).
- 8/18/1999 Email from Jon F. Moore (DuPont) to Lynwood K. Ireland (DuPont) and Dawn D. Jackson (DuPont) re: per DNR loss of hair in deer attributable to ring worm. [Same as above document] (Bates No. EID070261, LKI001756).
- 8/24/1999 Letter report from Frank Borsuk, Jr., (Protesta) to Jay S. DeBee (DuPont) re: Benthic Macroinvertebrate Surveys. (Bates No. EID037889-EID037897, SDB002981-SDB002989).
- 8/25/1999 Email memo from Ralph G. Stahl, Jr. to 10 addressees re: final report of cattle team study. (Bates No. EID042330, GPS001168).
- 8/31/1999 Letter from R.L. Ritchey to Barbara Taylor re: transmission of benthic macroinvertebrate survey, and no sample was collected from Dry Run Creek due to no flow conditions. [Report same as 8/24/99 above] (Bates No. EID001779-EID001788, CF000036-CF000045).
- 9/3/1999 Email from Robert L. Ritchey (DuPont) to DuPont personnel re: per Cindy Musser fetal deer brought into to DNR office had yellow toenails. (Bates No. EID008024, RLR001983).
- 9/8/1999 Letter to Dr. Edward M Snyder (WV Environmental Quality Board). re: Water Quality Standards-aluminum criterion. (Bates No. EID009587-EID009595, WCA000001-WCA00009).



9/13/1999 Letter to Dr. Edward M Snyder (WV Environmental Quality Board). re: Water Quality Standards-iron criterion. (Bates No. EID009596-EID009601, WCA000010-WCA000015).

9/16/1999 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, August 1999. (Bates No. EID001789-EID001798, CF003386-CF003382).

9/18/1999 Interoffice memo from David W. Johnson to distribution re: list of flowers recommended for the landfill area. (Bates No. EID070707-EID070708, RJZ000039-RJZ000040).

9/20/1999 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, September 1999. No samples taken. (Bates No. WVDEP 1559-WVDEP 1565).

9/21/1999 Email from Geroge Woytowich to Chris E. Shoop re: waste material should not be sent to Dry Run in steel drums. (Bates No. EID070269, GW007067).

9/24/1999 Email from George Woytowich to Chris E. Shoop re: sending calcium sulfate to Dry Run Landfill. (Bates No. EID070376, AC002473).

9/24/1999 Email from George Woytowich to Chris E. Shoop and Thomas R. Waldron re: disposal of CaSO<sub>4</sub> to Dry Run. (Bates No. EID070292, GW007090).

9/27/1999 Email from Alison A. Crane to George Woytowich re: reservations about sending calcium sulfate to Dry Run due to references to cobaltous chloride on MSDS. (Bates No. EID070377, AC002474).

9/27/1999 Email from Chris E. Shoop to Bryan P. Sautter, Tammie L. Zoller, and Alison A. Crane re: actions to be taken to resolve CaSO<sub>4</sub> disposal issues. (Bates No. EID070378-EID070379, AC002475-AC002476).

9/27/1999 Email from Bryan P. Sautter to Chris E. Shoop re: CaSO<sub>4</sub> to be landfilled does not contain cobaltous chloride. (Bates No. EID070380, AC002477).

9/27/1999 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, Benzene analysis (Bates No. EID001801-EID001802, CF000012-CF000013).

10/1/1999 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244. Quarterly Leachate Analysis Report, Third Quarter 1999. (Bates No. EID001803-EID001809).



10/1/1999 Quarterly Statistical Review of Groundwater Monitoring Results, Dry Run Landfill, Third Quarter 1999. (Bates No. EID023283-EID023293, CF002773-CF002793).

10/1/1999 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Quarterly Pond Underdrain Analysis Report, Third Quarter 1999. (Bates No. WVDEP 1541-WVDEP 1542)

10/4/1999 Memo from Ceil Mancini and Don spires (URS GreinerWoodward Clyde) to Ralph Stahl (DuPont) re: results of evaluation of staining in shrew teeth. (Bates No. EID046617-EID046618, RGS000018-RGS000019).

10/4/1999 Email from Alison A. Crane to Margaret H. Mellon re: landfill disposal of materials goes through George Woytowich and Tom Waldron. (Bates No. EID070381, AC002478).

10/4/1999 Email from Chris E. Shoop to Robert F. Pinchot re: disposal of scrubber packing rings in Dry Run OK since they are rinsed with water for 8 hrs. and C-8 would have been removed. (Bates No. EID070409, AC002506).

10/4/1999 Email from Chris E. Shoop to Robert F. Pinchot re: disposal of scrubber packing rings in Dry Run OK since they are rinsed with water for 8 hrs. and C-8 would have been removed. [Same as document listed above.] (Bates No. EID070409, AC002506).

10/4/1999 Email from Robert F. Pinchot to Chris E. Shoop re: presence/absence of C-8 on scrubber packing rings and their disposal. (Bates No. EID070710, AC002507).

10/4/1999 Email from Chris E. Shoop to James W. Hunt and Alison A. Crane re: question of washing rings may not remove all of the C-8.

10/5/1999 Email from Greg P. Sykes (DuPont) to distribution re: preparation of Dry Run report. (Bates No. DUP 241).

10/6/1999 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Third Quarter 1999. (Bates No. EID023304-EID023360).

10/6/1999 Email from Roger J. Zipfel to Chris Shoop re: essentially no C-8 in packing due to high oven temperature. (Bates No. EID070710-EID070711, RJZ000042-RJZ000043).

10/11/1999 Email from George Waytowich to Thomas R. Waldron re: list of Teflon products that can be landfilled in Dry Run. (Bates No. EID021604-



EID021605, GWK000011-GWK000012).

- 10/13/1999 Email from Chris E. Shoop to George Woytowich and Robert F. Pinchot re: disposal of FEP HF Scrubber Packing Material sent to Dry Run to due C-8 ND (<0.5 ppm). (Bates No. EID070384, AC002481).
- 10/14/1999 Interoffice memo from Daniel A. Weber to distribution re: are issues in attached memo being addressed. [Includes interoffice memo from Daniel A. Weber to distribution re: monitoring well maintenance/issue list.] (Bates No. EID024360-EID024361).
- 10/14/1999 Email memo from F. Neal Schrick to Greg P. Sykes re: cattle prolactin values (Bates No. EID042339, GPS001177).
- 10/15/1999 Email from Pat Lane (DuPont) to Scott DeBee and George Woytowich (DuPont) re: elevated fecal coliform result. (Bates No. EID046062, JFM000637).
- 10/15/1999 Email from Pat Lane to Scott DeBee re: fecal coliform results. (Bates No. EID070195, JFM000790).
- 11/1/1999 Email from M. Therese Zotti (DuPont) to George Woytowich (DuPont) re: product for disposal in Dry Run. (Bates No. EID044951, GW007058).
- 11/1/1999 Email from M. Therese Zotti (DuPont) to George Woytowich (DuPont) re: product for disposal in Dry Run. [Same as above document.] (Bates No. EID070293, GW007091).
- 11/5/1999 Email from George Woytowich (DuPont) to M. Therese Zotti (DuPont) re: material cited as non-hazardous water may not be landfilled at Dry Run. (Bates No. EID044951, GW007058).
- 11/8/1999 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, October 1999. (Bates No. WVDEP 1566-WVDEP 1575).
- 11/12/1999 Email from Pat Lane to George Woytowich re: attached field sheets. (Bates No. EID070286, GW007084).
- 11/16/1999 Correction of Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, October 1999. (Bates No. EID001850-EID001852, CF003871-CF003873).
- 11/17/1999 Email from George Woytowich (DuPont) to Patricia Demaio (DuPont) re: material for disposal in Dry Run. (Bates No. EID044952, GW007059).



11/17/1999 Email from George Woytowich (DuPont) to Patricia Demaio (DuPont) re: material for disposal in Dry Run. [Same as above document.] (Bates No. EID070295, GW007093).

11/17/1999 Email from George Woytowich (DuPont) to Patricia Demaio (DuPont) re: material for disposal in Dry Run. [Same as above document.] (Bates No. EID070198, JFM000793).

11/18/1999 Email from Alison A. Crane to Michelle M. Dixon re: Butacite dye bags OK for landfill as long as they are completely empty. (Bates No. EID070358, AC002453).

12/2/1999 Letter from R.L. Ritchey to Barbara Taylor re: attempts to perform benthic macroinvertebrate survey unsuccessful. (Bates No. EID048348-EID048350, CF004054-CF004056).

12/2/1999 Acute Toxicity Bioassay Report, Job #: 1299-9911899. (Bates No. EID067698-EID067704, EID067718, SDB003256-SDB003262, SDB003276).

12/14/1999 Email from Wayne C. Appleton (DuPont) to R Gensemer (ENSR) re: requesting copy of paper on aluminum toxicity. (Bates No. EID009602, WCA000016).

12/16/1999 Kemron results for Outlet 001 collected 11/29/99. (Bates No. EID067705-067717, SDB003263-SDB003275).

12/20/1999 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, November 1999. Includes bioassay report. (Bates No. EID001853-EID001866, CF003875-CF003888).

12/23/1999 Tennant Farm Herd Health Investigation Cattle Team Report (Bates No. DUP 242-DUP-362).

12/31/1999 Quarterly Statistical Review of Groundwater Monitoring Results, Dry Run Landfill, Fourth Quarter 1999. (Bates No. EID048337-EID048347, CF004043-CF004053).

1/4/2000 Email from Alison A. Crane to Charles T. Abel re: coal ash stored at Ravenswood to be sent to Dry Run. (Bates No. EID070359, AC002454).

1/4/2000 Email from Alison A. Crane to Charles T. Abel re: coal ash stored at Ravenswood to be sent to Dry Run. [Same as above document.] (Bates No. EID070385, AC002482).



1/4/2000 Email from Alison A. Crane to Charles T. Abel re: coal ash stored at Ravenswood to be sent to Dry Run. [Same as above document.] (Bates No. EID070297, GW007095).

1/7/2000 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Fourth Quarter 1999. (Bates No. EID023361-EID023371).

1/7/2000 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Fourth Quarter 1999. (Bates No. EID023294-EID023303; SDB003291-SDB003300).

1/14/2000 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Quarterly Pond Underdrain Analysis Report, Third Quarter 1999. (Bates No. EID023372-EID023374).

1/14/2000 Washington Works Monitoring Report, Dry Run Landfill Permit WV0076244, Quarterly Leachate Analysis Report, Fourth Quarter 1999. (Bates No. EID023375-EID023382).

1/20/2000 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, December 1999. (Bates No. EID037172-EID037183, SDB 003315-SDB003326).

1/21/2000 Washington Works Monitoring Report, Semi-annual Stormwater Monitoring Report, Dry Run Landfill Permit WV076244. (Bates No. EDI067355-EID067385; SDB003391-SDB003421).

1/21/2000 Washington Works Monitoring Report, Semi-annual Stormwater Monitoring Report, Dry Run Landfill Permit WV076244. Includes Groundwater Sampling Field Data Sheets and tabulated results. (Bates No. EID037779- EID037810, CF004089CF004120; EID045943-EID045952, SDB002854-SDB002863; EDI045953-EID045978, SDB002864-SDB002888).

1/25/2000 Letter from R.L. Ritchey to William D. Brannon re: request reduction in frequency of effluent toxicity testing. (Bates No. EID048324-EID048325, CF004030-CF004031).

1/25/2000 Letter from R.L. Ritchey to William D. Brannon re: request reduction in frequency of effluent toxicity testing. (Bates No. EID067349, SDB003361).

1/31/2000 Email from Dawn Jackson to DuPont personnel re: local DNR representative inquired about results of study performed on deer. (Bates No. EID066063, RP000135).



1/31/2000 1999 Annual Landfill Report. Permit WV0076244. Includes cover letter from R.L. Ritchey to William D. Brannon. (Bates No. EID037768-EID037776, CF004079-CF004087).

2/1/2000 Email from Robert Ritchey to DuPont personnel re: request for cattle and small animal reports (Bates No. EID037697, JMM007758).

2/3/2000 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, January 2000. (Bates No. EID037184-EID037216, SDB002890-SDB002922).

3/7/2000 Letter from Allyn Turner (WVDEP) to R.L. Ritchey (DuPont) re: request to conduct whole effluent toxicity testing on an annual basis is acceptable. (Bates No. EID067350, SDB003362).

3/10/2000 Email from J. Scott DeBee to Dawn Marshall re: list of samples commonly run at Dry Run. (Bates No. EID070201, JFM000796).

3/13/2000 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, February 2000. (Bates No. EID066987-EID066997).

3/15/2000 Letter from Dawn Jackson to Mr. Cyril Graham re: copy of cattle study. (Bates No. EID070314, DDJ001520).

3/15/2000 Letter from Dawn Jackson to Mr. Robert C. Wigal re: copy of cattle study. (Bates No. EID070315, DDJ001521).

3/29/2000 Washington Works Monitoring Report Dry Run Landfill Permit WV0076244 Quarterly Leachate Analysis Report First Quarter 2000. (Bates No. EID067402-EID067414, CF004630-CF004642).

3/29/2000 Kemron results for samples received 1/10/00. (Bates No. EID06386-EID067401, SDB003447-SDB003462).

3/30/2000 Quarterly Statistical Review of Groundwater Monitoring Results 1st Quarter 2000 (Bates No. EID067416-EID067426, CF004604-CF004614).

4/5/2000 Washington Works Monitoring Report Dry Run Landfill Permit WV0076244 Quarterly Pond Underdrain Analysis Report First Quarter 2000. (Bates No. EID067020-EID067023).

4/6/2000 Washington Works - GW sampling (quarterly) Dry Run Landfill (Bates No. EID067542-EID068543).



4/12/2000 Washington Works Monitoring Groundwater Report, Dry Run Landfill Permit WV0076244, 1st Quarter 2000. (Bates No. EID003934-EID023942, JMM004525-JMM004533).

4/14/2000 Washington Works, Monthly Monitoring Report, Dry Run Landfill Permit WV0076244, March 2000. (Bates No. EID067009-EID067019).

4/20/2000 Email from Bharat O. Desai to George Woytowich re: Al exceedance due to naturally occurring condition. (Bates No. EID070320, RLR002140).

4/26/2000 Email from Thomas R. Woldron to Jon F. Moore, Lynwood K. Ireland, and Robert L. Ritchey re: complaint of odor coming from Dry Run Landfill by Tenants. (Bates No. EID070319, RLR002139).

5/16/2000 News Release 3M Phasing Out Some of its Specialty Materials.

5/30/2000 Email from George Woytowich to Bharat O. Desai re: lower pond put into service in Oct. 98. However, no discharge from Outlet 001 in October, November, and December 1998. (Bates No. EID070204, JFM000803).

6/8/2000 Email from Thomas R. Waldron to Lynwood K. Ireland re: location of well at Dry Run. (Bates No. EID070205, JFM000804).

6/23/2000 Letter from Gerald L. Kennedy to Dr. Charles M. Auer re: DuPont's uses of APFO. Includes Voluntary Use and Exposure Information Profile. (Bates No. EID070482-EID070492).

6/27/2000 Letter from R.L. Ritchey (DuPont) to Allyn G. Turner (WVDEP) re: fecal coliform permit exceedance. (Bates No. EID070590-EID070591).

6/29/2000 Suggested draft letter from R.L. Ritchey to Allyn Turner (OWR) re: Benthic Macroinvertebrate Survey: May 2000. [No report attached. Fax transmission cover pages included.] (Bates No. EID070265-EID070268, GW007063-GW007066).

6/30/2000 Interoffice memo from George Woytowich to Thomas R. Waldron re: cover crushed bins with fly ash to fill in voids. (Bates No. EID070989, TRW001518).

6/30/2000 Interoffice memo from George Woytowich to Thomas R. Waldron re: cover crushed bins with fly ash to fill in voids. [Same as above document.] (Bates No. EID070206, JFM000805).

6/30/2000 Email from Steve Hatcher to Becky Szakats Dines re: dust control on



landfill and respiratory protection. (Bates No. EID070990, TRW001519).

- 7/13/2000 Email from Thomas R. Waldron to Lyle K. Carder re: landfilling of orange bins. (Bates No. EID070991, TRW001520).
- 7/17/2000 Washington Works Monitoring Report Dry Run Landfill Permit WV0076244 June 2000. (Bates No. EID070053-EID070063, CF005954-CF005964).
- 7/19/2000 Wilbur Earl Tennant, et al. v. E.I. du Pont de Nemours and Company In the United States District Court for the Southern District of WV at Parkersburg, Civil Action No. 6:99-0488. E.I. duPont de Nemours & Company's Answers to Plaintiffs' Second Set of Interrogatories and Responses to Requests for Production of Documents and Other Tangible Things"
- 7/20/2000 Washington Works Monitoring Report Dry Run Landfill Permit WV0076244 Second Quarter 2000. (Bates No. EID070032-EID070043, CF005933-CF005944).
- 7/20/2000 Washington Works Monitoring Report Dry Run Landfill Permit WV0076244 Quarterly Leachate Analysis Report Second Quarter 2000. (Bates No. EID070044-EID070052, CF005945-CF005953).
- 7/20/2000 Washington Works Monitoring Report Dry Run Landfill Permit WV0076244 Quarterly Pond Underdrain Analysis Report Second Quarter 2000. (Bates No. EID070064-EID070067, CF005965-CF005968).
- 7/21/2000 Fax from Kevin McDonald (Kemron) to George Woytowich. Field sheets for sampling Dry Run monitoring wells. (Bates No. EID070712-EID070720, GW007113-GW007121).
- 7/24/2000 Email from J. Scott DeBee to George Woytowich re: Kemron lab results and blank forms for stormwaters from Dry Run. (Bates No. EID070301, GW007100).
- 7/24/2000 Email from J. Scott DeBee to George Woytowich re: semi-annual stormwater data summary (1st half 2000). from Dry Run. (Bates No. EID070309-EID070310, GW007108-GW007109).
- 7/24/2000 Email from J. Scott DeBee to George Woytowich re: Kemron formaldehyde results for 2 samples from Dry Run. (Bates No. EID070311-EID070313, GW007110-GW007112).



7/31/2000 Product Information sheet for fluorochemical acid.

7/31/2000 Safety data for pentadecafluorooctanoic acid.

8/1/2000 Fax from Kevin McDonald (Kemron) to George Woytowich. Field sheets for re-sampling Dry Run monitoring wells. (Bates No. EID070721-EID070727, GW007122-GW007129).

9/26/2000 Pacific Analytical semivolatiles results for samples collected 8/17/00.

10/9/2000 Galbraith Laboratories results for TR01.

Material Safety Data Sheets

9/4/1990 Kemron Appendix XI results for one Dry Run sludge sample collected 8/23/90. WO# NO-08-282. (Bates No. EID035196-EID035220, JMM003725-JMM003749).

9/4/1990 Kemron Fax Appendix XI results for one Dry Run sludge sample collected 8/23/90. WO# NO-08-282. (Bates No. EID035187-EID035195, CF001145-CF001153).

3/6/1996 Kemron metals and TCLP metals results for one bottom ash sample collected 2/21/96. WO# N6-02-457. (Bates No. EID035068-EID035073, JMM005701-JMM005706).

7/22/1993 Kemron preliminary results for one Dry Run 001 Outlet sample collected 7/15/93. WO# N3-07-251. (Bates No. EID036098-EID036100, GW006494-GW006496).

4/2/1991 Kemron metals results for one Tote Bin Wash Water collected 3/12/91. WO# N1-03-217. (Bates No. EID036053-EID036058, JMM005657-JMM005662).

1/14/1997 Quarterly Statistical Review of Groundwater Monitoring Results, Dry Run Landfill, First Quarter 1997. (Bates No. EID023089-EID023105, GW000479-GW000495).

12/31/1998 Quarterly Statistical Review of Groundwater Monitoring Results, Dry Run Landfill, Forth Quarter 1998. (Bates No. EID023242-EID023251, GW000618-GW000627).

7/12/1995 Report from Robert M. Crowley to George Woytowich, Dry Run Monitoring Wells MW-6, 6A, 12, 12A, 13, 13A, 14 Second Quarter, 1995. (Bates No. EID030544-EID030561, GW000719-GW000736).



3/10/1997 Interoffice memo from Richard A. Kirschner, Jr. to Daniel Weber re: disposal of materials from Washington Works. (Bates No. EID009492, EID031851-EID03154, RAK003220, GW000828-GW000831).

4/30/1990 TCLP results for one Bio Pond Sludge collected 4/23/90. Work Order # N0-04-276. (Bates No. EID030602- EID35604, JMM006932-JMM006934).

4/24/1990 Kemron TCLP results for one Bio Pond Sludge sample collected 4/23/90. (Bates No. EID0035626-EID035628, JMM006956-JMM006958).

4/12/2000 Washington Works Monitoring Groundwater Report, Dry Run Landfill Permit WV0076244, 1st Quarter 2000. (Bates No. EID066998-EID67008).

Tables Dry Run Soils Metals & Fluoride v background. (Bates No. EID031184-EID031185).

3/15/1991 Memo from P. C. Mahoney to C. F. Muska, Re: Dry Run Groundwater Flow Map. (Bates No. EID018026-EID018027).

6/2/1998 Kemron report for sample 001 OUTLET (Bates No. EID023503-EID023518, SDB001807-SDB001822).

Appendix E Support Documentation for EPA's 10/16/98 samples. (Bates No. EID034848-EID034864, JMM 001493-JMM 001509).

1/29/1997 Interoffice memo from Harley D. Bickerstaff to Ronald W. Meloon & Lynwood K. Ireland re: pH, TSS, and T-Fe results for sample taken from Outlet 001. (Bates No. EID039240, TRW001220).

5/12/1980 Memo from C. J. Babcock to D. H. Snyder, Re: Waste Bio Sludge/Fly Ash Codisposal. (Bates No. EID029688-EID029801).

1997 Dry Run Landfill Task Team Anticipated Questions. (Bates No. EID029797-EID029801, LKI001047-LKI001047).

Waste Characterization Forms with MSDS.

4/23/1990 Kemron Report for four monitoring wells MW-4, -5, -6, & -7 samples collected 3/27/90. (Bates No. EID03617, EID034990-EID035055, GW-006363, GW001160-GW001225).

8/24/1998 Letter report form Charles Anderson re: results of vegetation survey



performed on July 20-21, 1998. [Includes tables of observations and mineral results on grasses, and interoffice memo of transmittal.] (Bates No. EID030740-EID030758, RLR000701-RLR000719). with 9/4/98 cover Memo from R. L. Ritchey

- 3/10/1997 Interoffice memo from Richard A. Kirschner, Jr. to Daniel Weber re: disposal of materials from Washington Works. (Bates No. EID031853-EID03154, GW000830-GW000831).
- 1/19/1998 Interoffice memo from Andrew S. Hartten to Reitzl and Weberda Re: Dry Run Comments, Disposal of materials from Washington Works. (Bates No. EID031853-EID03154, GW000830-GW000831).
- 1/21/1994 Interoffice memo from Richard A. Kirschner, Jr. re: Dry Run Pond Nutrient Testing 1993. (Bates No. EID030786-EID00790, GW001320-GW001324).
- 6/3/1999 Interoffice memo from Ralph G Stahl, Jr to Robert L Ritchey. re: Dry Run Pond Animal Tissues. (Bates No. EID017406-EID017409, RLR001962-RLR001965).
- 9/3/1999 Email from Daniel A. Weber to Robert L. Ritchey (DuPont) re: 10/96 EPA Visit Summary. (Bates No. EID04319-EID024321, RLR002025-RLR002027).
- 2/2/1999 Email from Daniel A. Weber to Robert L. Ritchey (DuPont) re: Site Specific Variancery. (Bates No. EID017864-EID017866, DAW000022-DAW000024).
- 2/24/1999 Email from Daniel A. Weber to David Ramsey (DuPont) re: Dry Run Landfill 001 Discharge Limit with other attached emails. (Bates No. EID058058-EID058071, HDR001166- HDR001192).
- 8/4/1999 Email from Robert L. Ritchey to Daniel A. Weber (DuPont) re: Dry Run joint mtg minutes. (Bates No. EID037702-EID037703, JMM007767-JMM007768).
- 9/12/1997 Interoffice memo from Lynwood K. Ireland to Robert L Ritchey etc.. re: Attached Note from Bob with attached memos.. (Bates No.EID017307-EID017309, HDR000849-HDR000851).
- 7/7/1999 Email from Richard A. Kirschner, Jr. to George Woytowich (DuPont) re: FYI- Typical Background Fluoride levels. (Bates No. EID014197-EID014198, GW001299- GW001300).



9/3/1999 Email from Daniel A. Weber to Robert L. Ritchey (DuPont) re: Foam in Dry Run Landfill. (Bates No. EID016852, RLR002007).

1/29/1999 Interoffice memo from Richard A. Kirschner, Jr to Thomas R. Waldron.. re: Attached Note about using lower pond water for dust control.. (Bates No.EID039378-EID039380, TRW000977-TRW000979).

Table listing Pond 1 - Pre-Excavation Analytical Results, Single Sample Analysis After Sludge Removal, and Waste Composition for Anaerobic Digestion Ponds. (Bates No.EID034726-EID034727, JMM005864-??).

Sludge Test Results (Bates No.EID008485).

Anaerobic Digestion Ponds (Bates No.EID008485, JMM005863).

1/20/1998 Interoffice memo from Richard A. Kirschner, Jr to Daniel A. Weber to Robert L. Ritchey (DuPont) re: Pierson's Comments with 1/19/98 memo from Keith B. Pierson to Richard A. Kirschner, Jr, re: Wash Works Dry Run EPA Draft Report. (Bates No.EID0671288-EID067132, DAW000161-DAW000165).

1/6/1998 Interoffice memo from Robert L. Ritchey to distribution re: Dry Run permit Status & Insights. (Bates No. EID052906-EID052908, RLR0012887-RLR001288).

6/30/2000 Email from Becky S Dines to Thomas R. Waldron (DuPont) re: Boso. (Bates No. EID070987-EID070988, TRW001519-TRW001517).

9/8/1999 Email from Bharat O Desai to Richard A. Kirschner, Jr (DuPont) re: Results of Oberlin filtration test. (Bates No. EID070190-EID070192, JFM000785-JFM000787).

5/7/1999 Email from Richard A. Kirschner, Jr. to Jon F Moore (DuPont) re: Permit limits for Fe & Al. (Bates No. EID070178-EID070181, JFM000759-JFM000762).

5/25/1999 Email from Richard A. Kirschner, Jr. to Jon F Moore (DuPont) re: filtration tests. (Bates No. EID070176-EID070177, JFM000757-JFM000758).

5/12/1999 Email from Richard A. Kirschner, Jr. to Jon F Moore etc. (DuPont) re: Project Appropriation Request, Phase II - Leachate Collection System. (Bates No. EID070157-EID070175, JFM000738-JFM000756).

11/5/1999 Email from M. Therese Zotti (DuPont) to George Woytowich (DuPont)



re: Scrap for Dry Run. (Bates No. EID070294-EID070296, GW007092-GW007094).

- 11/16/1995 Email to George Woytowich (DuPont) re: Dry Run 4444 Message. (Bates No. EID070271-EID070296, GW007069-GW007070).
- 10/5/1999 Email from James W Hunt (DuPont) to Robert F Pinchot (DuPont) re: Disposal of FEP Scrubber Packing Rings. (Bates No. EID070412-EID070413, AC002509-AC002510).
- 10/6/1999 Email from Roger J. Zipfel to Chris Shoop re: essentially no C-8 in packing due to high oven temperature. (Bates No. EID070414-EID070415, AC002511-AC002512).
- 3/3/2000 Email from Alison A Crane to Chris Shoop re: Bagline Printer Ink Cartridges-Used. (Bates No. EID070393-EID070397, AC002490-AC002494).
- 1/13/2000 Email from Alison A Crane to Chris Shoop re: Disposal of FEP Scrubber Packing Rings. (Bates No. EID070386-EID070388, AC002483-AC002485).
- 10/7/1999 Email from Chris Shoop to James W Hunt (DuPont) re: Disposal of FEP Scrubber Packing Rings. (Bates No. EID070382-EID070380, AC002479-AC002480).
- 9/2/1999 Email from Chris Shoop to Roger J. Zipfel (DuPont) re: C-8 content of solids from supernate oberlin testing. (Bates No. EID070372-EID070374, AC002469-AC002470).
- 9/24/1999 Email from Chris Shoop to George Woytowich (DuPont) re: spent calcium sulfate. (Bates No. EID070375, AC002472).
- 12/9/1998 Email from Daniel A. Weber to Alison A Crane re: Uncapped Fluff, hazardous waste & the AFB. (Bates No. EID070362-EID070367, AC002457-AC002462).
- 3/9/1999 Email from Hayden E Lancaster to Alison A Crane etc. re: waste. (Bates No. EID070360-EID070361, AC002455-AC002456).
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| 006-0133-0121130 - 006-0133-0121131 |
| 006-0133-0122229                    |
| 006-0133-0128457 - 006-0133-0128503 |
| 006-0133-0128666 - 006-0133-0128668 |
| 006-0133-0136807 - 006-0133-0136816 |
| 006-0133-0136817 - 006-0133-0136818 |
| 006-0133-0137412                    |
| 006-0133-0137468 - 006-0133-0137469 |
| 006-0133-0142377 - 006-0133-0142378 |
| 006-0133-0143695 - 006-0133-0143703 |
| 006-0133-0143704 - 006-0133-0143719 |
| 006-0133-0144756 - 006-0133-0144785 |
| 006-0133-0144756 - 006-0133-0144785 |
| 006-0133-0146078 - 006-0133-0146086 |
| 006-0133-0146157 - 006-0133-0146159 |
| 006-0133-0147203 - 006-0133-0147205 |
| 006-0133-0147776 - 006-0133-0147777 |
| 006-0231-0000291                    |
| 006-0231-0001201 - 006-0231-0001260 |
| 006-0231-0001927 - 006-0231-0001928 |
| 006-0231-0002078 - 006-0231-0002089 |
| 006-0236-0004618                    |
| 006-0236-0005194 - 006-0236-0005195 |
| 006-0236-0009848 - 006-0236-0009849 |
| 006-0236-0019605 - 006-0236-0020023 |
| 006-0380-0000010 - 006-0380-0000015 |
| 006-0380-0000043 - 006-0380-0000070 |
| 006-0386-0000015 - 006-0386-0000039 |
| 006-0394-0000065 - 006-0394-0000076 |
| 008-0001-0014975 - 008-0001-0014988 |
| 008-0001-0018112 - 008-0001-0018113 |
| 008-0020-0000400 - 008-0020-0000405 |

| <b>Bates Numbered Documents</b>     |
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| 008-0020-0000421 - 008-0020-0000424 |
| 008-0020-0000426 - 008-0020-0000427 |
| 008-0020-0000428 - 008-0020-0000431 |
| 008-0135-0000186                    |
| 008-0372-0000006                    |
| 009-0139-0003342                    |
| 009-0139-0003409 - 009-0139-0003411 |
| 009-0139-0003437 - 009-0139-0003438 |
| 009-0139-0008990 - 009-0139-0008991 |
| 010-0158-0019495 - 010-0158-0019496 |
| 010-0243-0002258 - 010-0243-0002259 |
| 010-0360-0000001                    |
| 010-0400-0000001 - 010-0400-0000003 |
| 011-0001-0003496                    |
| 011-0001-0003811                    |
| 011-0161-0000326 - 011-0161-0000327 |
| 011-0161-0001460 - 011-0161-0001461 |
| 011-0161-0003601                    |
| 013-0002-0001044 - 013-0002-0001045 |
| 013-0242-0009863 - 013-0242-0009864 |
| 014-0002-0019144                    |
| 014-0002-0023167 - 014-0002-0023169 |
| 014-0343-0000010                    |
| 014-0389-0000527 - 014-0389-0000535 |
| 015-0002-0003114 - 015-0002-0003117 |
| 016-000-0005698                     |
| 016-0002-0000447 - 016-0002-0000453 |
| 016-0002-0001783 - 016-0002-0001784 |
| 016-0002-0006573 - 016-0002-0006577 |
| 016-0002-0007970 - 016-0002-0007988 |
| 016-0002-0010950                    |
| 022-0044-0000146 - 022-0044-0000149 |
| 022-0044-0000248 - 022-0044-0000291 |
| 022-0044-0000466                    |
| 022-0044-0000467                    |
| 022-0044-0000468                    |
| 022-0044-0001503 - 022-0044-0001511 |
| 022-0044-0001512 - 022-0044-0001515 |
| 022-0044-0001516                    |
| 022-0045-0000026 - 022-0045-0000032 |
| 022-0045-0001129                    |
| 022-0045-0001364 - 022-0045-0001379 |
| 022-0045-0001401                    |
| 022-0045-0001403                    |

| Bates Numbered Documents |                    |
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| 022-0045-0002285         | - 022-0045-0002287 |
| 022-0046-0000177         | - 022-0046-0000178 |
| 022-0046-0000179         | - 022-0046-0000182 |
| 022-0046-0000191         | - 022-0046-0000192 |
| 022-0046-0000209         |                    |
| 022-0046-0000212         |                    |
| 022-0046-0000213         | - 022-0046-0000214 |
| 022-0046-0000727         | - 022-0046-0000728 |
| 022-0046-0001353         | - 022-0046-0001354 |
| 022-0046-0001490         | - 022-0046-0001495 |
| 022-0046-0001500         | - 022-0046-0001501 |
| 022-0046-0001506         | - 022-0046-0001507 |
| 022-0046-0001508         |                    |
| 022-0046-0002006         | - 022-0046-0002013 |
| 022-0046-0002067         |                    |
| 022-0046-0002068         |                    |
| 022-0046-0002069         | - 022-0046-0002075 |
| 022-0046-0002076         |                    |
| 022-0046-0002077         |                    |
| 022-0046-0002458         | - 022-0046-0002459 |
| 022-0047-0000366         | - 022-0047-0000368 |
| 022-0047-0000571         | - 022-0047-0000574 |
| 022-0047-0000575         | - 022-0047-0000576 |
| 022-0047-0000614         | - 022-0047-0000616 |
| 022-0047-0000617         | - 022-0047-0000632 |
| 022-0047-0000633         | - 022-0047-0000637 |
| 022-0047-0000638         | - 022-0047-0000644 |
| 022-0047-0000645         | - 022-0047-0000652 |
| 022-0047-0000700         | - 022-0047-0000703 |
| 022-0047-0001035         | - 022-0047-0001037 |
| 022-0047-0001122         |                    |
| 022-0047-0001141         | - 022-0047-0001151 |
| 022-0047-0001152         | - 022-0047-0001156 |
| 022-0047-0001678         | - 022-0047-0001679 |
| 022-0047-0001686         | - 022-0047-0001688 |
| 022-0047-0001695         | - 022-0047-0001696 |
| 022-0047-0001705         | - 022-0047-0001724 |
| 022-0047-0001786         | - 022-0047-0001789 |
| 022-0048-0001522         | - 022-0048-0001524 |
| 022-0048-0001525         |                    |
| 022-0049-0000098         | - 022-0049-0000101 |
| 022-0049-0000555         | - 022-0049-0000560 |
| 022-0233-0001409         | - 022-0233-0001415 |
| 022-0233-0003695         | - 022-0233-0003698 |

| <b>Bates Numbered Documents</b>                       |
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| 022-0233-0006102 - 022-0233-0006103                   |
| 022-0233-0010063 - 022-0233-0010064                   |
| 024-0342-0000005                                      |
| 026-061-0000053                                       |
| 031-0002-0001352 - 031-0002-0001354                   |
| 031-0002-0001363 - 031-0002-0001366                   |
| 031-0074-0000033 - 031-0074-0000041; 031-0074-0000033 |
| 031-0149-0003075 - 031-0149-0003076                   |
| 052-0121-0000236 - 052-0121-0000246                   |
| 053-0001-0001409 - 053-0001-0001410                   |
| 053-0001-0003061 - 053-0001-0003065                   |
| 053-0001-0003070 - 053-0001-0003072                   |
| 053-0001-0003079 - 053-0001-0003085                   |
| 053-0001-0003491 - 053-0001-0003491                   |
| 053-0001-0005085                                      |
| 053-0001-0005472                                      |
| 053-0001-0006778 - 053-0001-0006779                   |
| 053-0001-0012164 - 053-0001-0012166                   |
| 053-0001-0012216 - 053-0001-0012218                   |
| 053-0001-0018768                                      |
| 053-0001-0018921                                      |
| 053-0001-0019235                                      |
| 053-0001-0026757                                      |
| 053-0001-0026758                                      |
| 053-001-0019259 - 053-0001-0019260                    |
| 053-0215-0005779                                      |
| 054-0001-0000203 - 054-0001-0000205                   |
| 054-0001-0000332 - 054-0001-0000334                   |
| 054-0001-0012821 - 054-0001-0012822                   |
| 054-0034-0001128 - 054-0034-0001133                   |
| 054-0169-0008864 - 054-0169-0008866                   |
| 054-0215-0002024 - 054-0215-0002027                   |
| 054-0361-0000001                                      |
| 058-0265-0000081 - 058-0265-0000104                   |
| 060-0001-0009293                                      |
| 060-0001-0014287 - 060-0001-0014289                   |
| 060-0001-0022196 - 060-0001-0022198                   |
| 060-0001-0022735                                      |
| 060-0001-0022737 - 060-0001-0022744                   |
| 060-0001-0022824 - 060-0001-0022828                   |
| 060-0001-0022960 - 060-0001-0022963                   |
| 060-0001-0023732 - 060-0001-0023734                   |
| 060-0001-0023760 - 060-0001-0023762                   |

| Bates Numbered Documents            |  |
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| 060-0001-0023817                    |  |
| 060-0001-0024060 - 060-0001-0024066 |  |
| 060-0001-0024203 - 060-0001-0024205 |  |
| 060-0001-0024210 - 060-0001-0024211 |  |
| 060-0001-0024283 - 060-0001-0024284 |  |
| 060-0001-0050334 - 060-0001-0050338 |  |
| 060-0001-0050599                    |  |
| 060-0001-0050626                    |  |
| 060-0002-0011197 - 060-0002-0011199 |  |
| 060-0002-0011438                    |  |
| 060-0002-0012843 - 060-0002-0012848 |  |
| 060-0002-0012849 - 060-0002-0012862 |  |
| 060-0035-0000001 - 060-0035-0000068 |  |
| 060-0035-0000001 - 060-0035-0000068 |  |
| 060-0036-0002297                    |  |
| 060-0149-0003330 - 060-0149-0003349 |  |
| 060-0149-0003331 - 060-0149-000337  |  |
| 060-0149-0003338 - 060-0149-0003349 |  |
| 060-0170-0007797                    |  |
| 060-0170-0007799 - 060-0170-0007803 |  |
| 060-0170-0007876                    |  |
| 060-0208-0000004 - 060-0208-0000005 |  |
| 060-0208-0000006                    |  |
| 060-0208-0000007                    |  |
| 060-0208-0000008                    |  |
| 060-0208-0000009                    |  |
| 060-0208-0000011; BJR000849         |  |
| 060-0208-0000012                    |  |
| 060-0208-0000013; BJR000851         |  |
| 060-0208-0000014; BJR000852         |  |
| 060-0208-0000015                    |  |
| 060-0208-0000016                    |  |
| 060-0208-0000017                    |  |
| 060-0208-0000018, BJR000856         |  |
| 060-0208-0000019; BJR000857         |  |
| 060-0208-0000020; BJR000858         |  |
| 060-0208-0000021; BJR000859         |  |
| 060-0219-0004769 - 060-0219-0004771 |  |
| 060-0235-0000030 - 060-0235-0000031 |  |
| 060-0235-0000801 - 060-0235-0000802 |  |
| 061-0001-0000011                    |  |
| 061-0001-0000026 - 061-0001-0000090 |  |
| 061-0001-0002368 - 061-0001-0002369 |  |
| 061-0001-0002368 - 061-0001-0002369 |  |

| <b>Bates Numbered Documents</b>     |
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| 061-0001-0004122 - 061-0001-0004125 |
| 061-0001-0004275 - 061-0001-0004276 |
| 061-0001-0004748                    |
| 061-0001-0004765 - 061-0001-0004768 |
| 061-0001-0007611                    |
| 061-0001-0007831 - 061-0001-0007833 |
| 061-0001-0007904 - 061-0001-0007905 |
| 061-0002-0000510 - 061-0002-0000512 |
| 061-0002-0001640 - 061-0002-0001650 |
| 061-0082-0000274 - 061-0082-0000278 |
| 061-0158-0000237                    |
| 061-0158-0001975 - 061-0158-0001976 |
| 061-0236-0001223                    |
| 062-0001-0001000                    |
| 062-0001-0001001                    |
| 062-0001-0001004                    |
| 062-0001-0001015 - 062-0001-0001016 |
| 062-0001-0001190 - 062-0001-0001192 |
| 062-0001-0001195 - 062-0001-0001196 |
| 062-0074-0000363 - 062-0074-0000367 |
| 062-0074-0000366                    |
| 062-0074-0000392 - 062-0074-0000402 |
| 062-0149-0000325                    |
| 062-0149-0000902 - 062-0149-0000904 |
| 062-0149-0001062 - 062-0149-0001063 |
| 062-0149-0005154 - 062-0149-0005160 |
| 062-0150-0000022                    |
| 062-0169-0005075 - 062-0169-0005083 |
| 062-0215-0000403 - 062-0215-0000404 |
| 062-0215-0000890                    |
| 062-0215-0001001                    |
| 062-0215-0001340                    |
| 062-0215-0004294                    |
| 062-0215-0004403 - 062-0215-0004465 |
| 063-0001-0000969 - 063-0001-0000970 |
| 063-0001-0001156 - 063-0001-0001181 |
| 063-0001-0001942 - 063-0001-0001943 |
| 063-0001-0003740 - 063-0001-0003746 |
| 063-0001-0003808 - 063-0001-0003809 |
| 063-0001-0004306                    |
| 063-0001-0004500 - 063-0001-0004501 |
| 063-0001-0005112 - 063-0001-0005116 |
| 063-0001-0005880 - 063-0001-0005892 |
| 063-0001-0007062 - 063-0001-0007064 |

| <b>Bates Numbered Documents</b>     |
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| 063-0001-0007073                    |
| 063-0001-0007660 - 063-0001-0007661 |
| 063-0001-0007974 - 063-0001-0007975 |
| 063-0001-0008075 - 063-0001-0008076 |
| 063-0001-0008869 - 063-0001-0008871 |
| 063-0001-0008972 - 063-0001-0008986 |
| 063-0001-0009102 - 063-0001-0009103 |
| 063-0002-0000009 - 063-0002-0000011 |
| 063-0002-0000659                    |
| 063-0002-0000682 - 063-0002-0000730 |
| 063-0151-0002259 - 063-0151-0002260 |
| 063-0151-0005555 - 063-0151-0005556 |
| 063-0151-0007708                    |
| 063-0151-0009648                    |
| 063-0151-0010259 - 063-0151-0010260 |
| 063-0151-0015726 - 063-0151-0015727 |
| 063-0151-0015743 - 063-0151-0015744 |
| 063-0151-0017153 - 063-0151-0017188 |
| 063-0151-0025370                    |
| 063-0151-0025371                    |
| 063-0151-0025372 - 063-0151-0025375 |
| 063-0151-0027486                    |
| 063-0151-0029861                    |
| 063-0151-0032978                    |
| 063-0151-0032979                    |
| 063-0151-0032980 - 063-0151-0032982 |
| 063-0151-0034769                    |
| 063-0151-0034770 - 063-0151-0034791 |
| 063-0151-0034770 - 063-0151-0034791 |
| 063-0151-0034792 - 063-0151-0034804 |
| 063-0151-0034851 - 063-0151-0034866 |
| 063-0151-0036930 - 063-0151-0036931 |
| 063-0151-0037439 - 063-0151-0037440 |
| 063-0151-0038411                    |
| 063-0151-0038659 - 063-0151-0038660 |
| 063-0151-0038721                    |
| 063-0151-0038782 - 063-0151-0038783 |
| 063-0151-0040674                    |
| 063-0151-0042163 - 063-0151-0042165 |
| 063-0151-0045638                    |
| 063-0151-0045640                    |
| 063-0151-0046057                    |
| 063-0151-0046968 - 063-0151-0046970 |
| 063-0151-0047507 - 063-0151-0047509 |

| Bates Numbered Documents |                                     |
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|                          | 063-0151-0048144                    |
|                          | 063-0151-0048450 - 063-0151-0048451 |
|                          | 063-0151-0048514 - 063-0151-0048516 |
|                          | 063-0151-0050940 - 63-0151-0050941  |
|                          | 063-0169-0001256 - 063-0169-0001279 |
|                          | 066-0002-0002417 - 066-0002-0002420 |
|                          | 066-0002-0003009                    |
|                          | 067-0141-0029363 - 067-0141-0029366 |
|                          | 070-0106-0000001 - 070-0106-0000021 |
|                          | 070-0140978                         |
|                          | 075-0126-0000344 - 075-0126-0000346 |
|                          | 075-0144-0000052 - 075-0144-0000054 |
|                          | 075-0144-0000067 - 075-0144-0000075 |
|                          | 075-0144-0000357                    |
|                          | 075-0144-0000598 - 075-0144-0000599 |
|                          | 075-0144-0001848 - 075-0144-0001850 |
|                          | 075-0144-0002837 - 075-0144-0002838 |
|                          | 075-0144-0003072 - 075-0144-0003073 |
|                          | 075-0144-0003074                    |
|                          | 075-0144-0004825                    |
|                          | 075-0144-0005163 - 075-0144-0005164 |
|                          | 075-0144-0005214                    |
|                          | 075-0144-0006515                    |
|                          | 075-0144-0008753                    |
|                          | 075-0144-0009744-075-0144-0009745   |
|                          | 075-0144-0010992                    |
|                          | 075-0144-0010993 - 075-0144-0010994 |
|                          | 075-0144-0011119                    |
|                          | 075-0144-0011120                    |
|                          | 075-0144-0011163 - 075-0144-0011164 |
|                          | 075-0144-0012180 - 075-0144-0012182 |
|                          | 075-0144-0013008 - 075-0144-0013140 |
|                          | 075-0144-0013431                    |
|                          | 075-0144-0013943 - 075-0144-0013945 |
|                          | 075-0237-0000665                    |
|                          | 077-0106-0000812 - 077-0106-0000814 |
|                          | 080-0002-0000208 - 080-0002-0000211 |
|                          | 083-0002-0000004 - 083-0002-0000005 |
|                          | 083-0159-0010731 - 083-0159-0010735 |
|                          | 087-0122-0000062 - 087-0122-0000075 |
|                          | 087-0164-0000678 - 087-0164-0000679 |
|                          | 087-0164-0002029                    |
|                          | 087-0171-0000511 - 087-0171-0000512 |
|                          | 092-0163-0007334 - 092-0163-0007335 |

| Bates Numbered Documents            |
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| 092-0163-0078439 - 092-0163-0078441 |
| 098-0361-0000002.XLS                |
| 098-0361-0000010                    |
| 104-0107-0000482 - 104-0107-0000484 |
| 104-0107-0000630                    |
| 109-0162-0000212 - 109-0162-0000214 |
| 109-0162-0000559                    |
| 109-0162-0000564 - 109-0162-0000565 |
| 109-0162-0000569 - 109-0162-0000571 |
| 109-0162-0000651                    |
| 109-0162-0000657 - 109-0162-0000663 |
| 109-0162-0000850 - 109-0162-0000853 |
| 109-0162-0000864                    |
| 109-0162-0000870                    |
| 109-0162-0000871 - 109-0162-0000872 |
| 109-0162-0000981 - 109-0162-0000982 |
| 109-0162-0001160 - 109-0162-0001161 |
| 124-0226-0001644 - 124-0226-0001673 |
| 139-0358-0000006 - 139-0358-0000025 |
| 177-0401-0000001 - 177-0401-0000006 |
| 196-2023-0000001 - 196-2023-0000006 |
| 196-2023-0000007 - 196-2023-0000010 |
| 196-2023-0000011 - 196-2023-0000017 |
| 196-2023-0000018 - 196-2023-0000024 |
| 196-2023-0000025 - 196-2023-0000031 |
| 196-2023-0000032 - 196-2023-0000037 |
| 196-2023-0000038 - 196-2023-0000042 |
| 196-2023-0000043 - 196-2023-0000047 |
| 196-2023-0000048 - 196-2023-0000049 |
| 196-2023-0000050 - 196-2023-0000055 |
| 196-2023-0000056 - 196-2023-0000062 |
| 196-2023-0000063 - 196-2023-0000068 |
| 196-2023-0000073 - 196-2023-0000079 |
| 196-2023-0000080 - 196-2023-0000085 |
| 196-2023-0000086 - 196-2023-0000094 |
| 196-2023-0000095 - 196-2023-0000101 |
| 196-2023-0000102 - 196-2023-0000103 |
| 196-2023-0000104 - 196-2023-0000112 |
| 196-2023-0000113 - 196-2023-0000122 |
| 196-2023-0000123 - 196-2023-0000130 |
| 196-2023-0000131 - 196-2023-0000137 |
| 196-2023-0000138 - 196-2023-0000152 |
| 196-2023-0000153 - 196-2023-0000163 |
| 196-2023-0000164 - 196-2023-0000176 |

| Bates Numbered Documents            |
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| 196-2024-0000004                    |
| 196-2024-0000016                    |
| 196-2024-0000017 - 196-2024-0000042 |
| 196-2024-0000043 - 196-2024-0000045 |
| 196-2024-0000051                    |
| 196-2024-0000052                    |
| 196-2024-0000128 - 196-2024-0000132 |
| 196-2024-0000133                    |
| 196-2024-0000137                    |
| 196-2024-0000138 - 196-2024-0000158 |
| 196-2024-0000159 - 196-2024-0000160 |
| 196-2024-0000161 - 196-2024-0000167 |
| 196-2024-0000168 - 196-2024-0000172 |
| 196-20240000173 - 196-20240000178   |
| 196-2024-0000179 - 196-2024-0000182 |
| 196-2024-0000183 - 196-2024-0000186 |
| 196-2024-0000187 - 196-2024-0000211 |
| 196-2024-0000212 - 196-2024-0000308 |
| 196-2024-0000309 - 196-2024-0000323 |
| 196-2024-0000324 - 196-2024-0000325 |
| 196-2024-0000326 - 196-2024-0000327 |
| 196-2024-000048 - 196-2024-0000050  |
| 196-2025-0000001 - 196-2025-0000004 |
| 196-2025-0000005 - 196-2025-0000006 |
| 196-2025-0000007 - 196-2025-0000008 |
| 196-2025-0000009 - 196-2025-0000011 |
| 196-2025-0000012 - 196-2025-0000013 |
| 196-2025-0000014                    |
| 196-2025-0000016 - 196-2025-0000017 |
| 196-2025-0000018 - 196-2025-0000019 |
| 196-2025-0000020 - 196-2025-0000022 |
| 196-2025-0000023 - 196-2025-0000024 |
| 196-2025-0000025 - 196-2025-0000027 |
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| 196-2026-0000001 - 196-2026-0000004 |
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| 196-2026-0000007 - 196-2026-0000008 |
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| MAK008091 - MAK008094; EID610565 - EID610568            |  |
| MAK008248 - MAK008253; EID610683 - EID610688            |  |
| MAK008280 - MAK008281; EID610715 - EID610716            |  |
| MAK008339 - MAK008357; EID610773 - EID610791            |  |
| MAK008689 - MAK008712; EID611122 - EID611145            |  |
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| MAK008829; EID611262                          |  |
| MAK009075 - MAK009085; EID611508 - EID611518  |  |
| MAK009075 - MAK009085; EID611508 - EID611518  |  |
| MAK009125 - MAK009128; EID611558 - EID611561  |  |
| MAK010526 - MAK010561; EID612959 - EID612994  |  |
| MAK010852 - MAK010853; EID732688 - EID732689  |  |
| MAK010861 - MAK010879; EID732697 - EID732715  |  |
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| MAK011526; EID733343                          |  |
| MAK011527 - MAK011554; EID733344 - EID733371  |  |
| MAK011555 - MAK011582; EID733372 - EID733399  |  |
| MAK011813 - MAK0011824; EID733629 - EID733640 |  |
| MLR002254 - MLR002257; EID799992 - EID799995  |  |
| MLR002340 - MLR002342; EID800070 - EID800072  |  |
| MLR002357 - MLR002361; EID800087 - EID800091  |  |
| NKT000001 - NKT000001; EID735221 - EID735222  |  |
| NKT000003 - NKT000004; EID735223 - EID735224  |  |
| NSR000300 - NSR000306; EID735328 - EID735334  |  |
| NSR000307 - NSR000308; EID735335 - EID735336  |  |
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| PJB000371 - PJB000374; EID196253 - EID196256  |  |
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| PJB003957 - PJB003967; EID613649 - EID613659  |  |
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| RJZ032721 - RJZ032722; EID185185 - EID185186                             |  |
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| SAPPHIRE-002361 - SAPPHIRE-002370              |  |
| SAPPHIRE-002371 - SAPPHIRE-002374              |  |
| SHK000115 - SHK000117; EID152077 - EID152079   |  |
| SL001102; EID523003                            |  |
| SL001103 - SL1104; EID523004 - EID523005       |  |
| SL001105 - SL001106; EID523006 - EID523007     |  |
| SL001107; EID523008                            |  |

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| SMK000294 - SMK000296; EID739253 - EID739255 |  |
| SMK000297; EID739256                         |  |
| SMK000302 - SMK000305; EID739261 - EID739264 |  |
| SMK000306; EID739265                         |  |
| SMK000316; EID739275                         |  |
| SMK001047 - SMK001059; EID740005 - EID740017 |  |
| SMK001047 - SMK001059; EID740005 - EID740017 |  |
| SMK001047 - SMK001059; EID740005 - EID740017 |  |
| SMK001073 - SMK001088; EID740031 - EID740046 |  |
| SMK001089 - SMK001091; EID740047 - EID740049 |  |
| SMK001105 - SMK001107; EID740063 - EID740065 |  |
| SMK001110 - SMK001112; EID740068 - EID740070 |  |
| SMK001243 - SMK001253; EID740201 - EID740211 |  |
| SMK001297 - SMK001298; EID740255 - EID740256 |  |
| SMK001312 - SMK001321; EID740270 - EID740279 |  |
| SMK001405 - SMK001408; EID740363 - EID740366 |  |
| SMK001421 - SMK001431; EID740379 - EID740389 |  |
| SMK001649 - SMK001652; EID740607 - EID740610 |  |
| SMK001653 - SMK001655; EID740611 - EID740613 |  |
| SMK001658 - SMK001659; EID740616 - EID740617 |  |
| SMK001750 - SMK001761; EID740708 - EID740719 |  |
| SMK002035; EID740993                         |  |
| SMK002097; EID741055                         |  |
| SMK002100 - SMK002110; EID741058 - EID741068 |  |
| SMK002111 - SMK002121; EID741069 - EID741079 |  |
| SPD01524 - SPD01533                          |  |
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| SPD01788 - SPD01930                          |  |
| SPD01931 - SPD02067                          |  |
| SPR000131 - SPR000132; EID714048 - EID714049 |  |
| SPR000227 - SPR000231; EID714144 - EID714148 |  |
| SPR000232 - SPR000233; EID714149 - EID714150 |  |
| SPR000237 - SPR000240; EID714154 - EID714157 |  |
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| SRP000039 - SRP000042; EID921943 - EID921946 |  |
| SRP001764 - SRP001768; EID214975 - EID214979 |  |
| SRP003425 - SRP003441; EID741158 - EID741174 |  |
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| SRP003538 - SRP003542; EID741271 - EID741275 |  |
| STB004018 - STB004024                        |  |
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| STB004072 - STB004080                        |  |
| STB008756 - STB008757; EID741618 - EID741619 |  |

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| STB008758 - STB008759; EID741620 - EID741621                                                                                      |  |
| STB009131 - STB009132; EID741993 - EID741994                                                                                      |  |
| STB009286 - STB009288; EID742148 - EID742150                                                                                      |  |
| STB009290 - STB009291; EID742152 - EID742153                                                                                      |  |
| STB009362 - STB009363; EID742224 - EID742225                                                                                      |  |
| STB009589 - STB009604; EID742451 - EID742466                                                                                      |  |
| T2568                                                                                                                             |  |
| T2578                                                                                                                             |  |
| TPM001824 - TPM001828; EID742473 - EID742477                                                                                      |  |
| TSB002753 - TSB002758; EID742496 - EID742501                                                                                      |  |
| UMC000072 - UMC000090; EID742732 - EID742750                                                                                      |  |
| UMC000091 - UMC000115; EID742751 - EID742775                                                                                      |  |
| UMC002338 - UMC002354; EID806662 - ERID806678                                                                                     |  |
| USEPA000477 - USEPA000494; EID743698 - EID743715                                                                                  |  |
| USEPA10463 - USEPA10485; CF005394 - CF005416                                                                                      |  |
| USEPA10508 - USEPA10511; RJZ009222 - RJZ009225                                                                                    |  |
| USEPA10517 - USEPA10520; ASH009965 - ASH009968                                                                                    |  |
| USEPA14862 - USEPA14910; RLR002204 - RLR002252                                                                                    |  |
| USEPA14926 - USEPA14931; CF009524 - CF009529                                                                                      |  |
| USEPA14967 - USEPA14968; RJZ009210 - RJZ009211                                                                                    |  |
| USEPA14986; RJZ009207                                                                                                             |  |
| USEPA14987; DAW000638                                                                                                             |  |
| USEPA14988; DAW000627                                                                                                             |  |
| USEPA14989 - USEPA14993; ASH010159; ASH010156;<br>ASH010161 - ASH010164                                                           |  |
| USEPA15038; GW007440                                                                                                              |  |
| USEPA15039; AC003618                                                                                                              |  |
| USEPA15047 - USEPA15050; RLR002788 - RLR002791; 000004 -<br>000005                                                                |  |
| USEPA15047 - USEPA15051; RLR002788 - RLR002792; 000001;<br>000005                                                                 |  |
| USEPA15051; RLR002792                                                                                                             |  |
| USEPA15098 - USEPA15099; JRW000015 - JRW000016                                                                                    |  |
| USEPA15121 - USEPA15122; RLR003573 - RLR003574                                                                                    |  |
| USEPA15886 - USEPA15934; RAK004946 - RAK004994                                                                                    |  |
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| USEPA7936 - USEPA7951; WAB000005 - WAB000020                                                                                      |  |
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| USEPA8844-45; JRW000022-23                                                                                                        |  |
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| USEPA8884; JRW000019                                                                          |
| USEPA8885 - USEPA886; JRW000017 - JRW000018                                                   |
| WAB002635 - WAB002641; EID715413 - EID715419                                                  |
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| WEGMAN00567 - WEGMAN00588                                                                     |
| YAA000030 - YAA000052                                                                         |
| YAA000389 - YAA000390                                                                         |
| YAA000393 - YAA000394                                                                         |

| <b>Descriptions of Documents Without Bates Numbers</b>                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Book: <u>Stain -Resistant, Nonstick, Waterproof and Lethal: The Hidden Dangers of C-8</u> , authored by Callie Lyons                                                                                                                                                                                                                      |
| USEPA Complaint filed 7/8/04, <i>In the Matter of E.I. DuPont</i> , EPA Docket Nos. TSCA-HQ-2004-0016 and RCRA-HQ-2004-0016                                                                                                                                                                                                               |
| DuPont's Answer, filed 8/11/04, <i>In the Matter of E.I. DuPont</i> , EPA Docket Nos. TSCA-HQ-2004-0016 and RCRA-HQ-2004-0016                                                                                                                                                                                                             |
| DuPont's Motion for Accelerated Decision on Counts II and III, filed 9/8/04, <i>In the Matter of E.I. DuPont</i> , EPA Docket Nos. TSCA-HQ-2004-0016 and RCRA-HQ-2004-0016                                                                                                                                                                |
| USEPA's Memorandum in Support of its Response to DuPont's Motion for Accelerated Decision on Count II, filed 10/8/04, <i>In the Matter of E.I. DuPont</i> , EPA Docket Nos. TSCA-HQ-2004-0016 and RCRA-HQ-2004-0016                                                                                                                       |
| USEPA's Memorandum in Support of its Response to DuPont's Motion for Accelerated Decision on Count III, <i>In the Matter of E.I. DuPont</i> , EPA Docket Nos. TSCA-HQ-2004-0016 and RCRA-HQ-2004-0016                                                                                                                                     |
| Affidavit of Oscar Hernandez of USEPA dated 10/6/04, filed <i>In the Matter of E.I. DuPont</i> , EPA Docket Nos. TSCA-HQ-2004-0016 and RCRA-HQ-2004-0016                                                                                                                                                                                  |
| Affidavit of Mary Beck of USEPA dated 10/8/04, <i>In the Matter of E.I. DuPont</i> , EPA Docket Nos. TSCA-HQ-2004-0016 and RCRA-HQ-2004-0016                                                                                                                                                                                              |
| USEPA's Motion for Temporary Stay filed 11/22/04, <i>In the Matter of E.I. DuPont</i> , EPA Docket Nos. TSCA-HQ-2004-0016 and RCRA-HQ-2004-0016                                                                                                                                                                                           |
| Order entered 11/23/04 Denying USEPA's Motion for Stay, Granting Limited Extension of Time for USEPA to File Reply in Support of its Motion for Accelerated Decision on Liability for Count III, and Amending Prehearing Exchange Schedule, <i>In the Matter of E.I. DuPont</i> , EPA Docket Nos. TSCA-HQ-2004-0016 and RCRA-HQ-2004-0016 |
| USEPA Complaint filed 12/6/04, <i>In the Matter of E.I. DuPont</i> , EPA Docket No. TSCA-HQ-2005-5001                                                                                                                                                                                                                                     |
| USEPA's Reply in Support of Accelerated Decision on Count III, filed 12/13/04, <i>In the Matter of E.I. DuPont</i> , EPA Docket Nos. TSCA-HQ-2004-0016 and RCRA-HQ-2004-0016                                                                                                                                                              |
| Affidavit of David Gray dated 12/13/04, filed <i>In the Matter of E.I. DuPont</i> , EPA Docket Nos. TSCA-HQ-2004-0016 and RCRA-HQ-2004-0016                                                                                                                                                                                               |
| USEPA's Post-Argument Brief on Count III, filed <i>In the Matter of E.I. DuPont</i> , EPA Docket Nos. TSCA-HQ-2004-0016, RCRA-HQ-2004-0016 and TSCA-HQ-2005-5001                                                                                                                                                                          |
| USEPA's Post-Argument Briefs on Counts II and III filed on 2/4/05, <i>In the Matter of E.I. DuPont</i> , EPA Docket Nos. TSCA-HQ-2004-0016, RCRA-HQ-2004-0016 and TSCA-HQ-2005-5001                                                                                                                                                       |
| USEPA's Initial Prehearing Exchange for Hearing on Count I, filed 2/17/05, <i>In the Matter of E.I. DuPont</i> , EPA Docket Nos. TSCA-HQ-2004-0016, RCRA-HQ-2004-0016 and TSCA-HQ-2005-5001                                                                                                                                               |
| Order dated 3/29/05 Denying Motions for Accelerated Decision on Counts II and III, Order Setting Prehearing Exchange Schedule for Counts II, III, and IV, <i>In the Matter of E.I. DuPont</i> , EPA Docket Nos. TSCA-HQ-2004-0016, RCRA-HQ-2004-0016 and TSCA-HQ-2005-5001                                                                |
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| US EPA Memorandum dated 12/14/05 from Granta Nakayama to Environmental Appeals Board re: DuPont Consent Agreement and Proposed Final Order                                                                                                                                                                                                |
| Consent Agreement and Final Order filed 12/14/05, <i>In the Matter of E.I. DuPont</i> , EPA Docket Nos. TSCA-HQ-2004-0016, RCRA-HQ-2004-0016 and TSCA-HQ-2005-5001                                                                                                                                                                        |
| Shin, H., Ryan, P., et al., "Modeling the Air-Soil Transport Pathway of Perfluorooctanoic Acid in the Mid-Ohio Valley Using Linked Air Dispersion and Vadose Zone Models", <u>Atmospheric Environment</u> , 51: 67-74 (2012)                                                                                                              |
| Shin, H., Viera, V., et al., "Environmental Fate and Transport Modeling for Perfluorooctanoic Acid Emitted from the Washington Works Facility in West Virginia," <u>Environ. Sci. &amp; Technol.</u> 45, 1435-1442 (2011)                                                                                                                 |
| Expert report of Shane Snyder dated 2/15/13 in Little Hocking v. DuPont case                                                                                                                                                                                                                                                              |

| <b>Descriptions of Documents Without Bates Numbers</b>                                                                                                           |
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| DuPont Expert Witness Disclosure of Harold M. McNair, in the <i>Leach v. DuPont</i> case                                                                         |
| DuPont Expert Witness Disclosure of Andrew Hartten in <i>Leach v. DuPont</i> case                                                                                |
| DuPont's Responses to Plfs.' First Set of Interrogatories in <i>Leach v. DuPont</i> case, Feb. 2002                                                              |
| Letter from Robert A. Bilott to Paula Durst Gillis, Esq. Re: Wilbur E. Tennant, et al. v DuPont, re: C-8, 8/15/2000                                              |
| Letter from Lubeck Public Service District, James Cox Manager to PSD Customers re: C-8, 10/31/2000                                                               |
| DuPont calendar entry appointment, "Expect call from George Senkler re: C8 update", 10/08/2001                                                                   |
| Bernard Reilly email to Bern re: drinking water results, 10/20/2001                                                                                              |
| The Little Hocking Water Association news release re C-8, 1/15/2002                                                                                              |
| DuPont Calendar Entry Appointment ",Expecting a call from George Senkler re: C8", 2/26/2002                                                                      |
| DuPont email from G Irvin Lipp, to Chad Holliday, et al., re: Daily Communications Report, 3/20/2002                                                             |
| WVDEP email from Dave Watkins to Allyn Turner, Dee Ann Staats re: EPA Laboratory,5/6/2002                                                                        |
| DuPont email from Anthony R. Farina to Chad Holliday, et al., re: Daily Communications Report, 5/13/2002                                                         |
| DuPont Email from Anthony R. Farina to Chad Holliday, et al., re: Daily Communications Report , 5/16/2002                                                        |
| DuPont email from Clifton Webb to Chad Holliday, et al., re: Daily Communications Report, 10/9/2002                                                              |
| DuPont email from Irv Lipp to Chad Holliday, et al., re: Daily Communications Report, 10/11/2002                                                                 |
| DuPont email from G Irvin Lipp to Chad Holliday, et al., re: Daily Communications Report, 10/28/2002                                                             |
| Pages from transcript of George H. Senkler in <i>Leach v. DuPont</i> case, 11/21/2002                                                                            |
| DuPont email from Anthony R. Farina to Chad Holliday, et al. re Daily Communications Report, 12/20/2002                                                          |
| DuPont email from Clifton Webb to Chad Holliday, et al. re: Weekend Report Feb.16 , 2/16/2003                                                                    |
| DuPont email from Anthony R. Farina to Chad O. Holliday, et al., Re: Daily Communications Report, 2/26/2003                                                      |
| DuPont email from Clifton Webb to Chad Holliday, et al., re: Daily Communications Report, 2/16/2003                                                              |
| DuPont email from G Irvin Lipp to Chad Holliday, et al. re: Daily Communications Report, 3/17/2003                                                               |
| DuPont email from G Irvin Lipp to Chad Holliday, et al., re: Daily Communications Report, 3/28/2003                                                              |
| DuPont email from G Irvin Lipp to Chad Holliday, et al., re: Stories on C8 Picked up across US, 3/30/2003                                                        |
| DuPont email from R Clifton Webb to Chad Holliday, et al., re: Daily Communications Report, 4/2/2003                                                             |
| April 2003 DuPont information re: USEPA released a preliminary risk assessment for C-8 ; also DuPont Calendar entry "Call from George Senkler re C8", 4/3/2003   |
| DuPont email from Scott F. Nelson to Chad Holliday, et al. re: Daily Communications Report, 4/4/2003                                                             |
| DuPont email from Scott F. Nelson to Chad Holliday, et al., re: Weekend Communications Report, 4/5/2003                                                          |
| DuPont email from Anthony R. Farina to Chad Holliday, et al., re: Daily Communications Report, , 4/7/2003                                                        |
| DuPont email from Anthony R. Farina to Chad Holliday, et al., re Daily Communications Report, 4/8/2003                                                           |
| Letter to Christine Todd Whitman of USEPA from EWG re: DuPont's failure to submit key health studies under the requirements of TSCA 8e, 15 U.S.C 2607, 4/11/2003 |
| EWG website pages: PFCs Global Contaminants - DuPont's Spin About PFOA, undated                                                                                  |
| DuPont email from Chad Holliday to Richard J. Angiullo, re:Daily Communications Report, 4/11/2003                                                                |
| DuPont email from Anthony R. Farina to Chad Holliday, et al., Re: Weekend Communications Report, 4/12/2003                                                       |
| DuPont email from R. Clifton Webb to Chad Holliday, et al., Re: Daily Communications Report, 4/16/2003                                                           |
| DuPont Calendar Entry appointment: " George Senkler will call (C8), 4/22/2003                                                                                    |
| Letter from "A Concerned Citizen" to Christine T. Whitman EPA Administrator re DuPont, 4/22/2003                                                                 |
| DuPont email from Chad Holliday to Nandakumar Rao re: Daily Communications Report, 4/28/2003                                                                     |
| DuPont email from Chad Holliday to Lois Juliber re: Contact with Gore, 4/29/2003                                                                                 |
| DuPont email from Anthony R. Farina to Chad Holliday, et al., re: Daily Communications Report, 4/30/2003                                                         |
| Order Granting Plaintiff's Second Motion for Sanctions Against DuPont, in <i>Leach v. DuPont</i> case, 5/1/2003                                                  |
| DuPont email from R. Clifton Webb to Chad Holliday, et al. Re: Daily Communications Report , 5/8/2003                                                            |

| <b>Descriptions of Documents Without Bates Numbers</b>                                                                                      |
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| DuPont email from Chad O. Holliday to Thomas M. Connelly, DuPont re Weekend Communications Report, 5/11/2003                                |
| DuPont email from Alexa L Girardi to Donna Saunders forwarding Daily Communications Report, 5/13/2003                                       |
| AR226-1318                                                                                                                                  |
| DuPont email from Chad O. Holliday to Louise B. Lancaster re Agenda for Board Meeting , 5/26/2003                                           |
| From USEPA Dockets website: Document #OPPT-2003-0012-0124, dated 6/20/2003                                                                  |
| DuPont email from G Irvin Lipp to Chad O. Holliday, et al. re; Weekend Communications Report, 6/21/2003                                     |
| Latham & Watkins presentation slides: "Chemicals in the Body," dated 6/24/03 (68 pages)                                                     |
| DuPont email from Anthony Farina to Chad O. Holliday, et al., re: Daily Communications Report, 6/25/2003                                    |
| DuPont email from Anthony R. Farina to Chad O. Holliday, et al., Re: Daily Communications Report , 7/7/2003                                 |
| DuPont email from Anthony R, Farina to Chad O. Holliday, et al., Re: Daily Communications Report 7/9/2003                                   |
| DuPont email from Anthony R. Farina to Chad O. Holliday, et al. re: Daily Communications Report , 7/10/2003                                 |
| DuPont email from G Irvin Lipp to Chad O. Holliday, et al. Re: News Journal Coverage of CPSC, 7/12/2003                                     |
| DuPont email from Anthony R. Farina to Chad O. Holliday, et al. Re: Daily Communications Report, 7/28/2003                                  |
| DuPont email from Anthony R. Farina to Chad O. Holliday, et al., re: Daily Communications Report, 7/29/2003                                 |
| DuPont email from Clifton Webb to Chad Holliday, et al., re: Daily Communications Report, 8/6/2003                                          |
| DuPont email from Anthony R. Farina to Chad Holliday, et al., re: Daily Communications Report, 8/18/2003                                    |
| DuPont email from R. Clifton Webb to Chad Holliday, et al., re; Daily Communications Report, 8/22/2003                                      |
| DuPont email from R. Clifton Webb to Chad O. Holliday, et al., re: Weekend Report , 8/23/2003                                               |
| DuPont email from Anthony R. Farina to Chad O. Holliday, et al., re: Daily Communications Report, 9/23/2003                                 |
| DuPont email from G. Irwin Lipp to Chad O. Holliday, et al., re: Daily Communication Report, 9/30/2003                                      |
| DuPont email from Anthony R. Farina to Chad O. Holliday, et al., re: Daily Communication Report, 10/24/2003                                 |
| DuPont email from G. Irwin Lipp to Chad Holliday, et al., Re: Daily Communications Report , 10/28/2003                                      |
| DuPont email from Catherine L. Andriadis to Chad O. Holliday, et al., re: Daily Communications Report, 10/31/2003                           |
| DuPont email from Chad O. Holliday to Lois Juliber forwarding Communication Report , 11/15/2003                                             |
| Email from Louise B. Lancaster of DuPont to Alain Belda of Alcoa, et al., re DuPont's to Statement on ABC's 20/20 Segment, 11/15/2003       |
| DuPont email from G Irvin Lipp to Chad O. Holliday, et al., re Weekend Communications Report, 11/16/2003                                    |
| DuPont email from R Clifton Webb to Chad Holliday, et al., re: Daily Communications Report, 11/22/2003                                      |
| DuPont email from R Clifton Webb to Chad O. Holliday, et al., Re: Weekend Report- November 23, 11/23/2003                                   |
| DuPont email from G Irwin Lipp to Chad O Holliday, et al., re: Daily Communications Report, 11/24/2003                                      |
| DuPont email from G Irvin Lipp to Chad O. Holliday, et al., Re: Daily Communications Report, 11/26/2003                                     |
| DuPont Email from Kathleen H. Forte to Chad O. Holliday, et al., re: Possible Questions and Topics for Community Leaders Meeting, 12/2/2003 |
| DuPont email from Scott Nelson to Chad Holliday, et al., re: Daily Communications Report, 12/5/2003                                         |
| DuPont email from Scott F. Nelson to Chad O. Holliday, et al., re: Weekend Communications Report, 12/6/2003                                 |
| DuPont email from Chad O Holliday to W Donald Johnson, forwarding Communications Report, 1/3/2004                                           |
| DuPont email from Lori A. Captain to Chad Holliday, et al., re: Daily Communications Report, 1/6/2004                                       |
| DuPont email from Chad O. Holliday to Francine C. Shaw, re: 2003 Yr In Review, 1/10/2004                                                    |
| DuPont email from Catherine L. Andriadis to Chad Holliday, et al., re: Daily Communications Report, 1/16/2004                               |
| DuPont email from G. Irwin Lipp to Chad O. Holliday, et al., re: Daily Communication Report, 2/11/2004                                      |
| DuPont email from G Irwin Lipp to Chad O. Holliday, et al., Re: Daily Communications Report, 2/14/2004                                      |
| DuPont email from Chad Holiday to Scot Holliday, et al., forwarding Daily Communications Report, 2/12/2004                                  |

| <b>Descriptions of Documents Without Bates Numbers</b>                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DuPont email from Anthony R. Farina to Chad O. Holliday, et al., re: Daily Communications Report, 2/27/2004                                                                                                                          |
| DuPont email from G. Irvin Lipp to Chad Holliday, et al., re: Daily Communications Report, 3/3/2004                                                                                                                                  |
| DuPont email from G. Irvin Lipp to Chad Holliday, et al., re: Daily Communications Report, 3/4/2004                                                                                                                                  |
| Bullet-point list dated 3/15-3/16/05 titled: Global Regulatory Meeting (6 pages) (from McCabe & Associates' third-party production in Rowe/Rhodes cases).                                                                            |
| Email dated 2/22/2006 from David Wegman to Tom Beauchamp re: questions for ERB re the Community Study (5 pages) (from Ellen Eisen's third-party production in Rowe/Rhodes cases).                                                    |
| DuPont email dated 5/1/06 from Susan Silencer to Robert Rickard, et al., re: Core Team Meeting (1 page) (from McCabe & Associates' third-party production in Rowe/Rhodes cases).                                                     |
| DuPont email dated 5/23/06 from Susan Stalnecker to Robert Rickard, et al., re: Core Team Meeting (1 page) (from McCabe & Associates' third-party production in Rowe/Rhodes cases).                                                  |
| DuPont email dated 6/13/06 from Susan Stalnecker to Robert Rickard, et al., re: Core Team Meeting (1 page) (from McCabe & Associates' third-party production in Rowe/Rhodes cases).                                                  |
| DuPont email dated 7/10/06 from Susan Stalnecker to Robert Rickard, et al., re: Core Team Meeting Agenda (1 page) (from McCabe & Associates' third-party production in Rowe/Rhodes cases).                                           |
| DuPont email dated 7/18/06 from Susan Stalnecker to Susan Stalnecker, with numerous copyholders, re: Agenda (3 pages) (from McCabe & Associates' third-party production in Rowe/Rhodes cases).                                       |
| DuPont email dated 8/11/06 from Susan Stalnecker to Robert Rickard, et al., re: John Hopkins Update (1 page) (from McCabe & Associates' third-party production in Rowe/Rhodes cases).                                                |
| Email dated 11/9/06 from Michael McCabe to David Boothe, et al., re: Dalton Study (1 page) (from McCabe & Associates' third-party production in Rowe/Rhodes cases).                                                                  |
| DuPont undated PowerPoint slides titled: Global Regulatory Strategy. (4 pages) (from McCabe & Associates' third-party production in Rowe/Rhodes cases).                                                                              |
| DuPont slides: "Clean Hardball", 9/20/2007                                                                                                                                                                                           |
| 9/17/2009 USEPA Consent Agreement and Final Order                                                                                                                                                                                    |
| 3/6/2001 Bilott letter to USEPA re request for immediate governmental action                                                                                                                                                         |
| 12/6/2004 USEPA Complaint re DuPont                                                                                                                                                                                                  |
| United States District Court Southern District of Ohio Eastern Division, Complaint, Earl Edgar Frum v. E.I. DuPont De Nemours and Company, 2/7/2013                                                                                  |
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Various publicly-available documents, in addition to those listed above, which were obtained from state or federal agencies pursuant to FOIA/records requests, as well as pages printed from those agencies' websites

| <b>Deposition Transcripts and Exhibits</b>                                             |
|----------------------------------------------------------------------------------------|
| Timothy Bingman, taken in <i>Leach v. DuPont</i> case on 4/19/04                       |
| Glenn Evers, taken in <i>Leach v. DuPont</i> case on 4/30/04                           |
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