Pease PFC Testing Program: Final Report

Benjamin Chan, MD, MPH
State Epidemiologist
NH Department of Health & Human Services
June 16, 2016
PFOS, PFOA, and PFHxS were found in statistically higher levels in the Pease community compared to the general U.S. population.

The absolute difference in mean levels is small:
- PFOS: 2.3 ppb difference
- PFOA: 1.0 ppb difference
- PFHxS: 2.8 ppb difference

There were not large differences in levels between children and adolescents/adults at Pease.
Levels of PFOS and PFOA are similar, if not lower, than levels found in the general U.S. population 10 years ago.

Levels of PFOS, PFOA, and PFHxS are lower than other environmentally exposed communities and occupationally exposed workers.

Other PFCs found in very low amounts.
Age, sex, and time spent on Pease were most consistently associated with serum PFC levels.

Besides contaminated drinking water, likely many other unaccounted for factors contributing to serum PFC levels not evaluated in our brief questionnaire.

Based on known sources of exposure, hand-to-mouth behavior is likely contributing to childhood exposure and could explain the higher levels seen in the 3-5 year old age group.
Purpose of Tonight’s Meeting

- Review the final results of the Pease PFC serum testing
- Provide a context to aide interpretation of individual test results
- Address additional questions and concerns
## Current Areas of Work

### Aquifer Restoration
- **Lead:** U.S. Air Force
  - EPA (Administrative Order)
  - NHDES (Waste Management Division)

### Public Health Evaluation
- **Lead:** NHDES ("Health Consultation" report)
- **Lead:** ATSDR (Community Assistance Panel)

### Human Exposure Assessment
- **Lead:** NH DHHS (PFC Serum Testing)
- **ATSDR** (Technical Assistance)

---

**ATSDR:** Agency for Toxic Substances Disease Registry  
**EPA:** U.S. Environmental Protection Agency  
**NHDES:** New Hampshire Department of Environmental Services  
**NH DHHS:** New Hampshire Department of Health & Human Services
Why did NH DHHS Conduct PFC Blood Testing?

- Assess individual exposure to PFCs at the community’s request
- Not a health study and no medical information assessing health outcomes from PFC exposure was collected
- PFC blood test does not tell a person where the PFCs came from, and is not able to tell someone whether there might be a health impact
May 12 2014: Haven well was shut down after finding PFOA and PFOS levels above the EPA’s Provisional Health Advisory level.

April—October 2015: NH DHHS conducted blood sampling for PFC serum testing to assess exposure levels

Preliminary community meetings:
- June 2015: first 98 adult test results
- Sept 2015: first 108 pediatric results
Brief Timeline

- Last individual PFC test results were mailed out in April 2016
- May 2016: ATSDR formed the Community Assistance Panel (CAP) to help inform and plan for public health evaluation
- June 16, 2016: Final PFC blood testing report released and community meeting held to discuss results
# PFC Levels in Water April 2014

<table>
<thead>
<tr>
<th>PFC Name</th>
<th>Abbreviation</th>
<th>Haven Well</th>
<th>Harrison Well</th>
<th>Smith Well</th>
</tr>
</thead>
<tbody>
<tr>
<td>perfluorooctane sulfonic acid</td>
<td>PFOS</td>
<td>2.50</td>
<td>0.05</td>
<td>0.02</td>
</tr>
<tr>
<td>perfluorooctanoic acid</td>
<td>PFOA</td>
<td>0.35</td>
<td>0.009</td>
<td>0.004</td>
</tr>
<tr>
<td>perfluorohexane sulfonic acid</td>
<td>PFHxS</td>
<td>0.83</td>
<td>0.04</td>
<td>0.01</td>
</tr>
<tr>
<td>perfluorononanoic acid</td>
<td>PFNA</td>
<td>0.02</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>perfluorodecanoic acid</td>
<td>PFDeA</td>
<td>0.005</td>
<td>ND</td>
<td>0.004</td>
</tr>
<tr>
<td>perfluoroundecanoic acid</td>
<td>PFUA</td>
<td>ND</td>
<td>ND</td>
<td>0.02</td>
</tr>
<tr>
<td>Perfluorododecanoic acid</td>
<td>PFDoA</td>
<td>ND</td>
<td>ND</td>
<td>0.01</td>
</tr>
<tr>
<td>Perfluoropentanoic acid</td>
<td>PFPtA</td>
<td>0.27</td>
<td>0.008</td>
<td>0.004</td>
</tr>
<tr>
<td>Perfluorobutane sulfonic acid</td>
<td>PFBuS</td>
<td>0.05</td>
<td>0.002</td>
<td>0.0009</td>
</tr>
<tr>
<td>Perfluorohexanoic acid</td>
<td>PFHxA</td>
<td>0.33</td>
<td>0.009</td>
<td>0.004</td>
</tr>
<tr>
<td>Perfluoroheptanoic acid</td>
<td>PFHpA</td>
<td>0.12</td>
<td>0.005</td>
<td>0.003</td>
</tr>
</tbody>
</table>

**Note:** 1 μg/L = 1 ng/mL = 1 ppb = 1000 ppt

- 2009 PFOS PHA: 0.2 μg/L
- 2009 PFOA PHA: 0.4 μg/L

A full report on Pease drinking water testing can be found at: [http://www.cityofportsmouth.com/publicworks/phwn.html](http://www.cityofportsmouth.com/publicworks/phwn.html)

ND = Not Detected
PHA = Provisional Health Advisory level (from 2009)
# Serum PFC Testing Laboratory Panel

<table>
<thead>
<tr>
<th>PFC Name</th>
<th>PFC Abbreviation</th>
<th>CDC</th>
<th>AXYS</th>
<th>CA State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfluorooctane sulfonic acid</td>
<td>PFOS</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Perfluorooctanoic acid</td>
<td>PFOA</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Perfluorohexane sulfonic acid</td>
<td>PFHxS</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Perfluorononanoic acid</td>
<td>PFNA</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Perfluorodecanoic acid</td>
<td>PFDeA</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Perfluoroundecanoic acid</td>
<td>PFUA</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Perfluoroctane sulfonamide</td>
<td>PFOSA</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2-(N-methyl-perfluorooctane sulfonamido) acetic acid</td>
<td>Me-PFOSA-AcOH</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>2-(N-ethyl-perfluorooctane sulfonamido) acetic acid</td>
<td>Et-PFOSA-AcOH</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Perfluorobutane sulfonic acid</td>
<td>PFBS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perfluorododecanoic acid</td>
<td>PFDoA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perfluoroheptanoic acid</td>
<td>PFHpA</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CDC** = Centers for Disease Control and Prevention laboratory  
**AXYS** = AXYS Analytical Services laboratory  
**CA State** = California State biomonitoring laboratory
Serum PFC test results can be compared to other study populations including:

- General U.S. adolescent/adult without a known exposure tested as part of the CDC’s National Health and Nutrition Examination Survey (NHANES)
- Environmentally exposed communities
- Occupationally exposed workers

There is not a serum PFC level at which a health problem is known or expected to occur.
Primary Data Collected and Analyzed

- Serum PFC concentrations (reported in μg/L, or ppb)
- Demographic information: age, sex
- Exposure information:
  - Time spent on Pease (cumulative years of exposure to contaminated water)
  - Time since last on Pease (lag time for exposure to contaminated water)
  - Average daily water consumption (amount of daily exposure to contaminated water)
  - Firefighting occupation (other source of exposure)
Three Different Analyses

- Summary test statistics (geometric mean, Min/Max, 95^{th} percentile, distribution graphs)

- Assess for individual relationships between demographic (age and sex) or exposure (water consumption, time on Pease, etc) characteristics and serum PFC levels

- Multivariate (multivariable) analysis (factoring in all demographic and exposure variables) simultaneously into a “linear regression model”.
**Terminology**

- **Median**: The middle number in a group of results.
- **Geometric Mean**: A type of average used for non-normally distributed results.
- **Range**: minimum and maximum value.
- **95th Percentile**: Out of 100 people, 95 would be expected to be at or below the 95th percentile level; 5 would normally be expected to be above this level.
- **95% Confidence Intervals**: Indicates the range where there is a 95% chance (or confidence) that the actual (“true”) result is
### Summary of All Results (N=1578)

<table>
<thead>
<tr>
<th>PFC Tested</th>
<th>Detection Frequency</th>
<th>Geometric Mean (µg/L)</th>
<th>Max (µg/L)</th>
<th>% Above NHANES 95th Percentile</th>
<th>Geometric Mean (µg/L)</th>
<th>Max (µg/L)</th>
<th>95th Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFOS</td>
<td>99.8</td>
<td>8.59 *</td>
<td>95.6</td>
<td>9.1</td>
<td>6.31</td>
<td>235.0</td>
<td>21.7</td>
</tr>
<tr>
<td>PFOA</td>
<td>99.2</td>
<td>3.09 *</td>
<td>32</td>
<td>16.5</td>
<td>2.08</td>
<td>43.0</td>
<td>5.7</td>
</tr>
<tr>
<td>PFHxS</td>
<td>94.2</td>
<td>4.12 *</td>
<td>116</td>
<td>39.8</td>
<td>1.28</td>
<td>47.8</td>
<td>5.4</td>
</tr>
<tr>
<td>PFNA</td>
<td>85.2</td>
<td>0.73 ¥</td>
<td>5.2</td>
<td>2.2</td>
<td>0.88</td>
<td>80.8</td>
<td>2.5</td>
</tr>
<tr>
<td>PFDeA</td>
<td>42.1</td>
<td>0.22</td>
<td>5.6</td>
<td>1.6</td>
<td>0.20</td>
<td>17.8</td>
<td>0.7</td>
</tr>
<tr>
<td>PFUA</td>
<td>30.0</td>
<td>0.19</td>
<td>1.6</td>
<td>1.2</td>
<td>NC</td>
<td>7.0</td>
<td>0.6</td>
</tr>
<tr>
<td>PFOSA</td>
<td>2.0</td>
<td>0.13</td>
<td>0.4</td>
<td>N/A</td>
<td>NC</td>
<td>0.6</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Me-PFOSA-AcOH</td>
<td>36.1</td>
<td>0.09</td>
<td>1.58</td>
<td>2.1</td>
<td>NC</td>
<td>4.3</td>
<td>0.7</td>
</tr>
<tr>
<td>Et-PFOSA-AcOH</td>
<td>2.6</td>
<td>0.06</td>
<td>0.51</td>
<td>1.0</td>
<td>NC</td>
<td>0.7</td>
<td>0.1</td>
</tr>
<tr>
<td>PFBS</td>
<td>18.7</td>
<td>0.04</td>
<td>0.24</td>
<td>N/A</td>
<td>NC</td>
<td>0.8</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>PFDsA</td>
<td>4.7</td>
<td>0.08</td>
<td>0.31</td>
<td>2.8</td>
<td>NC</td>
<td>1.4</td>
<td>0.1</td>
</tr>
<tr>
<td>PFHpA</td>
<td>0.9</td>
<td>0.07</td>
<td>0.39</td>
<td>NS</td>
<td>NC</td>
<td>1.6</td>
<td>0.2</td>
</tr>
</tbody>
</table>

N/A=not applicable, NT=not tested, NS=not shown to protect confidentiality, NC=Not Calculated.

* Geometric mean is significantly higher than NHANES comparison data,
¥ Geometric mean is significantly lower than NHANES comparison data.
<table>
<thead>
<tr>
<th>PFC Tested</th>
<th>PEASE TRADEPORT</th>
<th>NHANES, 2011-2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Geometric Mean (μg/L)</td>
<td>Max (μg/L)</td>
</tr>
<tr>
<td>PFOS</td>
<td>8.74 *</td>
<td>95.6</td>
</tr>
<tr>
<td>PFOA</td>
<td>2.99 *</td>
<td>32.0</td>
</tr>
<tr>
<td>PFHxS</td>
<td>4.21 *</td>
<td>116.0</td>
</tr>
<tr>
<td>PFNA</td>
<td>0.68 ¥</td>
<td>4.9</td>
</tr>
<tr>
<td>PFDaE</td>
<td>0.22</td>
<td>5.6</td>
</tr>
<tr>
<td>PFUA</td>
<td>0.19</td>
<td>1.6</td>
</tr>
<tr>
<td>PFOSA</td>
<td>0.12</td>
<td>0.35</td>
</tr>
<tr>
<td>Me-PFOSA-AcOH</td>
<td>0.09</td>
<td>1.58</td>
</tr>
<tr>
<td>Et-PFOSA-AcOH</td>
<td>0.06</td>
<td>0.4</td>
</tr>
<tr>
<td>PFBS</td>
<td>NC</td>
<td>NS</td>
</tr>
<tr>
<td>PFDaA</td>
<td>NC</td>
<td>NS</td>
</tr>
<tr>
<td>PFHpA</td>
<td>NC</td>
<td>NS</td>
</tr>
</tbody>
</table>

N/A=not applicable, NT=not tested, NS=not shown to protect confidentiality, NC=Not Calculated.

* Geometric mean is significantly higher than NHANES comparison data,

¥ Geometric mean is significantly lower than NHANES comparison data.
## Summary of Results for Ages 11 and Younger (N=366)

<table>
<thead>
<tr>
<th>PFC Tested</th>
<th>PEASE TRADEPORT</th>
<th>NHANES, 2011-2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Geometric Mean (μg/L)</td>
<td>Max (μg/L)</td>
</tr>
<tr>
<td>PFOS</td>
<td>8.11 *</td>
<td>30.8</td>
</tr>
<tr>
<td>PFOA</td>
<td>3.43 *</td>
<td>12.0</td>
</tr>
<tr>
<td>PFHxS</td>
<td>3.83 *</td>
<td>31.7</td>
</tr>
<tr>
<td>PFNA</td>
<td>0.92</td>
<td>5.2</td>
</tr>
<tr>
<td>PFDeA</td>
<td>0.23</td>
<td>0.7</td>
</tr>
<tr>
<td>PFUA</td>
<td>0.18</td>
<td>0.5</td>
</tr>
<tr>
<td>PFOSA</td>
<td>0.17</td>
<td>0.4</td>
</tr>
<tr>
<td>Me-PFOSA-AcOH</td>
<td>0.10</td>
<td>1.3</td>
</tr>
<tr>
<td>Et-PFOSA-AcOH</td>
<td>0.07</td>
<td>0.5</td>
</tr>
<tr>
<td>PFBS</td>
<td>NC</td>
<td>NS</td>
</tr>
<tr>
<td>PFDoA</td>
<td>NC</td>
<td>NS</td>
</tr>
<tr>
<td>PFHpA</td>
<td>NC</td>
<td>NS</td>
</tr>
</tbody>
</table>

N/A=not applicable, NT=not tested, NS= not shown to protect confidentiality, NC=Not Calculated.

* Geometric mean is significantly higher than NHANES comparison data.
Comparison of Geometric Means

NHANES=National Health and Nutrition Examination Survey, 2011-2012 data
* Indicates a statistically significant difference compared to NHANES
† Indicates a statistically significant difference comparing Pease children to Pease adolescents & adults
PFOS Distribution of Results

PFOS Serum Concentrations

# of Persons

Level (μg/L)

NHANES Geo Mean

NHANES 95th Percentile
PFOA Distribution of Results

PFOA Serum Concentrations

# of Persons

Level (μg/L)

<0.5  0.5-1  1-1.5  1.5-2  2.25  2.5-3  3.35  3.5-4  4.45  4.5-5  5.5-5  5.55  5.6  6.5-7  7-7.5  7.5-8  8.5-9  9-9.5  9.5-10  10-10.5  11-11.5  11.5-12  12+

NHANES Geo Mean

NHANES 95th Percentile
PFOSA Distribution of Results

PFOSA Serum Concentrations

Number of Persons

Level (μg/L)

<0.5
Me-PFOSA-AcOH Distribution of Results

Me-PFOSA-AcOH Serum Concentrations

Number of Persons vs. Level (µg/L)
Et-PFOSA-AcOH Distribution of Results

Et-PFOSA-AcOH Serum Concentrations

Number of Persons

Level (μg/L)

<0.1

0.1

0.2

0.3

0.4

0.5+
PFBS Distribution of Results

PFBS Serum Concentrations

<table>
<thead>
<tr>
<th>Level (µg/L)</th>
<th># of Persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.05</td>
<td>90</td>
</tr>
<tr>
<td>0.06</td>
<td>1</td>
</tr>
<tr>
<td>0.07</td>
<td>5</td>
</tr>
<tr>
<td>0.08</td>
<td>3</td>
</tr>
<tr>
<td>0.09</td>
<td>2</td>
</tr>
<tr>
<td>0.1</td>
<td>1</td>
</tr>
<tr>
<td>0.1+</td>
<td>1</td>
</tr>
</tbody>
</table>
PFHpA Distribution of Results

PFHpA Serum Concentrations

# of Persons

Level (μg/L)

<0.1

0.1

0.2

0.3
## Adult Comparison Studies

<table>
<thead>
<tr>
<th>Study Population</th>
<th>Years Blood Tested</th>
<th># Participants</th>
<th>Reference</th>
</tr>
</thead>
</table>

* Reports on arithmetic mean serum concentration (instead of geometric mean). Arithmetic mean is usually higher than the geometric mean. All other studies report geometric mean serum concentration.

Note: Compares Geometric Mean, unless otherwise noted*
<table>
<thead>
<tr>
<th>Study Population</th>
<th>Years Blood Tested</th>
<th># Participants</th>
<th>Reference</th>
</tr>
</thead>
</table>

* Reports on arithmetic mean serum concentration (instead of geometric mean). Arithmetic mean is usually higher than the geometric mean. All other studies report geometric mean serum concentration.

Note: Compares Geometric Mean, unless otherwise noted*
PFOS Adult Population Comparison (Includes occupationally exposed)

- 3M Workers, Decatur AL (2000)
- Ohio River Valley (2005-2006)
- Decatur, Alabama (2009)
- Red Cross Donors in 6 cities (2006)
- NHANES (2005-2006)
- NHANES (2011-2012)
- Pease Tradeport NH, age ≥12 (2015)
- Pease Tradeport NH, age <12 (2015)

PFOS Level (µg/L)
PFOS Adult Population Comparison (Excludes Occupationally Exposed)

Ohio River Valley (2005-2006)
Decatur, Alabama (2009)
E. Metro Minnesota Pilot (2008-2009)
Red Cross Donors in 6 cities (2006)
NHANES (2005-2006)
NHANES (2011-2012)
Pease Tradeport NH, age ≥12 (2015)
Pease Tradeport NH, age <12 (2015)

PFOS Level (µg/L)
PFOA Adult Population Comparison (Includes Occupationally Exposed)

* Indicates Arithmetic mean reported (instead of geometric mean). Arithmetic mean is usually higher than the geometric mean.
PFOA Adult Population Comparison (Excludes Occupationally Exposed)

- Ohio River Valley (2005-2006)
- Decatur, Alabama (2009)
- Red Cross Donors in 6 cities (2006)
- NHANES (2005-2006)
- NHANES (2011-2012)
- Pease Tradeport NH, age ≥12 (2015)
- Pease Tradeport NH, age <12 (2015)

PFOA Level (μg/L)
* Indicates Arithmetic mean reported (instead of geometric mean). Arithmetic mean is usually higher than the geometric mean.
PFHxS Adult Population Comparison
(ExcludesOccupationally Exposed)

- Ohio River Valley (2005-2006)
- Decatur, Alabama (2009)
- Red Cross Donors in 6 cities (2006)
- NHANES (2005-2006)
- NHANES (2011-2012)
- Pease Tradeport NH, age ≥12 (2015)
- Pease Tradeport NH, age <12 (2015)
PFNA Adult Population Comparison (Excludes Occupationally Exposed)

- Ohio River Valley (2005-2006)
- Decatur, Alabama (2009)
- NHANES (2005-2006)
- NHANES (2011-2012)
- Pease Tradeport NH, age ≥12 (2015)
- Pease Tradeport NH, age <12 (2015)
## Pediatric Comparison Studies

<table>
<thead>
<tr>
<th>Location</th>
<th>Years Blood Tested</th>
<th># Participants</th>
<th>Age Range (years)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas*</td>
<td>2009</td>
<td>300</td>
<td>0-12</td>
<td>Schecter et al. Polyfluoroalkyl Compounds in Texas Children from Birth through 12 Years of Age. Environ Health Perspect 2012;120:590-594.</td>
</tr>
</tbody>
</table>

* Reports on median serum concentration. All other studies report geometric mean serum concentrations.
# Pediatric Comparison Studies

<table>
<thead>
<tr>
<th>Location</th>
<th>Years Blood Tested</th>
<th># Participants</th>
<th>Age Range (years)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas*</td>
<td>2009</td>
<td>300</td>
<td>0-12</td>
<td>Schecter et al. Polyfluoroalkyl Compounds in Texas Children from Birth through 12 Years of Age. Environ Health Perspect 2012;120:590-594.</td>
</tr>
</tbody>
</table>

* Reports on median serum concentration. All other studies report geometric mean serum concentrations.
PFOS Pediatric Population Comparison of Central Measure (circle) and Range (blue bars)

- **Ohio River Valley**: No Maximum & Minimum Reported
  - Minimum: 20.6 µg/L
  - Maximum: 515 µg/L
  - Mean: 37.5 µg/L
  - Median: 13.2 µg/L

- **23 states & D.C.**: Minimum: 13.2 µg/L
  - Maximum: 4.1 µg/L
  - Mean: 6.3 µg/L
  - Median: 8.1 µg/L

- **Francisco Bay**: Minimum: 13.2 µg/L
  - Maximum: 8.1 µg/L
  - Mean: 6.3 µg/L
  - Median: 8.1 µg/L

- **Northern California**: Minimum: 4.1 µg/L
  - Maximum: 8.1 µg/L
  - Mean: 6.3 µg/L
  - Median: 8.1 µg/L

- **Texas**: Minimum: 6.3 µg/L
  - Maximum: 8.1 µg/L
  - Mean: 6.3 µg/L
  - Median: 8.1 µg/L

- **Pease Tradeport**: Minimum: 8.1 µg/L
  - Maximum: 8.1 µg/L
  - Mean: 8.1 µg/L
  - Median: 8.1 µg/L
PFOS Pediatric Population Comparison of Central Measure (circle) and Range (blue bars)

- Ohio River Valley: 20.6
- 23 states & D.C.: 37.5
- Greater Cincinnati: 13.2
- San Francisco Bay: 13.2
- Northern California: 6.3
- Texas: 4.1
- Pease Tradeport: 8.1

No Maximum & Minimum Reported
PFOA Pediatric Population Comparison of Central Measure (circle) and Range (blue bars)

- Ohio River Valley: 4.9
- 23 states & D.C.: 7.8
- Greater Cincinnati: 5.7
- San Francisco Bay: 4.5
- Northern California: 2.9
- Texas: 3.4
- Pease Tradeport: 36.9

No Maximum & Minimum Reported
PFHxS Pediatric Population Comparison of Central Measure (circle) and Range (blue bars)

- Ohio River Valley: 7.0
- 23 states & D.C.: 4.5
- Greater Cincinnati: 5.1
- San Francisco Bay: 3.0
- Northern California: 1.3
- Texas: 1.2
- Pease Tradeport: 3.8

No Maximum & Minimum Reported
PFNA Pediatric Population Comparison of Central Measure (circle) and Range (blue bars)

- Ohio River Valley: 1.7
- Greater Cincinnati: 1.4
- San Francisco Bay: 1.7
- Northern California: 1.8
- Texas: 1.2
- Pease Tradeport: 0.9

No Maximum & Minimum Reported
ANALYSIS OF INDIVIDUAL DEMOGRAPHIC AND EXPOSURE CHARACTERISTICS
### Age Distribution of Testing Population

<table>
<thead>
<tr>
<th>Age Group (years)</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>75</td>
<td>4.8</td>
</tr>
<tr>
<td>3-5</td>
<td>164</td>
<td>10.4</td>
</tr>
<tr>
<td>6-8</td>
<td>91</td>
<td>5.8</td>
</tr>
<tr>
<td>9-11</td>
<td>36</td>
<td>2.3</td>
</tr>
<tr>
<td>12-19</td>
<td>31</td>
<td>2.0</td>
</tr>
<tr>
<td>20-39</td>
<td>369</td>
<td>23.4</td>
</tr>
<tr>
<td>40-59</td>
<td>611</td>
<td>38.7</td>
</tr>
<tr>
<td>60+</td>
<td>201</td>
<td>12.7</td>
</tr>
</tbody>
</table>

**Characteristics**

**Age Distribution**

Age (Years)

# of Persons

0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100

**Note:** The graph and table indicate the age distribution of the testing population, with the highest percentage being in the 40-59 age group (38.7%) followed by the 20-39 age group (23.4%).
* Indicates a significantly higher mean concentration compared to youngest age group (0-2 years). Note: the age groups 9-39 for PFOA and 12-39 for PFNA are significantly lower compared to youngest age group.
Serum PFC Levels by Age Group

PFOS

PFOA

PFHxS

PFNA
Serum PFC Levels by Sex

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>639</td>
<td>40.1</td>
</tr>
<tr>
<td>Female</td>
<td>856</td>
<td>54.3</td>
</tr>
<tr>
<td>Unknown</td>
<td>83</td>
<td>5.3</td>
</tr>
</tbody>
</table>

* Indicates a significantly higher mean concentration compared to females
Serum PFC Levels by Water Consumption (cups per day)

* Indicates a significantly higher mean concentration compared with lowest water consumption group (0-3 cups/day)
Serum PFC Levels by Cumulative Time Spent on Pease (Years)

* Indicates a significantly higher mean concentration compared with group with lowest number of years spent on Pease (<1 years)
Serum PFC Levels by Time Spent on Pease

**PFOS**

- Time Spent on Pease (years):
  - <1
  - 1-4
  - 5-9
  - 10-19
  - 20+

**PFOA**

- Time Spent on Pease (years):
  - <1
  - 1-4
  - 5-9
  - 10-19
  - 20+

**PFHxS**

- Time Spent on Pease (years):
  - <1
  - 1-4
  - 5-9
  - 10-19
  - 20+

**PFNA**

- Time Spent on Pease (years):
  - <1
  - 1-4
  - 5-9
  - 10-19
  - 20+
Serum PFC Levels by Time Since Last on Pease (Years)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Since Last on Pease (years)</td>
<td>(median=0.0)</td>
<td></td>
</tr>
<tr>
<td>&lt;1</td>
<td>948</td>
<td>60.1</td>
</tr>
<tr>
<td>1-4</td>
<td>144</td>
<td>9.1</td>
</tr>
<tr>
<td>5-9</td>
<td>88</td>
<td>5.6</td>
</tr>
<tr>
<td>10-19</td>
<td>74</td>
<td>4.7</td>
</tr>
<tr>
<td>20+</td>
<td>34</td>
<td>2.2</td>
</tr>
<tr>
<td>Unknown</td>
<td>290</td>
<td>18.4</td>
</tr>
</tbody>
</table>
Serum PFC Levels by Self-Identified Firefighter Occupation ("yes")

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firefighter (yes)</td>
<td>98</td>
<td>6.2</td>
</tr>
</tbody>
</table>

* Indicates a significantly higher mean concentration in firefighters compared with those who did not report firefighting work.
MULTIVARIATE (MULTIPLE VARIABLE) ANALYSIS USING LINEAR REGRESSION MODELING
Multivariate Linear Regression: Significant Predictors of Serum PFC Levels

**PFOS:**
- Age
- **Sex** (male)
- Time spent on Pease

**PFOA:** (stratified by age due to “interaction”)
- **Sex** (significant for age groups 20-39 and 40-59)
- Time spent on Pease (significant for age groups 20-39 and 40-59)
Multivariate Linear Regression: Significant Predictors of Serum PFC Levels

**PFHxS:** (stratified by age due to “interaction”)
- **Sex** (significant for age groups 20-39 and 40-59)
- **Time spent on Pease** (significant for age groups 20-39, 40-59, and 60+)
- **Water consumption** (significant for age groups 0-19, 20-39, and 40-59)
- **Time since last on Pease** (significant for age groups 0-19, 20-39)

**PFNA:**
- **Sex** (male)
Summary of Multivariate Analysis

- Age, sex, and Time Spent on Pease seem to be most consistently associated with serum PFC levels.
- Data quality is a limitation.
- Multiple other exposures and factors related to PFC level that are unaccounted for in our analysis.
Association between male sex and PFC levels is well described in the scientific literature (not unique to Pease)

Association with age (especially in children), may indicate age-related behaviors that predispose children to PFC exposure (i.e. hand-to-mouth behavior)
# Commercial and Industrial Products That Use PFCs

<table>
<thead>
<tr>
<th>Commercial Products</th>
<th>Industrial Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cookware (Teflon®, Nonstick)</td>
<td>Photo Imaging</td>
</tr>
<tr>
<td>Fast Food Containers</td>
<td>Metal Plating</td>
</tr>
<tr>
<td>Candy Wrappers</td>
<td>Semiconductor Coatings</td>
</tr>
<tr>
<td>Microwave Popcorn Bags</td>
<td>Aviation Hydraulic Fluids</td>
</tr>
<tr>
<td>Personal Care Products (Shampoo, Dental Floss)</td>
<td>Medical Devices</td>
</tr>
<tr>
<td>Cosmetics (Nail Polish, Eye Makeup)</td>
<td>Firefighting Aqueous Film-Forming Foam</td>
</tr>
<tr>
<td>Paints and Varnishes</td>
<td>Insect Baits</td>
</tr>
<tr>
<td>Stain Resistant Carpet</td>
<td>Printer and Copy Machine Parts</td>
</tr>
<tr>
<td>Stain Resistant Chemicals (Scotchgard®)</td>
<td>Chemically Driven Oil Production</td>
</tr>
<tr>
<td>Water Resistant Apparel (Gore-Tex®)</td>
<td>Textiles, Upholstery, Apparel and Carpets</td>
</tr>
<tr>
<td>Cleaning Products</td>
<td>Paper and Packaging</td>
</tr>
<tr>
<td>Electronics</td>
<td>Rubber and Plastics</td>
</tr>
<tr>
<td>Ski Wax</td>
<td></td>
</tr>
</tbody>
</table>
Assess the total daily exposure to PFOS and PFOA via various pathways

7 age groups

- Infants (age 0-1)
- Toddlers (age 1-4)
- Children (age 5-11)
- Teenagers, male & female (age 12-20)
- Adults, male & female (age >20)
Pathways of PFOA Exposure

- Infants: Food & water, ingestion (60%)
- Toddlers: Carpet, mill-treated, hand-to-mouth, oral (40%)
- Children: Carpet, home-treated, hand-to-mouth, oral (60%)
- Female teens: Dust, ingestion (40%)
- Male teens: Paper, migr., into food, oral (60%)
- Female adults: Clothes, impregnating, inhalation (60%)
- Male adults: Other pathways (40%)
Consumption of food is the most important pathway for exposure to PFOA/PFOS (includes migration of PFCs into food from boxes and packaging).

Ingestion of contaminated dust is a significant source of exposure (carpets, upholstery, clothing).

In infants, toddlers, and children, hand-to-mouth contact with treated carpets is a significant exposure.
PFOS, PFOA, and PFHxS were found in statistically higher levels in the Pease community compared to the general U.S. population.

The absolute difference in mean levels is small:
- PFOS: 2.3 ppb difference
- PFOA: 1.0 ppb difference
- PFHxS: 2.8 ppb difference

There were not large differences in levels between children and adolescents/adults at Pease.
Pease Testing Summary (2)

- Levels of PFOS and PFOA are similar, if not lower, than levels found in the general U.S. population 10 years ago.
- Levels of PFOS, PFOA, and PFHxS are lower than other environmentally exposed communities and occupationally exposed workers.
- Other PFCs found in very low amounts.
Pease Testing Summary (3)

- Age, sex, and time spent on Pease were most consistently associated with serum PFC levels.
- Besides contaminated drinking water, likely many other unaccounted for factors contributing to serum PFC levels not evaluated in our brief questionnaire.
- Based on known sources of exposure, hand-to-mouth behavior is likely contributing to childhood exposure and could explain the higher levels seen in the 3-5 year old age group.
ADDITIONAL COMMENTS
How Will the Individual PFC Blood Levels be Used?

The purpose of the PFC testing was to provide individuals more information about their level of exposure.

ATSDR has formed a Community Assistance Panel (CAP) to help address health concerns.

We have shared serum PFC test results with ATSDR as they plan for further health evaluation.

We will continue to work with ATSDR to support and be involved in their efforts.
Who Should I Talk to About Health Concerns?

- Talk to your healthcare provider about any health concerns you have
- Monitoring of your health should be conducted through your healthcare provider
- Healthcare providers are the most appropriate person to decide whether additional steps should be taken to monitor your health
- We are in the process of engaging healthcare providers further to support them
Should I Have my Blood re-tested for PFCS?

- There is no medically approved or appropriate way to remove PFCS faster from your body.
- Your body will remove PFCS slowly over time after exposure is stopped.
- There is no recommendation to re-test blood for PFCS in the future because of the limited health information obtained from PFC blood testing and the expectation that levels should slowly decline over time.
Resources

Questions or concerns can be directed to the NH DHHS Inquiry Line: 603-271-9461

Questions specific to individuals’ test results can be directed to the Northern New England Poison Center: 1-800-562-8236

Frequently Asked Questions (FAQs) about PFCs can be found on the NH DHHS website: http://www.dhhs.nh.gov/dphs/investigation-pease.htm

The full final Pease PFC blood testing report can be downloaded on our website: http://www.dhhs.nh.gov/dphs/documents/pease-pfc-blood-testing.pdf