# RELATIVE RISK SITE EVALUATION

## Fresno Air National Guard Base, California

### Introduction

The Department of Defense (DoD) identified certain per- and polyfluoroalkyl substances (PFAS) as emerging contaminants of concern which affected installations across the Air Force. When the term "Air Force" is used in this fact sheet, it includes Air National Guard (ANG). Specifically, perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS) are components of legacy Aqueous Film Forming Foam (AFFF) that the Air Force began using in the 1970s as a firefighting agent to extinguish petroleum fires. The U.S. Environmental Protection Agency (EPA) issued lifetime drinking water Health Advisories (HA) for PFOS and PFOA, and health-based regional screening levels for PFBS.

The Air Force has systematically evaluated potential AFFF releases on all Installations and former Installations. It began with the Preliminary Assessments, or PAs, that identified potential release areas. First responders, fire chiefs, and hangar staff were interviewed to determine where a release or a spill may have occurred on an Installation (for example, aircraft crash site or an accidental hangar AFFF release). After the information in the PA was collected, Site Inspections, or SIs, were initiated to take soil and water samples and analyzed the media for PFAS compounds at the potential release areas. The intention of the SI was to determine if a release had occurred and to determine the impacts to soil and/or groundwater. The next step in the process is called the Relative Risk Site Evaluation, or RRSE, which is a tool used to sequence Sites/Installations to begin a Remedial Investigation, or RI. Air Force Installations are at the beginning of the more detailed investigative stage, the RI, to determine where action is needed and to identify remedial technologies.

The Fresno Air National Guard Base (ANGB) PFAS PA and SI can be found at the Air Force Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Administrative Record (AR): https://ar.afcec-cloud.af.mil/ Scroll to the bottom of the page and click on “Continue to site”, then select Air National Guard (e.g., Active, ANG, BRAC), scroll down the Installation List and click on Fresno Air Guard Base, CA, then enter the AR Number 474892 in the “AR #” field for the PA. For the SI, enter the AR Number 589586. Then click “Search” at the bottom of the page. Click on the spy glass to view the document.

More information on the Air Force response to PFOS and PFOA can be found at: https://www.afcec.af.mil/WhatWeDo/Environment/Perfluorinated-Compounds/

**Acronyms**

AFFF - Aqueous Film Forming Foam

ANG - Air National Guard

ANGB - Air National Guard Base

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

CHF – Contaminant Hazard Factor

DoD - Department of Defense

EPA – US Environmental Protection Agency

HA – Health Advisory

MPF – Migration Pathway Factor

PA – Preliminary Assessment

PFAS - Per-and polyfluoroalkyl substances

PFBS – Perfluorobutanesulfonic acid

PFOA - Perfluorooctanoic acid

PFOS - Perfluorooctane sulfonate

PRL - Potential Release Location

RF – Receptor Factor

RI – Remedial Investigation

RRSE – Relative Risk Site Evaluation

SI – Site Inspection

# RELATIVE RISK SITE EVALUATION, cont.

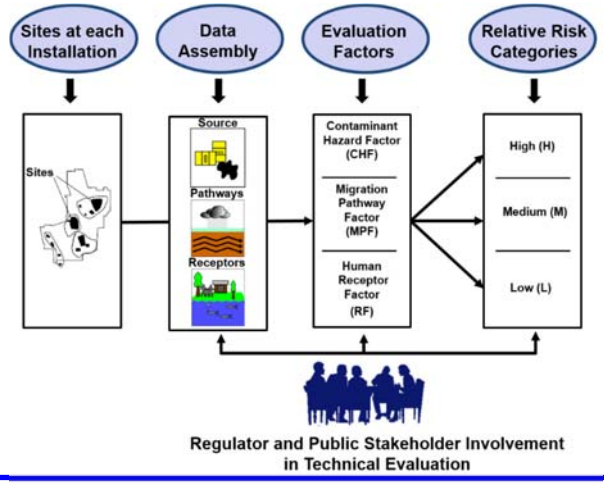
**Q. What is the Relative Risk Site Evaluation (RRSE)?**

**A.** RRSE is a methodology to sequence environmental restoration work used by the DoD. The RRSE process is used to evaluate the relative risk posed by an environmental restoration site in relation to other sites. The DoD fundamental premise in site prioritization is "worst first," meaning the DoD Component shall address sites that pose a relatively greater potential risk to public safety, human health, or the environment before sites posing a lesser risk. Relative risk is not the sole factor in determining the sequence of environmental restoration work, but it is an important consideration in the priority setting process. The methodology is described in the DoD, Relative Risk Site Evaluation Primer, Summer 1997 Revised Edition: https://denix.osd.mil/references/dod/policy-guidance/relative-risk-site-evaluation-primer/

**Q. What is the RRSE framework?**

**A.** The RRSE framework provides a DoD-wide approach for evaluating the relative risk to human health and the environment posed by contamination present at sites. The **Relative Risk Site Evaluation Concept Summary** (shown in the figure) illustrates the selection of sites, evaluation of the site data using three evaluation factors, and placement into high, medium, and low categories. The relative risk site evaluation framework is based on information fundamental to risk assessment: sources, pathways, and receptors to sequence restoration work. The RRSE is not a baseline risk assessment or health assessment in the CERCLA process. Regulators and public stakeholders in the environmental restoration process are provided the opportunity to participate in the process in accordance with the DoD Defense Environmental Restoration Program.

**Relative Risk Site Evaluation Concept Summary**

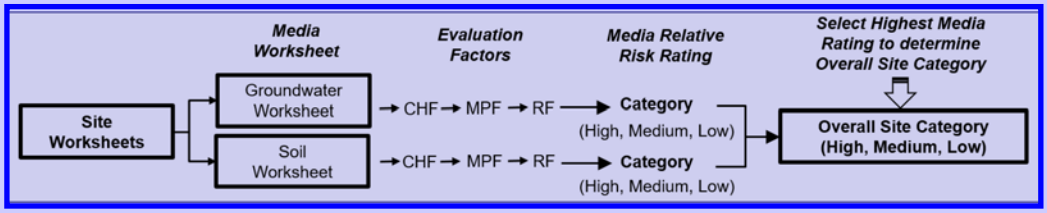



## Sites at Each Installation

**Q. What restoration sites are required to be evaluated in the RRSE process?**


**A.** Restoration sites in CERCLA phases prior to remedy-in-place are evaluated in the process. Worksheets are developed for environmental media at each site. For consistency across all the Installations, only surface soil (0-1 foot deep) and groundwater media were evaluated in the RRSE.

The figure shows the process for a media to be evaluated using the contaminant hazard factor (CHF), the migration pathway factor (MPF), and the receptor factor (RF). Each media is scored to obtain a relative risk rating of High, Medium, or Low. The highest media rating determines the Overall Site Category.




**Q. How is the Contaminant Hazard Factor (CHF) determined?**

**A.** The **CHF** is determined by dividing the maximum level for a contaminant at each site by the approved screening values (i.e., risk-based comparison values). Contaminant concentration ratios are totaled to arrive at a **CHF.** A CHF sum of greater than 100 earns a **Significant (High)** ranking. **Moderate (Medium)** is when the total is 2 to 100. **Minimal (Low)** is when a CHF is less than two.

**FOR MORE INFORMATION**

**Air Force Civil Engineer Center**
**Environmental Restoration Program**
www.afcec.af.mil

**AFCEC CERCLA**
**Administrative Record (AR)**
https://ar.afcec-cloud.af.mil/


**POINT OF CONTACT**
Mark Dickerson NGB/A4VR
(240) 612-8445
mark.dickerson@us.af.mil


**Q. How is the Migration Pathway Factor (MPF) determined?**

**A.** The movement of contamination at a site is evaluated and assigned a **MPF** rating.

Ratings for MPFs are designated as: **evident**, **potential**, or **confined** (for **High, Medium, and Low**). **Evident** exposure means the contamination is at a point where exposure to humans or the environment can occur, such as at a drinking water well. **Potential** ratings are given to sites where exposure may happen. A **confined** rating is given to sites where a low possibility for exposure may occur.

**Q. How is the Receptor Factor (RF) determined?**

**A.** The **RF** is determined by a receptor's, such as humans, potential to come into contact with contaminated media. **RFs** are designated as: identified, potential, or limited **(High, Medium, and Low).**

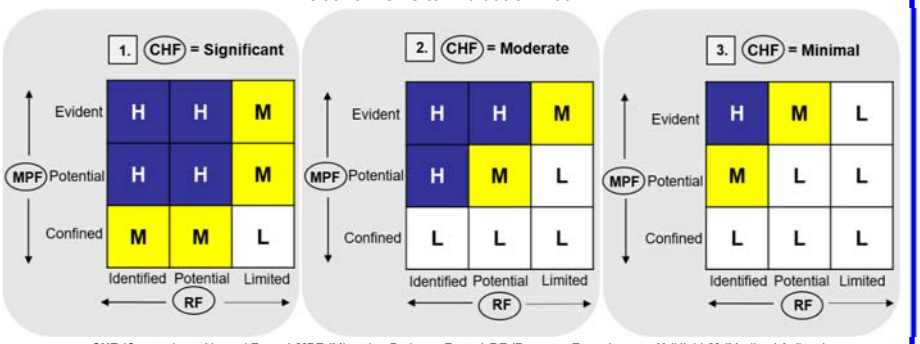
**Identified** rating is given when receptors are in contact or threat of contact with contaminated media. **Potential** is given when receptor may contact contaminated media. **Limited** is given when there is little or no contact with contaminated media.

# RELATIVE RISK SITE EVALUTION, cont.

## Media Relative Risk Rating

**Q. How is the media relative risk rating determined?**
**A**. Use the chart to determine the relative risk rating for each media evaluated. Start by choosing the **CHF** result of the evaluation. If the **CHF** is **Significant**, use **box 1.**; if **Moderate**, use **box 2.**; if **Minimal**, use **box 3.** Then find the **MPF** and **RF** results and move to the square where the results meet. That square indicates the media relative risk rating. For example, if the **CHF** is **Significant (go to box 1.)**, the **MPF** is **Potential** and the **RF** is **Identified**, then the rating is High (**H**).

**Relative Risk Site Evaluation Matrix**




**CHF** (Contaminant Hazard Factor) **MPF** (Migration Pathway Factor) **RF** (Receptor Factor) **H** (High) **M** (Medium) **L** (Low)

## Overall Site Category

**Q. How do I determine the Overall Site Category?**
**A.** The highest relative risk media rating becomes the **Overall Site Category** for the site. For example, if a site has a groundwater relative risk rating of **High**, and soil relative risk rating of **Low**, then the Overall Site Category rating for the site is **High**.

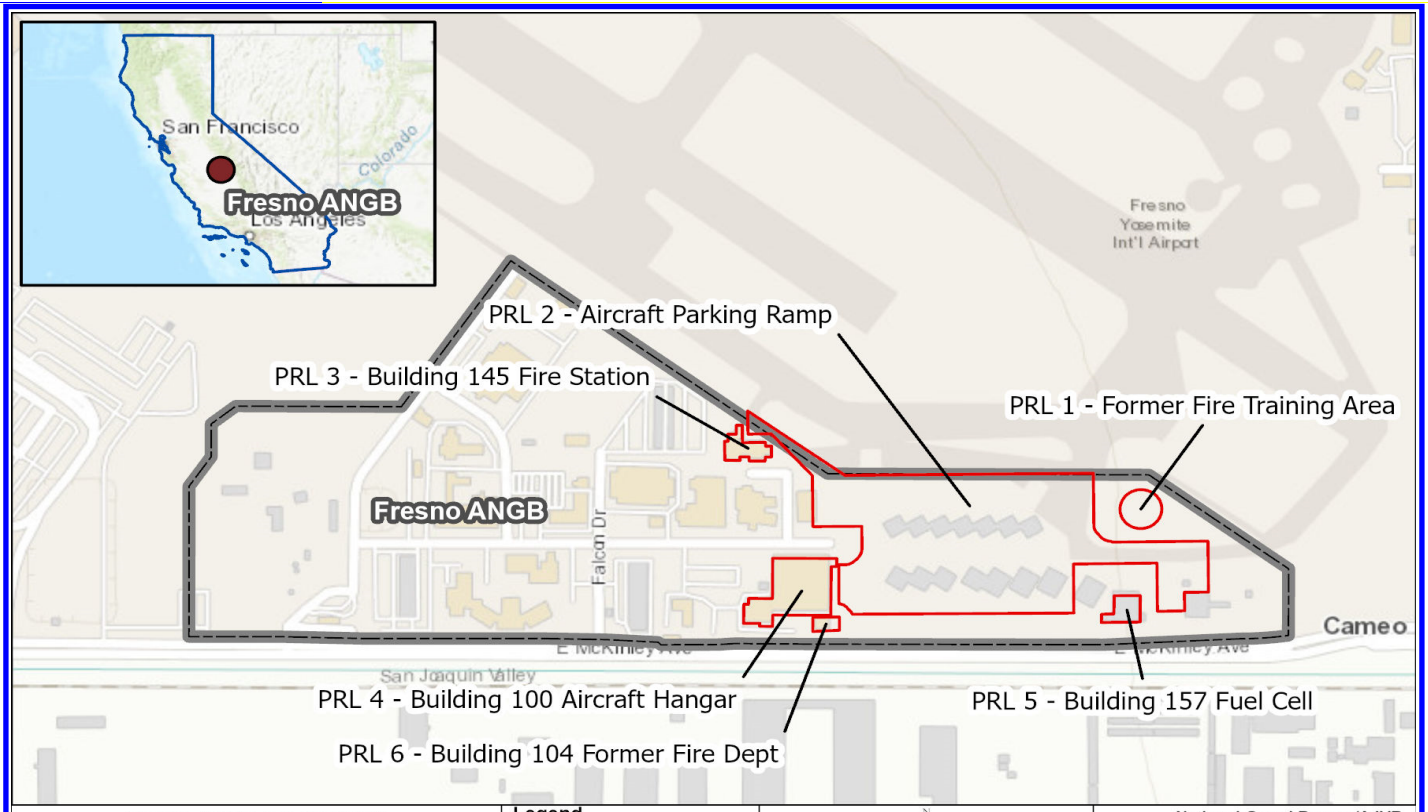
## Regulatory and Stakeholder Involvement

Q. **How do I participate as Stakeholder?**

**A.** To offer opportunity to participate in RRSE, the Air Force announces a public comment period in your local newspaper. There is also opportunity to participate during installation Restoration Advisory Committees where active. Installation Restoration Advisory Committee meetings are also announced in your local newspaper.

## Relative Risk Site Evaluation Summary Fresno ANGB, CA

| Overall Site Category | Site Name (Sites are shown on the map below and RRSE Worksheets are attached) |
|---|---|
| HIGH | PRL 1, PRL 3, PRL 4 |
| MEDIUM | |
| LOW | PRL 2, PRL 5, PRL 6 |




**Fresno ANGB Relative Risk Site Evaluation (RRSE) Figure**
National Guard Bureau
Fresno Air National Guard Base, California

**Legend**
AFFF Release Areas
Fresno ANGB Installation Boundary

N
0 250 500 1,000
Feet

**National Guard Bureau/A4VR Environmental Restoration**
3500 Fetchet Ave
Joint Base Andrews, MD 20762

AFFF Area is another term for Potential Release Location (PRL).

| Site Background Information | | | |
|---|---|---|---|
| **Installation:** | Fresno ANGB | **Date:** | 10/14/2021 |
| **Location (State):** | California | **Media Evaluated:** | Groundwater, Soil |
| **Site Name and ID:** | Former Fire Training Area - PRL 1 | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Mark Dickerson | **Agreement Status (e.g., Federal Facility Agreement date** | N/A |
| **OVERALL SITE CATEGORY: HIGH** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | The Former Fire Training Area (FTA) – Installation Restoration Program (IRP) Site 1 covers approximately 0.4 acres and is located in the Northeast portion of Parcel A which is in the Southeast portion of the Fresno-Yosemite International Airport (IAP). The FTA was constructed as a circular, 10-inch high, unlined earthen berm approximately 60 feet in diameter. Firefighting training activities were executed at this location between the late 1950s and early 1970s. Between 25,000 and 40,000 gallons of flammable material were used at the FTA over this time period. After igniting the flammable materials for firefighting training, flames were extinguished with aqueous film forming foam (AFFF). The AFFF used in the training exercises was protein-based foam consisting of approximately 6% AFFF diluted with 94% water. At the FTA, an estimated 500 to 1,000 gallons of flammable material was used each month at this PRL. |
| **Brief Description of Pathways:** | The Sierra Nevada Mountains form the physiographic barrier on the eastern side of the San Joaquin Valley. Seven waterbearing zones have been identified in the vicinity of the base; these units contain a higher percentage of sand compared to the intervening aquitards, which are primarily silt with secondary sand and clay. First encountered groundwater at the base ranges between 80-120 ft. below ground surface (bgs). Groundwater is found in unconfined or semiconfined conditions within alluvial fan deposits that extend to depths of 3,500 ft. bgs. Samples were collected from approx. 71-147 ft. bgs at PRL wells during the PFOS/PFOA SI. Given the relatively low concentrations detected during the SI, assume the intervening aquitards act as a vertical barrier for PFOS/PFOA migration into the deeper units, where wells may be screened. Direction of regional groundwater flow is generally south-southwest, though during the site investigation (SI) field activities the local groundwater flow was northwest.<br><br>PRL 1 is covered by asphalt. |
| **Brief Description of Receptors:** | There are currently no known drinking water supply wells at the base. The base is provided water via three City of Fresno public water supply wells. Fifteen wells are located within 1.0 mile of the Fresno ANGB. Three of the fifteen wells are owned by the United States Geological Survey (USGS) California Water Science Center and are located to the southwest, south-southeast, and north-northwest of the base; status and use for these three USGS wells was not identified in the PA Report. Twelve water wells are listed on the California (CA) Wells database. One of these wells is owned by the Fresno ANG and is located 1/8 mile upgradient of the base. One well, located ½ to 1 mile west of the site and potentially downgradient, does not include sufficient information to determine its use, owner, or status. One well, located ½ to 1 mile southwest of the Base is listed as “Active” and is owned by the Bakman Water Company of Fresno. Depth to groundwater is approximately 111 to 120 ft. bgs.<br><br>PRL-1 is within the base boundaries between the aircraft parking area and the active runway and would be accessible to base personnel. |

# Groundwater Worksheet

**Installation** Fresno ANGB

**Site ID:** PRL 1 **AFFF Release Area #:** AFFF 1

| Contaminant | Maximum Concentration (ug/L) | Comparison Value (ug/L) | Ratios |
|---|---|---|---|
| PFOA | 0.17 | 0.04 | 4.3 |
| PFBS | 0.12 | 0.602 | 0.2 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF)** | **4.4** |
| **CHF > 100** | **H (High)** | $CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$ | |
| **100 > CHF > 2** | **M (Medium)** | | |
| **2 > CHF** | **L (Low)** | | |
| **CHF Value** | | **CHF VALUE** | **M** |

## Migratory Pathway Factor

| | | |
|---|---|---|
| **Evident** | Analytical data or direct observation indicates that contamination in the groundwater has moved to a point of exposure (e.g., well) | |
| **Potential** | Contamination in the groundwater has moved beyond the source or insufficient information available to make a determination of Evident or Confined | M |
| **Confined** | Analytical data or direct observation indicates that the potential for contaminant migration from the source via groundwater is limited (possibly due to geological structures or physical controls) | |
| **Migratory Pathway Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |

## Receptor Factor

| | | |
|---|---|---|
| **Identified** | Impacted drinking water well with detected contaminants or existing downgradient water supply well within 4 miles and groundwater is current source of drinking water (EPA Class I or IIA groundwater) | H |
| **Potential** | Existing downgradient drinking water well beyond 4 miles with no contaminant detection(s) or no known drinking water wells downgradient and groundwater is currently or potentially usable for drinking water (i.e., EPA Class I or II groundwater) or other beneficial use (e.g., agricultural) | |
| **Limited** | No known water supply wells downgradient and groundwater is not considered potential drinking water source and is of limited beneficial use (Class III) | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | H |
| | **Groundwater Category** | **HIGH** |

# Soil Worksheet

**Installation** Fresno ANGB

**Site ID:** PRL 1 **AFFF Release Area #:** AFFF 1

| Contaminant | Maximum Concentration (mg/kg) | Comparison Value (mg/kg) | Ratios |
|---|---|---|---|
| PFOS | 0.01 | 0.126 | 0.1 |
| PFOA | 0.0016 | 0.126 | 0.0 |
| PFBS | 0.0004 | 1.9 | 0.0 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF** | **0.1** |
| **CHF > 100** | **H (High)** | | |
| **100 > CHF > 2** | **M (Medium)** | | |
| **2 > CHF** | **L (Low)** | | |
| **CHF Value** | | **CHF VALUE** | **L** |

$$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$$

| | | |
|---|---|---|
| **Migratory Pathway Factor** | | |
| **Evident** | Analytical data or observable evidence that contamination is present at a point of exposure | |
| **Potential** | Contamination has moved beyond the source, could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined | M |
| **Confined** | Low possibility for contamination to be present at or migrate to a point of exposure | |
| **Migratory Pathway Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |
| **Receptor Factor** | | |
| **Identified** | Receptors identified that have access to contaminated soil | |
| **Potential** | Potential for receptors to have access to contaminated soil | M |
| **Limited** | No potential for receptors to have access to contaminated soil | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |
| | **Soil Category** | **LOW** |

| Site Background Information | | | |
|---|---|---|---|
| **Installation:** | Fresno ANGB | **Date:** | 10/14/2021 |
| **Location (State):** | California | **Media Evaluated:** | Soil |
| **Site Name and ID:** | Aircraft Parking Ramp - PRL 2 | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Mark Dickerson | **Agreement Status (e.g., Federal Facility Agreement date signed):** | N/A |
| **OVERALL SITE CATEGORY: LOW** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | The Aircraft Parking Ramp is a large concrete area where drainage is characterized by sheet flow into either grassy, vegetated areas to the north or storm drains lining the southern portion. Although there are not any documented releases of AFFF to the aircraft parking apron, this area was included as a PRL in the preliminary assessment (PA) Report due to the potential use and discharge of AFFF associated with this area.<br>No groundwater samples were collected. |
| **Brief Description of Pathways:** | The Sierra Nevada Mountains form the physiographic barrier on the eastern side of the San Joaquin Valley. Groundwater stored in the alluvial deposits is bounded on the eastern flanks and below by the consolidated Cretaceous and Tertiary sedimentary rocks and Sierra Nevada granitic rocks. Seven waterbearing zones have been identified in the vicinity of the base; these units contain a higher percentage of sand compared to the intervening aquitards, which are primarily silt with secondary sand and clay. First encountered groundwater at the base ranges between 80-120 ft. bgs. Direction of regional groundwater flow is generally south-southwest, though during the SI field activities the local groundwater flow was northwest. The groundwater flow at PRL-2 is toward the northwest.<br>PRL-2 is a paved area, with small landscaped areas in the northwestern extent of the PRL. |
| **Brief Description of Receptors:** | There are currently no known drinking water supply wells at the base. The base is provided water via three City of Fresno public water supply wells. Fifteen wells are located within 1.0 mile of the Fresno ANGB. Three of the fifteen wells are owned by the USGS California Water Science Center and are located to the southwest, south-southeast, and north-northwest of the base; status and use for these three USGS wells was not identified in the PA Report. Twelve water wells are listed on the CA Wells database. One of these wells is owned by the Fresno ANG and is located 1/8 mile upgradient of the base. One well, located ½ to 1 mile west of the site and potentially downgradient, does not include sufficient information to determine its use, owner, or status. One well, located ½ to 1 mile southwest of the Base is listed as “Active” and is owned by the Bakman Water Company of Fresno. Depth to groundwater is approximately 111 to 120 ft. bgs.<br>PRL-2 is within the base and would be accessible to base personnel. |

# Soil Worksheet

**Installation:** Fresno ANGB

**Site ID:** PRL 2 **AFFF Release Area #:** AFFF 2

| Contaminant | Maximum Concentration (mg/kg) | Comparison Value (mg/kg) | Ratios |
|---|---|---|---|
| PFOS | 0.07 | 0.126 | 0.6 |
| PFOA | 0.0047 | 0.126 | 0.0 |
| PFBS | 0.00031 | 1.9 | 0.0 |

| CHF Scale | CHF Value | Contamination Hazard Factor (CHF) | 0.6 |
|---|---|---|---|
| CHF > 100 | H (High) | | |
| 100 > CHF > 2 | M (Medium) | $CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$ | |
| 2 > CHF | L (Low) | | |
| CHF Value | | CHF VALUE | L |

## Migratory Pathway Factor

| | | |
|---|---|---|
| **Evident** | Analytical data or observable evidence that contamination is present at a point of exposure | |
| **Potential** | Contamination has moved beyond the source, could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined | M |
| **Confined** | Low possibility for contamination to be present at or migrate to a point of exposure | |
| **Migratory Pathway Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |

## Receptor Factor

| | | |
|---|---|---|
| **Identified** | Receptors identified that have access to contaminated soil | |
| **Potential** | Potential for receptors to have access to contaminated soil | |
| **Limited** | No potential for receptors to have access to contaminated soil | L |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | L |
| | **Soil Category** | **LOW** |

| Site Background Information | | | |
|---|---|---|---|
| **Installation:** | Fresno ANGB | **Date:** | 10/14/2021 |
| **Location (State):** | California | **Media Evaluated:** | Groundwater, Soil |
| **Site Name and ID:** | Building 145 (Fire Station) - PRL 3 | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Mark Dickerson | **Agreement Status (e.g., Federal Facility Agreement date signed):** | N/A |
| **OVERALL SITE CATEGORY: HIGH** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | Building 145 was built in 1992 and has operated as the Fire Station since. At the time of the PA site visit, the base had four Aircraft Rescue and Fire Fighting (ARFF) vehicles in service, including a P-34 vehicle carrying 70 gallons of AFFF, a P-19 vehicle carrying 130 gallons of AFFF, a P-22 vehicle carrying 50 gallons of AFFF, and a Stryker carrying 220 gallons of AFFF. Additionally, Trailer 2 sits on the east apron and is used for storage of 350 gallons of AFFF. At that time, base personnel indicated that AFFF was transferred to Trailer 2 via five gallon containers. Trailer 2 was used to fill all ARFF vehicles since the new station was built. There have been no known releases of AFFF within or around the Fire Station. In the event of an accidental release of AFFF, the discharged material would flow into the floor drains within the Fire Station which are connected to an oil/water separator (OWS) which is connected to the storm sewer. ARFF vehicles were stored and washed within the Fire Station; any wash fluid would discharge to the floor drains. |
| **Brief Description of Pathways:** | The Sierra Nevada Mountains form the physiographic barrier on the eastern side of the San Joaquin Valley. Groundwater stored in the alluvial deposits is bounded on the eastern flanks and below by the consolidated Cretaceous and Tertiary sedimentary rocks and Sierra Nevada granitic rocks. Seven waterbearing zones have been identified in the vicinity of the base; these units contain a higher percentage of sand compared to the intervening aquitards, which are primarily silt with secondary sand and clay. First encountered groundwater at the base ranges between 80-120 ft. bgs. Groundwater is found in unconfined or semi-confined conditions within alluvial fan deposits that extend to depths of 3,500 ft. bgs. Samples were collected from approx. 71-147 ft. bgs at PRL wells during the PFOS/PFOA SI. Given the relatively low concentrations detected during the SI, assume the intervening aquitards act as a vertical barrier for PFOS/PFOA migration into the deeper units, where wells may be screened. Direction of regional groundwater flow is generally south-southwest, though during the SI field activities the local groundwater flow was northwest.<br><br>Exposed soils are limited to small landscaped areas around the fire station. |
| **Brief Description of Receptors:** | There are currently no known drinking water supply wells at the base. The base is provided water via three City of Fresno public water supply wells. Fifteen wells are located within 1.0 mile of the Fresno ANGB. Three of the fifteen wells are owned by the USGS California Water Science Center and are located to the southwest, south-southeast, and north-northwest of the base; status and use for these three USGS wells was not identified in the PA Report. Twelve water wells are listed on the CA Wells database. One of these wells is owned by the Fresno ANG and is located 1/8 mile upgradient of the base. One well, located ½ to 1 mile west of the site and potentially downgradient, does not include sufficient information to determine its use, owner, or status. One well, located ½ to 1 mile southwest of the Base is listed as “Active” and is owned by the Bakman Water Company of Fresno. Depth to groundwater is approximately 111 to 120 ft. bgs.<br><br>PRL-3 is within the base and would be accessible to fire station personnel and escorted visitors to the fire station. |

# Groundwater Worksheet

**Installation:** Fresno ANGB

**Site ID:** PRL 3 **AFFF Release Area #:** AFFF 3

| Contaminant | Maximum Concentration (ug/L) | Comparison Value (ug/L) | Ratios |
|---|---|---|---|
| PFBS | 4.5 | 0.602 | 7.5 |

| CHF Scale | CHF Value | Contamination Hazard Factor (CHF) | 7.5 |
|---|---|---|---|
| CHF > 100 | H (High) | $CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$ | |
| 100 > CHF > 2 | M (Medium) | | |
| 2 > CHF | L (Low) | | |
| CHF Value | | CHF VALUE | M |

## Migratory Pathway Factor

| | | |
|---|---|---|
| **Evident** | Analytical data or direct observation indicates that contamination in the groundwater has moved to a point of exposure (e.g., well) | |
| **Potential** | Contamination in the groundwater has moved beyond the source or insufficient information available to make a determination of Evident or Confined | M |
| **Confined** | Analytical data or direct observation indicates that the potential for contaminant migration from the source via groundwater is limited (possibly due to geological structures or physical controls) | |
| **Migratory Pathway Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |

## Receptor Factor

| | | |
|---|---|---|
| **Identified** | Impacted drinking water well with detected contaminants or existing downgradient water supply well within 4 miles and groundwater is current source of drinking water (EPA Class I or IIA groundwater) | H |
| **Potential** | Existing downgradient drinking water well beyond 4 miles with no contaminant detection(s) or no known drinking water wells downgradient and groundwater is currently or potentially usable for drinking water (i.e., EPA Class I or II groundwater) or other beneficial use (e.g., agricultural) | |
| **Limited** | No known water supply wells downgradient and groundwater is not considered potential drinking water source and is of limited beneficial use (Class III) | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | H |
| | **Groundwater Category** | **HIGH** |

# Soil Worksheet

**Installation:** Fresno ANGB

**Site ID:** PRL 3 **AFFF Release Area #:** AFFF 3

| Contaminant | Maximum Concentration (mg/kg) | Comparison Value (mg/kg) | Ratios |
|---|---|---|---|
| PFBS | 0.001 | 1.9 | 0.0 |
| PFOS | 0.084 | 0.126 | 0.7 |
| PFOA | 0.00071 | 0.126 | 0.0 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF)** | **0.7** |
| **CHF > 100** | **H (High)** | | |
| **100 > CHF > 2** | **M (Medium)** | $CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$ | |
| **2 > CHF** | **L (Low)** | | |
| **CHF Value** | | **CHF VALUE** | **L** |

| Migratory Pathway Factor | | |
|---|---|---|
| **Evident** | Analytical data or observable evidence that contamination is present at a point of exposure | |
| **Potential** | Contamination has moved beyond the source, could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined | |
| **Confined** | Low possibility for contamination to be present at or migrate to a point of exposure | L |
| **Migratory Pathway Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | L |

| Receptor Factor | | |
|---|---|---|
| **Identified** | Receptors identified that have access to contaminated soil | |
| **Potential** | Potential for receptors to have access to contaminated soil | M |
| **Limited** | No potential for receptors to have access to contaminated soil | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |
| | **Soil Category** | **LOW** |

| Site Background Information | | | |
|---|---|---|---|
| **Installation:** | Fresno ANGB | **Date:** | 10/14/2021 |
| **Location (State):** | California | **Media Evaluated:** | Groundwater, Soil |
| **Site Name and ID:** | Building 100 (Aircraft Hangar) - PRL 4 | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Mark Dickerson | **Agreement Status (e.g., Federal Facility Agreement date signed):** | N/A |
| **OVERALL SITE CATEGORY: HIGH** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | Building 100 was constructed in 1955 and is equipped with an fire suppression system (FSS), which was supplied with AFFF between 1994 and 2007. The FSS was retrofitted for use of high expansion foam (HEF) after 2007. The FSS contained approximately 400 gallons of AFFF and was likely tested every two to three years, with the last test in 2005. Some of the valves on the FSS would leak AFFF to the floor when touched. During FSS system testing, it is estimated by base personnel that approximately 10 gallons of AFFF was discharged. Base personnel believe there was an accidental release of AFFF from the FSS prior to 2004; however base records could not confirm the release. AFFF discharged from the FSS was washed into trench drains within the hangar. The trench drains discharge to a 5,000 gallon underground holding tank located southeast of the hangar which connects to the storm sewer. The holding tank also receives storm water runoff from the Aircraft Parking Ramp. According to base personnel, the holding tank has a valve that is normally kept in the closed position to contain water for inspection prior to release to the storm sewer. It is unknown if the AFFF discharged into this holding tank was removed and sent for offsite disposal or released to the storm sewer. |
| **Brief Description of Pathways:** | The Sierra Nevada Mountains form the physiographic barrier on the eastern side of the San Joaquin Valley. Groundwater stored in the alluvial deposits is bounded on the eastern flanks and below by the consolidated Cretaceous and Tertiary sedimentary rocks and Sierra Nevada granitic rocks. Seven waterbearing zones have been identified in the vicinity of the base; these units contain a higher percentage of sand compared to the intervening aquitards, which are primarily silt with secondary sand and clay. First encountered groundwater at the base ranges between 80-120 ft. bgs. Groundwater is found in unconfined or semi-confined conditions within alluvial fan deposits that extend to depths of 3,500 ft. bgs. Samples were collected from approx. 71-147 ft. bgs at PRL wells during the PFOS/PFOA SI. Given the relatively low concentrations detected during the SI, assume the intervening aquitards act as a vertical barrier for PFOS/PFOA migration into the deeper units, where wells may be screened. Direction of regional groundwater flow is generally south-southwest, though during the SI field activities the local groundwater flow was northwest.<br><br>PRL-4 is covered in asphalt wtih a small landscaped area with grass and bare soil. |
| **Brief Description of Receptors:** | There are currently no known drinking water supply wells at the base. The base is provided water via three City of Fresno public water supply wells. Fifteen wells are located within 1.0 mile of the Fresno ANGB. Three of the fifteen wells are owned by the USGS California Water Science Center and are located to the southwest, south-southeast, and north-northwest of the base; status and use for these three USGS wells was not identified in the PA Report. Twelve water wells are listed on the CA Wells database. One of these wells is owned by the Fresno ANG and is located 1/8 mile upgradient of the base. One well, located ½ to 1 mile west of the site and potentially downgradient, does not include sufficient information to determine its use, owner, or status. One well, located ½ to 1 mile southwest of the Base is listed as “Active” and is owned by the Bakman Water Company of Fresno. Depth to groundwater is approximately 111 to 120 ft. bgs. Fresno ANGB is currently zoned for public and institutional activities, and the surrounding area includes zoning for residential, light industrial, commercial, open space, and office uses. PRL-4 is within the base boundaries and would be accessible by base personnel. |

# Groundwater Worksheet

**Installation:** Fresno ANGB

**Site ID:** PRL 4 **AFFF Release Area #:** AFFF 4

| Contaminant | Maximum Concentration (ug/L) | Comparison Value (ug/L) | Ratios |
|---|---|---|---|
| PFOA | 0.13 | 0.04 | 3.2 |

| CHF Scale | CHF Value | Contamination Hazard Factor (CHF) | 3.2 |
|---|---|---|---|
| CHF > 100 | H (High) | $CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$ | |
| 100 > CHF > 2 | M (Medium) | | |
| 2 > CHF | L (Low) | | |
| CHF Value | | CHF VALUE | M |

| Migratory Pathway Factor | | |
|---|---|---|
| Evident | Analytical data or direct observation indicates that contamination in the groundwater has moved to a point of exposure (e.g., well) | |
| Potential | Contamination in the groundwater has moved beyond the source or insufficient information available to make a determination of Evident or Confined | M |
| Confined | Analytical data or direct observation indicates that the potential for contaminant migration from the source via groundwater is limited (possibly due to geological structures or physical controls) | |
| Migratory Pathway Factor | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |

| Receptor Factor | | |
|---|---|---|
| Identified | Impacted drinking water well with detected contaminants or existing downgradient water supply well within 4 miles and groundwater is current source of drinking water (EPA Class I or IIA groundwater) | H |
| Potential | Existing downgradient drinking water well beyond 4 miles with no contaminant detection(s) or no known drinking water wells downgradient and groundwater is currently or potentially usable for drinking water (i.e., EPA Class I or II groundwater) or other beneficial use (e.g., agricultural) | |
| Limited | No known water supply wells downgradient and groundwater is not considered potential drinking water source and is of limited beneficial use (Class III) | |
| Receptor Factor | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | H |
| | Groundwater Category | HIGH |

# Soil Worksheet

**Installation** Fresno ANGB

**Site ID:** PRL 4 **AFFF Release Area #:** AFFF 4

| Contaminant | Maximum Concentration (mg/kg) | Comparison Value (mg/kg) | Ratios |
|---|---|---|---|
| PFOS | 0.14 | 0.126 | 1.1 |
| PFOA | 0.0052 | 0.126 | 0.0 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF)** | **1.2** |
| **CHF > 100** | **H (High)** | | |
| **100 > CHF > 2** | **M (Medium)** | | |
| **2 > CHF** | **L (Low)** | | |
| **CHF Value** | | **CHF VALUE** | **L** |

$$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$$

| Migratory Pathway Factor | | |
|---|---|---|
| **Evident** | Analytical data or observable evidence that contamination is present at a point of exposure | |
| **Potential** | Contamination has moved beyond the source, could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined | |
| **Confined** | Low possibility for contamination to be present at or migrate to a point of exposure | L |
| **Migratory Pathway Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | L |

| Receptor Factor | | |
|---|---|---|
| **Identified** | Receptors identified that have access to contaminated soil | |
| **Potential** | Potential for receptors to have access to contaminated soil | M |
| **Limited** | No potential for receptors to have access to contaminated soil | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |
| | **Soil Category** | **LOW** |

| Site Background Information | | | |
|---|---|---|---|
| **Installation:** | Fresno ANGB | **Date:** | 10/14/2021 |
| **Location (State):** | California | **Media Evaluated:** | Soil |
| **Site Name and ID:** | Building 157 Fuel Cell - PRL 5 | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Mark Dickerson | **Agreement Status (e.g., Federal Facility Agreement date signed):** | N/A |
| **OVERALL SITE CATEGORY: LOW** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | Building 157 was built in 1988 and a FSS supplied with AFFF was installed in 1994 and was in place through 2007. The PA Report stated that the FSS was retrofitted in 2007 to support use of HEF. The FSS was tested every two to three years and it was noted by base personnel that during FSS testing, approximately 10 gallons of AFFF would be discharged with each testing. Additionally, the valves of the FSS reportedly leaked. The discharged AFFF was washed into trench drains within the building which connected to a 1,000 gallon OWS that discharges to the sanitary sewer.<br><br>No groundwater samples were collected. |
| **Brief Description of Pathways:** | The Sierra Nevada Mountains form the physiographic barrier on the eastern side of the San Joaquin Valley. Groundwater stored in the alluvial deposits is bounded on the eastern flanks and below by the consolidated Cretaceous and Tertiary sedimentary rocks and Sierra Nevada granitic rocks. Seven waterbearing zones have been identified in the vicinity of the base; these units contain a higher percentage of sand compared to the intervening aquitards, which are primarily silt with secondary sand and clay. First encountered groundwater at the base ranges between 80-120 ft. bgs. Groundwater is found in unconfined or semi-confined conditions within alluvial fan deposits that extend to depths of 3,500 ft. bgs. Samples were collected from approx. 71-147 ft. bgs at PRL wells during the PFOS/PFOA SI. Given the relatively low concentrations detected during the SI, assume the intervening aquitards act as a vertical barrier for PFOS/PFOA migration into the deeper units, where wells may be screened. Direction of regional groundwater flow is generally south-southwest, though during the SI field activities the local groundwater flow was northwest.<br>PRL 5 is contained within Building 157 which has a concrete floor which would limit contact with surface soil and inhibit infiltration. |
| **Brief Description of Receptors:** | There are currently no known drinking water supply wells at the base. The base is provided water via three City of Fresno public water supply wells. Fifteen wells are located within 1.0 mile of the Fresno ANGB. Three of the fifteen wells are owned by the USGS California Water Science Center and are located to the southwest, south-southeast, and north-northwest of the base; status and use for these three USGS wells was not identified in the PA Report. Twelve water wells are listed on the CA Wells database. One of these wells is owned by the Fresno ANG and is located 1/8 mile upgradient of the base. One well, located ½ to 1 mile west of the site and potentially downgradient, does not include sufficient information to determine its use, owner, or status. One well, located ½ to 1 mile southwest of the Base is listed as “Active” and is owned by the Bakman Water Company of Fresno. Depth to groundwater is approximately 111 to 120 ft. bgs. Fresno ANGB is currently zoned for public and institutional activities, and the surrounding area includes zoning for residential, light industrial, commercial, open space, and office uses. PRL-5 is within the base boundaries and would be accessible by base personnel. |

# Soil Worksheet

**Installation** Fresno ANGB

**Site ID:** PRL 5 **AFFF Release Area #:** AFFF 5

| Contaminant | Maximum Concentration (mg/kg) | Comparison Value (mg/kg) | Ratios |
|---|---|---|---|
| PFOS | 0.029 | 0.126 | 0.2 |
| PFOA | 0.00054 | 0.126 | 0.0 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF)** | **0.2** |
| **CHF > 100** | **H (High)** | | |
| **100 > CHF > 2** | **M (Medium)** | | |
| **2 > CHF** | **L (Low)** | | |
| **CHF Value** | | **CHF VALUE** | **L** |

$$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$$

| | | |
|---|---|---|
| **Migratory Pathway Factor** | | |
| **Evident** | Analytical data or observable evidence that contamination is present at a point of exposure | |
| **Potential** | Contamination has moved beyond the source, could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined | |
| **Confined** | Low possibility for contamination to be present at or migrate to a point of exposure | L |
| **Migratory Pathway Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | L |
| **Receptor Factor** | | |
| **Identified** | Receptors identified that have access to contaminated soil | |
| **Potential** | Potential for receptors to have access to contaminated soil | |
| **Limited** | No potential for receptors to have access to contaminated soil | L |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | L |
| | **Soil Category** | **LOW** |

| Site Background Information | | | |
|---|---|---|---|
| **Installation:** | Fresno ANGB | **Date:** | 10/14/2021 |
| **Location (State):** | California | **Media Evaluated:** | Soil |
| **Site Name and ID:** | Building 104 (Former Fire Station) - PRL 6 | **Phase of Execution (e.g., RI, Record of Decision (ROD)):** | N/A |
| **RPM's Name:** | Mark Dickerson | **Agreement Status (e.g., Federal Facility Agreement date signed):** | N/A |
| **OVERALL SITE CATEGORY: LOW** | | | |

| Site Summary | |
|---|---|
| **Brief Site Description:** | Building 104 which was built in 1957 served as the original Fire Department until 1992 when the new Fire Department, Building 145, was constructed. The PA Report noted that AFFF was stored on the parking apron to the east of the building. ARFF vehicles were washed and filled up with AFFF on the parking apron as well. There are no known releases of AFFF in or around the former fire station. If any releases did occur within the building or on the apron to the east, the AFFF would have been washed down or left to dissipate.<br><br>No groundwater samples were collected. |
| **Brief Description of Pathways:** | The Sierra Nevada Mountains form the physiographic barrier on the eastern side of the San Joaquin Valley. Groundwater stored in the alluvial deposits is bounded on the eastern flanks and below by the consolidated Cretaceous and Tertiary sedimentary rocks and Sierra Nevada granitic rocks. Seven waterbearing zones have been identified in the vicinity of the base; these units contain a higher percentage of sand compared to the intervening aquitards, which are primarily silt with secondary sand and clay. First encountered groundwater at the base ranges between 80-120 ft. bgs. Groundwater is found in unconfined or semi-confined conditions within alluvial fan deposits that extend to depths of 3,500 ft. bgs. Samples were collected from approx. 71-147 ft. bgs at PRL wells during the PFOS/PFOA SI. Given the relatively low concentrations detected during the SI, assume the intervening aquitards act as a vertical barrier for PFOS/PFOA migration into the deeper units, where wells may be screened. Direction of regional groundwater flow is generally south-southwest, though during the SI field activities the local groundwater flow was northwest.<br>PRL 6 includes Building 104 and the immediately adjacent area. The ground cover in and around Building 104 is concrete which would limit contact with surface soil and inhibit infiltration. |
| **Brief Description of Receptors:** | There are currently no known drinking water supply wells at the base. The base is provided water via three City of Fresno public water supply wells. Fifteen wells are located within 1.0 mile of the Fresno ANGB. Three of the fifteen wells are owned by the USGS California Water Science Center and are located to the southwest, south-southeast, and north-northwest of the base; status and use for these three USGS wells was not identified in the PA Report. Twelve water wells are listed on the CA Wells database. One of these wells is owned by the Fresno ANG and is located 1/8 mile upgradient of the base. One well, located ½ to 1 mile west of the site and potentially downgradient, does not include sufficient information to determine its use, owner, or status. One well, located ½ to 1 mile southwest of the Base is listed as “Active” and is owned by the Bakman Water Company of Fresno. Depth to groundwater is approximately 111 to 120 ft. bgs. Fresno ANGB is currently zoned for public and institutional activities, and the surrounding area includes zoning for residential, light industrial, commercial, open space, and office uses. PRL-6 would be accessible by base personnel, however the area is adjacent to a public road and foot path. |

# Soil Worksheet

**Installation** Fresno ANGB

**Site ID:** PRL 6 **AFFF Release Area #:** AFFF 6

| Contaminant | Maximum Concentration (mg/kg) | Comparison Value (mg/kg) | Ratios |
|---|---|---|---|
| PFOS | 0.57 | 0.126 | 4.5 |
| PFOA | 0.051 | 0.126 | 0.4 |
| **CHF Scale** | **CHF Value** | **Contamination Hazard Factor (CHF)** | **4.9** |
| **CHF > 100** | **H (High)** | $CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$ | |
| **100 > CHF > 2** | **M (Medium)** | | |
| **2 > CHF** | **L (Low)** | | |
| **CHF Value** | | **CHF VALUE** | **M** |

| Migratory Pathway Factor | | |
|---|---|---|
| **Evident** | Analytical data or observable evidence that contamination is present at a point of exposure | |
| **Potential** | Contamination has moved beyond the source, could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined | |
| **Confined** | Low possibility for contamination to be present at or migrate to a point of exposure | L |
| **Migratory Pathway Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | L |

| Receptor Factor | | |
|---|---|---|
| **Identified** | Receptors identified that have access to contaminated soil | |
| **Potential** | Potential for receptors to have access to contaminated soil | M |
| **Limited** | No potential for receptors to have access to contaminated soil | |
| **Receptor Factor** | DIRECTIONS: Record the single highest value from above in the box to the right (maximum value = H). | M |
| | **Soil Category** | **LOW** |