I MINA'TRENTAI SINGKO NA LIHESLATURAN GUÅHAN

Informational Briefing/ Oversight Hearing / Roundtable Hearing

STANDING COMMITTEE / SENATOR	HEARING	COMMITTEE REPORT	HEARING DATE	DATE COMMITTEE REPORT FILED	NOTES
Committee on Environment, Revenue and Taxation, and Procurement	Informational Briefing	Per-And Polyfluoroalkyl Substances (PFAS)	7/25/19 9 a.m.	8/30/19 5:17 p.m.	

OFFICE OF SENATOR SABINA FLORES PEREZ
Chairperson
Committee on Environment, Revenue and Taxation, and Procurement
I MINA'TRENTAI SINGKO NA LIHESLATURAN GUÅHAN
35TH GUAM LEGISLATURE

August 29, 2019

RBL.

The Honorable Régine Biscoe Lee
Chairperson, Committee on Rules
I Mina'trentai Singko Na Liheslaturan Guåhan
163 Chalan Santo Papa
Hagåtña, Guam 96910

RE: Committee Report on Informational Hearing on Per- And Polyfluoroalkyl Substances (PFAS)

2019 AUG 30 PM 5:17

Håfa adai Chairperson Lee,

Transmitted herewith is the Committee Report on the Informational Hearing on Per- And Polyfluoroalkyl Substances (PFAS).

Si Yu'os ma'åse',

Sabina Flores Perez

Sabina Flores Perez

RECEIVED
AUG 29 2019
3:05pm.
COMMITTEE ON RULES

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Chairperson
Committee on Environment, Revenue and Taxation, and Procurement
I MINA'TRENTAI SINGKO NA LIHESLATURAN GUÅHAN
35TH GUAM LEGISLATURE

COMMITTEE REPORT

INFORMATIONAL HEARING
on

PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

By Senator Sabina Flores Perez

194 Hernan Cortes Avenue, Terlaje Professional Building, 1st Floor, *Hagåtña*, Guam 96910
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Gmail by Google

1st Notice of Informational Hearing: Thursday, July 25, 2019 at 9:00 a.m.

Office of Senator Sabina Perez <office@senatorperez.org> Wed, Jul 17, 2019 at 11:26 AM
To: "Walter S. Leon Guerrero" <walter.leonguerrero@epa.guam.gov>, nic.rupley@epa.guam.gov, Conchita San Nicolas Taitano <conchita.taitano@epa.guam.gov>, brian.bearden@epa.guam.gov, julie.mendoza@epa.guam.gov, carmencita.cortez@epa.guam.gov, Miguel Bordallo <mcbordallo@guamwaterworks.org>, "Ann D. Borja, CPM" <annborja@guamwaterworks.org>, paulkemp@guamwaterworks.org, daniel.stone@gfd.guam.gov, kathleen.leonguerrero@gfd.guam.gov, tom.ada@guamairport.net, raymondm@guamairport.net, rsantos@guamairport.net, catherine.norton@fe.navy.mil, YONG SANG KIM <kimys@triton.uog.edu>, jjenson@triton.uog.edu, Fred Nishihira <fnishihira@guamag.org>, korcutt@guamag.org, "Leevin T. Camacho" <law@guamag.org>, catherine_lutz@brown.edu, hcristobalmom@gmail.com, angelbmarquez15@gmail.com, kennethkuper@gmail.com, "Paul E.R. Packbier" <paul@pcrguam.com>
Cc: Sabrina Salas Matanane <sabrina@kuam.com>, nestor@kuam.com, Chris Barnett <malafunkshun@kuam.com>, joan@kuam.com, news@sorensenmediagroup.com, reporters@postguam.com, news@guampdn.com, news@k57.com, phill@k57.com, rlimtiaco@guampdn.com, heugenio@guampdn.com, John O'Connor <johntaoconnor@gmail.com>, kstokish@gmail.com, editor@pacificislandtimes.com, Maureen Maratita <publisher@glimpsesofguam.com>, businesseditor@glimpsesofguam.com, assist_editor@glimpsesofguam.com, reporter2@glimpsesofguam.com, Guam Progress <guamprogress@yahoo.com>, colinperez@gmail.com, Gabejereza@gmail.com, aebenavente@gdoe.net, phnotice@guamlegislature.org

July 17, 2019

MEMORANDUM

To: All Senators, Stakeholders and Media

Fr: Senator Sabina Flores Perez, *Chairperson*

Subject: **1st Notice of Informational Hearing: Thursday, July 25, 2019 at 9:00 a.m.**

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9:00 a.m.

Per- And Polyfluoroalkyl Substances (PFAS)

- PFAS Background Information
- Agency Actions and Efforts Regarding PFAS
- National Trends of PFAS
- Attorney General Updates on Public Law 35-25

In compliance with the Americans with Disabilities Act, individuals requiring special accommodations or services should contact the Office of Senator Sabina Flores Perez at 989-2968.

1st Notice.pdf
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Chairperson
Committee on Environment, Revenue and Taxation, and Procurement
I MINA'TRENTAI SINGKO NA LIHESLATURAN GUÅHAN
35TH GUAM LEGISLATURE

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2nd Notice of Informational Hearing: Thursday, July 25, 2019 at 9:00 a.m.

Office of Senator Sabina Perez <office@senatorperez.org> Tue, Jul 23, 2019 at 8:44 AM
To: "Walter S. Leon Guerrero" <walter.leonguerrero@epa.guam.gov>, nic.rupley@epa.guam.gov, Conchita San Nicolas Taitano <conchita.taitano@epa.guam.gov>, brian.bearden@epa.guam.gov, julie.mendoza@epa.guam.gov, carmencita.cortez@epa.guam.gov, Miguel Bordallo <mcbordallo@guamwaterworks.org>, "Ann D. Borja, CPM" <annborja@guamwaterworks.org>, paulkemp@guamwaterworks.org, daniel.stone@gfd.guam.gov, Kathleen Leon Guerrero <kathleen.leonguerrero@gfd.guam.gov>, tom.ada@guamairport.net, raymondm@guamairport.net, rsantos@guamairport.net, catherine.norton@fe.navy.mil, YONG SANG KIM <kimys@triton.uog.edu>, jjenson@triton.uog.edu, Fred Nishihira <fnishihira@guamag.org>, korcutt@guamag.org, "Leevin T. Camacho" <law@guamag.org>, Catherine Lutz <catherine_lutz@brown.edu>, hcristobalmom@gmail.com, angelbmarquez15@gmail.com, kennethkuper@gmail.com, "Paul E.R. Packbier" <paul@pcrguam.com>, Sabrina Salas Matanane <sabrina@kuam.com>, nestor@kuam.com, Chris Barnett <malafunkshun@kuam.com>, joan@kuam.com, news@sorensenmediagroup.com, reporters@postguam.com, news@guampdn.com, news@k57.com, phill@k57.com, rlimtiaco@guampdn.com, heugenio@guampdn.com, John O'Connor <johntaoconnor@gmail.com>, kstokish@gmail.com, editor@pacificislandtimes.com, Maureen Maratita <publisher@glimpsesofguam.com>, businesseditor@glimpsesofguam.com, assist_editor@glimpsesofguam.com, reporter2@glimpsesofguam.com, Guam Progress <guamprogress@yahoo.com>, colinperez@gmail.com, Gabejereza@gmail.com, aebenavente@gdoe.net, phnotice@guamlegislature.org

July 23, 2019

MEMORANDUM

To: All Senators, Stakeholders and Media

Fr: Senator Sabina Flores Perez, *Chairperson*

Subject: **2nd Notice of Informational Hearing: Thursday, July 25, 2019 at 9:00 a.m.**

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Committee on Environment, Revenue and Taxation, and Procurement
I MINA'TRENTAI SINGKO NA LIHESLATURAN GUÅHAN
35TH GUAM LEGISLATURE

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Marines defend preservation efforts

By Kevin Kerrigan
kevin@postguam.com

Most of the limestone forest across Northwest Field, where construction of a firing range complex is underway, will be preserved. And for every acre of land that is developed another acre must be restored, according to Albert Borja, the environmental director for Marine Corps Activity Guam.

Most of the historical artifacts found at the roughly 60 locations across the range complex have been left in place. Artifacts have only been removed from 14 locations for preservation elsewhere, said Marine Corps Activity Guam archaeologist Sandra Yee.

Borja and Yee, along with Marine Corps Communication Officer 1st Lt. Brett Lazarof, sat down with The Guam Daily Post recently to talk about what they're doing to preserve the environment and protect the island's cultural heritage during the construction of the firing range complex.

Lay of the land

To begin with, Northwest Field is not a sacred untouched landscape. Large tracts of Northwest Field and its limestone forest have been damaged by war and invasive species.

Lazaroff points out that the area was bombed by American forces when it was occupied by the Japanese during World War II. It was a battleground during the liberation and then converted afterward by the Air Force, which used it as a base for B-29s to bomb Japan. Remnants of the war are among the artifacts being found now.

The brown tree snake, rhino beetle and other invasive species have done damage here, as elsewhere. Wild pigs and deer have beaten broad paths through the brush.

Read more

Read the full story online at PostGuam.com.

Borja said the entire complex will be fenced off and the deer and pigs left inside will be eradicated.

As for the impact on indigenous species such as the Mariana Fruit Bat, Borja said, "We consulted with the Fish and Wildlife Service and they determined that the noise and the associated 'stressors' as they call it, will not jeopardize the existence of listed species."

More than half of the 700-acre range complex will remain undeveloped.

The five firing ranges and the accompanying structures and access roads to them will take up 315 acres, of which 89 acres of limestone forest will be cut down.

"The rest will be preserved," said Borja.

In addition, as required by their agreement with the U.S. Fish and Wildlife Service, for every one of the 315 acres being developed, including the 89 acres of limestone forest, the Marines must restore an equal number of acres back to as near their natural state as possible.

Overall, at both the firing range complex and the Marine Corps barracks and base under construction in Finegayan, Borja said "the military will restore 1,000 acres of forest habitat as part of the forest enhancement project."

White House sends Liberation Day message to Guam

The White House on Sunday issued a message commemorating the 75th anniversary of Guam's liberation from Japanese occupation during World War II.

In the message, President Donald Trump recognized the more than 1,200 service members "who laid down their lives so that future generations in Guam would know the blessings of freedom."

He also paid respect to "the more than 1,000 Guam residents who lost their lives in the invasion and during the Japanese occupation."

The president said the "second battle" of Guam was "paramount to the success of Operation Forager" and the airfields built on the island following the battle proved "instrumental" in the defeat of Japan.

He said that Guam "continues to be an important strategic hub" in the Western Pacific, "as well as an economic and cultural asset of the United States."

Presidential message

The following is the presidential message on the 75th anniversary of the Liberation of Guam, issued July 21:

"Seventy-five years ago, American forces landed on Guam to liberate the United States territory that Japan had seized following the attack on Pearl Harbor. Today, as we celebrate the liberation of Guam, we also remember the more than 1,200 Marines, Soldiers, Sailors, and Airmen who laid down their lives there so that future generations in Guam would know the blessings of freedom. We also pay our respects to the more than 1,000 Guam residents who lost their lives in the invasion and during the Japanese occupation that followed.

"Lasting nearly three weeks, the Second Battle of Guam was paramount to the success of Operation Forager, in which the United States Armed Forces gained a foothold in the Pacific campaign of World War II. After our forces emerged victorious, the United States Navy constructed airfields to accommodate the United States Army Air Forces. These facilities would prove to be instrumental to the success of aerial attacks throughout the Pacific theater and our defeat of the forces of Imperial Japan.

"Today, Guam continues to be an important strategic hub in the Western Pacific, as well as an economic and cultural asset of the United States. As we commemorate the 75th anniversary of the liberation of Guam, Melania joins me in recognizing all of our country's service members and their families for their sacrifice in defending our cherished liberties."

(Daily Post Staff)

Senator Sabina Flores Perez
Committee on Environment, Revenue and Taxation, and Procurement

Informational Hearing Notice
Thursday, July 25, 2019 at 9:00 a.m.
I Liheslaturan Guahan, Public Hearing Room

AGENDA

Per-And Polyfluoroalkyl Substances (PFAS)

- PFAS Background Information
- Agency Actions and Efforts Regarding PFAS
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- Attorney General Updates on Public Law 35-25

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35TH GUAM LEGISLATURE

Informational Hearing
Thursday, July 25, 2019, 9:00am
I Liheslaturan Guahan, Public Hearing Room

Per- And Polyfluoroalkyl Substances (PFAS)

NAME (please print)	AGENCY/ ORGANIZATION	ORAL TESTIMONY	WRITTEN TESTIMONY	CONTACT INFORMATION
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Joey A. Manibusan	GFI) acting F/C			671 483 1622
Fred Nishihira	OAG			
Barry Kim	WERC			735-1223
John Jenson	"			735-2689
Tom Ada	GIAA			482-5548
Walter C	GEPA			
BRIAN BEARDEN	GEPA			

SHEET NO. 1

OFFICE OF SENATOR SABINA FLORES PEREZ
Chairperson
Committee on Environment, Revenue and Taxation, and Procurement
I MINA'TRENTAI SINGKO NA LIHESLATURAN GUÅHAN
35TH GUAM LEGISLATURE

Informational Hearing
Thursday, July 25, 2019, 9:00am
I Liheslaturan Guahan, Public Hearing Room

Per- And Polyfluoroalkyl Substances (PFAS)

NAME (please print)	AGENCY/ ORGANIZATION	ORAL TESTIMONY	WRITTEN TESTIMONY	CONTACT INFORMATION
MIGUEL BORDALLO	GWA			
Atty Leevin Camacho	OAG			475-3324 x.5015
JESSE T. CRUZ	Guam EPA			
Hope Cristobal	[illegible]			
Shaina Kasper	Toxics Action Center			

SHEET NO. 2

PERFLUOROOCTANE SULFONATE (PFOS): A CONTAMINANT OF EMERGING CONCERN IN GUAM'S GROUNDWATER

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Abstract: Perfluorooctane sulfonate (PFOS) is a fully fluorinated anion that was once widely used in industry. It is very persistent and has substantial bioaccumulation and biomagnification properties, particularly in humans. PFOS is moderately water soluble (~600 mg/L) and has recently emerged as a drinking water contaminant of potential concern. In 2009, USEPA issued a provisional drinking water health advisory (HA) for PFOS of 200 ng/L. A final HA of 70 ng/L was promulgated in May 25, 2016. The Guam Waterworks Authority (GWA) began monitoring PFOS in Guam's groundwater in March 2015, in response to USEPA's third *Unregulated Contaminant Monitoring Rule*, (UCMR3). Overall, five of their production wells were identified as PFOS contaminated and levels in two of them were consistently above the USEPA's 70 ng/L benchmark. Values recorded in the most contaminated well ranged from 160-410 ng/L. Both wells were taken offline in June 2016 and all further monitoring was suspended. WERI saw merit in continuing to monitor both wells in order to decide upon best management strategies prior to bringing them back on line. As a first step in this direction WERI implemented monthly monitoring of the most contaminated well in June 2017. A preliminary assessment of data obtained thus far is presented here. A highly significant, positive relationship between well PFOS levels and rainfall was observed. A delayed well response time of at least one month following major rain events was also evident. Well PFOS concentrations substantially declined over a similar time frame during dry weather conditions but remain above 200 ng/L as of this writing. Potential sources of PFOS and their locations within the watershed are briefly discussed together with management options. (275 words)

Keywords- perfluorooctane sulfonate, PFOS, groundwater contamination, seasonal influences, Guam.

I. INTRODUCTION

Perfluorooctane sulfonate (PFOS) belongs to a larger group of perfluoroalkyl chemicals first produced commercially in the US in 1949 by the 3M Company [1]. The unique surface-active (water and oil repellent) properties and thermal and chemical stability of these compounds made them highly desirable for industry. Historically, PFOS has been extensively used in the manufacture of water-proof apparel; stain-resistant carpeting; upholstery and leather goods; oil- and grease-proof cardboard and paper products; various industrial and household cleaning agents; cookware coatings and coating additives; and fire-fighting foams; as well as in insecticide applications and oil drilling [2,3,4]. Such a diverse array of industrial applications for PFOS coupled with the chemical's strong resistance to natural degradation processes has resulted in it becoming a global contaminant of some note [5]. Of particular concern is its capacity to bioaccumulate up food chains and target liver and blood proteins in mammalian species [2,6]. The fact that it is reasonably water soluble (600 mg/L) and has been detected in 2% of public water systems across the USA [7] is also worrying, especially since epidemiological data from work-place and industrial exposures suggest possible links to birth defects, immune system deficiencies, liver damage, and cancer [6].

In 2009, USEPA introduced a provisional drinking water health advisory (HA) for PFOS of 200 ng/L. A final HA of 70 ng/L was promulgated in May 2016 [8]. The Guam Waterworks Authority (GWA) began monitoring PFOS in their drinking water production wells in March 2015 in response to USEPA's third *Unregulated Contaminant Monitoring Rule* (UCMR3) [9]. Overall, five production wells were identified as PFOS contaminated and levels in two of them were consistently above USEPA's 70 ng/L benchmark (Fig. 1). These two wells (A-23 and A-25) are high-production, sister wells and almost certainly draw water from the same portion of the underlying aquifer within the Agana Groundwater Basin. The highest PFOS levels were confined to well A-25 and ranged from 220-410 ng/L in March and September of 2015 respectively.

Both A-23 and A-25 are currently offline as a result of the contamination and may be retrofitted with

GAC filters sometime in the future. Until then, all further monitoring of PFOS in these wells has ceased. WERI saw merit in continuing to regularly monitor both wells to determine if GACs were really necessary. In two past instances, GACs had been fitted to TCE and EDB contaminated wells at a combined cost of $1.4 million, only for GWA to discover too late that both contaminants had naturally attenuated below levels of concern when the wells were eventually brought back online [10]. With this in mind, WERI and GWA embarked upon a collaborative project to continue monitoring well A-25 indefinitely for the time being in order to better understand the PFOS dynamics within the system. The project commenced in June 2017 and is ongoing. The primary objectives of the study were to identify: a) seasonal fluctuations in PFOS concentrations within well A-25 and any relationships between these levels and local precipitation rates; b) any long-term temporal trends in PFOS levels within the well that suggest concentrations in the underlying aquifer are increasing, have stabilized, or are attenuating; c) potential primary sources of PFOS and their possible locations within the watershed and beyond the study area; and d) the most practical and cost-effective management strategies for resolving this issue in order to get both wells back on line.

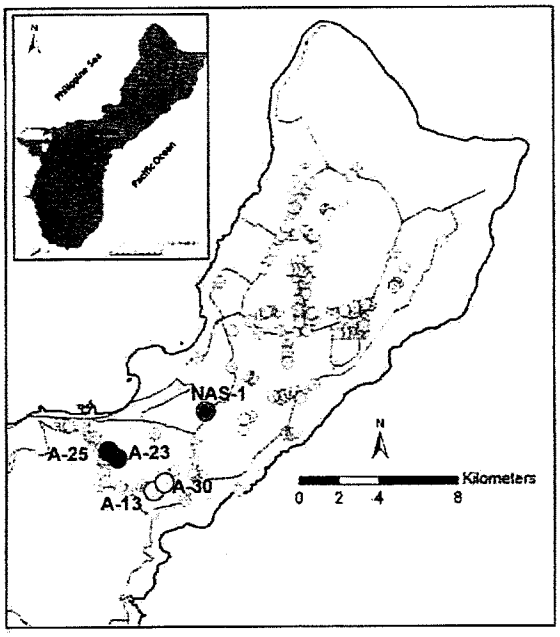

Figure 1: Map of Guam (inset) showing GWA drinking water production wells in the northern half of the island (main map). Wells color coded red and yellow have consistently shown PFOS levels above and below the 70 ng/L HA benchmark, respectively. The orange well has only shown one HA exceedance to date. No PFOS detects in all other (grey) wells shown.

II MATERIAL AND METHODS

2.1. Description of study area.

GWA wells A-23 and A-25 lie within the village of Agana on the western side of central Guam. They are located on the southwestern flank of the Agana-Chaot River Basin, a low lying area that occupies a total area of about 22.5 square km (Fig. 2). The basin is bounded to the east and northeast by the limestone plateau that comprises most of northern Guam. The unit comprising the surface of the basin is the Agana Argillaceous Member of the Mariana Limestone, a Pleistocene lagoonal deposit containing 3 to 5 percent clay derived from the adjacent volcanic upland to the southwest [14]. A narrow limestone escarpment borders the basin to the west and southwest and separates it from the village of Sinajana immediately to the west. Windows of Miocene Alifan Limestone in the southwest ridge indicate that the Alifan Limestone may comprise much of the aquifer beneath argillaceous limestone that forms the flank and bottom of the basin. Both units have low matrix porosity and are prone to forming discrete conduits. A mixed wet forest and marshy area dominates the central region of the basin and is the largest wetland of its kind on Guam [11]. Locally known as 'Agana Swamp,' this wetland is primarily fed by the Chaot River which enters the southern end of the basin and is diffusely spread throughout the swamp. Water drains from the swamp into Agana Bay at the coast via the Agana River [12,13]. Other important water sources to the basin are several springs and runoff from the surrounding roads and residential areas.

2.2. Description of well sites.

A-23 and A-25 well heads stand 35 and 60 feet above sea level, respectively, and extend 85 and 70 feet below ground surface. Depths to freshwater are 29 and 50 feet at each site and correspond to 6 and 10 feet above mean seawater level. Water is drawn from the parabasal zone of the underlying aquifer and under normal pumping conditions is not impacted by seawater. Chloride levels in both wells rarely exceed 100 mg/L.

2.3. Rainfall data.

Daily rainfall measurements for years 2015-2018, were obtained from the Guam National Oceanic and Atmospheric Administration Weather Forecast Office website (http://www.prh.noaa.gov/guam/). The data were collected at the Guam International Airport meteorological station on the central western side of the island. The linear distance between the station and the center of the Agana-Chaot River Basin is approximately 4 km.

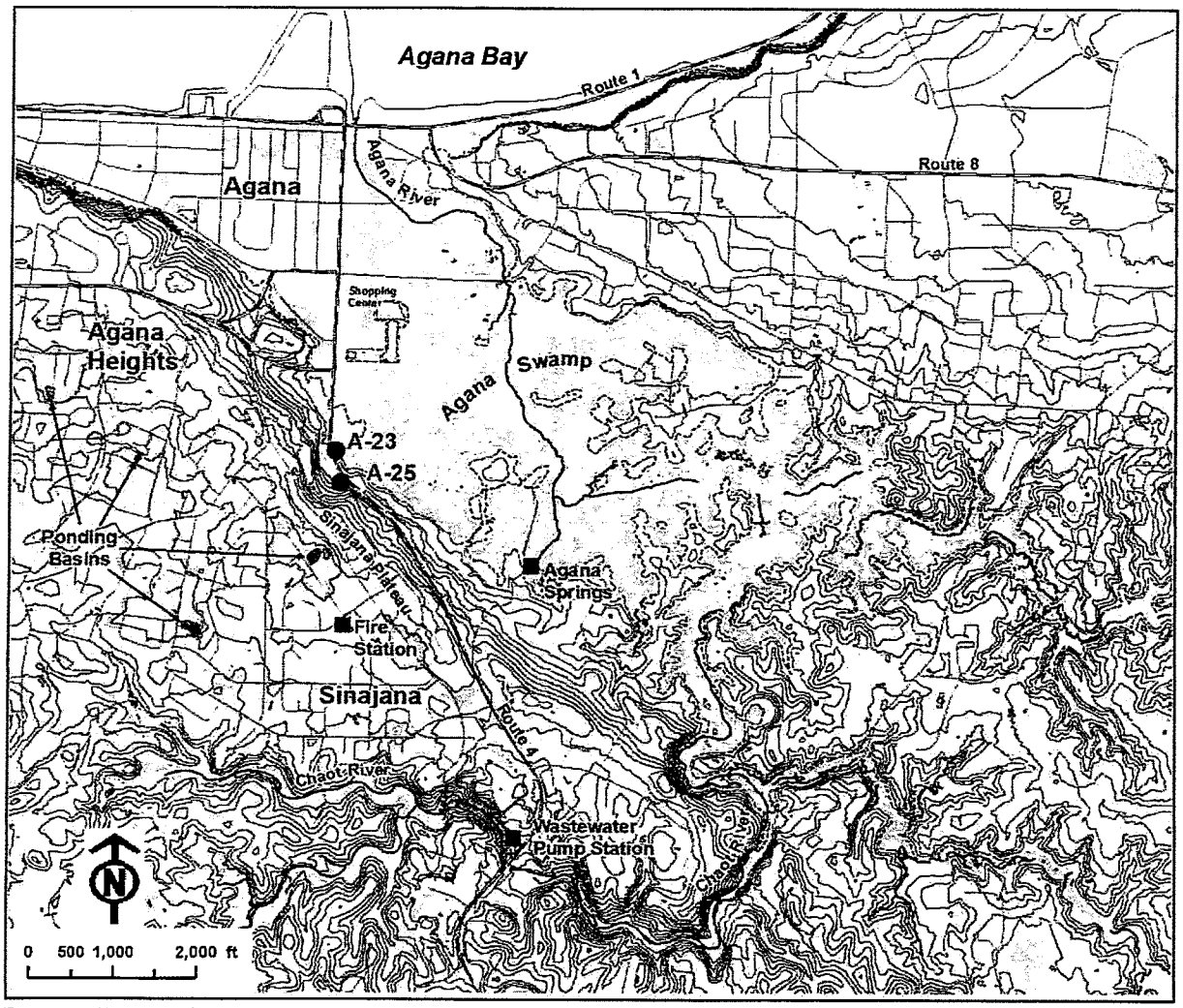

Figure 2: Five meter interval contour map of the Agana-Chaot River Basin showing major topographical features and potential PFOS source locations. Villages of importance within the study area are Agana, Agana Heights, and Sinajana. Dotted line around Agana Swamp represents the 5-m contour above sea level. See text for further details.

2.4. Groundwater collection and analysis.

Monthly groundwater sampling from A-25 commenced in June 2017 and is ongoing. While funds have yet to be found for sampling well A-23, its close proximity to A-25 suggests it is impacted by the same PFOS source(s) and likely mirrors any contaminant trends shown by its sister well.

Well A-25 was run to waste for two hours prior to each sample collection to flush any residual PFOS contamination remaining in the plumbing. Subsequently, all samples were collected in 250-ml polypropylene bottles (Nalgene) and immediately cooled on ice before same-day shipping to *Eurofins Eaton Analytical* (Monrovia, California, USA) for analysis. This laboratory is certified to test for all regulated and non-regulated chemicals listed under the Safe Drinking Water Act.

III RESULTS AND DISCUSSION

3.1. Rainfall data.

Guam climate is tropical with distinct wet and dry seasons. The wettest months are usually from July through November while the driest typically extend from January through April. The mean annual rainfall is about 100 inches and can be considerably higher in El Niño years, when tropical storms and typhoons are more prevalent. The monthly rainfall data shown in Figure 3 illustrate the rainfall disparities within and between months for the years in which PFOS determinations have been made on Guam, including GWA's earlier data.

It is noteworthy that 2015 was an epic El Niño year, delivering 104 inches of rain to the island. In contrast, 2016 was a post El Niño year and brought drought conditions to the island for the first half of the year and near record rains for the remainder. Year 2017 was considered a weak La Niño year as is the current year. Total rainfall for both years was 94 and 97 inches, respectively. Total rainfall for January and February of the current year has been unusually low.

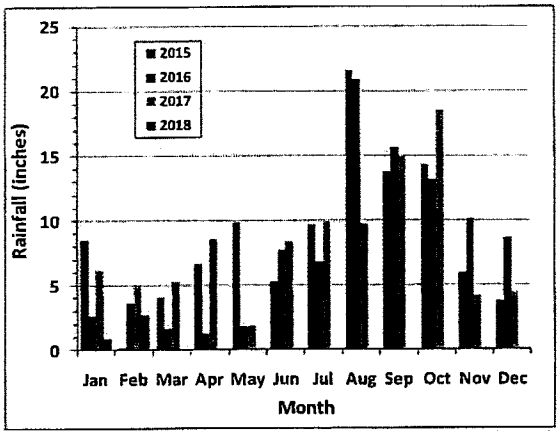

Figure 3: Monthly rainfall values taken at Guam International Airport for years 2015-2017 and 2018 (January-February only)

3.2. PFOS data: well response time.

Monthly PFOS values determined in groundwater samples from well A-25 are presented in Table 1 together with cumulative precipitation recorded 30, 60, 90 and 120 days immediately prior to each sampling event. The 2015-16 PFOS data obtained by GWA are also included for comparative purposes.

Table 1: PFOS in well A-25 and cumulative rainfall data prior to each sampling event

Collection Date	PFOS (ng/L)	Total Rainfall Prior to Sampling (inches)			
		30 Days	60 Days	90 Days	120 Days
26-Mar-15	220	3.47	4.17	13.53	16.29
28-Sep-15	410	13.65	35.1	45.04	50.04
11-Aug-16	220	16.93	24.67	27.91	29.56
08-Jun-17	210	2.81	10.91	15.99	18.86
24-Aug-17	260	12.19	20.07	25.78	28.24
28-Sep-17	340	14.13	26.96	33.41	41.81
30-Oct-17	360	19.57	33.51	43.12	52.65
11-Dec-17	260	4.6	19.55	32.36	46.8
22-Jan-18	270	1.55	6.2	10.01	29.51

July sample not taken and November sample not delivered to analytical lab in US

Second order polynomial regression analysis gave the best fit line to all PFOS-rainfall data plots. Coefficients of determination (R^2) comparisons were used to approximate the response time of well A-25 to episodic releases of PFOS into the aquifer. A weak association was noted between PFOS and the 30-day cumulative rainfall data (R^2 = 0.313). The relationship strengthened appreciably with the 60-day and 90-day datasets (R^2 = 0.801 and 0.842 respectively), and weakened thereafter. The graphed 90-data sets are provided below for illustrative purposes (Fig. 4).

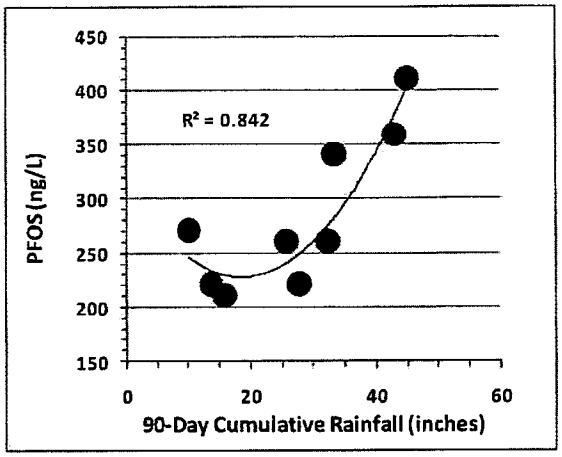

Figure 4: PFOS levels in well A-25 vs. 90-day cumulative rainfall prior to each sampling event. Trend line fitted to the data using a second order polynomial regression model.

From these initial findings it was tentatively concluded that episodic inputs of PFOS into the study area take about a month to reach well A-25. Variations in the duration and intensity of rain events over the preceding month seem to have the greatest influence on this estimate. Comparisons between the September 2015 and October 2017 PFOS-rainfall datasets serve to illustrate this point. Levels of PFOS found on these occasions were 410 and 360 ng/L respectively. Given the similarity in accumulative rainfall prior to each sampling event, this temporal decline in PFOS levels might be seen as natural attenuation. However, close inspection of daily precipitation rates for the two months preceding each sampling event suggests otherwise. For example, PFOS determined in the September 2015 sample was undoubtedly influenced by the two-day storms that dumped almost 14 inches of rain over the study area in mid August, 46 days prior to sampling (Fig. 5A). This volume accounted for 60% of total precipitation recorded for that month. September 2017, by way of contrast, was relatively dry and the substantial rains that fell during the latter half of October came too late to boost PFOS levels in well A-25 much beyond that encountered in the September sample taken a month earlier (Fig. 5B, Table 1).

3.3. PFOS data: well clearance time.

As of this writing, there have been no major rains over the study area since the second week of October 2017 (Fig. 5B). Total rainfalls recorded in November and December of 2017, and in January of 2018, were 4.23, 4.49, and 0.94 inches, respectively. Since

rainfall provides the only means of transporting PFOS from its land-based source into the region of the aquifer that serves well A-25, the lower PFOS levels noted in the December 2017 and January 2018 samples were not surprising. Presumably, the leveling off of PFOS to around 260 ng/L (Table 1) coincides with little to no water movement through the aquifer and takes about a month to occur once monthly rainfall drops to around five inches or less. At this point, the default 'baseline' PFOS concentration lies somewhere between 200 and 250 ng/L (Fig. 4).

In light of these findings, any further PFOS attenuation in well A-25 seems unlikely unless the major source or sources of contamination impacting the watershed are identified and removed.

3.4 Potential point sources of PFOS.

Point-sources of PFOS impacting well A-23 and A-23 are currently unknown. Primary sources identified elsewhere include landfill leachate, wastewater from sewage treatment plants (STPs) and broken sewer lines, and urban runoff and recharge from areas receiving water-based fire-fighting foam applications [15,16]. Possible locations of these sources within the study area or nearby are considered here.

3.4.1. Landfills.

There are no landfills within the watershed although parts of it are heavily trashed and have been for some time. Agana Spring at the southern end of the swamp was one such site back in the 1960s (Fig. 2). Prior to WWII Agana Springs was under the jurisdiction of the US Navy and tapped for drinking water. Records indicate that it supplied Guam residents with about 20% of their drinking water needs from 1948-1952. The site was abandoned in 1957 as a result of fecal contamination emanating from nearby housing developments and for the next decade was completely neglected. During that period Agana Spring became a general dumping ground for all kinds of waste. In 1967, the area was cleaned up by the Guam Science Teachers Association and turned into a nature preserve by executive order [12]. High PCB concentrations were later found in soil at the site where a US Navy water pump station was once located [17]. As far as we know, soils and soil pore waters in this area have never been tested for PFOS, despite the availability of PFOS adsorbent cartridges and ceramic cup lysimeters into which such materials could be conveniently deployed. Such an exercise is currently slated for further investigation at WERI.

3.4.2. STPs.

While there are no STPs in the immediate vicinity of the impacted wells, the Chaot River was chronically polluted with raw sewage for over 25 years starting in 1981 [11]. The problem was caused by a defective wastewater pump station (Fig. 2) that was finally upgraded in 2006 (GWA 2006). The incident caused the discharge of millions of gallons of wastewater into the headwaters of the Agana Swamp over the years and undoubtedly mobilized significant quantities of PFOS and other contaminants into the area. While the swamp itself rises several feet above mean sea level in places, the water table within it rarely varies by more than a few inches above this value except during extreme wet weather conditions [12,13]. Moreover, the hydrological gradient in the vicinity of well A-25 runs from west to east (Fig. 2) which precludes the possibility of swamp water infiltrating the aquifer at this point, except perhaps during typhoon conditions.

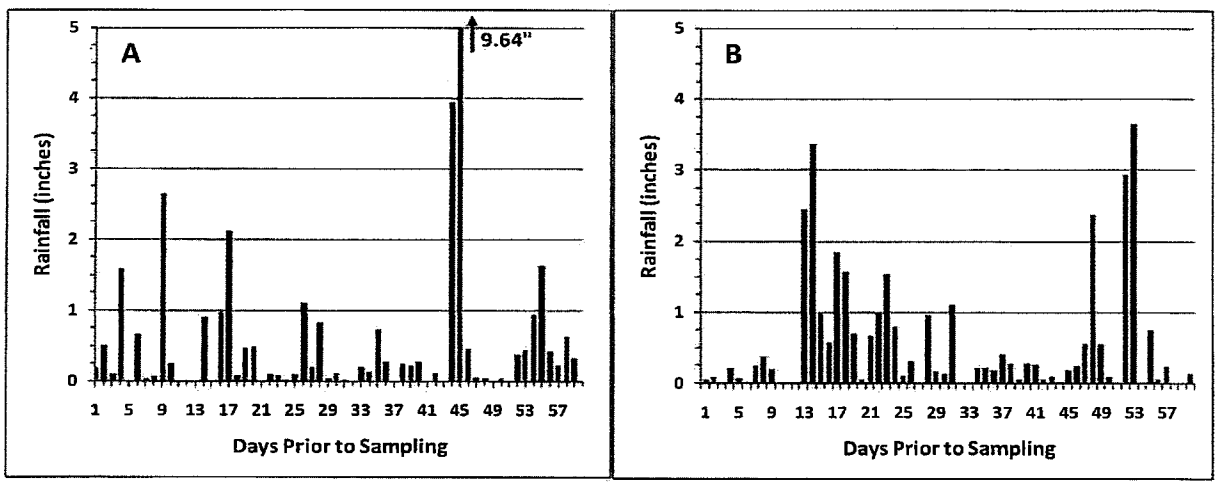

Figure 5: Daily rainfall records for 60 days immediately prior to sampling from well A-25 on September 28, 2015 (Chart A) and October 30, 2017 (Chart B). Samples were collected on day one of each chart.

3.4.3. Septic tanks and urban runoff.
In light of the above, it seems reasonable to assume that the PFOS source impacting wells A-23 and A-25 lies to the west of the limestone escarpment that borders the western edge of the Agana-Chaot River Basin. The escarpment stands at a height of approximately 200 feet and gently slopes to the west. The table area is predominantly residential and belongs to the villages of Sinajana and Agana Heights (Fig. 2). While the majority of houses in these two villages are connected to sewer lines, about 30% of homes in Agana Heights are on septic systems [18]. Soil depths along the plateau are relatively shallow and range from less than one foot up to 10 feet. The area is also prone to flooding during wet weather conditions. This has prompted construction of ponding basins and dry injection wells at strategic locations to accommodate the excess runoff by channeling it into the underlying aquifer [18].

Contaminated recharge from septic tanks and ponding basins can sometimes be differentiated from one another by monitoring fecal indicator bacteria detections over time. For example, occasional detections of *Escherichia coli* in groundwater reflect episodic storm events, whereas repeated detections of these bacteria over time are indicative of constant contributing sources, like septic tanks and cesspools. Ground water samples collected quarterly from well A-23 and A-25 from 2005 to 2016 revealed *E. coli* detections 30% and 23% of the time, respectively. These data indicate that rainfall is currently more important than septic discharges in moving contaminants vertically through the section of the Sinajana plateau that serves both wells.

3.4.4. Fire-fighting foam use within the basin.
While the above findings certainly merit soil testing for PFOS at possible contributing sites, it seems doubtful that such potentially diffuse sources of this contaminant could collectively elevate PFOS to levels currently seen in both wells. Point source contamination, perhaps from flame retardant foam applications, would seem more likely, all things considered. Typically fluorinated fire fighting foams contain 0.5-1.5% PFOS [19]. It is therefore noteworthy that a small unit of the Guam Fire Department is located in Sinajana and is within a half-mile of the impacted wells (Fig. 2). Whether employees within this unit held regular fire drills on the property using fluorinated fire-fighting foams has yet to be determined. Historic records of all fires in the general area that were treated with such flame retardants also need to be examined.

3.4.5. Fire-fighting foam use beyond the basin.
Contaminant transport within karst limestone systems, while a complex affair, is typically rapid. Indeed, vertical transport of aqueous contaminants through several hundred feet of carbonate vadose zone can occur within a matter of hours [20]. Given the appreciable delay in response time of well A-25 to PFOS following major rain events, one has to wonder whether such a lag is likely for any PFOS sources on the Sinajana plateau that are no more than a few hundred meters from the well head. Such considerations clearly open up the possibility that the major PFOS source impacting well A-25 is located some distance from the study area and may involve both vertical and horizontal migrations though fast- and slow-track conduits in the rocky matrices through which the contaminant has to travel.

The unfortunate crash of Korean Air Flight 801, on August 6, 1997, comes to mind here. The aircraft came down in hilly terrain approximately four miles west of the Guam International Airport. Heavy rains greatly impeded rescue attempts and all but 26 of the 254 passengers aboard perished primarily from smoke inhalation [21]. Accounts of the rescue operations are conflicting although according to the Fire Chief in charge at the time, fire trucks never made it to the accident scene despite fires reported to be burning there eight hours after impact [22]. This implies that PFOS-impregnated flame retardants were never employed near the wreckage. A simple soil test is all that is needed to confirm this statement.

3.5. Well remediation options.
Three viable options are considered here and are outline below.

3.5.1. Capping and abandoning.
Well A-25 and its nearby sister well, A-23, are high production wells optimally producing in excess of 300 gallons per minute of low chloride water. Losing such valuable components of the water distribution system is not an option at this point in time, which takes capping and abandoning the wells off the list. Nevertheless the excessive PFOS levels in both wells and the likelihood that such concentrations are unlikely to drop permanently below USEPA's 70 ng/L benchmark any time soon, means that other management strategies have to be considered.

3.5.2. Blending.
The most convenient and cost-effective way of dealing with this crisis, would therefore be to blend water from both wells with water from other wells in the area that are not contaminated. Guam's water distribution system was originally designed as a

multi-blended system by the military at the end of WWII, so incorporating A-23 and A-25 into existing distribution networks should be a relatively easy and straight forward process.

3.5.3. Pump and treat.

The final option is to fit GAC filters to both wells. This method has the advantage of not requiring major road and land excavations to reroute well plumbing to the existing water distribution network. The downside of this option is that it is relatively expensive to install and could run as high as three to five million dollars to retrofit both wells at today's prices. Installations could also take several months or even years to complete. Refurbishing and relocating an existing GAC that serviced well F-8 for ethylene dibromide contamination in the northern part of the island in the late 1990s could conceivably be done to lower overall installation costs. GACs incur extra analytical costs as samples have to be taken before and after filtration. Moreover GACs are relatively high maintenance and involve additional expenditures associated with pump installation and repair; power consumption; and the purchase, replacement and disposal of spent adsorbent.

CONCLUSIONS

Initial data are presented here from an ongoing study of PFOS levels in well A-25, a high-production well on the western side of central Guam. Levels so far encountered ranged from 210-360 ng/L and together with prior data gathered by GWA correlate strongly with rainfall intensity. The delay in well response time to PFOS after major storm events suggests the source of contamination is located some distance from the well head, and is being flushed through discrete pathways that become active when charged by storm water. Various source scenarios are considered, although none have yet to be unequivocally implicated. The occurrence of what appears to be steady state conditions of PFOS above 200 ng/L during dry weather conditions are an ominous reminder of the extreme recalcitrance of this compound. Clearly, remediation strategies that involve blending or 'pump and treat' technology need to be implemented if both wells are to be brought back on line in the shortest possible time.

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- What does your agency know about PFAS?

  We are aware that PFAS is group of man-made chemical compounds with application in a variety of industrial and consumer products ranging from the well-known use if aqueous film forming foam (AFFF) to stain repellant fabric coatings, polishes, paints, and cleaning products to food packaging products like bottle top seals, popcorn bags, fast-food containers and wrappers. GWA worked with Guam EPA and US EPA in the sampling and analysis for these compounds in GWA's source waters as part of the EPA's Unregulated Contaminant Monitoring Rule (UCMR-3) in 2015. GWA knows that one of these compounds, Perflourooctanoic Suflonate (PFOS), has been persistent in three (3) of its 120 ground water wells.

- Is there evidence of contamination to date?

  Yes, GWA has two wells, A-23 and A-25 which are still off-line due to PFOS levels above the EPA Health Advisory Level of 70ppt.

- What actions are being pursued?

  GWA has completed refurbishment of and is operating a granular activated carbon treatment system for the NAS-1 well. We are also in the process of designing a treatment system for A-23 and A-25 and intend to construct the system once the design is complete so we can resume production from those wells. GWA is also supporting efforts by WERI to conduct a study to determine the potential source(s) of the compound affecting our wells so that the contaminating material can be removed from the environment.

- What are the effects of PFAS on the public's health?

  GWA's knowledge on the public health effects are limited to what is publicly available knowledge, as these matters are normally undertaken by the USEPA and other scientific institutions. To our knowledge, these compounds can accumulate and remain in the body, and there are concerns that certain compounds within the PFAS family are linked to reproductive, developmental, liver and kidney effects in laboratory animals. There is limited information in the body of scientific knowledge on other effects including effects on the immune system, cancer and thyroid hormone disruption.

- How were PFAS brought to Guam? What are the uses of PFAS, and who used or is using them?

GWA is uncertain about the source of the PFAS compounds on Guam, but it has been documented that AFFF that has been used by both the military and GovGuam is the apparent source for PFOS in the groundwater produced by GWA's NAS-1 well. The source for PFOS in our wells A-23 and A-25 has not been determined. It is also apparent by the long list of consumer products which have used PFAS compounds, that many of these items are very likely to have been imported into Guam, and are also likely still being imported into Guam.

- How urgently must PFAS be addressed and why?

GWA has been proactively addressing the presence of PFOS in Guam's groundwater since Guam EPA and US EPA raised it as a concern in 2016. Guam's drinking water remains safe to drink with the treatment systems put in place, and disconnection of affected wells from the distribution system. GWA believes that the most urgent action that needs to be taken is the identification and removal of source material affecting our wells A-23 and A-25.

PFAS Data – Contamination and Toxicology

1) When was GWA aware of PFOS and PFOA as emerging contaminants? GWA became aware that these compounds were emerging contaminants in 2015 as part of the discussions surrounding UCMR-3 sampling and analysis.
2) When was PFAS testing of wells initiated? The first samples taken under UCMR-3 were in March of 2015.
3) What were the results of the testing? Of all GWA operating wells sampled, 4 wells tested positive for PFOS in amounts above the EPA health advisory level ranging from 88 to 410 PPT.
4) What actions were taken for those that exceeded the health advisory limit? Wells above the advisory level were either disconnected from the distribution system (A-23 & A-25) or equipped with GAC treatment systems (NAS-1).
5) Which communities are served by the wells contaminated with PFAS in your 2015 and 2016 testing, and in per your current testing period? What citizens were serviced by these wells? Communities served by wells which introduced water into the distribution system above the health advisory limits werethe Tiyan area, Agana, Asan and some areas of Piti. This ceased in August of 2016. Subsequent to this, two of the wells were shut-down and disconnected from the distribution system (A-23 and A-25) and one was equipped with a GAC treatment system (NAS-1).
6) Have surface water sources for drinking water (i.e. Fena Reservoir) tested for PFAS contamination? Are there plans for testing surface water sources? Water from Fena was sampled at the point-of-entry into GWA's distribution system as part of UCMR-3 in 2015 and analytical results indicated non-detect for PFOS.

7) What is your understanding of toxicological profiles, and setting limits for PFAS? What toxicological data can you provide for PFAS? GWA can provide no toxicological data for this purpose. Our understanding is that toxicology data is developed by the scientific community through research and studies seeking to expand the body of scientific knowledge on this contaminant. We further understand that this body of knowledge is the basis for EPA's rule-making on regulatory levels that would be set as part of the Safe Drinking Water Regulations.

Methodology and Technology

8) How often do you test for PFAS, what types of PFAS do you test for, what methodology is used, what are the results of the tests for drinking water? Initially, GWA tested for all thirteen PFOS/PFOA compounds required in UCMR-3 using EPA Method 537. Only PFOS and PFHxS were detected. See response to Question 3 for results of testing.

9) What treatment technologies are available for PFAS, and what are currently being used by GWA? GWA is aware of Granular Activated Carbon and Powder Activated Carbon (for surface water) treatment, as well as nano-filtration and reverse osmosis as treatment methods. There is also ion-exchange resin treatment systems which can be used for PFAS compound removal. GWA currently uses GAC treatment.

10) Can you clarify what is a non-detect (ND) level? This is the level below which the analytical method being used is unable to reliably repeat a quantitative result.

11) Do you ever dilute your samples/engage in the practice of the dilution? Sample dilution is not something that GWA would conduct in relation to PFAS. This activity is often conducted by analytical laboratories by a laboratory technician for conditions where the concentration is too high for the method of analysis.

12) Are there other water matrices that you can test, monitor, and treat for apart from drinking water (e.g. wastewater)? Wastewater effluent from our treatment plants can be tested for PFAS compounds, but the analytical sensitivity is not as good as it would be for clean drinking water. Stormwater may benefit from such an analysis.

13) What interagency actions have you undertaken with JRM? GWA has shared data in regards to PFAS in our water sources. GWA meets with DoD representatives bi-weekly as part of the OneGuam initiative to coordinate on water systems issues, and as part of those activities, discuss production, treatment and disposal issues.

14) What are some of the challenges and costs of treating affected water sources and disposal of GAC filters? Challenges include maintaining levels of service with a reduced number of wells in operation resulting from impacts of PFOS (A-23 and A-25), planning for long-term treatment without corresponding efforts for source removal, and the additional expenses of providing treatment and monitoring. The costs for treatment for

NAS-1 have been about $200k for refurbishing the treatment system. Estimated annual costs for operation and maintenance of these treatment systems are between $100k and $200k. Estimated capital costs for a new treatment system are approximately $700k to $1M. Disposal costs are dependent on whether the material can be accepted at the Layon landfill or if off-island disposal is required.

15) How might establishing an MCL affect your capacity to treat and monitor for PFAS and provide water? Insofar as GWA is already providing treatment and monitoring in accordance with EPA long-term Health Advisory Levels, the establishment of an MCL that is in-line with the current body of scientific knowledge and EPA advisory level will not affect GWA's current practices.

16) Are there procedures in place to manage other emerging contaminants? Yes. The EPA's Unregulated Contaminant Monitoring Rule (UCMR) and Contaminant Candidate Rule both set procedures for identifying and managing emerging contaminants and chemicals of potential concern.

Informational hearing on Thursday, July 25 at 9:00 AM, regarding per- and polyfluoroalkyl substances (PFAS)

- **What does your agency know about PFAS?**

The A.B. Won Pat International Airport Authority (Guam) has been following the PFAS, as an emerging chemical-of-concern, issue for a couple of years. PFAS chemicals are an important component of the Aqueous Film-Forming Foam (AFFF) our firefighters are required to use by FAA mandate.

- **Is there evidence of contamination to date?**

Since PFAS chemicals are, at present, not regulated by the U.S. or Guam EPA, the presence of this group of chemicals in the environment is not considered "contamination." However, there have been guidelines developed for maximum exposure levels for approximately four (4) out of the hundreds of PFAS chemicals that are manufactured and which are present, or have been present, in AFFF. Testing by GWA in 2015, and subsequent testing by the US Navy last year of monitoring wells located at, and around the airport, showed evidence of PFAS in the groundwater underlying Tiyan.

- **What actions are being pursued?**

Fortunately, due to previous and ongoing groundwater remediation efforts at Airport wells, Granulated Activated Carbon (GAC) treatment systems are already installed and are effective in removing PFAS chemicals from the groundwater prior to disinfection and distribution as drinking water by GWA.

- **What are the effects of PFAS on the public's health?**

Studies are still ongoing, and risk assessments are being conducted by EPA and others. At this time only four (4) of the hundreds of PFAS chemicals are "suspect carcinogens" or show possible health effects in laboratory animals. The real issue with PFAS is that this group of chemicals are very resilient and they don't break down easily in nature. Because of this, they bio-accumulate and build up in our environment and organs and tissues over time.

- **How were PFAS brought to Guam? What are the uses of PFAS, and who used or is using them?**

PFAS are used in a wide variety of consumer and industrial products, which includes AFFF. Because of the wide use in consumer products, elevated levels of PFAS are being detected in all municipal wastewaters. About 3% of all PFAS manufactured in the US is used in AFFF. The US military operated the ARFF facility until 1995, and initially imported and used AFFF. Since 1995 GIAA has operated the ARFF operations. At this time GIAA purchases exclusively "short-chain" PFAS containing AFFF, which do not include some of the legacy long-chain PFAS (like PFOA and PFOS).

- **How urgently must PFAS be addressed and why?**

Although there appear to be no "immediately dangerous to life or health (IDLH)" issues in regard to PFAS, the fact is that this group of chemicals bioaccumulates, and some PFAS have shown to have potential adverse effects if ingested for a long period of time. Therefore, EPA and other agencies are taking the lead in evaluating and addressing public risks. In the meanwhile Best Management Practices must be followed in the use and disposal of PFAS containing products, including AFFF. GIAA is committed to doing our part in reducing risks and managing all potential hazards at our facility.

Aqueous Film-Forming Foam (AFFF)

1 Introduction

1.1 What is AFFF?

Aqueous film-forming foam (AFFF) is highly effective foam intended for fighting high-hazard flammable liquid fires. AFFF products are typically formed by combining hydrocarbon foaming agents with fluorinated surfactants. When mixed with water, the resulting solution achieves the interfacial tension characteristics needed to produce an aqueous film that spreads across the surface of a hydrocarbon fuel to extinguish the flame and to form a vapor barrier between the fuel and atmospheric oxygen to prevent re-ignition. This film formation is the defining feature of AFFF.

There are two major classes of firefighting foams: Class A and Class B. Class A foams were developed in the 1980s for fighting wildfires. They are also used to fight structure fires. Class B foams are any firefighting foams that have been designed to effectively extinguish flammable and combustible liquids and gases; petroleum greases, tars, oils and gasoline; and solvents and alcohols. Class B foams can be synthetic foams, including aqueous film-forming foam (AFFF) or alcohol-resistant aqueous film-forming foam (AR-AFFF), or protein foams. This fact sheet focuses on AFFF as these foams contain fluorosurfactants and they are widely used. Per- and polyfluoroalkyl substances (PFAS) are the active ingredients in fluorosurfactants.

ITRC has developed a series of fact sheets that summarize the latest science and emerging technologies regarding Per- and Polyfluoroalkyl Substances (PFAS) (ITRC 2018). This fact sheet is targeted to local, state, and federal regulators and tribes in environmental, health, and safety roles as well as AFFF users at municipalities, airports, and industrial facilities.

The purpose of this fact sheet is to outline how to properly identify, handle, store, capture, collect, manage, and dispose of AFFF.

The fact sheet is not intended to replace manufacturer specifications, or industry guidance for AFFF use, or discuss alternatives in detail. It is only intended to educate users on AFFF use to reduce and eliminate potential harm to human health and the environment.

All Class B foams are not the same. Although not usually categorized this way from a fire protection viewpoint, they can be divided into two broad categories from a per- and polyfluoroalkyl substances (PFAS) perspective: Fluorinated foams that contain PFAS and fluorine-free foams that do not contain PFAS.

The vast majority of Class B firefighting foam that is currently in stock or service in the United States is AFFF or AR-AFFF. All AFFF products contain PFAS. This applies to foams used in the past and those being sold today. Foam currently in stock or new foam that is labeled as AFFF or AR-AFFF, contains perfluoroalkyl or polyfluoroalkyl substances, or both, as active ingredients (DOD 2018; Darwin 2004).

AFFF is used where there is a significant flammable liquid hazard present, including but not limited to the following locations:

- chemical plants
- flammable liquid storage and processing facilities
- merchant operations (oil tankers, offshore platforms)
- municipal services (fire departments, firefighting training centers)
- oil refineries, terminals, and bulk fuel storage farms
- aviation operations (aircraft rescue and firefighting, hangars)
- military facilities

Most AFFF products sold and currently stocked in the United States are either listed by Underwriters Laboratory (UL) based on conformance with UL Standard 162, "Foam Equipment and Liquid Concentrates" or have been tested by the U.S. Naval Research Laboratory (NRL) and qualified as meeting the requirements of the U.S. Department of Defense (DOD) Military Specification (MILSPEC), MIL-PRF-24385, "Fire Extinguishing Agent, Aqueous Film-Forming Foam" (DOD 2017). AFFF foams that meet the MILSPEC are required for use in military applications and at Federal Aviation Administration (FAA) regulated airports. All other AFFF foams are specified to UL Standard 162 (UL 2018) or other specifications for

Perfluoroalkyl substances are fully fluorinated (perfluoro-) alkane (carbon-chain) molecules. Their basic chemical structure is a chain of two or more carbon atoms with a charged functional group attached at one end.

Polyfluoroalkyl substances are not fully fluorinated. Instead, they have a non-fluorine atom (typically hydrogen or oxygen) attached to at least one, but not all, carbon atoms, while at least two or more of the remaining carbon atoms in the carbon chain are fully fluorinated.

More information is included in the ITRC *Naming Conventions and Physical and Chemical Properties of Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet (ITRC 2018).

applications outside of military and FAA applications. DOD maintains an online qualified products database (QPD) that lists all the AFFF foams that have been qualified to meet the MILSPEC (DOD 2018).

1.2 Human Health and Environmental Concerns with AFFF Use

All Class B foams have the potential to create an adverse environmental impact if released uncontrolled to the environment, particularly if the foam solutions reach drinking water sources, groundwater, or surface waters. Discharge of foams to surface waters, including fluorine-free foams, may potentially harm aquatic life due to excessive biological and chemical oxygen demand and, in some cases, acute toxicity, and may increase nutrient loading.

AFFF products (as well as other fluorinated foams, see Figure 1) are of concern because they contain PFAS. Some PFAS pose a risk to groundwater and surface water quality, but they are also highly persistent, may be highly mobile, and some bioaccumulate in organisms. PFAS are also not removed or destroyed by conventional wastewater treatment processes unlike many other hazardous substances.

- Long-chain PFAS are defined as perfluoroalkyl carboxylates (PFCAs) with eight or more carbons, including perfluorooctanoate (PFOA), and perfluoroalkane sulfonates (PFSAs) with six or more carbons, including perfluorohexane sulfonate (PFHxS) and perfluorooctane sulfonate (PFOS).
- Short-chain PFAS are defined as PFCAs with seven or fewer carbons, such as perfluorohexanoate (PFHxA), and PFSAs with five or fewer carbons, such as perfluorobutane sulfonate (PFBS),

Naming Conventions and Physical and Chemical Properties of Per- and Polyfluoroalkyl Substances (PFAS) fact sheet (ITRC 2018)

The health effects of PFOS, PFOA, PFHxS, and perfluorononanoate (PFNA) have been more widely studied than other PFAS. Numerous animal and human studies have evaluated both non-cancer and cancer health effects related to exposure to a limited number of PFAS, including PFOA and PFOS. Little to no health-effects data are available for many PFAS. See the *Regulations, Guidance, and Advisories for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet (ITRC 2018) for more detailed discussion of potential health effects related to PFAS.

To date there have been only limited studies of human health effects specifically related to use of AFFF. Glass et al. (2014) reported elevated rates of some cancers among more highly exposed firefighters, but their study was not designed to evaluate specific associations between these health effects and any particular chemical among the many chemicals to which firefighters may be exposed. Rotander et al. (2015) measured PFOA, PFOS, and PFHxS levels in firefighters' serum but did not observe any association with studied health effects. A limited study in Norway observed elevated PFOS and PFHxS serum levels in 10% of firefighters studied, (Kärrman et al. 2016), and suggested that use of personal protective equipment (PPE) may account for why elevated levels were not seen in more of the firefighters. Studies suggest that perfluoroalkyl acids like PFOS and PFOA are not well absorbed through the skin (ATSDR 2018), which is the most likely exposure pathway for AFFF foams. However, should the PFAS in AFFF enter the body they could cause health problems, so appropriate PPE should be used to prevent or minimize direct contact, ingestion, or inhalation of AFFF.

PFAS encompass a wide range of fluorinated carbon-chain compounds of differing carbon chain lengths, physical and toxicological properties, and environmental impacts. Long-chain PFAS are of particular concern and include PFOS and PFOA, which are recognized as persistent, bioaccumulative and toxic (PBT). Depending on when it was manufactured, AFFF may also contain fluorinated precursors known as fluorotelomers, that can breakdown in the environment to PFOA or other PFCAs. See the *Naming Conventions and Physical and Chemical Properties and the History and Use of Per- and Polyfluoroalkyl Substances (PFAS)* fact sheets (ITRC 2018) for more information.

1.3 Determining the Type of PFAS in AFFF in Current Inventory

Within these broad categories of Class B foams there are different types of foams. Figure 1 illustrates the categories of Class B foams and AFFF specifically. There are three possible types of AFFF products including:

- legacy PFOS AFFF
- legacy fluorotelomer AFFF (contain some long-chain PFAS)
- modern fluorotelomer AFFF (contain almost exclusively short-chain PFAS)

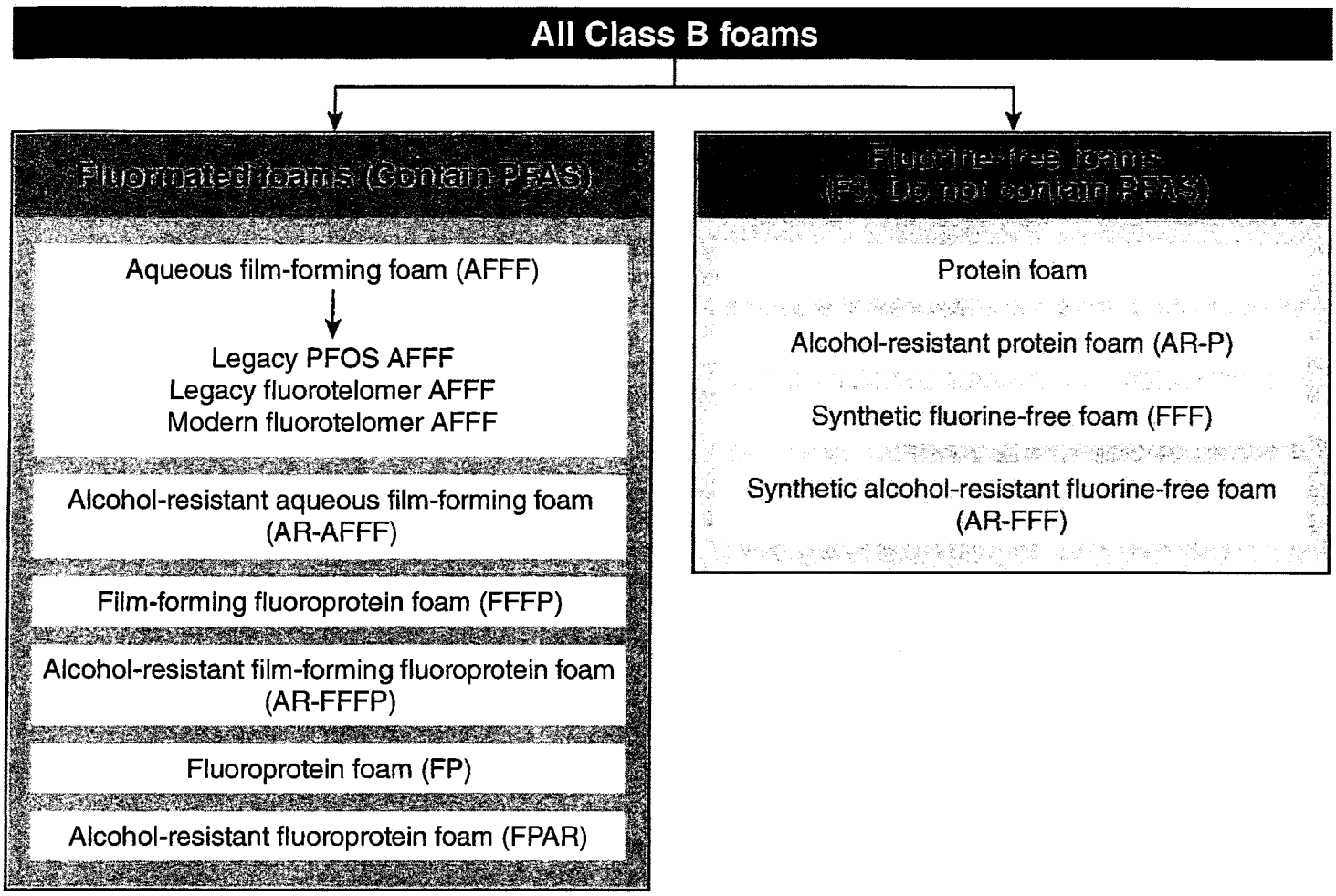

Figure 1. Types of Class B foams
(Source: S. Thomas, Wood plc, used with permission)

1.3.1 Legacy PFOS AFFF

These foams were manufactured in the United States from the late 1960s until 2002 exclusively by 3M and sold under the brand name "Lightwater" (DOD 2014). Lightwater AFFF contains PFOS and various precursors that could potentially break down in the environment to PFOS and shorter chain PFSAs such as PFHxS. Some of these PFSAs, including PFHxS, are also considered to be persistent. Older formulations may also contain PFOA as well as fluorinated precursors. The fluorinated precursors may also break down in the environment to PFOA and other perfluoroalkyl carboxylates (PFCAs) (Backe, Day, and Field 2013).

1.3.2 Legacy Fluorotelomer AFFF (contain some long-chain PFAS)

These foams were manufactured and sold in the United States from the 1970s until 2016 and encompass all other brands of AFFF besides 3M Lightwater (Schultz, Barofsky, and Field 2004). Although not made with PFOA, they contain polyfluorinated precursors (Backe, Day and Field 2013; Place and Field 2012) that are shown to degrade to PFOA and other PFCAs in the natural environment (Weiner et al. 2013; Harding-Majanovic et al. 2015). They may contain trace quantities of PFOA as an unavoidable byproduct of the manufacturing process. Legacy fluorotelomer-based AFFF foams have historically contained predominantly short-chain (C6) PFAS with formulations ranging from about 50–98% short-chains and the balance as long-chain PFAS. Importantly, the long-chain PFAS content of these foams has the potential to break down in the environment to PFOA and other PFCAs, but not to PFOS or other PFSAs (Weiner et al. 2013).

1.3.3 Modern Fluorotelomer AFFF (contain almost exclusively short-chain PFAS)

In response to the U.S. Environmental Protection Agency (USEPA) 2010/2015 voluntary PFOA Stewardship Program (USEPA 2015), most foam manufacturers have now transitioned to the production of short-chain (C6) fluorotelomer-based PFAS. These foams are referred to as "modern" to distinguish them from the legacy foams manufactured before the phase-out. Short-chain (C6) PFAS do not contain or breakdown in the environment to PFOS and other long-chained

PFAS such as PFHxS and PFOA (see below) and are currently considered lower in toxicity and have significantly reduced bioaccumulation potential compared to long-chain PFAS (USEPA 2018). However, foams made with only short-chain (C6) PFAS may still contain trace quantities (parts per billion [ppb] levels) of PFOA and PFOA precursors as byproducts of the manufacturing process. As documented in the Helsingør Statement: "although some of the long-chain PFAS are being regulated or phased out, the most common replacements are short-chain PFAS with similar structures, or compounds with fluorinated segments joined by ether linkages. While some shorter-chain fluorinated alternatives seem to be less bioaccumulative, they are still as environmentally persistent as long-chain substances or have persistent degradation products" (Scheringer et al. 2014). Concerns have been raised that "little information is publicly available on [the] chemical structures, properties, uses, and toxicological profiles" of these shorter-chain formulations and that "increasing use of fluorinated alternatives will lead to increasing levels of stable perfluorinated degradation products in the environment, and possibly also in biota and humans" (Blum et al. 2015). Under the recently published European Union Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation on PFOA and PFOA-related substances, foams based on short-chain PFAS can contain no more than 25 ppb PFOA and 1,000 ppb total PFOA-related substances to be sold in the European Union (EU) after July 4, 2020 (Commission Regulation (EU) 2017).

1.4 When to Use Legacy AFFF

The decision about whether to use legacy AFFF should be considered in the development of Best Management Practices (BMPs; see Section 3) and in fire response plans. The decision should be based on a site-specific evaluation that considers likely fire hazards and potential risks associated with use of legacy AFFF. These decisions should be made prior to an emergency where Class B AFFF would be used so that BMP equipment, procedures, and training are already in place. During an actual response to a fire, the final decision on whether to use any Class B AFFF should be made by the emergency manager (for example, fire chief, incident commander or terminal manager) based on federal, state and local laws and the nature of the emergency. Decisions regarding the use of any type of foam should consider the nature of the firefighting properties of the foam and the benefits they provide for preservation of life, public safety, and property protection versus the potential environmental, public health, and financial risks the use of such foam could pose.

Decisions about when and how to use PFAS-containing foams should be made before, not during, an emergency. The team should consider key factors such as these:

- **The nature of the firefighting properties of the foam**
- **The nature of the emergency**
- **The risk to life, public safety, and property**
- **Potential environmental, public health, and financial liabilities of using the foam**

Currrently, federal law does not prohibit the use of legacy AFFF remaining in existing stocks, whether containing PFOS or other long-chain PFAS. However, any discharge to a stormwater system, including AFFF containing long-chain PFAS, could be considered a pollutant and is regulated by the Clean Water Act. If long-chain PFAS from an AFFF release enters a drinking water source, it may impact entire communities. Depending on the size of the release and available dilution, the release could contaminate the source above USEPA drinking water health advisory levels or more stringent state and local regulatory criteria. These are potential liabilities that should be weighed against the cost of legacy AFFF disposal and replacement of a current inventory of AFFF during emergency response planning (DOD 2014).

While the disposal cost of legacy PFOS AFFF or certain formulations of legacy fluorotelomer (polyfluoroalkyl compounds produced by the telomerization process) AFFF solutions may be much greater than the cost of purchasing modern, shorter-chain replacement foam, the potential risks of keeping and using this legacy foam may be even greater. Also, replacement of legacy AFFF with short-chain AFFF or other foams may require thorough flushing and possible modification of existing systems that could produce significant amounts of flush water containing PFAS that would require proper disposal. Despite these issues, serious consideration should be given to the continued use, storage, and disposal of legacy AFFF. Organizations that are considering replacing their legacy AFFF stocks should focus first on removing from service legacy PFOS AFFF. A release of legacy PFOS AFFF to the environment, that is not mitigated, is likely to result in PFOS impacts to soils and possibly groundwater and surface water.

Legacy AFFF should only be used for emergency purposes in cases where insufficient amounts of short-chain AFFF or other foams are available and where there is a risk to human life, public safety or property. Where no regulation exists to the contrary, use of legacy AFFF containing PFAS remaining in inventory may depend on whether the facility can contain, collect, and treat the wastewater generated fighting the fire, and on the sensitivity of the surrounding environment. Use of alternative firefighting materials (for example, Class B fluorine-free foams) or Class A foams for smaller fires should be strongly considered whenever possible (FFFC 2016).

Firefighting industry best practice for Class B foams calls for the use of fluorine-free foam (FFF) for testing and training (FFFC 2016; Lastfire 2016). If the authority having jurisdiction requires testing of foam equipment or training of firefighters with AFFF, then only modern fluorotelomer AFFF should be considered for this purpose and any foam discharge should be collected and disposed of properly (see Table 1, Disposal).

1.5 Regulations Affecting the Sale and Use of AFFF

In the United States, 3M voluntarily ended production of PFOS-based AFFF in 2002. The USEPA subsequently restricted the future manufacture and import of most PFOS-based products, including firefighting foams, through two Significant New Use Rules (SNURs) (40 CFR 721.9582, Final Rules published 03-11-02 [13 PFAS] and 12-9-02 [75 PFAS]). In 2006, USEPA instituted the 2010/2015 voluntary PFOA Stewardship Program that resulted in the elimination of PFOA and other long-chain PFAS production by eight major fluorochemical manufacturers by 95% by 2010 and entirely by 2015. As a result, foam manufacturers have transitioned to the production of modern fluorotelomer AFFF (containing only short-chain [C6] PFAS) and other fluorinated Class B foams. In 2007, USEPA issued amendment to 40 CFR 721.9582 regulating another 183 PFAS (SNUR on 10-09-07). In 2015, USEPA proposed a SNUR for PFOA and other long-chain PFAS as a regulatory follow-up to the voluntary PFOA Stewardship Program (USEPA 2015); the SNUR has not been finalized. The SNURs subject specific PFAS chemicals to reporting requirements, but do not restrict the use of existing stocks of legacy AFFF containing those PFAS chemicals.

Currently, the DOD and FAA-regulated airports must meet the requirements established in the military specification MIL-PRF-24385 for AFFF formulations (DOD 2017; FAA 2004). Only AFFF formulations containing fluorosurfactants currently meet the MILSPEC, but the DOD is actively evaluating fluorine-free foams to determine if any can meet the MILSPEC performance requirements (SERDP-ESTCP 2017).

In addition to federal efforts for managing AFFF, several state governments have regulations or other programs that address the use of PFAS-containing foams. Organizations should check with their state and local government for regulations or policies that could impact their use and disposal of AFFF and other Class B foams. Examples of state regulations and policies are included in the following sections.

1.5.1 New York

State regulation 6 NYCRR Part 597 identifies PFOS and PFOA as hazardous substances. The release of more than 1 pound of PFOS and/or PFOA must be reported to the state. (For legacy fluorotelomer AFFF, it would normally require a release of thousands of gallons of foam concentrate to result in release of 1 pound of PFOA.) (New York State 2017).

1.5.2 Washington

In March 2018, the state of Washington passed a new law (Washington State 2018) that restricts the sale and use of Class B foams that contain PFAS. As of July 1, 2018, PFAS-containing foams may not be discharged or otherwise used in the state of Washington for training purposes. Beginning on July 1, 2020, PFAS-containing foams may be sold or distributed in the state only for the following specific uses:

- applications where federal law requires the use of a PFAS-containing firefighting foam, including but not limited to the requirements of 14 CFR 139.317 (such as military and FAA-regulated airports)
- petroleum terminals (as defined in RCW 82.23A.010)
- oil refineries
- chemical plants (WAC 296-24-33001)

1.6 Legacy Foam Replacements

Several states have implemented take-back programs for AFFF products. For example, in May 2018, the Massachusetts Department of Environmental Protection, in partnership with the Massachusetts Department of Fire Services, implemented a take-back program to assist fire departments in the proper disposal of legacy firefighting foams that could impact water resources (MA DEP 2018). Vermont has also announced a take-back program (VT 2018). Users should contact their state regulatory agency for information on available take-back programs.

1.6.1 Synthetic Fluorine-free Foam

Organizations should determine whether a Class B fluorine-free foam (FFF) can achieve the required performance specifications for specific hazards as part of their pre-planning for replacement materials (FFFC 2016). Most foam manufacturers now produce Class B FFF. The performance of these foams has improved significantly over the last

decade and is expected to continue to improve in the future. Purchasers of Class B foams, especially those not required to use MILSPEC AFFF, should investigate whether a Class B FFF will meet the site-specific requirements and should continue to review the performance specifications of FFF products as they make future purchasing decisions.

1.6.2 Modern Fluorotelomer AFFF

If it is determined that the performance of a fluorinated Class B foam is required for a specific hazard, or where federal regulations require AFFF use (for example, military applications and FAA-regulated airports), then organizations should purchase foams that consist of short-chain (C6) PFAS, modern fluorotelomer AFFF. U.S. foam manufacturers have switched over to using short-chain (C6) PFAS so it is likely that any AFFF bought today would meet that requirement (Tyco 2016). Users should confirm with their supplier. There is likely to be some designation on the label and the Safety Data Sheet that the foam contains short-chain (C6) PFAS, but even then, there will be a small amount of longer-chain (C8) impurities as stated in Section 1.3.3.

2 Best Management Practices (BMPs) For Class B AFFF Use

Firefighting foams are an important tool to protect human health and property from flammable liquid fire threats. Proper management and usage strategies combined with the current refinement of environmental regulations will allow an informed selection of the viable options to sustainably use firefighting foams.

BMPs should be established for the use of any firefighting foam to prevent possible releases to the environment that can lead to soil, groundwater, surface water, and potentially drinking water contamination. The discharge of firefighting foam to the environment is of concern because of the potential negative impacts it can have on ecosystems and biota due to the presence of chemicals such as PFAS. For example, for AFFF, the amount of PFAS from foam that may enter groundwater depends on information such as the type and amount of foam used, when and where it was used, the type of soil, and the depth to groundwater. AFFF is typically discharged on land but can run off into surface water or stormwater or infiltrate to groundwater. A more detailed description of the fate and transport of PFAS is included in the ITRC PFAS *Environmental Fate and Transport for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet (ITRC 2018).

BMPs are particularly important when Class B foams are used near sensitive environmental areas where impacts from chemicals present in foams have potential for lasting damage. Example sensitive areas:

- wetlands
- surface water bodies (particularly those used for water supplies like reservoirs or rivers with municipal water supply intakes)
- sensitive or endangered species habitat
- areas close to public and private drinking water supply wells
- sole source aquifers
- groundwater recharge areas

BMPs start with pre-planning and deciding which foam to keep in stock. The team should consider key factors such as these:

- Whether fluorine-free foams can meet site-specific performance requirements
- Site-specific evaluation of likely fire hazards and potential risks for life, public safety, and property
- Potential environmental, human health, and financial liabilities associated with AFFF releases
- Site constraints, including existing equipment retrofit requirements to adapt to alternate foams

BMPs are key to fostering the safest use of AFFF in an environmentally responsible manner with the goal of minimizing risk from its use. It is important to establish BMPs before an emergency where AFFF would be used so that BMP equipment, procedures, and training are already in place. Although firefighting personnel may be aware that the foams they are using contain chemicals, they may not be aware of the potential environmental effects of AFFF use. Training of firefighting personnel is important to ensure BMPs are discussed and employed consistently and effectively.

Table 1 gives a summary of example BMPs. Users should follow BMPs to protect themselves, others, and the environment when using AFFF. Further BMP guidance can be found in other documents, such as the *Best Practice Guidance* developed by the Fire Fighting Foam Coalition (FFFC 2016), the US National Fire Protection Association's NFPA 11 (2016), and the Airport Cooperative Research Program's *Use and Potential Impacts of AFFF Containing PFASs at Airports* (ACRP 2017). Users at DOD facilities have other BMPs to follow and other requirements to meet MILSPEC, which would be followed in those circumstances.

Aqueous Film-Forming Foam (AFFF) *continued*

Table 1. BMPs for Foam Selection, Storage, Use, Planning, Mitigation, and Disposal

Foam Selection
Evaluate whether a Class B fluorine-free foam (FFF) can provide the required performance for the specific hazard. "Alternative techniques and agents must be evaluated well in advance of an emergency situation" (FFFC 2016).
Use AFFF and other fluorinated Class B foams only in situations of significant flammable liquid hazard with risk for public safety or significant property loss, where the performance of other foams has not been demonstrated to date.
Consider adopting a two-foam approach with FFF used to respond to small incidents and AFFF kept as emergency backup for major incidents. Ensure that proper labeling is in place and personnel are trained when multiple inventories exist at one facility to avoid comingling of foams.
Storage
Develop a foam inventory and stock tracking system documenting the foam composition, brand, and manufacturer.
"Obtain and follow manufacturers' recommendations for foam concentrate and equipment" (FFFC 2016). The amount of foam in the system should be at least sufficient for the group of hazards that simultaneously need to be protected against.
Designate transfer areas and store fluorinated Class B foam concentrate in a covered area with secondary containment.
Design storage tanks to minimize evaporation of concentrate, label clearly to identify the type of concentrate and its intended concentration in solution. Keep foam within the temperature limitations provided by the manufacturer.
Properly maintain foam systems to ensure minimal accidental discharges. It is important to recognize the nature of the foam concentrates; small leaks of concentrate can create environmental impacts. Conduct regular inspections of tanks, storage containers, and any associated piping and machinery. Ensure that leaks are addressed promptly.
Consider the materials used for storage and handling. Corrosion is generally not an issue with foam concentrates, but some exceptions do exist. Manufacturers recommend stainless steel, high-density polyethylene (HDPE), or polypropylene containers for AFFF storage. Avoid using aluminum, galvanized metal, and zinc in storage tanks, piping, and handling equipment for foam concentrates (Angus 2017).
Ensure compatibility of foams before change-outs. Do not mix different types or brands of foam concentrates.
Use
Eliminate the use of AFFF products and other fluorinated "Class B foams for training and testing of foam systems and equipment" whenever possible (FFFC 2016). Instead, use specially designed non-fluorinated, PFAS-free training foams and surrogate liquid test methods available from most foam manufacturers.
If the authority having jurisdiction requires testing of foam equipment or training of firefighters with AFFF, then avoid the use of legacy AFFF and instead use modern AFFF that contains only short-chain (C6) PFAS whenever possible.
Evaluate if Class B foam is needed to fight a fire or if a Class A foam or just water can succeed in fighting the fire.
Provide containment, treatment, and proper disposal of foam solution. Avoid direct release to the environment to the greatest possible extent.
Collect, treat, and properly dispose of runoff/wastewater from training events or live fire events to the greatest extent possible.
Use appropriate personal protective equipment (PPE) when handling and using AFFF, and identify how to decontaminate materials and gear that comes into contact with foam.
"Follow applicable industry standards for design, installation, maintenance, and testing of foam systems" (FFFC 2016).
Keep records of when and where foam is used to respond to incidents, including foam type, manufacturer and brand, and amount used.
Make note of sensitive receptors (for example, streams, lakes, homes, areas served by wells) identified in the vicinity of foam use and report to environmental agencies as required.
Consider firefighter and public safety first.

Planning and Mitigation
Develop and communicate documented processes for a facility or installation with the stakeholders and regulatory agencies before a release occurs.
Develop runoff collection plans, equipment, and training processes specific to fluorinated Class B foam use.
Develop mitigation plans for uncontrolled releases of foam concentrate or foam solution to minimize environmental impacts.
Quickly and thoroughly clean up contaminated materials after an AFFF release.
Design new firefighting systems, when needed, to accommodate FFF products, considering their different properties, mode of action, and effectiveness.
Prioritize proper education, training, preplanning, and actions at an incident to ensure the most efficient use of the foam and equipment.
Disposal
Dispose of expired or unneeded Class B fluorinated foam concentrate at a Resource Conservation and Recovery Act (RCRA) permitted incinerator or another alternative incinerator that can ensure complete destruction of the PFAS. See *Remediation Technologies and Methods for Per- and Polyfluoroalkyl Substances* (PFAS) fact sheet for details on thermal destruction of PFAS (ITRC 2018).
Monitor developments in new disposal technologies.
Discontinue expired or unneeded AFFF concentrate donation programs (for example, donation to fire training school).

The ACRP developed a macros-enabled Microsoft Excel™ workbook screening tool that allows users to "better integrate BMPs into the AFFF life cycle at their facilities, identify and manage potential risks associated with historical or current AFFF use at their site, and prioritize where resources need to be allocated to address concerns regarding AFFF and PFAS" (ACRP 2017). Owners of AFFF stocks should consider evaluating this tool to see if it can assist them in implementing BMPs for their specific situation.

3 AFFF Releases and Recommended Investigative Actions

After a release of AFFF and firewater containing AFFF, immediate cleanup of AFFF followed by an environmental investigation may be needed to determine the type and extent of environmental impacts and whether additional response actions are needed. Users should identify if there are state or local environmental agency requirements for notification that apply to their site and circumstances.

3.1 Immediate Cleanup of Standing Foam and Foam-Impacted Materials

One of the most effective and least expensive methods of minimizing human health or environmental impacts of an AFFF release is to quickly and thoroughly clean up contaminated materials. Cleanup may include recovering standing flammable liquids, foam or capturing water used during firefighting operations with a vacuum truck, pumps, or hand-held equipment (for example, shovels, mops, other absorbent materials). Once cleanup is completed, if a large amount of foam soaked into the ground, removal of soils saturated with the foam should be considered. In all of these initial cleanup efforts, response personnel should use proper PPE (for example, turnout gear, Tyvek, gloves, boots) during handling of contaminated media. This task may require temporary stockpiling of these soils (on a liner with a cover) before final disposal or treatment can be arranged. For more information, see the *Remediation Technologies and Methods for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet (ITRC 2018).

3.2 Information Gathering After a Release of AFFF

For new releases, it is important to start the information gathering process as soon as possible after a discharge has occurred to maximize the quality of the information gathered and to be protective of human health and the environment. Questions to ask first responders or others with information related to the released AFFF include:

1. Based on readily available information (for example, Safety Data Sheets [formerly MSDSs], applicable MILSPECs), what are the active ingredients (name, concentration, proportions), brand, and manufacturer of the released foam? What volume was discharged?
2. What areas of the site were affected and are there drains, ditches, stormwater drainage systems, or other structures that could cause off-site migration of the foam?

3. Did the release occur inside a building (such as an airport hangar)? If so, it may be beneficial for the personnel to leave the structure until the AFFF has been removed from the building. The owner of the building may consider having the indoor air tested before the building is reoccupied. For more information, see the *Site Characterization Considerations, Sampling Precautions, and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet (ITRC, 2018).

3.3 Surface Delineation (Visual) After New Releases

Site delineation can be performed immediately after a discharge occurs by using visual observations of foam and standing water, as a guide. Site delineation becomes harder to conduct as time passes, so it is important to conduct an initial site evaluation and delineation effort as soon as it can be safely performed. Photographic documentation of the affected areas and the use of markers (for example, survey tape, lath, pin flags) to identify the location of where AFFF was released can help to ensure that the continued characterization effort will provide accurate results and fewer resources will be spent assessing unaffected areas.

3.4 Field-Screening for First Responders After Releases

Currently, field-screening methods are limited to visual observation as described above as well as placing AFFF-contaminated media (add a little water if medium is solid) in a clear container and shaking the container, looking for resulting foam. Foaming in the container would qualitatively indicate that the media in this area may contain residual levels of AFFF that may require cleanup. Screening for released AFFF in the field using mobile instrumentation may soon be a practical alternative and could provide a way to quickly delineate affected surface soils and groundwater. Sensor-based technologies are under development (Chen et al. 2013), as well as inexpensive high-throughput screening tools such as particle-induced gamma emission that quantifies total fluorine on surfaces (Shaider et al. 2017; Ritter et al. 2017) and is being modified for quantifying total fluorine in groundwater.

If field screening during the initial delineation indicates significant surficial and near-surface contamination is present, removing and stockpiling soils should be considered, in consultation with environmental professionals and consistent with regulatory requirements, to minimize potential leaching to groundwater or runoff to nearby surface water. Confirmatory sampling may be needed after removal of contaminated material or after screening if no contaminated material is observable. If concentrations are less than applicable actions levels (check with the individual state authorities to determine the site-specific action levels), then no additional remedial activities may be necessary. Knowledge regarding the volume released, the concentration of PFAS in the released product, whether it was a mixture or concentrate, and the area affected is important. If only a small volume of AFFF concentrate is released in combination with a large amount of fresh water and is dispersed over a large area, the concentration in soil may not warrant cleanup. The initial cleanup actions (capture of AFFF and standing water) and collection of confirmation samples may be all that is needed for site closure. The *Regulations, Guidance, and Advisories for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet (ITRC 2018) includes more information.

3.5 Determining the Need for Further Actions

It is important to establish a working relationship with relevant stakeholders, including local or state regulatory agencies, preferably before, but at least immediately after a release of AFFF to determine the need for investigation and remedial activities. Developing and communicating documented processes for a facility with the stakeholders and regulatory agencies before a release occurs should be considered a best practice. The environmental media (for example, surface soil, subsurface soil, surface water, groundwater, sediment, biota) to be sampled are determined by identifying the potential media affected and in consultation with environmental professionals and consistent with regulatory requirements. The required site characterization effort will often become more involved and expensive as the time between release, discovery, and potential remedial actions increases. If a release is discovered immediately and remedial actions are taken promptly, the need for sampling activities is often reduced because fewer environmental media will be affected and potential impacts are more limited and easier to identify. Additional information about sampling and site characterization are included in the *Site Characterization Considerations, Sampling Precautions and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet (ITRC 2018). Additional information about remediation methods is included in the *Remediation Technologies and Methods for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet (ITRC 2018).

3.6 Sampling After Discovery of a Historical Discharge

The sampling methods used, and locations investigated after an AFFF discharge, will depend on both the amount and type of foam released, as well as site-specific characteristics such as topography, affected media, land use, potential

infrastructure, and presence or absence of environmentally sensitive areas. Information about sampling, precautions, equipment, and laboratory analysis methods, are included in the *Site Characterization Considerations, Sampling Precautions and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet (ITRC 2018). PFAS migration within and between different environmental media is influenced by many processes. The *Environmental Fate and Transport for Per- and Polyfluoroalkyl Substances (PFAS)* fact sheet (ITRC, 2018) includes more information on these processes. Except for conducting an initial sampling effort to confirm or refute a release of AFFF, entities collecting samples to delineate the degree and extent of PFAS should prepare and follow a detailed site sampling plan.

If a historical release of AFFF is suspected, it may be difficult to use visual observations to determine where to begin the delineation or characterization effort. Environmental professionals and state or local regulatory agencies should be consulted to determine investigation strategies and relevant regulatory requirements. For example, if a release occurred from a permanent structure (such as a tank or hangar fire-suppression system), the topography of the adjacent landscape, potential drainages or preferential pathways, or surface depressions may indicate where to begin a sampling effort. Gathering information from historical records (for example, internal incident reports or summaries, historic aerial photos, various documents available through a local regulatory agency) or interviewing individuals with knowledge of AFFF use and events at a facility may aid location of potential source areas.

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October 2018

July 25, 2019
Statement by: Hope Alvarez Cristobal

Buenas yan hafa adai, Honorapblé Sinadora Sabina Flores Perez yan I Membron I Kumité Siha,

For the record, I am Hope Alvarez Cristobal, grandmother, mother, wife and resident of Tamuning Village. I want to extend my *dangkolo na si Yu'os ma'åse'* to the Mina'trentai Singko na Liheslaturan Guåhan for holding such an important informational hearing on this very serious topic of PFAS dangerous and toxic chemicals that have contaminated our municipal drinking water supply in three wells in central Guåhan: Water Wells NAS-1, A-23 and A-25. Well NAS-1 has been placed back on the grid but there has not been much information to explain what, if any, type of PFAS filtration or treatment system was implemented or guidelines recommended to prevent its recontamination, etc.

Before I continue, I want to make clear at the outset that I am not a scientist or a chemist nor do I pretend to be one. I am, however, an interested and concerned member of our community learning and educating myself about water and soil contamination and one who is currently medicated for cancer.

It has been an uphill battle in the past year and a half, just trying to obtain existing data currently dispersed across many sources in government agencies to make sense of current and historic levels of water and soil contamination on this island. When the news broke out a year or so ago about the central municipal wells found to have high levels of PFAS chemical, it was important to learn more about the safety of our drinking water. The former Naval Air Station at Tiyan was my focus because the source of toxic chemicals is basically found where past military activities occurred. But, of course, we all realize that a great majority of contaminated sites on our entire island are within and outside U.S. Navy and U.S. Air Force bases.

Senator, I do want to encourage your Committee to expand the breadth of your research to cover all toxic contaminations on Guam, not just the family of PFAS. Let me elaborate. There have been many environmental assessments performed over the years by the US Navy and the US Air Force either directly or through private contracts. It is important that the government of Guam in developing good public policy identify potential and current contaminations with the chemicals involved and educate the public on prevention of health impacts. When enumerated by each of their separate locations, you will find at least a hundred of these sites on island. They include superfund sites, formerly used defense sites, and installation restoration program sites.

With over 75 years of military activity, Guam shares a history of contaminations with other base communities in the states. The difference is that contamination in Guam is more severe than at and around many U.S. domestic bases for a variety of reasons—in Guam there is a high concentration of military bases per square mile (28 percent of our lands is under DOD control), Guam's non-sovereign and colonial status and its effect on attitudes towards our people's health and well-being, Guam's having been a battlefield in World War II and a central launching pad for the war in Vietnam in particular, and Guam's lack of visibility in the US national media which has helped expose contamination problems elsewhere.

The chemical footprint of the U.S. military is highly predictable or consistent. It includes: (1) Use of extremely high volumes of petroleum fuels, including jet fuel, diesel, gasoline, benzene, perchlorate, and their combustion byproducts (the US military used 86 million barrels of fuel in FY2016 for operational purposes.[i] Air Force bases are the heaviest consumer of these fuels. (2) Extensive use of herbicides to create perimeters around bases and training areas, and to defoliate areas from which enemy exclusion is sought including Agent Orange. (3) Extensive use of pesticides in military buildings, particularly in foreign and tropical environments including, in the past, DDT and chlordane. (4) Use of strong solvents to wash down jets, ships and tanks. These include trichloroethylene (TCE) and perchloroethylene (Perc). Also known as VOCs, their health effects include damage to the nervous system and skin especially. These chemicals are easily converted to gas from liquid form and, when inhaled, damage the lungs. They cause cancer and birth defects. (5) Heavy metals with high toxicity including such things as the arsenic and lead used in ammunition. Training ranges can use millions of rounds a year, only some of which is or was collected after it is spent. (6) Radioactive materials used in munitions from DU to nuclear missiles.

Many of these are used in domestic, civilian contexts of course, but what makes their toxicity and impact on human health more severe in military applications are several things, including: (1) the idea that national security institutions' needs trump all other institutional or human needs and that it allows for less democratic openness/more secrecy in its operations. (2) the related intense investment in military institutions which allows for higher rates of consumption of the toxins than would otherwise be the case in more resource-limited contexts. (3) the inequality that exists in the places like Guam where the military has chosen to place its facilities. They tend to be in poorer rather than wealthier areas, whose residents have more clout in Washington. The military operates its bases in Guam with the impunity that comes with its colonial situation. (4) While military personnel are also exposed to contaminants on the bases (and, as workers with those substances, often more extremely exposed in those short periods of their deployment), presumably creating incentives to control contamination, those personnel have limited time on island/exposure to the contaminants in comparison with lifetime residents of Guam. Between extensive Navy basing around Apra Harbor and Andersen AFB in the north there is an underground path along the roads and over the Northern Guam Lens Aquifer that runs the oil pipeline that takes fuels from the harbor to the jets and vehicles at AAFB.

Off to the side of virtually any road on the island are sites of military contamination. These sites have been variously categorized:

(1) The military dubbed FUDS, or Formerly Used Defense Sites. These include sites in use from the US invasion and reoccupation of Guam in 1944 after a brief but brutal Japanese occupation. The program was instituted in 1986 to deal with protest of the lethal contamination of land the Department of Defense has owned and operated in the past.

On the FUDS properties have been found whole tanks and planes, mustard gas canisters, construction debris, household waste, drums of various oil and other chemical contents dropped empty or full in areas throughout the island. Some hazardous wastes were buried, others bulldozed over cliffsides, others simply left on the surface to be eventually swallowed by

vegetation. The DoD lists 17 sites of toxic wastes or possible buried munitions or UXO.[ii] Many more have not received recognition.

Soil and water tests required and funded by the FUDS program have found extremely high levels of the chemicals just mentioned above.

(2) Another set of contaminated properties are in areas returned to the government of Guam or private landowners in the last several decades of BRAC (Base Closure and Realignment) rounds beginning in 1988. These areas of contamination must by law be cleaned (or more commonly, *remediated*) with BRAC funds (security fencing or other access limiting action; alternate water supplies; relocation of individuals; excavation of contaminated materials, installation of controls on contaminant migration, and other actions consistent with a final remedy. The DoD lists 51 such sites on Guam!

(3) Contaminated areas on existing bases fall under the DERP-IRP (Defense Environmental Restoration Program – Installation Restoration Program) program, established in 2001. The DoD lists 157 sites in that category sites on Guam's bases as well as 25 base sites requiring response by the MMRP (Military Munitions Response Program). Andersen Air Force Base has so much toxicity that it is a Superfund site, still "*unremediated*" completely after over 25 years!

A number of areas are considered impossible or too expensive to restore to even limited industrial use, and have been cordoned off, presumably permanently. These dead zones occur throughout the United States as well as on Guam, though at much higher rates per square mile on Guam.

What existing programs do not do, however, is require an overview of the entire island's chemical contamination, require study of the cumulative and interactive effect of exposures to multiple chemicals over both short and long-term periods, and require biological studies of the accumulation of contaminants in the human body and in the food chain and other biota of the island, and require the DOD present data on how much additional contamination should be expected as a result of the military buildup and the live-fire training range complex.

While there are a set of processes by which the DoD or the services themselves are supposed to keep affected populations aware of contamination and clean-up, the data are so vast in scale and so complex and the incentives to widely disseminate the contamination status of each of these many sites are so low, that the people of Guam have been barely informed or not at all informed about this contamination or about the status of any clean-up efforts. The result is a widespread sense of insecurity, fear of the environment and particularly of the water and fish on the island.

I get the sense that our local officials in charge with caring for the environment and the health of our island community do not always push for more transparency and more action to deal with contamination. After all, how do you hold the U.S. military accountable when we are powerless to prevent their contamination?
(https://www.acq.osd.mil/eie/Downloads/OE/FY16%20OE%20Annual%20Report.pdf)

Last year, I was invited to participate in a Call for Action by the Green Science Policy Institute in Berkeley, CA. More than 6 million people are drinking water polluted with highly fluorinated chemicals. These substances, used as stain and water repellents and in fighting aviation fires, are associated with serious health problems including kidney and testicular cancer, thyroid disease, decreased sperm quality, high cholesterol, and decreased response to vaccines.

There is great need for coordination among government agencies to protect the health of our people. Cancer is racing to the top of the list of causes of deaths in Guam. After the closure of water Wells A-23 and A-25 (located going up the hill to Sinajana), the GWA no longer monitored the levels of PFOS there. WERI seems all too glad to study the paper trails of contaminations in their annual reports. And GEPA or PHSS have not had much to say to the community. A coordinated plan has yet to take shape to protect our community and to clean up and to prevent further contamination by fluorinated chemicals or, for that matter, any of the toxic substances affecting our health and rendering our soil and water polluted and poisoned from military activities—largely responsible for most all contaminations on this island.

Education is definitely lacking in regards to prevention and cleanup of contaminations for a island sustainability. Good government policies must always provide a seat at the table to allow the community voices to be front and center in decisions important to our health. As you have done today, Senator Sabina Perez, I thank you for this informational hearing. What we want to know is what is the government of Guam doing, what is the plan to protect the people from dangerous chemicals, toxic contaminations being perpetrated on a colonial people by the continued militarization and contamination of our lands? Where can the people of Guam learn about all this technical information of chemical contamination that is killing us? As you can see, there is great need for increased transparency.

Guam is an impacted community of PFAS! We need better testing of our drinking water. We need analytical methods for identifying all PFAS, we need technical assistance for clean-up, we need information on PFAS use, and we need support for changing MILSPEC on use of these insidious contaminants. We need a Guam enforceable drinking water standards that are protective of infants, children, and our most vulnerable community for the combined total of all detectable PFAS. And we need homeowners kits so that we can test water coming out from our faucets for PFAS. The government of Guam must deem PFAS a hazardous material/substance. And, our agencies need clear **authority** for clean-up. We definitely need more information from manufacturers and more independent research on PFAS besides PFOA and PFOS. Guam needs a plan for clean-up, not **mitigation**.

Visit: https://www.regulations.gov
Enter docket number: EPA-HQ-OW-2018-0270

There are four chemicals classified as PFAS. The most well studied are PFOA and PFOS as well as PFHxS and PFNA. None are subject to Guam's drinking water standards and neither are they subject to U.S. federal regulations. None have had the kind of public scrutiny it should have either by the local EPA, the GWA nor the PHSS due to its insidious health effects in affected

communities across the United States plus the fact that over 80% of northern Guam homeowners get water from the same native source, the Northern Guam Lens Aquifer that is directly under the major military bases.

(SEE ATSDR HANDOUT)
PFAS, as your Committee has explained, stands for per- and polyfluoroalkyl substances—which is a whole class of thousands of industrial chemicals. Although found in Teflon, food wrappers, water repelling clothing, some cosmetics, and stain resistant carpets, it is found in military-grade firefighting foam regularly used on military bases, at airports and firefighting pits. I've learned that they are also called "forever chemicals" because they can build up in our bodies and take decades to breakdown naturally.

At very low levels of PFAS exposure in drinking water, health effects include kidney and liver disease; immune, reproductive and developmental problems, high cholesterol; and potentially certain cancers.

PFAS are suspected carcinogens and linked to a variety of severe health problems including learning disorders in infants and children, fertility and pregnancy issues and impaired liver, thyroid and pancreatic function. It is estimated that almost every American has at least one of these substances in their blood. They're called "forever chemicals" because they never fully break down.

> "It's out of sight, out of mind," says Tara Schroeder, education coordinator for Green Mountain Conservation Group. "You don't see what's happening under the ground."

Go to: **https://pfasproject.com**

WEBINAR:
USEPA OFFICE OF GROUND WATER AND DRINKING WATER WEBINAR: JULY 16, 2019 - NOTES

The Office of Ground Water and Drinking Water at USEPA recently held a public meeting and webinar on July 16th 2019 on "Development of the Proposed Unregulated Contaminant Monitoring Rule for the Fifth Monitoring Cycle (UCMR 5) to provide an opportunity for stakeholders to learn and discuss potential approaches to developing the proposal for the fifth **Unregulated Contaminant Monitoring Rule (UCMR 5)** on the impacts of the (AWIA) or America's Water Infrastructure Act of 2018; the Analytical methods and analytes being considered including Per – and Polyfluoroalkyl Substances (PFAS); Sampling design; Laboratory Approval and other possible requirements. The presentation was done by Eric Burneson of the Office of Ground Water and Drinking Water Standards and Risk Management Division.

Mr. Dan Hautman of Office of Ground Water and Drinking Water Standards and Risk Mngt Division, Technical Support Center provided an overview of the Unregulated Contaminant Monitoring Program (July 2019):

Regulatory background for UCMR –

- Unregulated Contaminant Monitoring (UCM) program.
- Safe Drinking Water Act (SDWA) authority.
- Relationship to Contaminant Candidate List (CCL), Regulatory Determinations, and 6-Yr Review.

SDWA

- Passed in 1974, SDWA authorized the EPA to set enforceable health standards for contaminants in drinking water
  - Natl Primary Drinking Water Regulations (NPDWRs)
- 1986 SDWA amendments were the basis for the original UCM program
  -State drinking water programs managed the original UCM program
  -Public Water Systems (PWSs) serving >500 people were required to monitor.
- 1996 SDWA amendments changed the process of developing and reviewing NPDWRs.
  -CCL
  -UCMR
  -Regulatory Determination
  -Six-Year Review

(See the General Flow of SDWA Regulatory Processes slide 9 of 278 by Hautman July 2019)

CCL – Contaminant Candidate List

- SDWA 1412(b)(1)(B) established listing of contaminants for consideration
  -Contaminants are:
    *Not subject to any proposed or promulgated NPDWR
    *Known or anticipated to occur in PWSs
    *May require regulation under SDWA
  -List must be published every 5 years.
  (The Final CCL 4 was published Nov. 17, 2016 and includes 97 chemicals or chemical groups and 12 microbes)

(See the General Flow of SDWA Regulatory Processes Slide 11 of 278 by Hautman July 2019)

UCMR – Unregulated Contaminant Monitoring Regulation

- SDWA section 1445(a)(2), as amended in 1996, established requirements for the UCMR Program:
  - Issue list of no more than 30 unregulated contaminants, once every 5 years.
  -Require PWSs serving population (more than or equal to) 10,000 people as well as a nationally representative sample of

small PWSs serving (less than or equal to) 10,000 people to monitor

-Store analytical results in the National Contaminant Occurrence Database for Drinking Water (NCOD)

-EPA funds shipping/analytical costs for small PWSs

- EPA manages program in partnership with States.

America's Water Infrastructure Act of 2018 (AWIA 2018)

- SDWA was amended in 2018 by Public Law 115-270
  -AWIA
  -Enacted October 23, 2018
- KEY changes to UCMR (See SDWA section 1445(j)) include:
  - Require PWSs serving between 3,300 and 10,000 to monitor
  -Ensure that only a representative sample of PWSs serving fewer than 3,300 people monitor
- Limitations:
  -Subject to the availability of appropriations and sufficient laboratory capacity to accommodate the analysis.
- Authoriztion of Appropriations:
  -Additional $15,000,000 in each fiscal year for which monitoring is required to be carried out.

Objective of UCMR Program – Collect nationally representative occurrence data for unregulated contaminants that may require regulation under the SDWA:

-Consider data collected as part of future EPA decisions on actions to protect public health.

-Provide data to States, local governments and to the public for their use in decisions regarding public health protection

(National occurrence data publicly available at: http://www.epa.gov/dwucmr/occurrence-data-unregulated-contaminant-monitoring-rule

UCMR History:

- UCMR 1 (2001-2005, 26 CONTAMINANTS) published in Federal Register on 9/17/1999
- UCMR 2 (2007-2011), 25 Contaminants) published in FR on 1/4/2007
- UCMR 3 (2012-2016, 30 Contaminants) published in FR 4/16/2012
- UCMR 4 (2017-2021, 30 Contaminants) published in FR 12/20/2016
- Anticipating proposal summer 2020 and final rule late 2021
- PWSs monitor 2023-2025

(Each new UCMR cycle is established via a revision to the rule for the ongoing/preceding cycle).

General Process for Developing UCMR

- Early public stakeholder meetings
  -Provide background on statutory requirements
  -Discuss method development for emerging contaminants
  -Discuss anticipated elements of the proposal
- Agency development of the proposal
  -Includes a workgroup of multi-state and multi-office representatives, and tribal consultation.
- Publish proposed rule in the Federal Register (FR)
  -Provides a public comment period (generally 60 days)
- Public stakeholder meeting during public comment period
- Publish final rule in the FR
- Public stakeholder meeting after final rule publication
  -Review final rule and prepare for implementation

(See General Flow of SDWA Regulatory Processes, Slide 17 Hautman July 2019)

Regulatory Determinations

- Every 5 years, the Administrator shall, after notice of the preliminary determination and opportunity for public comment, for not fewer than 5 contaminants included in the CCL, make determinations on whether or not to regulate such contaminants.
- SDWA requires EPA to publish a maximum contaminant level goal (MCLG) and promulgate an NPDWR for a contaminant if the Administrator determines that:
  1. The contaminant may have an adverse effect on the health of persons.
  2. The contaminant is known to occur or there is substantial likelihood that the contaminant will occur in public water systems with a frequency and at levels of public health concern; **and,**
  3. In the sole judgment of the Administrator, regulation of such contaminant presents a meaningful opportunity for health risk reduction for persons served by public water systems.

  (SDWA Section 1412(b)(1)

(See General Flow of SDWA Regulatory Processes, Slide 19 by EPA's Hautman July 2019)

(General Flow of SDWA Regulatory Processes: Increased specificity and confidence in the type of supporting data used (e.g. health, occurrence, treatment) is needed at each stage.)

Six-Year Review

- SDWA Section 1412(b)(9) requires review and revision, as appropriate, of each NPDWRs not less often than every six years. The review includes:
  - Re-evaluation of exposure to regulated contaminants based on their health effects and occurrence in drinking water.
  -Evaluation of exposure to unregulated contaminants connected to regulated contaminants.
- Any revisions to existing NPDWRs must maintain protection or provide for greater health protection

UCMR 5 Potential Approaches
By Brenda Bowden, U.S. EPA Office of Ground Water and Drinking Water Standards and Risk Management Division Technical Support Center

Overview
• Timeline
• Sampling design considerations
• PWS types
• Approach to tiered monitoring – Assessment Monitoring (AM) – Screening Survey (SS) – Pre-Screen Testing (PST)
• Applicability
• Sampling frequency and locations
• Implementation roles: EPA • States • Small PWSs • Large PWSs
Potential changes between UCMR 4 and UCMR 5

Draft Timeline of UCMR 5 Activities

2018 2019 2020 2021
2018 – 2010 UCMR 5 Development
2021 - Publish Final Rule
2018 Method Development Stakeholder Meeting (June 6, 2018)
2019 Pre-Proposal Stakeholder Meeting (July 16, 2019)
2010 Publish Proposal,
60 day Public Comment Period, Stakeholder Meeting (Summer 2020)
2021 Publish UCMR 5 Final Rule (Winter 2021)
2020 Post Proposal: Initiate Implementation
• Lab Approval
• PWS SDWARS registration/notification/Inventory
•Partnership Agreements (PAs), State Monitoring Plans (SMPs), Small System Inve ntory (SSI), Large System Inventory (LSI)
• Ground Water Representative Monitoring Plan (GWRMP) submittal
• Outreach/trainings

Draft Timeline of UCMR 5 Activities
2022 to 2026

2022 Pre-monitoring Implementation • Continuation of Lab Approval •
PWS SDWARS registration/notification/Inventory • PAs, SMPs, SSIs, LSIs
• GWRMP submittal • Outreach/trainings
2023 - 2025 Monitoring Implementation Activities • Assist PWSs with compliance •
Implement small system monitoring • Post data quarterly to NCOD
Reporting and analysis of data • All PWSs serving 3,300 or more people •
Representative sample of small PWSs serving fewer than 3,300 people
2026 Post-monitoring Phase • Complete resampling, as needed • Conclude data reporting •
Finalize NCOD • Compliance assistance/enforcement, as needed

Sampling Design Considerations

• Sampling and statistical design used in UCMR 1, 2, 3 and 4 was:
  – Vetted with stakeholders
  – Peer reviewed
  – Three rounds of public comment
  – Update to incorporate AWIA

Data Quality Objectives

• Unbiased national exposure estimates; small margin of error
• Account for differential occurrence
• Stratify across system size and source water type to for differences
• Multiple sample events over multiple years to address temporal variability
• Allocation across States proportional to population served; at least two per State

PWS Types

•PWS: provides water for human consumption through pipes or other constructed conveyances t o at least 15 service connections or serves anaverage of at least 25 people for at least 60 days a y ear
• Community water system (CWS) – PWS that supplies water to the same population year-round
• Non-Transient Non-Community Water System (NTNCWS) –
PWS that supplies water to at least 25 of the same people at least six months per year, but not ye ar-round – For example, schools
• Transient Non-
Community Water System (TNCWS) (not generally included in UCMR monitoring) –
PWS that provides water where people do not remain for long periods of time –
For example, gas stations and campgrounds

UCMR Approach

• UCMR approach relies on using one or more of 3 monitoring tiers
  • Assessment Monitoring (primary approach to-date)
  • Screening Survey (used in UCMR 1, UCMR 2, UCMR 3)
  • Pre-Screen Testing (used in UCMR 3)
• Based on:
  • Availability and complexity of analytical methods
  • Laboratory capacity
  • Sampling frequency

• Relevant universe of PWSs
*Other considerations (e.g., cost/burden)

Assessment Monitoring: Statistical Approach

•Presuming availability of appropriations and lab capacity, AWIA will expand participating systems to include: –

*Nationally representative sample of 800 small systems serving fewer than 3,300 –
*Census of small systems serving between 3,300 and 10,000 persons –
*Census of large systems serving > 10,000 persons

• Small-system statistical sample and census, combined with large-system census data provides a powerful tool for assessing contaminant occurrence

Screening Survey: Statistical Approach

• Designed to ensure the data can be used to support regulatory decisions
• Account for possible laboratory capacity issues
• Approach used in UCMR 2 and 3 involved:
– National sample of 800 systems, allocated across systems serving 100,000 or fewer people – Census of all systems serving 100,001 and over (~400 systems)

*Adds further confidence in the sampling results by including a census of the largest systems

• **Total number of systems ~1,200**

Pre-Screen Testing

•Envisioned for use with methods that are in the early stages of development, and/or very specialized (such as those for viruses or DNA/microchips)
•May be conducted by limited number of PWSs identified as vulnerable (by EPA and/or State agencies), as was done with UCMR 3 virus monitoring

Draft UCMR System Applicability per AWIA (See Slide 32 Hautman July 2019)

For Community Water Systems & Non-Transient Non-Community Water System serving >100,000 people – Assessment Monitoring; Screening Survey are applicable. Pre-screen testing may be conducted by limited # of Public Water Systems.

UCMR Sampling Frequency

• UCMR 1 – UCMR 4 have used similar sampling frequency

• Surface Water (SW)--
surface water systems (including groundwater under the direct influence of surface water) sampled four times during their year of monitoring
• Ground Water (GW)--
ground water systems sampled two times during their year of monitoring
•Specialized sampling frequency was used for focused sample designs (e.g., eight sample events for cyanotoxins in UCMR 4)

UCMR Sampling Locations

Sampling locations for potential AM and SS contaminants:

• Contaminants generally sampled at the entry points to the distribution systems (EPTDSs)
• Disinfection byproducts and microbial contaminants
generally sampled at Disinfectants and Disinfection Byproducts Rules (D/DBPR) Total Trihalo methanes (TTHM)/Haloacetic Acids (HAA5) distribution system (DS) locations or at the at the distribution system maximum residence time (DSMRT) location
•Adjustment in sampling locations may be warranted depending on the final selection of UCMR 5 contaminants

EPA Implementation Roles

• Small PWS support:
    • Maintain lab and implementation contracts to support UCMR
    • Compile contact and inventory information
    • Manage sample kit distribution and tracking
    • Responsible for data review and reporting
• Large and Small PWS support:
    •Extract data from the Safe Drinking Water Accession and Review System (SDWARS) for evaluation and reporting to NCOD
    • Support SDWARS reporting system and users
    • Perform inventory and schedule updates
    • Provide technical assistance
    • Use SDWARS for real-time communication and outreach
    • Review and track PWS applicability and monitoring progress
    • Coordinate Laboratory Approval Program
    • Provide technical support for Regions, States, PWSs and laboratories
    • Coordinate outreach
    • Support Regional compliance assistance and enforcement efforts

Extended UCMR Implementation Team

•Office of Ground Water and Drinking Water (OGWDW), Drinking Water Protection Division (DWPD), Infrastructure Branch – Assist with SDWARS development and operation
•EPA Regional Offices – Coordinate State PAs--
Assist States and PWSs with UCMR requirements, compliance assistance, and enforcement
•Partnering States – Support various levels of monitoring coordination

States' Role in the UCMR Program

•Participation by States, tribes and territories (herein after referred to as "States") is voluntary
• State roles are documented via PAs
• States help EPA implement the UCMR program; help to ensure high data quality
• PA activities can include any/all of the following:
    • Review and revise SMPs
    • Provide inventory for small and large PWSs
    • Review and approve proposed GWRMPs
    • Provide compliance assistance
    • Notify and instruct systems
    • Collect samples
    Other

UCMR Responsibilities – Large PWSs

•PWSs serving more than10,000 people are responsible for the costs associated with analyses
• PWS coordinates sample analyses with an approved laboratory
• Laboratories post the data to SDWARS
• PWS reviews and can act upon (e.g., approve) data in SDWARS
• States and EPA review results

There are potential changes between UCMR 4 and UCMR 5 Proposal for GWRMPs and, UCMR 4 and UCMR 5 Proposal Deadlines.

The slide presentation included:
UCMR 5 Candidate Prioritization, Rationale and Method Considerations

- CCL 4 Contaminants – There is List of Monitored Contaminants then a List of those not yet monitored in UCMR. There is also the CCL 5 Nominations including the UCMR 5 Prioritization Process along with CCL and Related Candidates for UCMR 5 with completed method and methods in development.
- (Candidate Selection Process and Rationale
- Method Considerations
- Health and Occurrence Data with Sources
- Contaminant Specific Information by Method)

EPA Health Assessment Data Sources

• Office of Pesticide Programs (OPP)
• https://iaspub.epa.gov/apex/pesticides/f?p=chemicalsearch:1
• Office of Research and Development
• Integrated Risk Information System (IRIS) https://cfpub.epa.gov/ncea/iris_drafts/AtoZ.cfm • Provisional Peer-Reviewed Toxicity Values (PPRTVs)
https://www.epa.gov/pprtv/provisional-peer-reviewed-toxicity-values-pprtvs-assessments
• Office of Water Health Advisory (HA) or Health Effect Support Document (HESD)
• https://www.epa.gov/dwstandardsregulations/drinking-water-contaminant- human-health-effects-information

Non-EPA Health Assessment Data Sources

• Available non-EPA health assessments were also included in the "Additional Health Values" section, for example:
•Agency for Toxic Substances and Disease Registry (ATSDR) https://www.atsdr.cdc.gov/az/a.html
• World Health Organization (WHO) https://www.who.int/gho/en/
• Health Canada Guidelines for Canadian Drinking Water Quality (Health Canada) https://www.canada.ca/en/health-canada/services/environmental- workplace-health/reports-publications/water-quality.html#tech_doc

Health Values

• The health values are calculated drinking water concentrations based on publicly-available information:

- 2018 Edition of Drinking Water Standards and Health Advisories (DWSHA) Tables
- https://www.epa.gov/sites/production/files/2018-03/documents/dwtable2018.pdf
- CCL 4 Contaminant Information Sheets (CISs)
- https://www.epa.gov/sites/production/files/2016-11/documents/815r16003.pdf
- Human Health Benchmarks for Pesticides (HHBP)
- https://ofmpub.epa.gov/apex/pesticides/f?p=109:3::::::
- Other non-EPA sources (e.g., Health Canada)
- The health values are:
    - Not federally enforceable
    - Subject to change as health effects information becomes available
    - Calculated using different assumptions (e.g., body weight, intake, population group)

Occurrence Data and Information Sources

Finished Water Data:

- Unregulated Contaminant Monitoring Rule (UCMR) (2001 - current)
- Unregulated Contaminant Monitoring (UCM) Round 1 and 2 (1988 - 1997)
- National Inorganics and Radionuclides Survey (NIRS) (1984 – 1986)
- Disinfection Byproduct Information Collection Rule (DBP-ICR) Data (1997 – 1998)
- Groundwater Ambient Monitoring and Assessment (GAMA) Program through the U.S. Geological Survey (USGS)
- U.S. Department of Agriculture (USDA) Pesticide Data Program (PDP)
- Pesticide Monitoring Program (PMP)
- California Department of Health Services (CAL DHS)
- Small-Scale Local Occurrence Studies

Supplemental Drinking Water and Ambient Water Data:

- USGS, Ambient Water
- National Water Quality Assessment Program (NAWQA)
- National Reconnaissance of Emerging Contaminants (NREC) • Special reports •

Other specialized studies and literature Production, Release, Usage and Other Data:

- Toxic Release Inventory (TRI)
- National Center for Food and Agricultural Policy (NCFAP)
- Cancellation Status for Pesticides
- Persistent, Bioaccumulative and Toxic (PBT) Profiler
- Chemical Data Reporting (CDR) under the Toxic Substance Control Act (TSCA)

Candidate Analyte Information For each candidate analyte group the sets of slides that follow will address the following:

- Method number/technology type/name
- Potential sampling location
- Analytes under consideration
- Background (including the availability of health effects and occurrence information)

Metals EPA Method 200.7 (ICP-AES), 1994

Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasm a-Atomic Emission Spectrometry

Paying attention only to the health/occurrence data status on Sampling of metals:

Lithium – Adverse effects in several organs and systems (e.g. Kidney effects)
Bifenthrin – Possible human carcinogen, Group C. Reductions in locomotor activity; supported by multiple guideline studies.
Malathion – IARC: Probably carcinogenic to humans (Grp 2A).
(Organic Contaminants) Acephate – Possible human carcinogen (Grp C)
Phenytoin – Possibly carcinogenic to humans (Grp 2B)
Dibromoacetonitrile (DBAN) – Possibly carcinogenic to humans (Grp 2B)
Acetaldehyde – Possibly human carcinogen. (Grp 2B)
Formaldehyde – Carcinogenic to humans (Group 1)
Urethane – Probable human carcinogen. (Grp 2A)

PFAS

- Group of man-made chemicals manufactured and used in a variety of industries globally
- Exposure to certain PFAS can lead to adverse human health effects
- PFOS and PFOA have been most extensively produced and studied
    - Very persistent in the environment and human body
    - Voluntarily phased out by U.S. Manufacturers
    - GenX chemicals are a common replacement for PFOA
    - PFBS is a common replacement for PFOS

Those monitored under UCMR 3 are the following Contaminants (PFAS):
Perfluorobutanesulfonic acid (PFBS)
Perfluoroheptanoic acid (PFHpA)
Perfluorohexanesulfonic acid (PFHxS))
Perfluorononanoic acid (PFNA)
Perfluorooctanoic acid (PFOA)
Perfluorooctanesulfonic acid (PFOS)

Many do not have EPA health assessment available. The following do however:

*Perfluorobutanesulfonic acid (PFBS) – Health effect is kidney hyperplasia.
*Perfluorooctanoic acid (PFOA) – Suggestive evidence of carcinogenic potential (S); possibly carcinogenic to humans.
* Perfluorooctanesulfonic acid (PFOS) – Suggestive evidence of carcinogenic potential (S)

Anticipated Process for Approval of Laboratories Supporting UCMR 5

Presented by Paul Grimmett, US EPA, Standards and Risk Mngt Div., Technical Support Ctr.

Overview

- Applying for EPA approval to support UCMR
- Maintaining approval
- Minimum Reporting Level

General Expectations

•Laboratory Approval Program expected to be similar to the process used for all previous UCMR cycles
• Only EPA approved laboratories can analyze UCMR samples collected at PWSs
• Approval is by method and by individual laboratory locations
• A laboratory may apply for approval for any method(s)
• Laboratories need to meet:
    • UCMR 5 approval program criteria
    • Required equipment criteria
    • Laboratory performance criteria
    • Data reporting in text file format to SDWARS
    •Labs would still need to be approved to support UCMR 5 even if already certified by state, primacy entity or accredited through the National Environmental Laboratory Accreditation Program (NELAP) for a particular method

Laboratory Approval General Procedure

• Step 1: Request to Participate
• Step 2: Registration
• Step 3: Application Package
• Step 4: EPA Review of Application Package
• Step 5: Proficiency Testing (PT)
• Step 6: Written EPA approval

Step 1 – Request to Participate
•Interested laboratories submit a written request to the <UCMR_Sampling_Coordinator@epa.gov>
• EPA provides registration material
• EPA provides a custom application package based on registration information

Step 2 – Registration
• Complete registration sheet typically includes:
• List of the UCMR methods, for which the laboratory sought approval
• Laboratory information
• Mailing and shipping address
• Contact information

Step 3 – Application Package
• Separate application for each method
• Application typically required to include:
    •Proof of current drinking water laboratory certification (for select compliance monitoring methods)
    • Personnel information
    • Quality Assurance (QA) information
    • Information regarding analytical equipment and sample handling procedures
    • Data submission for each method (e.g., Initial Demonstration of Capability (IDC) study, QC sample results, quantification reports) •
Lab would receive a copy of the Laboratory Approval Manual

Step 4 – Review of Application Package
• EPA reviews application package
    •If deficiencies are identified EPA gives the lab an opportunity to make corrective acti ons and submit new application information
    •If all requested information is present and acceptable, EPA notifies the laboratory that they are eligible to participate in corresponding PT studies

Step 5 – Proficiency Testing
• EPA provides method-specific PT samples
• Laboratories:
    • Analyze PT sample(s) for each analyte and method
    • One successful PT per method
    • Successfully report PT data to SDWARS using text file format
    • No PT studies after monitoring begins but audits on-going during monitoring

Step 6 – Written EPA Approval
•After successful participation in a PT study for a specific method, EPA notifies the laboratory i n writing
•EPA posts a list of approved laboratories and associated methods at: https://www.epa.gov/dwucmr

Laboratory Approval Manual

• Procedures for obtaining UCMR approval and procedures for revocation of approval
• QA requirements
• QC requirements
    • Minimum reporting level (MRL) verification
    • Initial demonstration of capability
    • Initial calibration • Continuing calibration checks
    • Surrogate and internal standard criteria
    • Reagent blanks and fortified blanks
    • QC samples
    • Spiked field samples
    • Field blank criteria (if required by the method)
• Sample handling requirements

Typical Criteria for Maintaining Approval

• Adhere to QA/QC measures in the methods, rule language, and the Laboratory Approval Manual
• Post occurrence data and required QC data via SDWARS within prescribed timeframe
• Respond to inquiries or requests from the Laboratory Approval Coordinator
• Participate and pass on-site and/or paper audits

MRL Background

•MRL is an estimate of the quantitation level, achievable with a 95% confidence, by at least 75% of laboratories nationwide

•EPA establishes the MRL using data from several laboratories performing Lowest Concentration Minimum Reporting Level (LCMRL) studies
•LCMRL is an estimate of lowest concentration at which measurements of specified quality can be repeatedly made by a particular laboratory
• Simultaneous application of precision and accuracy
•Established to achieve quality and consistency across all UCMR laboratories, while allo wing for appropriate national laboratory capacity
•MRLs are generally established as low as is feasible; typically lower than current HRLs and health advisories
•EPA will consider raising MRLs if there is evidence that an MRL is unattainable/impractical

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[i] https://www.acq.osd.mil/eie/Downloads/OE/FY16%20OE%20Annual%20Report.pdf, p. 3. This amount does not include fossil fuel use for installation uses, which take an additional 35 million barrels.

[ii] The program is extremely limited, both in coverage and funding. It requires the U.S. Army Corps of Engineers to do environmental cleanup on "eligible properties that were formerly owned by, leased to, or otherwise possessed by DoD. The FUDS program only applies to properties that DoD transferred from its control before October 17, 1986." https://www.denix.osd.mil/fuds/about/

THE WERI REPORT:

PFOS Trend Monitoring in a Guam Drinking Water Well

Funded by:
US Geological Survey, Water Institute Program

Principal Investigators:

Gary Denton, John W. Jenson, Mark A. Lander & Carmen Suian-Denton

In 2012, USEPA released its third *Unregulated Contaminant Monitoring Rule* (UCMR3) (USEPA, 2012). Included in this list was the fluorinated organic compound, perfluorooctane sulfonate (PFOS). This recalcitrant chemical was once widely used in industry and is now considered an ubiquitous environmental contaminant. It is moderately water soluble (~600 mg/L) and has recently emerged as a drinking water contaminant of potential concern, having so far been detected in approximately 2% of public water systems across the Nation (Hu 2016). PFOS has also been shown to bioaccumulate in wildlife and target liver and blood proteins in mammalian species (ASTDR 2009, Lim *et al.* 2011). Understandably there are human safety concerns associated with this chemical's presence in drinking water, especially since epidemiological data from work-place and

Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS)

Frequently Asked Questions

8/22/17

What are PFAS?

Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are a large group of man-made chemicals that have been used in industry and consumer products worldwide since the 1950s.

- PFAS do not occur naturally, but are widespread in the environment.
- PFAS are found in people, wildlife and fish all over the world.
- Some PFAS can stay in people's bodies a long time.
- Some PFAS do not break down easily in the environment.

How can I be exposed to PFAS?

PFAS contamination may be in drinking water, food, indoor dust, some consumer products, and workplaces. Most non worker exposures occur through drinking contaminated water or eating food that contains PFAS.

Although some types of PFAS are no longer used, some products may still contain PFAS:

- Food packaging materials
- Nonstick cookware
- Stain resistant carpet treatments
- Water resistant clothing
- Cleaning products
- Paints, varnishes and sealants
- Firefighting foam
- Some cosmetics

How can I reduce my exposure to PFAS?

PFAS are present at low levels in some food products and in the environment (air, water, soil etc.), so you probably cannot prevent PFAS exposure altogether. However, if you live near known sources of PFAS contamination, you can take steps to reduce your risk of exposure.

- If your drinking water contains PFAS above the EPA Lifetime Health Advisory, consider using an alternative or treated water source for any activity in which you might swallow water:
  - » drinking
  - » food preparation
  - » cooking
  - » brushing teeth, and
  - » preparing infant formula
- Check for fish advisories for water bodies where you fish.
  - » Follow fish advisories that tell people to stop or limit eating fish from waters contaminated with PFAS or other compounds.
  - » Research has shown the benefits of eating fish, so continue to eat fish from safe sources as part of your healthy diet.
- Read consumer product labels and avoid using those with PFAS.

How can PFAS affect people's health?

Some scientific studies suggest that certain PFAS may affect different systems in the body. NCEH/ATSDR is working with various partners to better understand how exposure to PFAS might affect people's health—especially how exposure to PFAS in water and food may be harmful. Although more research is needed, some studies in people have shown that certain PFAS may:

- affect growth, learning, and behavior of infants and older children
- lower a woman's chance of getting pregnant
- interfere with the body's natural hormones
- increase cholesterol levels
- affect the immune system and
- increase the risk of cancer

At this time, scientists are still learning about the health effects of exposures to mixtures of PFAS.

How can I learn more?

You can visit the following websites for more information:

- **CDC/ATSDR:**
  - » CDC Info: https://www.cdc.gov/cdc-info/, or **(800) 232-4636**.
  - » www.atsdr.cdc.gov/pfc/index.html
  - » https://www.cdc.gov/exposurereport/index.html
- **Environmental Protection Agency (EPA):** https://www.epa.gov/chemical-research/research-and-polyfluoroalkyl-substances-pfas
- **Food and Drug Administration:** https://www.fda.gov/food/newsevents/constituentupdates/ucm479465.htm
- **National Toxicology Program:** https://ntp.niehs.nih.gov/pubhealth/hat/noms/pfoa/index.html

If you have questions about the products you use in your home, please contact the **Consumer Product Safety Commission (CPSC)** at **(800) 638-2772**.

List of Common PFAS and Their Abbreviations:

Abbreviation	Chemical name
PFOS	Perfluorooctane sulfonic acid
PFOA (or C8)	Perfluorooctanoic acid
PFNA	Perfluorononanoic acid
PFDA	Perfluorodecanoic acid
PFOSA (or FOSA)	Perfluorooctane sulfonaminde
MeFOSAA (aka Me-PFOSA-AcOH)	2-(N-Methyl-perfluorooctane sulfonamido) acetic acid
Et-FOSAA (aka Et-PFOSA-AcOH)	2-(N-Ethyl-perfluorooctane sulfonamido) acetic acid
PFHxS	Perfluorohexane sulfonic acid

The Family Tree of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS)

Names and Abbreviations

8/1/17

This fact sheet tells you about chemical names within the family of perfluoroalkyl and polyfluoroalkyl substances (PFAS) and their basic chemical structure. It also spells out abbreviations for common PFAS.

PFAS are a family of man-made chemicals that contain carbon, fluorine, and other elements.

The family tree image below, Figure 1, shows some of the different families of PFAS. For simplicity, it does not include all PFAS subfamilies. Follow along – starting at the "fallen apple" of PFC and then continuing up the tree trunk into the branches.

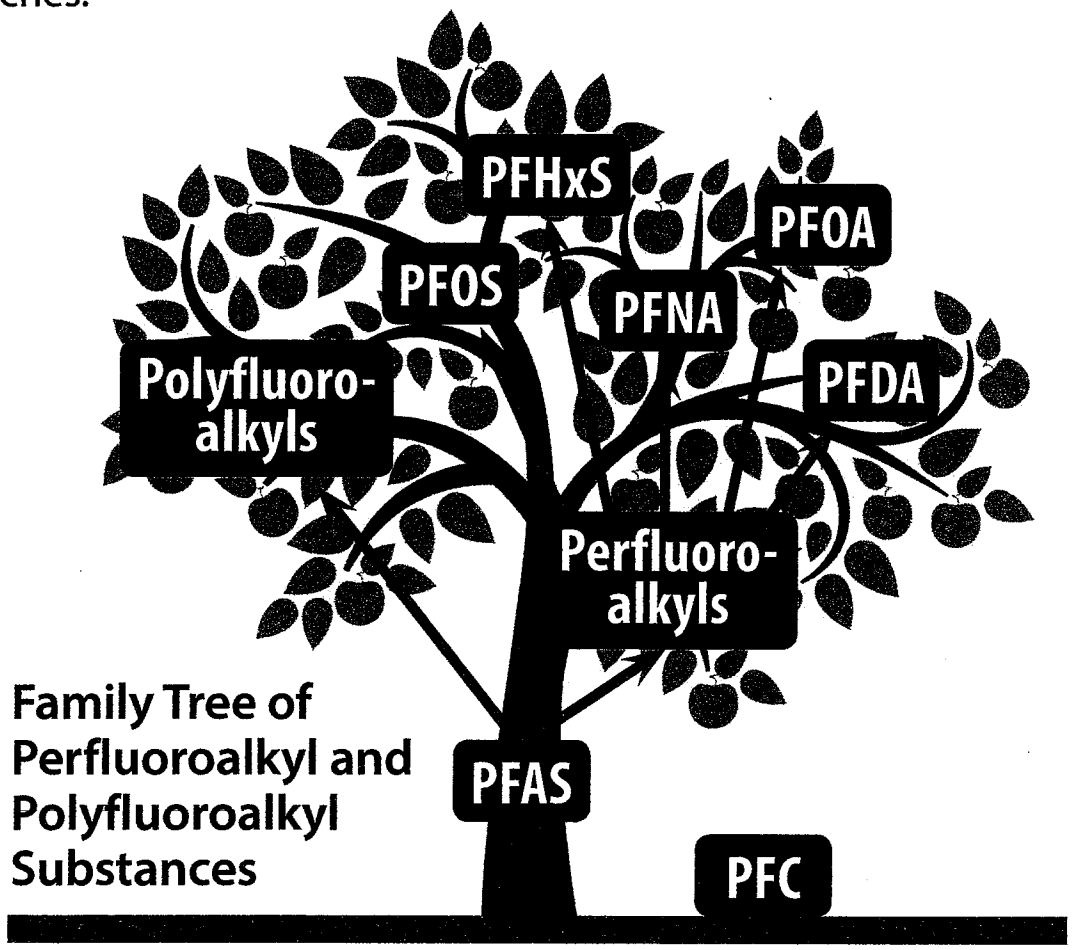

Figure 1

PFC

In the past, scientists used the abbreviation PFC to stand for perfluorinated chemicals.

However, using the abbreviation PFC can be confusing because it is also an abbreviation for perfluorocarbons. Perfluorocarbons are an entirely different family of chemicals, also known as greenhouse gases.

The term PFC has fallen off the family tree, but it remains in the diagram as a reminder of past use. You may still see informational materials using the term "PFC" instead of PFAS.

PFAS

Perfluoroalkyl substances and polyfluoroalkyl substances are called PFAS for short. The PFAS family includes hundreds of chemicals. The different structures of the PFAS molecules are the basis for different chemical properties and different chemical names. See Table 1 for abbreviations and chemical names.

Table 1. **Common PFAS: Abbreviations and Names**

Abbreviation	Chemical name
PFOS	Perfluorooctane sulfonic acid
PFOA (aka C8)	Perfluorooctanoic acid
PFNA	Perfluorononanoic acid
PFDA	Perfluorodecanoic acid
PFOSA (aka FOSA)	Perfluorooctane sulfonaminde
MeFOSAA (aka Me-PFOSA-AcOH)	2-(N-Methyl-perfluorooctane sulfonamido) acetic acid
Et-FOSAA (aka Et-PFOSA-AcOH)	2-(N-Ethyl-perfluorooctane sulfonamido acetic acid
PFHxS	Perfluorohexane sulfonic acid

OFFICE OF SENATOR SABINA FLORES PEREZ
Chairperson
Committee on Environment, Revenue and Taxation, and Procurement
I MINA'TRENTAI SINGKO NA LIHESLATURAN GUÅHAN
35TH GUAM LEGISLATURE

COMMITTEE REPORT DIGEST

I. OVERVIEW

The Committee on Environment, Revenue and Taxation, and Procurement convened an informational hearing on Per- And Polyfluoroalkyl Substances (PFAS) on Thursday, July 25, 2019 at 9:00 AM in *I Liheslatura's* Public Hearing Room.

Public Notice Requirements
Public Hearing notices were disseminated via email to all Senators and all main media broadcasting outlets on July 17, 2019 and again on July 23, 2019. Publication was conducted in the **Guam Daily Post**, *a newspaper of general circulation*, fulfilling the 5-Day Notice and 48 Hour Notice of the Open Government Law requirements respectively.

Senators Present

Senator Sabina Flores Perez	*Committee Chairperson*
Senator Therese M. Terlaje	*Committee Vice Chairperson*

II. SUMMARY OF TESTIMONY AND DISCUSSION

The informational hearing was Called-to-Order at 9:00AM.

Chairperson Perez: I would like to thank my colleagues who have joined me here today. To my left is Senator Therese Terlaje and to her left is Senator William Castro. Thank you for joining me here today. The agenda for today's informational hearing is the following: to discuss per and polyfluoroalkyl substances. The first item is going to be an update by the Attorney General. Due to time constraints, we put them up on the agenda; followed by a national perspective provided by Shaina Kasper, who is the Vermont and New Hampshire State Director of the Toxics Action Center; then followed by a recap and overview of PFAS, and the agency's' experience and actions related to PFAS. The intention for this informational briefing is to answer these overarching questions: What does it mean that PFAS is an emerging contaminant? How much and how long have the residents of Guam been exposed to PFAS? What are the findings of the current toxicological studies of PFAS? What steps are being taken to address PFAS contamination, federally, on the state level and locally? How would establishing a maximum contaminant level be useful in addressing PFAS contamination here in Guam? How is this MCL, or maximum contaminant level, being determined? Is a Health Advisory Level sufficient? What is the estimated cost of remediation, if the MCL levels were lower to non-detect to 20 parts per trillion that tends to be the consensus some of these states that are taking the lead? In this uncertain regulatory setting of for PFAs, what intermediate steps has GEPA taken and other agencies taken to address PFS contamination, whether it is minimizing releases, treating drinking water, or remediating contaminated sites? We're going to begin the agenda for today with an update from the Attorney General, pertaining to a recent law that was passed. We're going to have you discuss. I know it's

just been two weeks, but it would be interesting to hear what you have so far. We prepared questions for the AG. I can have you discuss it.

Leevin Camacho, *Attorney General, Office of the Attorney General*: Thank you, Senator Perez and Good morning, Senators. Attorney General Leevin Camacho on behalf of the Office of the Attorney General. Our office did receive the seven questions that you had asked us to specifically address. The first is to discuss what the multi-district litigation process is. There are certain kinds of cases that can be filed in Federal District courts, usually, if there's a diversity jurisdiction or different kinds of defendants. What happened in this case was there were about 80 cases that have been filed across the country in multiple federal district courts. In situations like that, there is a panel, a federal panel of the multi-district litigation panel. They can review motions made by either plaintiff or defendant, to decide whether or not those actions should be consolidated into a single court for purposes of efficiency and consistency. The test is whether or not there are common questions of fact, that would be found in all of these cases and specific to PFAS. There was a motion made to consolidate all cases involving aqueous film forming foams or AFFF, which is, I'm sure, something that's going to be discussed at length, which contains PFOS and PFOA.

There was a motion that was made to consolidate all those cases into a single court and that motion was granted. The federal panel assigned the matter to Judge Gergel in the District of South Carolina To be clear, the purpose of the multi-district litigation court is to handle discovery and to handle any kinds of procedural motions, that would be common amongst defendants or plaintiffs. In this case, it's expected they're all probably motions to dismiss certain classes of defendants, based on things such as a contractor defense. After those motions and discovery has been completed, then they would go back to their respective venues, where the cases were originally filed, or they would have an option to choose where the venue would be litigated for trial purposes. I'm not sure if that gives you an overview of about what the MDL would be.

The second question is whether or not or specific multi-district lawsuits that our office would be joining. Our office actually would be we'll be filing a separate complaint, specific to Guam. And, procedurally, it would be either filed directly in the District of South Carolina or it would be transferred there involving AFFF. So, we would have our own complaint. It would be sent to the MDL if it does involve AFFF. After discovery and any motions are heard, then it would potentially come back to Guam for a jury trial. The status of the RFP. We have selected a team of six firms. I believe that if you haven't received a copy of that, we can go into details. They are Douglas and London firm, Kelly Drye and Warren, Kennedy and Madonna LLP, SL Environmental Law Group, Levin Papantonio, Thomas Atall. Those are the six firms that made up a single proposal to represent Guam, or to lend legal expertise to our office, in the pursuit of this case, on behalf of Guam.

What issues and causes of action? The contract was just signed yesterday. So, we haven't had a chance to speak with our attorneys about what specific causes of action one may file. Once we do have a copy of the complaint, we'll be sure to provide the Legislature with an update. As of right now, we are working to gather as much data as we can, that's publicly available, that involve PFAS, the larger umbrella, and specifically AFFF, because that is the what the MDL is addressing. That was why the urgency for the special session, and the law that was enacted three weeks ago.

As far as other lawsuits that are similar in nature--there are lots of cases. Over a hundred I believe now, that are part of the MDL. We'll have to meet with our attorneys and talk about what specific claims that we would be filing, and how much it would overlap with other existing cases. In terms of costs to the government of Guam. Under the terms of the fee agreement that we negotiated, the firms will be responsible for paying all upfront costs. We will not have to pay anything in terms of government of Guam resources. Part of our mission is to protect our natural resources in our environment. We will have at least three or four attorneys that will be handling this and be involved in this litigation. We look at that as being part of our mission and representing the government of Guam and the Territory of Guam. We will do what we can to minimize. For example, EPA has done studies. We probably will request, or we will be requesting those studies specific to the use of the detection of PFAS, PFOA and PFOS. The same would go with Guam Waterworks Authority. At this point, we just anticipate trying to get as much information. At that time, determine whether or not any additional testing, or expertise is going to be required. That would again, have to be discussed with the legal consultants.

Then, in terms of establishing an MCL, I understand that the New Hampshire and Vermont individual is going to be calling in. The team that is representing Guam actually currently represents New Hampshire and New Jersey in PFAS-related litigation. They should be very aware of the MCL and what impact it would have. At this point, all of the claims generally sound and product liability. I don't think it would affect what the claims would look like. It just may affect damages potentially. If we're setting a level at 70 parts per trillion, I think that was stated in the original bill. Now down to 20. In terms of establishing what type of a remediation we would need. If we set the baseline wherever we said. That's kind of what the goal would be. To get it cleaned up, to be below a certain threshold. That would be the only potential impact, that I could imagine would be at the damages stage. We will be prepared to answer a little bit more detail, once we get a little more information on the MCL.

Chairperson Perez: Thank you Attorney General. I would just like to take a moment for all that have been asked here today, to provide testimony. If we can have you sworn in before questioning? So, all the agencies if you can and anybody who's here in the community who's going to testify. Si yu'os ma'åse. I would like to open up questions to my colleagues. Senator Therese Terlaje, if you have any questions for the Attorney General regarding his update?

Senator Therese Terlaje: Just on the upfront cost that you said. The firm that you've joined with now, is going to bear the upfront cost. Is Guam going to be reimbursing that in the end? If we are successful?

Attorney General Camacho: If we are successful. Then cost would be deducted prior to any award being issued.

Senator Therese Terlaje: All right. What is their rate of compensation?

Attorney General Camacho: We set it at 15% if it's pretrial and 17.5% after trial commences. So, half of what was authorized by the Act.

Senator Therese Terlaje: That sounds great. Thank you. When you say cleanup or remediation. Is there an available remedy? Are there other remedies that you foresee?

Attorney General Camacho: I think we're going have to work with this team and see what types of relief that we're going to be requesting on behalf of Guam. I think some of its going to tie into the class of defendants. Although, we don't know specifically what defendants we will name. The three that seem to pop up consistently is AFFF in particular DuPont, 3M, and Chem Guard. The first two are the makers of PFAS umbrella and Chem Guard the actual manufacturer/distributor of these foams. I don't know, in terms of them being ordered to come to Guam to do any type of action here, would make sense. It seems very likely a lot of it will be monetary. I will have to confirm that with our team.

Chairperson Perez: Thank you so much for your update and I hope you can keep us posted on those documents.

Attorney General Camacho: Senators, I extend to you all, if you have any other questions, our office is more than happy to meet with you all and keep you abreast of what's happening, as we move forward in this process.

Chairperson Perez: Okay, thank you. Next in the agenda, we are inviting Shaina Kasper, from Vermont and New Hampshire State, to provide some overview of PFAS, what's happening nationwide. Shaina Kasper is a Director of the Vermont a New Hampshire State. Toxics Action Center is a New England wide non-profit, based in Boston, that organizes with communities on the front lines, or local environment on health threats. At the Toxics Action Center, she helps local community groups, to clean up hazardous waste sites and promote clean water, safe energy and zero waste. Shaina has worked with the community groups, has helped stop two pipelines, stop landfill expansions, and incinerator proposals, and more. She also facilitates the National PFAS Contamination Coalition. Shaina's organizing experience includes fossil fuel divestment, housing and economic justice, good governance, antiwater privatization, and join for justice Jewish organizing fellowship. Shaina lives in Vermont, where she enjoys her radical ladies book group, running, and skiing in the Green Mountains. Thank you so much Shaina for making yourself available, to provide some insights on what's happening nationally, as far as the emerging regulatory setting.

Shaina Kasper, *Director, Toxics Action Center*: Thank you for having me. Can you hear me?

Chairperson Perez: Okay, yes very well.

Ms. Kasper: Great, *Hafa Adai.* My name is Shaina Kasper. I'm from Vermont and New Hampshire State Director, at Toxics Action Center campaign. At the Toxics Action Center, we believe that, everyone has the right to breathe clean air, drinking clean water, and live in a healthy community, with the government that operates responsively, and democratically.

Chairperson Perez: If you could speak slowly. I think we're getting some echo here. Just a little bit slower.

Ms. Kasper: Sorry, about that. We envision a toxic-free world, where we phase out harmful chemicals for manufacturing and where we do everything possible to clean up the toxic legacies of past mistakes. We do this by organizing, side by side with community groups, saving environmental threats and their neighborhoods. For over 30 years, our goal has been to help first-time community activists create and execute strategies for cleaning up and preventing pollution. Nowhere has this been more important over the past years than in communities affected by PFAS. Chemical companies like DuPont and 3M have exploited loopholes in our country's Safe Drinking Water laws for executives. Meaning, that most communities are not required to test for these chemicals, much less clean them up. There is no national enforceable drinking water standard for PFAS, leaving these regulations to states and communities. These chemicals are used to make everything from Vortex fabrics, a firefighting foam, Teflon pan, other high-end coatings, are highly toxic. Even an extremely small concentrations have been linked to cancers, kidney disorders, reproductive disorders, and immune system problems.

As I said, there is no federal drinking water standards for PFAS. Without standards there's no requirement for communities to test for PFAS or to clean them up. So, working on the ground and in person with groups across New England, waking up to find out that the water coming out of the tap was not safe to drink, and likely had not been for years. The Toxics Action Center had been getting calls from communities across the country, finding out that their water was also polluted. At a national conference in Boston, in June of 2017, community leaders that attended were inspired with new ideas of how to win on their local sites. They wanted to collaborate and make change, beyond their backyard. That's why we launched the National PFAS Contamination Coalition with them. The National PFAS Contamination Coalition is made up of the community leaders from 30 groups, in 17 States and Guam who joined together, except, share information, being skilled, connect with experts, and work on state, and national campaigns together, for real solutions, and to build a collaborative, and powerful force to take on big polluters.

The Coalition has four main vision goals. First, a PFAS free world, where people are not exposed to any PFAS, where there is poison people's health is protected, where there is justice for harms and deaths for past exposures, where regulations change, so that nothing like this can happen again. For the past year and a half, the campaign goal has been a one part per trillion maximum contaminant level MCL for total PFAS at the federal level.

Chairperson Perez: Excuse me Shaina. Did you say one part per trillion is the goal? I just wanted for everyone to hear that you said. The goal is to set one part per trillion as the MCL.

Ms. Kasper: Correct. As the MCL. The more we learn about this family of chemicals, the more toxic we learn that it is. Even an extremely small amount had really significant health impacts. A drop of PFAS in an Olympic sized swimming pool will have significant health impacts on human health, and on the environment. To protect our health, we must stop exposures. The best way to regulate these chemicals is as a class. To have a one part per trillion maximum contaminant level or treatment technique for total PFAS. Recently, our country's leading toxicologist Linda Birnbaum, head of NIEHS National Institute of Environmental Health Sciences, said that a point one (0.1) part per trillion standard is what is needed to protect public health and the environment. In this campaign, states are really leading the way. Just six days ago, New Hampshire passed MCL for four PFAS, incorporating some of this new science. Showing how infants are exposed to PFAS

through breast milk, with standards of 12 parts per trillion for PFOA, 15 parts per trillion for PFOS, 18 parts per trillion for PFHxS, and 11 parts per trillion for PFNA. As we've mentioned New Jersey, Vermont, and other states, have a strong enforceable PFAS drinking water rules. Influx protection triggers testing. That is why we need enforceable drinking water standards. We also need to be treating PFAS as a class. While we've moved away from PFOA and PFOS, the most common ones, many shorter chain chemicals are replacing these. We must avoid the irrevocable substitution. As these studies are coming out showing that these shorter chained chemicals are just as bad, if not worse, than the legacy PFAS. The EPA continues to approve these new generation chemicals. We don't have time to study and treat each one in turn. We must keep viewing these chemicals as a class. That's why we're calling for a one per trillion maximum contaminant level or treatment technique for total PFAS. We're calling for this at the federal level but recognize that we need to lead the way at the local level.

Chairperson Perez: Thank you so much, Shaina. I would like to open the floor to my colleagues. Senator Terlaje? Senator Castro? Shaina, could you explain how was it determined that one parts per trillion was the recommended MCL? Is it based on studies relating to accumulation in humans, as far as transfer, through breast milk? Can you explain how that was determined? That one part per trillion is what the aim is for the MCL?

Ms. Kasper: In New Hampshire and Michigan, they've been going through regulatory processes in order to determine their MCLs. I encourage folks to read the NRDC, the endocrine disruptor study that came out earlier this year, that consolidates all of the newer science that we've been seeing.

Chairperson Perez: Sorry, just to recap. You were saying that the studies of an endocrine disruptor. What was the other Michigan study relating to?

Ms. Kasper: It was one study that was written by the National Resources Defense Council and The Endocrine Disruptor Exchange. So, NRDC and TEDX. They wrote this study that the Michigan. I can share it with the Senators, as well. It looks at all of the different health outcomes and endpoints for infant children, in utero, our most vulnerable population. If looking at these most vulnerable populations at the specific health outcome, these studies show that there is no safe level of exposure. We can't set a maximum contamination level for non-detect. We need to have some number. That's why we say one part per trillion, because that is getting close to what we can test for. Essentially, there is no safe level of PFAS in our water. Everything has an impact on human health in the environment.

Chairperson Perez: Do you know what non-detect level is as far as the sensitivity? The testing that we have today. What is it the most sensitive level that they can come down to at this point?

Ms. Kasper: My understanding is that the EPA method 537.1, which is one of the most commonly used testing methods for PFAS. It can get down to about two point four (2.4) parts per trillion. However, science is changing rapidly. When I started working on PFAS just a few years ago, it was much higher. So, we anticipate that as more and more communities are advocating for strong, enforceable, drinking water standards that are health protective for infants, children, and our most

vulnerable population, scientists will find a way to test down to those level, that we are concerned about.

Chairperson Perez: What is your take about carcinogenic? They set different limits based on carcinogenic and non-carcinogenic. If it's an endocrine disruptor that doesn't necessarily mean it's carcinogenic. It seems to me that when they're setting limits, they are stricter for carcinogens, than they are with the other ones. What you're saying here today is, that it doesn't have to be carcinogenic to require a lower level of an MCL?

Ms. Kasper: Correct. There's a lot of health endpoints that are very concerning for human health that are linked to PFAS. Alarmingly, epidemiological studies identify the immune system as a target of PFAS toxicity. Studies have found decreased antibody response to vaccines, association between PFAS levels and an immune system hypersensitivity, such as asthma. Autoimmune disorders, which is ulcerative colitis and other significantly harmful healthy impacts. It should also be noted that there are no medical interventions, that will remove PFAS from the body. As PFAS has been found in all environmental media, not just water, but soil, food, and air, PFAS has been found in nearly all of people tested in the United States. PFAS has been found in human breast milk and umbilical cord blood. So, children are born already contaminated with PFAS. There's some news that I heard coming out.

Chairperson Perez: Excuse me Shaina. Let me just interject here. You were talking about immune hypersensitivity. Is there a large body of evidence or what is the evidence, that shows that it's linked to immune disorders, such as asthma, and other immune-related diseases?

Ms. Kasper: These are all diseases that have been linked, by the Agency for Toxic Substances and Disease Registry, ATSDR. They are our highest federal toxicological body at the CDC. There are plenty of other studies that haven't come out yet. There's one that I just heard about that, came out a couple of weeks ago from a University of Southern Denmark saying that a baseline level of PFAS found in people's blood is enough to impact antibody immune function from your five-year booster shots. There's a lot of high levels of concern for low levels of PFAS.

Chairperson Perez: Just to recap. You were saying that there is no known method to remove it from our bodies. Is that correct?

Ms. Kasper: Correct. Different PFAS chemicals have different half-lives in our bodies. There is lots of different numbers that you will see, but it takes between two and eight years to get PFAS out of your blood, just from excreting and as your cell's turnover. Just as a comparison. BPA was in plastic water bottles. A lot of you know people were really concerned about that. Half-life of BPA is in the hours not years or even a decade.

Chairperson Perez: That's pretty startling. Thank you. I was asked if you can repeat. Just to recap what you said. It takes hours for BPA, which is found in plastics, to be removed from the bodies, whereas, PFAS takes years. Two to eight years, is that correct?

Ms. Kasper: Two to eight year is what I've seen, for different PFAS chemicals. Different studies.

Chairperson Perez: I didn't mean to interrupt you. You were talking more about the effects and PFAS.

Ms. Kasper: There's a lot of different pathways for human exposure for PFAS that will also impact their health on the body. This is where I wanted to get one of the scientists to come and so I apologize. It was something where I wasn't able to testify today. Maybe another time. There are many different pathways into our body. PFAS can have many different impacts on our health. I'm sorry I forgot what the question was.

Chairperson Perez: What is the determination as far as drinking water or food sources, that causes the most problem?

Ms. Kasper: Drinking water is definitely one of the biggest concerns in the country right now. According to Earthjustice, drinking water is the main pathway for high levels of PFAS exposure in the US. PFAS enters the drinking water through firefighting foam used at military bases or commercial airports, industrial site, runoff from leachate from wastewater treatment plants or landfills. When they get into a community's drinking water supply, people who use that water source are very highly exposed for very long periods of time. This is also particularly of concern because children drink more water per body weight than adults. As they are developing, they have even more significant impact from this PFAS exposure. PFAS are present in food supplies due to leaching from packaging, fish ingesting the water, irrigating vegetables with contaminated water, and other types of exposure. Inhalation near manufacturing sites, dermal absorption through the skin. Also, infants and toddlers may pass PFAS from hand to mouth from surfaces containing PFAS, crawling around PFAS-treated carpets. Overwhelmingly, 110 million Americans are estimated to be drinking water contaminated with PFAS. Some of these levels are extremely high. While PFAS are virtually unregulated at the federal level, there needs to be enforceable rules to protect our families from PFAS. This change must happen now, in particularly with drinking water.

Chairperson Perez: Thank you, Shaina. Just to make it clear. There are different ways we can regulate chemicals, emerging contaminants. One is through the drinking water. Another one is the groundwater and soil. What is the movement nationally to set those limits? What levels should a site be cleaned up? What levels for groundwater, that's not made drinking water? What are the different ways in which these families of chemicals? How are we setting that limit? What is the general trend nationally?

Ms. Kasper: Thank you. I have been seeing two main trends at the local and state level, in order to deal with the PFAS drinking water contamination crisis. One has been through treatment techniques. I should say there both for food drinking water protection. We petitioned our six New England seats, to pass drinking technique standards, to regulate drinking water, to minimize public health hazards such as PFAS. There is broad authority under the regulatory bodies, to establish standard requirements for drinking water quality. Treatment techniques is an enforceable procedure or level of technological performance. Public water systems must follow in order to ensure control of a contaminant. The other pathway that we've been seeing is MCL, maximum contaminant levels. This is where states can pass enforceable drinking water standards for PFAS, but based off of what's in the water, rather than what levels the treatment needs to be. Those are both for public drinking water sources. There is a movement for enforceable drinking water

standards for those not on public water sources but a private well. I'm not sure what the ratio of public to private water sources Guam has. I've been seeing drinking water standards, as a really effective way to protect their residents from PFAS chemicals and contaminants.

Chairperson Perez: Thank you so much. I would like to open the floor to my colleagues. Do you have any follow up questions? Thank you, Shaina. I know it's late there on the East Coast. I appreciate you calling in.

Ms. Kasper: Good evening from Vermont. Thank you, for having me. Do reach out if there's any specific technical or health-related questions. I can get one of our epidemiologists or scientific experts to be able to answer them for you.

Chairperson Perez: Thank you very much. I really appreciate that. We're going to take a quick recess to reset the cameras. Si Yu'os ma'åse. We're going to start with the slides. We're back from our recess. I would like to recap some of the basic information regarding PFAS. We put together a presentation to give some background information. PFAS also is known as per- and polyfluoroalkyl substances. They're a large family of manmade chemicals. Their general makeup is their carbon containing compounds similar in the fashion of gasoline, but in place of hydrogen they've substituted with fluorine or other side chains. It's a family of about 4,700 compounds and that list is growing as new chemicals are being developed. The most common ones that we've heard of is PFOS, perfluorooctane sulfonic acid, PFOA, perfluorooctanoic acid, PFHxS perfluorohexanesulfonic acid, and PFNA perfluorononanoic acid. The differences between this has to do with the size of the chemical, which is the number of carbons in them.

Chlorine and fluorine are such a strong bond it makes that chemical very stable and persistent in the environment. There's the per-. The difference between per and poly. Perfluoraalkyl substances are fully fluorinated, so all their hydrogens have been replaced with fluorine. Making them very stable the Polyfluorinated substances are not fully fluorinated and can break down they're known as precursor substances. They can break down to the more stable kinds, which is the Perfluoroalkyl substances.

PFAS properties make it very useful in many commercial products. It can repel oil stains, heat, It is used in food packaging, and nonstick cookware, Teflon, water resistant clothing, upholstery, and carpets. It also can lower surface tension and therefore is used in many applications, from aerospace, medical, electronic, and automotive industries. It's a common component in the AFFF or Aqueous Film Forming Foam, that's used in firefighting foam. The point of this slide is to show you that Aqueous Film Forming Foams aren't the same when it first was created. The first one was called the Legacy Foam and that contained PFOS. As it was developed further, there was a move to make these foams with a shorter chain compound, and eventually to nonfluorinated foams. In fact, a lot of this has been spurred by litigation, as well as legislation. In 2018, Federal Aviation Administration Act is moving to phase out fluorinated foams by 2021.

PFAS is an emerging contaminant and with specific focus on PFOA and PFOS. Those two are the most well studied PFAS chemicals. What does it mean to be emerging? These are chemicals that pose potential threats to human health and the environment. They're consistently found in the environment. As Shaina was mentioning, 110 million Americans have been potentially exposed to

and even more to PFAS chemicals. They lacked sufficient human health and environmental impact data. Part of this is because it's a large family of chemicals. It's very difficult to test. It requires a lot of expertise and special testing methods to test. We're still developing a standard protocol and testing these chemicals. As time goes by it becomes more sensitive. Before you know were testing it at higher levels. According to Shaina the sensitivity of these tests is down to two point four (2.4) parts per trillion. However, that doesn't include all of the PFAS chemicals. That's just a subset. I believe the last round of testing was up to 25 compounds of the 4,700 compounds out there. Another important determinant to make is, determining whether it's carcinogenic and noncarcinogenic.

In the regulatory framework carcinogenic would require a lower level, as far as what's allowable. As you heard in the testimony from Shaina Kasper, if you look at endocrine disrupter studies, it's not necessary for it to be carcinogenic, for it to be harmful to health, and especially when we're dealing with vulnerable populations, developing fetuses and children that are still growing. They consume large amounts of water in comparison to their body mass. As far as what is carcinogenic. Various agencies are making their determination on whether it is a carcinogen or not. It looks like PFOA is one according to the information that I have here indicates that it is a potential carcinogen, but according to USEPA it's both PFOS and PFOA. These chemicals are persistent organic pollutants as determined by the Stockholm Convention. What that means is they don't break down easily in the environment. Dioxin is also another persistent organic pollutant. PFOS is identified as a POP or Persistent Organic Pollutant. There is a move to identify more or list more as Persistent Organic Pollutants. Knowing what we know about the chemical makeup, it seems to make sense. The other determination that needs to be made, is whether it's a hazardous substance. What that means in the regulatory world is that it would provide more teeth to enforcing cleanup. As of now, we don't have a very clear picture of how we should handle these. It's really up to our local agencies to take proactive steps, to minimizing and eliminating these chemicals.

In the testimony earlier, there are links to immune effects. It affects the liver. They're adverse effects to growth and development of infants and children, decrease fertility among women, increased cholesterol levels, potential carcinogen and a hormone disruptor, a thyroid hormone disrupter.

PFAS is widespread and it's very mobile. It can infiltrate water sources readily. It persists in the environment and in our bodies as you heard. Two to eight years for it to clear the human body, potentially. It's detected in the blood serum. Current studies are being made for different communities to determine what their levels are.

PFAS contamination has been found in industrial sites areas that have manufactured PFAS, fire training, and fire response areas, because of the foam that's used. The reason why it's used in foam is because it's found to be effective in stopping hydrocarbon fires. Department of Defense sites, landfills, airports, wastewater treatment, and biosolids are common areas where you would find them nationwide. The exposure routes mentioned was through drinking water, food contamination through food like fish, packaging, it could be transferred. It could be transferred through breathing in dust, as well as dermal transfer. If you touch products, you can absorb it.

The history of use of Aqueous Film Forming Foam. The Department of Defense has used it. According to many documents that we've come across from the Government Accountability Office from Legislation such as the National Defense Authorization Act of 2017, 2018, 2019, and currently 2020. The report from Department of Defense to Congress in June 2018 and other documents, it shows that Department of Defense has used this chemical. In the 1960s, the US Navy developed these foams to provide better fire protection, than the old protein foam. It's been estimated that of PFOS containing foam, about 75% was utilized by the Department of Defense. Some of these formulations may contain PFOA. There is still inventory within the Department of Navy, that they are working towards reducing or eliminating completely. We also know that the Air Force has released foam in the sewage system, as well, in 2018, on Guam. According to the October 2017, Government Accountability Report, Department of Defense data for fiscal years 2013 and 2015 indicate the Department of Defense public water systems complied with the Environmental Protection Agency and state health-based drinking water regulations at levels comparable with systems in the United States. However, the military departments did not report all violations to Department Defense. While seventy-seven installations reported violations to Department of Defense, the Government Accountability Office found that at least 16 installations did not. Department of Defense has not used its data to determine, why it's two types of systems. One that provides Department of Defense treated water and another that provides non-Department of Defense treated water have different compliance rates. Department of Defense data indicate, that about 99 percent of the people who receive non-DoD treated drinking water were served by systems of no violations, while 89 percent of the people who receive the DoD treated drinking water were served by systems with no violations.

Some of the current actions of the Department of Defense. The Navy's in the process of identifying locations and preparing to remove this Aqueous Film Forming Foam for proper disposal and destruction. Their efforts to replace the legacy foam with one that reduces the PFOS, PFOA exposure. The 2018 National Defense Authorization Act required biomonitoring through the CDC, which is being implemented by the CDC and ATSDR. Some of the protocols by the Department of Defense include 4715.18. Emerging contaminants. DoD currently is completing a preliminary assessment site inspection at Naval Base Guam. It has recently sampled surface soil on Navy owned property and results are pending. Investigation for PFAS use, handling, and storage, identified facilities and sites including Naval Base Guam, NCTAMS, Barrigada, Nimitz Hill, Naval Hospital, Naval Base Guam ordnance annex, and NCTS Finegayan is being engaged. The preliminary assessments are under development for Anderson Air Force Base. According to September 2018 reports, DoD has identified 401 active and closed military installations, with known or suspects it releases of PFOS and PFOA. As of December 2016, the military departments have reported spending approximately 200 million, at or near 263 installations for environmental investigations, and responses to PFOS and PFOA. According to DoD, it may take several years for the department to determine how much it will cost to clean up PFOS and PFOA contamination at or near military installations. DoD reported taking actions as of August 2017 to address PFOS and PFOA levels exceeding those recommended in the EPA's health advisories for drinking water, for people in 13 installations in the US and outside 22 military installations in the US. According to their DoD report to Congress in June 2018, DoD has proposed a 380 parts per trillion cleanup level for PFOS and PFOA. Cleanup costs so far are estimated at two billion dollars or more for Department of Defense.

This picture depicts how exposure can take place. Although, the site of use may be far away these chemicals are highly mobile it can be transferred through any water source. It could also be transferred in the air through dust. Its bioaccumulated in animals and plants. We can be exposed through our diets.

New Jersey is the only one that has an MCL limit, which determines the level allowable in drinking water alone. It doesn't set any standards for soil or groundwater. That's not used for drinking water. They've set an MCL for PFNA. It's perfluorononanic acid. They set it at a level of 13 parts per trillion. The health advisory limit is at 70 parts per trillion (PFOA and PFOS only). Back in 2014, it was at 200 parts per trillion. As time goes by the methods become more sensitive as toxicology studies come in the levels are being lowered, we don't have a level at which we're setting it at federally. That's going to take some time, federally, to determine the level, because of all the studies. This is just a slide that shows New Jersey's efforts. They're one of the leaders in setting standards. They're setting standards for groundwater quality. They're listing it as a hazardous substance, which sets forth more cleanup. For PFOA and PFOS, there is an interim groundwater quality standard. PFOA is set at ten parts per trillion. PFOS is also at ten parts per trillion. As of April 2019, it seems to be increasing up to 14 parts per trillion for PFOA and 13 parts per trillion for PFOS. There is also a move to add it on their hazardous substance lists. Also, to include it in private wells.

For Guam, it was detected during a cycle of testing under the Safe Drinking Water Act. It's called the Unregulated Contaminant Monitoring Rule. This was cycle 3. On Guam there were 6 PFAS tested on Guam's drinking water sources. There were two types that were detected PFOS and PFHxS were detected in six wells in 2016. GWA resampled and detected it in five wells. Wells A23, A25, and NAS1 were shut down at the time. NAS1 is located in Naval Air Station Agana, in Tiyan at the Guam International Airport. A23 and A25 offsite but are downstream from Tiyan. Currently A23 and A25 have are still shut down. They've placed a GAC's filter on NAS1 and it's in operation right now.

In 2017, there was a community effort to include Guam in the biomonitoring of PFOS chemicals made by the Guam Coalition for Peace and Justice and the Northern Soil and Water Conservation District. These are the results from the testing that was done in 2014, 2015, and 16. You'll see Andersen Air Force Base non detects. There was a 2.5 at some point for PFHxS perfluorohexanesulphonic acid. At the Navy there was non-detect. Keep in mind, a non-detect is a moving target. It depends on the testing. We have to be able to define that, depending on what type of methodology was used. These are the wells that tested positive at their different dates, at different times, or different dates. NAS1, 44 it says micrograms per liter, but that needs to be verified. There was wells that have tested positive for various PFAS. Of the 6 PFAs that were tested. We have A4 that was tested positive. A23, and A25 were the ones that exceeded that 70 parts per trillion, which was the health advisory limit. A23 had 30 parts per trillion. These are the wells that have tested positive for PFAS. At the Agana Heights tank, there was a measurement made. They found Perfluorohexanesulphonic acid (PFHxS), as well as Perfluorooctanesulfonic acid (PFOS). The Airport also has tested positive for those two compounds.

Currently, there are bills on the Legislative agenda that seeks to address this problem. Bill 174-35, which seeks to establish a maximum contaminant level in drinking water, which is a legally

enforceable limit. It's co-sponsored by Senator Therese Terlaje Vice Speaker Nelson and introduced by my office. The other is Bills 163-35. It allows the AG to establish a contingent set fee for litigation on PFAS, PFOA, and other contaminants. It was introduced by Senator Therese Terlaje. The bill that was recently passed, Prutehi I Hanom Act, which authorizes the AG to participate in the multi-district litigation. We just received an update today. There is Resolution 168-35, which urges inclusion into testing of sites by DoD introduced by Senator Nelson, co-sponsored by myself, and Senator Amanda Shelton. That is the background information thus far. At this part of the agenda I would like to ask Guam EPA to have a seat at the table. I did send questions ahead of time. If you would like to just speak to those questions. We can have follow-up questions by our panel here. For the record, you can introduce yourself as well.

Walter Leon Guerrero, *Administrator, Guam Environmental Protection Agency*: Good morning Senators. Walter Leon Guerrero, Administrator of the Guam EPA.

Brian Bearden, *Chief Engineer and Water Divison Director, Guam Environmental Protection Agency*: Good Morning Senators. I'm Brian Bearden US Public Health Service, detailed through the USEPA to the Guam EPA. I'm serving as the Chief Engineer and Water Division Director at Guam EPA.

Chairperson Perez: Do you have a prepared statement, or do you want me to ask the questions?

Mr. Leon Guerrero: I would prefer if you just ask the question to answer.

Chairperson Perez: First question. What role does Guam EPA have in setting regulatory levels and regulating PFAS chemicals?

Mr. Bearden: We regulate, or we administer regulatory programs for drinking water, surface water, groundwater, and site remediation. Once we receive a regulatory limit, whether that's established through USEPA or we would promulgate locally, we would then administer that program to enforce those regulations. We cover all those media. Ordinarily, we utilize regulatory limits that are established by the USEPA, especially, for drinking water maximum contaminant limits. Guam EPA has never adopted its own MCL. We also utilize other standards that USEPA adopts as well for surface water standards, site remediation goals, etc.

Mr. Leon Guerrero: Senator, I would just like to add. If there is a concern that Guam EPA is establishing MCLs, because it's a long-drawn-out science, and currently Guam EPA does not have that technical expertise. We rely on EPA. I just wanted to put that out there.

Chairperson Perez: Can you explain the process of regulating PFAS? Which PFAS will be regulated and what is its anticipated timeline?

Mr. Bearden: Currently, we have the EPA health advisory, drinking water health advisory, which set a number of 70 nanograms per liter, which is 70 parts per trillion for PFOS and PFOA only. It did not include any of the other contaminants. Guam EPA has taken that number and worked with GWA to take action as soon as we knew about that number back in 2016. We spoke with USEPA to find out what their current take on the schedule is for regulating at the end of 2020. USEPA

must move forward with its regulatory determination. It is a go/no-go decision by the Administrator of the United States EPA, on whether to regulate PFOS and PFAS components. If they decide that it does need to be regulated at that point, then they will move on with developing a proposed standard, which would be an MCL. They have a two-year regulatory, or statutory limit to set their proposed standard. It could happen quicker. They believe it would probably happen quicker at that point. Then they put that proposed standard out there for public review. They have 18 months after that process to issue their final rule. Then beyond that, they often issue a kind of a time period for utilities to comply that can be up to an additional two years. It could be as many as four to six years, before we see an actual MCL from the USEPA.

Mr. Leon Guerrero: To that Senator, most emerging contaminants, when they actually do meet the regulated level, the studies, can actually take anywhere from 10 to 12 years. USEPA, due to the PFOS/PFOA issue and its complexity and its possible ill-health effects, they have fast-tracked this. They've put their mind to it, I believe two years ago. They are moving as rapidly as they can, in their science that they feel comfortable with. That is one of the things that we'll get into discussion with. The previous speaker talked about some of the levels that should be done. I think she has a great thought process going. Unfortunately, a lot of these studies have not been done in unison. Even as you showed, most of the states in the Northeast, they can't even agree to what MCL should be. One state has put it out there, but others are looking at it. They do have toxicologists. Yes. The numbers currently, are lower than the USEPA health advisory, but there's no general uniform number that everybody agrees to at this point.

Chairperson Perez: Mr. Bearden, you're talking about go/no-go. What happens if they say no go?

Mr. Bearden: If they say no go, then they will not take action to regulate it as an MCL. I forgot to mention that EPA has already proposed groundwater levels for the CERCLA process. Both a groundwater standard, which would be the cleanup standard, and the screening level. Walter can explain, what the difference between a screening level and a groundwater standard is.

Mr. Leon Guerrero: Again, USEPA started to fast track it. They know that DoD in the past has been a primary source or a responsible party. A lot of the meetings, information conferences, and teleconferences that I've been involved in, DoD said, USEPA, you have this process, if you really think it's a problem, you can put this under the CERCLA hazardous list. It is almost there, as far as being able to regulate it under the CERCLA guidelines. That in itself will help Guam because as you know, we do have our green parcel DSMOA program division that does the CERCLA cleanups. It is DoD's Installation Restoration Program, their BRAC program, the Environmental Restoration Program. We do have regulatory oversight, once USEPA puts it on the CERCLA process.

Chairperson Perez: If they say no go, that's for the MCL, but are they also working towards...

Mr. Leon Guerrero: I understand your question Senator. I can't give a definitive answer. I'm not USEPA, but everything is showing that for the CERCLA process, which is the easier step to do. It looks like it'll be done by this year. There will be an established CERCLA screening level. That means they have to clean it to that level.

Chairperson Perez: Sorry Administrator, you're saying that they're going to establish a cleanup level under CERCLA?

Mr. Leon Guerrero: That's what they're hoping to do within this next year.

Chairperson Perez: Has there been a report for the public to respond to? Has that draft report been sent out to the public?

Mr. Bearden: Yes. They proposed cleaning up the groundwater remedial goal and the screening level, they were issued for public comments in April of this year. The public comment period closed in June and we've also been told that the listing of hazardous substance listing would be is scheduled for this October.

Chairperson Perez: What are the levels?

Mr. Bearden: That would just be for listing as a hazardous substance. That allows it to be regulated in CERCLA. There's no level associated with that. The levels for the groundwater remedial goal of 70 nanograms per liter and the screening level is 40 nanograms per liter for PFOA and PFOS combined.

Chairperson Perez: Just to recap that it's on its way to be determined as a hazardous substance.

Mr. Leon Guerrero: To be determined as a hazardous substance under CERCLA, Correct. And they're hoping, as Brian mentioned, they're hoping to designate. Again, they're fast-tracking. It's a hope to have the drinking water MCL.

Chairperson Perez: That's only for PFOS and PFOA.

Mr. Bearden: Well on the drinking water side. We don't know yet. It may be, but once they hit that go/no-go point and there'll be two-year process where they would establish what their proposed MCL would be at that point. It could include additional chemicals. As you've mentioned before. There's additional toxicological data coming out. They'll have more information than they did when they developed a 2016 health advisory.

Chairperson Perez: Okay, thank you. What is your understanding of the toxicological data, so far, in establishing this limit?

Mr. Bearden: Well, we're not toxicologists. We're not experts in that. I would hesitate to say much detail, but we are familiar. We've read the EPA drinking water health advisory. It goes into great detail. We are familiar with the ATSDR toxicological profile. We've read that as well. I have quotes I could read to you, that we prepared from those reports. The health advisory that EPA selected, of 70 nanograms per liter, even though they looked at a number of different endpoints such as cancer, immuno-response type endpoints. They based it on the most sensitive that they found, which was those developmental endpoints in there, based on mouse studies, reduced ossification and reduced pup weight. Their statement in their health advisory was that by choosing

those most the smallest limits, that was then protective of the other endpoints that they evaluated including cancer. Again, that was mostly based on PFOA. They also looked to PFOS. They determined that the two of those combined would be the what the limit applied to.

Mr. Leon Guerrero: I'd like to offer that. I didn't know that you guys could do the closed network or teleconference, but if you would like, we could establish a conference call with one of the toxicologists from Region 9. You could talk to them. Again, what Brian said, we are not toxicologists. We can repeat what they've provided us. If you would like to set up a call with one of the USEPA regions toxicologist. We could try to do that now.

Mr. Bearden: Just to let you know. We did talk to them. We've asked them to give us their best explanation of why other states are choosing lower MCL or potential MCLs. We need to clarify that there are no MCLs yet for PFOA and PFOS. There's no real comparison yet. Their answer to us was that toxicology is basically an art at this point. When you get a number, you have a number of health studies you can look at. You have a number of different endpoints. One rat study or mouse study might be done for cancer. One might be done for immuno-response. Toxicologist can choose which of those they want to work on. Beyond that, they choose a number of uncertainty factors. When you read through these development papers and presentations we've received from New Jersey, you can see where they made those choices. Those choices have huge consequences. They can change things by factors of 100 to 1000. What EPA told us was that the difference between EPA's number and New Jersey's for example, was that they chose the different endpoints. Number one a different study. They made different choices in the way they allocated those uncertainty factors. It really boiled down to the individual choices of the toxicologists involved in each study. It is worth saying that of the other.

We did look at how many other states are developing MCLs based on an AASDWA survey, which is the American Association of State Drinking Water Administrators, they said that seven states as of June, were planning to set an MCL. We looked at those seven. We determined that only six of them were. Pennsylvania was listed as one of them and Pennsylvania's website now says that they do not intend to set an MCL. They don't have the resources to do so. They're a state that's much larger than Guam, as far as resources for the drinking water programs go. Of those six states, PFOA, the proposed MCL ranges from very small for Vermont, which is proposing a list of five PFAS substances to be combined concentration of 20 nanograms per liter. Michigan says 9. New Hampshire uses EPA's number. They're proposing 70 right now. Sorry, four combined but for PFOA alone, they're using 38. New Jersey says 14. New York says 10. They're all very different numbers. If we were to select a number based on another state, we already have a problem. We don't know which one to choose. Each one has been based on somebody else's professional judgment. It's very difficult for us to evaluate which of those professional judgments to use. That's why in the past we've always utilized. The whole country has utilized the USEPA, because those judgments are made in a national setting where everyone across the country gets a chance to have input on that.

Chairperson Perez: Thank you. Can you explain what determinations were made to create such a different outcome? What was the decision points?

Mr. Bearden: I did not look at the detailed rationale from each state. I don't know. As I said, I believe that each state chooses different studies and endpoints. I know New Jersey used a mouse or rat mammary gland development study. They used an immunodeficiency development of plaque forming cells to set either the PFOA or PFOS. Then it's those choices of those uncertainty factors. They might use a 10 or they divide the number by10 for one of them. In one case, they change that from 10 to 3. Then another one they use 10 for a different calculation. There are usually multiple uncertainty factors that can add up to like a factor of a hundred. What EPA had told us was that the numbers that they use, versus what the numbers that New Jersey had used, just boiled down to a choice of those uncertainty factors and that endpoint that they selected.

Chairperson Perez: For the health advisory limit, what were those decision factors to bring it to 70?

Mr. Bearden: I'd have to go back and look to tell you what those uncertainty factors are. They used mouse studies for PFOA, which was the reduced ossification, which had delayed bone growth in mouse pups. It also decreased birth weight of the pups. The reason they selected those is because even though they're calling it a lifetime health advisory for a nursing mother, or a pregnant woman, they're concerned that those development effects are very extreme. In that effect it becomes a short term. They even say so. That's a short-term limit. By setting that very conservative limit in EPA's words, they believe that's protective of all the other endpoints that they know of so far. But hat was at the time of the study.

Chairperson Perez: Thank you. With the biomonitoring occurring right now. What are the reports showing, as far as levels, and human subjects?

Mr. Bearden: We don't have any information on that. That's with the CDC and the ATSDR. We don't know. We had talked to USEPA about whether that had was going to be occurring here. What they told us was that no location in Region 9 was selected for that study.

Chairperson Perez: I saw an email that there was a potential to apply. Was that determination made actually?

Mr. Leon Guerrero: As we were working through NAVFAC Pac. We actually made the request to look to bring them in to have this discussion. There were requests done. Even USEPA tried to make Guam be one of the targeted Region 9 sites. The powers that be at CDC and ATSDR, chose otherwise. We did request. Even Region 9 requested Guam be on it.

Chairperson Perez: Even Region 9 that covers California and other areas, they were not tested?

Mr. Bearden: We were just informed yesterday. As far as the Region 9 drinking water program is aware, no Region 9 locations were selected as part of that DoD, ATSDR, and CDC study, under the NDAA.

Chairperson Perez: Are there going to be other opportunities for this testing to come?

Mr. Leon Guerrero: I was talking with Jesse over there about your Bill you guys passed on July 3rd. I'm hoping that there's more. We've made the request and we'd like to work with you again. I don't think we need to wait for an opportunity. We could just go ahead and ask. We'll ask USEPA to support. They did support us the first time. They did recommend putting Guam on the list. Just no Region 9 sites were picked.

Chairperson Perez: Thank you. Just for the audience, can you explain what is the difference between a health advisory level and the maximum contaminant levels? What is the difference on a regulatory perspective?

Mr. Bearden: Well sure, health advisory levels are a non-regulatory determination. It's information that's provided to States. They can take action as they are able to. An MCL is a fully enforceable requirement. Once an MCL is established, for example, a public water system, which is what we regulate would not be able to provide water that exceeded the MCL or they would have to face enforcement action from us. The health advisory level is at this point it's just an advisory. We have treated it as an MCL together with Guam Waterworks. We have made sure that no water is being delivered to any public water system that exceeds the health advisory level. Once we knew about it. I don't know what the timeframe was. I think it was within months. That was before I got here. It is not enforceable.

Mr. Leon Guerrero: I'd like to correct Brian's statement just a tiny bit. We don't treat it as an MCL, because it isn't regulated, but we do treat it as an action level. GWA is totally on board in upholding that to ensure Guam doesn't get drinking water from their system above 70.

Chairperson Perez: Thank you. Can you explain the action plan? If you can briefly describe what our action plan is for setting an MCL for drinking water, groundwater, and other media?

Mr. Bearden: Well, it's similar to what I had said before. The process of setting the MCL now is underway. At the end of the year, EPA has to decide whether to set an MCL or not. Then after that two years, to create the proposed rule. Then 18 months to create a final rule.

Chairperson Perez: As far as groundwater and biosolids.

Mr. Bearden: The groundwater rules. The groundwater remedial goal and screening level has already been proposed, as of this April. I don't know what the timeframe is for adopting it, now that the public comment period has closed. I have not heard anything about a biosolid standard and other media, that's going to be regulated.

Chairperson Perez: What is the difference of regulating hazardous substances versus emerging contaminants, or substances that have yet to be classified as hazardous?

Mr. Bearden: Well, if it's not classified yet, it's not regulated. We can't regulate it. We have to have a number to go off of, or a designation as hazardous, before our regulations can kick in.

Chairperson Perez: Being that these chemicals are emerging. You're saying that you're treating the 70 parts per trillion as if it was an enforceable amount.

Mr. Leon Guerrero: Not quite Senator. Again, because we don't have the regulatory authority over it, we also recommend. So, we cannot use the term enforceable. It is not something that we could use at this point. That's why I often stress the cooperation of a GWA. They have done it voluntarily and that must be stated over and over, because we can't enforce anything at this point.

Chairperson Perez: What would that look like? What's the difference between enforcing?

Mr. Leon Guerrero: What GWA has done would be if we were able to enforce it. That's what we would mandate them to do. Maybe, there would be more frequency of sampling.

Mr. Bearden: I could add to that. Once you have an MCL, there's also monitoring requirements. Right now, there're no monitoring requirements to go beyond what we already have monitored. An MCL would require a routine monitoring for that chemical, which means that you keep a more constant eye on what's out there in the environment. You keep an eye on what's going into the water system. There's an additional cost, of course, associated with that, but that's the main difference.

Chairperson Perez: Thank you. Can you explain the relevance of regulating PFAS as a hazardous substance under CERCLA, and the implications for addressing PFAS without this regulation in relation to CERCLA.

Mr. Leon Guerrero: Okay. In regard to CERCLA, for those that don't know CERCLA, it is just cleaning up former contaminated sites if they remain. It looks like the USEPA is going to enforce this as a hazard associated in a CERCLA role. Then we can't look for potential responsible parties where there is PFAS existing, bring them to the table and say this is now an enforceable hazardous substance. You now need to determine the extent of the contamination if any, levels of the contamination, and the cleanup of that contamination.

Chairperson Perez: Thank you. As outlined in CERCLA, what processes are available to mitigate and remediate PFAS, given that PFAS have not yet been regulated as a hazardous substance?

Mr. Leon Guerrero: I don't have a clear answer on that right now. The science is still new, as far as, being able to appropriately delineate the contamination or the impacts of the emerging contaminate. Some of the problems are because there's no set methodology, except for safe drinking water sample analysis. Labs can tweak their methods numerous ways. But much like what Brian was saying about risk management, to determine the different risk goals that is why there's different levels of potential MCL in other States. Labs can also do different things that would result in different lab results. That's why for Guam EPA, we really endorse what USEPA endorses, because they have been resources to be able to go through the long sampling process, to identify, which is the best.

Chairperson Perez: Can you explain this risk assessment process? You were talking about the risk assessment that has to be done in order for cleanup.

Mr. Leon Guerrero: Again, I think it would be better that I put you in touch and have a discussion with the toxicologist. Anytime you do a risk assessment, you have to come to an agreement or

there should be an agreement on what your risk assessment goals are. Based on those goals, you use your risk management decision points. Those could be numerous depending on what you're looking at. As Brian mentioned, he's not sure and nor am I about the risk management decision points that were used. I would need to look at it more in depth per state. Again, I think for this toxicology discussion, I would be more comfortable if we use, as our technical expertise, and have the USEPA on the line to discuss that.

Chairperson Perez: Okay, some of the things that I've read is that if you find something in 70 parts per trillion in the environment, it accumulates in parts per billion. The way some of these states are setting their limits is, they're setting it based on the most vulnerable populations, which are developing children. Is that risk assessment going to be linked to that concept of what is going to be the maximum contaminant level in drinking water?

Mr. Leon Guerrero: Those are exactly the type of risk decision management points that need to be agreed upon. It's like when we work with DoD to decide what risk management clean-up goals are. That's the kind of things that we look at. What sensitive populations are involved? What impacts that may be done to them? Again, those are decision points that I am not too familiar with as far as the specifics. That's one of the points that you can consider.

Mr. Bearden: We're mixing up two different things. The way an MCL is determined is different than what Walter tells about the risk assessment. That's the site remediation goal. They work in very different world. Oftentimes, a site remediation goal will be set on a very site-specific risk assessment. Where you look at, whether or not there's any risk at all. That particular site will contaminate drinking water, or if children will be eating the soil. There're all these things you look at for a site. Whereas, a drinking water MCL is set one time, based on just drinking water exposure for the entire country and the most sensitive populations.

Chairperson Perez: Considering that PFAS is highly mobile, it seems to me that the site, the weight of that should at least be taken into consideration. This is a highly mobile substance. It can migrate off-site depending on where the water flows. What other decision points besides toxicology and determining risk assessment?

Mr. Bearden: Risk assessment is always a combination between toxicity and exposure. You could have an extremely toxic substance. In toxicology class, I took in graduate school, the professor showed a slide of a surfer with a shark fin behind him, then a wheat field. He said which of these settings have the highest risk of a shark attack. If there's no chance that anyone will be exposed to groundwater that's contaminated, the risk is very low and that's why site remediation goals are often site-specific. Whereas MCL, is because you are already assuming people are drinking that water, are the more stringent of them. Usually, the drinking water MCL, if you're talking about groundwater will form the baseline, most stringent goal that you'll reach. In some locations that may not be appropriate. If there's no groundwater use or if the groundwater flows in a direction where it would never be used.

Mr. Leon Guerrero: Yes. When we were talking that's the CERCLA process that's the risk management process that would be used instead of having that set MCL.

Chairperson Perez: Thank you. I know will have WERI talking about our wonderful aquifer, and all our water resources in a minute. Maybe that could potentially be a part of the discussion. About where we set these risks assessments, or how we determine the risk assessment, or how we go about doing risk assessments? The other question is. Are you familiar with applicable relevant and appropriate requirements? That concept. What is their significance in relation to PFAS?

Mr. Leon Guerrero: ARARS are associated with the CERCLA process. When you come into a site you come into a negotiation with a responsible party and the regulatory authority. You make decisions. You take a look at what are your regulations. The local, state, as well the federal regulations. You determine which ones, are the ones that would be impacting the site. Those are the ARARS that you would be used, to associate with the data of the site.

Chairperson Perez: It's a negotiation process?

Mr. Leon Guerrero: It's Guam EPA or USEPA saying these are the regulations that must be upheld. You use all your regulations. Even though it's called a negotiation, it's just the process that is needed to be done.

Chairperson Perez: The current regulations that we have are federal regulations which Guam mirrors?

Mr. Leon Guerrero: That's correct for a CERCLA process.

Chairperson Perez: Do we have any other regulations that are more stringent than the federal regulations?

Mr. Leon Guerrero: We do have some of our clean up requirements lower. Not in water division, but in the Air and Land division, RCRA. We do have several that are lower.

Chairperson Perez: Thanks. Should the PFAS investigation be carried out at a site where foam was used, but there are no records supporting that it contained PFAS.

Mr. Leon Guerrero: You're talking about AFFF being used at the site?

Chairperson Perez: Just any foam from unknown contents. Would you recommend that it be investigated?

Mr. Leon Guerrero: Being an Administrator and employee of Guam EPA, I'd err on the side of protectiveness of the community. Maybe some people think otherwise. Based on that question even though there's a lot of variables, if there was an impact that would affect the community health-wise, I would definitely look to try to attempt that. I know it's a sad statement to make, but sometimes money is the driving force to be able to do something. We don't have a lot of funding.

Chairperson Perez: Okay, thank you. Can you explain the role and importance of the unregulated contaminant monitoring rule? The third and also can you talk about the fifth cycle that's coming up?

Mr. Bearden: Well, the third Unregulated Contaminant Monitoring Rule. First of all, for anyone who doesn't know what the UCMR is, it is the mechanism by which EPA begins to establish a new MCL. This is why it's often a multi-decade process. It'll start with a candidate contaminant lists, which is developed nationwide. These are the emerging contaminants that people are concerned with. If it gets on that list, EPA pushes it forward into the next phase, which is to find out how widespread these chemicals are in the environment. They do that by the UCMR where they require monitoring throughout the country. They try to find out if these chemicals are truly widespread in the groundwater, are people being exposed to them. For the UCMR, the sampling for that took place back in 2014 or 15 and included the PFAS constituents in the EPA method 537 at that time. I don't know the total number of those but based on the publicly available data. Anybody can download this off of the EPA website. Based on that data, there is a 109 water wells in Guam that were sampled during that time period. Usually, two sampling events per well and that included a surface water system, the Fena Reservoir operated by the Navy. PFAS compounds were detected in 6 wells out of those 109. The detection is included only PFOS, PFHxS, and PFHA. We did not detect any PFOA, which is the main subject of the EPA health advisory. PFOS is also included in that. That was what alerted Guam to the presence of these chemicals in our aquifer. That's how the importance of that is and that's what triggered. Then of course, the movement by Guam EPA and Guam Waterworks to try to take care of that.

UCMR5 is still under development. There are PFAS compounds that will be included. Nothing is final on that. We can't really provide any detailed information on that. It is still the sampling. It is due to take place 2023 through 2025. As more information becomes available, we'll know more. As far as analytical methods, it is still under development. Up in the air. We're not sure what detection levels will be by that time, but it will give us more information for sure.

Chairperson Perez: To your knowledge you don't know the list of chemicals that are going to be tested?

Mr. Bearden: I've seen a candidate list, but we did not bring it with us, because it's not final.

Chairperson Perez: Of the PFAS chemicals, which ones are listed or are going to be tested?

Mr. Bearden: I don't have that list with me.

Chairperson Perez: Okay and again, you're not familiar with the methodology, and the sensitivity of that methodology?

Mr. Bearden: No and I believe that's still under discussion and development. They've got ideas. They had a webinar last week about it, but they're not yet saying that's firm. UCMR4 is still not kicked off yet here. That's something that was just approved recently by EPA. That monitoring should start later this year or next year.

Chairperson Perez: Was PFAS included in that?

Mr. Bearden: UCMR4 did not include any PFAS chemicals.

Chairperson Perez: How should investigation-derived waste from PFOS sites be disposed of?

Mr. Bearden: I think we asked this question of USEPA. Their answer is that, there's just so little known about this. It is such a new topic that there's no procedures yet. There're no guidelines. It's still something that they're developing guidelines for.

Chairperson Perez: When we filter it out of our water, where should we put that? What are the guidelines at least?

Mr. Bearden: We still do not have guidelines. We don't know what to do with the carbon from these GAC filters that have PFAS contained in it. If we find PFAS in our sewage sludge, we still don't have an alternative yet, for where that would be safely disposed. We're waiting and hoping, as is the whole country at this point.

Mr. Leon Guerrero: Again, because it's unregulated. There are no requirements at this point. If it becomes a hazardous substance, then disposal will be regulated as such, as a hazardous substance.

Chairperson Perez: Can the environmental restoration or ESCA Agreements. How are they utilized to investigate and remediate PFAS?

Mr. Leon Guerrero: CERCLA requires that any responsible party. For Guam it was there are CERCLA sites, or anything that deals with CERCLA, unfortunately, the military. During cleanup and investigation, the proper science behind would be utilized. I know this needs to be addressed for the general public. The sample methods outside of safe drinking water, which is the only one that has been standardized by USEPA. You can modify different methods. Depending on your modification of your lab methods, you can get different results. Without a standardized sampling method of soil sediment, it will be depended on who's actually paying the lab to do the modification and what type of modification they would want.

Chairperson Perez: It seems like there's a problem here. We're making a move towards phasing out PFAS. When we do these cleanups, where are we going to put all of these chemicals. I mean that's a huge loophole. If we were trying to minimize exposure that needs to be addressed. Do you know what the action plan is? How the USEPA going to address that?

Mr. Bearden: I don't know exactly. I do know that they are looking at whether or not this stuff will stay in a landfill. If you put it there or if it will migrate with the leachate out of the landfill and back into the environment. They're looking at all that stuff right now. The science is still developing and until they can figure that out, they won't be able to give us very good recommendations on how to get rid of it. I'm not even sure if you can destroy the carbon with an incineration at this point.

Mr. Leon Guerrero: That's my understanding. I think if it reaches the CERCLA hazardous substance level, which I do assuming it'd be done by this year. Then any contaminated charcoal would have to be disposed as a hazardous substance. What has been done, as Brian mentioned, t has been sent to a facility that can heat it up beyond just regular incinerator levels.

Chairperson Perez: PFAS is an emerging contaminant. What has Guam EPA done as far as consultation with Gov Guam agencies to develop standard operating procedures, pertaining to the use, management, and disposable of these substances?

Mr. Leon Guerrero: Again, working with GWA, GWA has voluntarily decided to remove the exposure of above 70 to the general community. I don't believe any of the charcoal from the GAC systems has been removed due to PFOS. This is because of hazardous substance. It is above their levels and it would have to be disposed of as a hazardous waste. Currently, no exposure from drinking waters are being done.

Chairperson Perez: Have you consulted with other agencies like Airport Authority, Guam Fire Department? Have you taken proactive steps to communicate procedures on how to handle and use, or handle and dispose of?

Mr. Leon Guerrero: At this point, not directly. We're conducting an investigation under the Guam International Airport under ARRF, which we try to look into any of the disposal methods that may have been done. We are currently looking into that, Senator.

Chairperson Perez: What is ARF can you explain for the public? Are permits required for releases into the environment? What is your take on that?

Mr. Leon Guerrero: That's kind of a tricky question. We do not. Releases are not usually planned. Now, if you're talking about something that is being done like the sewer systems and things. Yes, there's a required permit for that. When we talk more about releases, it's more like an accident or an emergency that is established. For PFOS nothing is permitted because it's unregulated. We still do not have any permit process for that.

Chairperson Perez: Is that something you're going to work towards, as far as developing how to handle discharges into the sewage system?

Mr. Bearden: Well, discharges into the sewer system are covered under the USEPA permits for each treatment plant. They have an NPDES permit issued to GWA under those permits. We can let GWA talk to that a little bit more. Under those permits, GWA must have its own discharge permitting program. They have to review and approve any discharge of non-domestic waste. Any kind of industrial waste. That would include any PFOS. I would like to just add. With the Guam Airport Authority, we had discussed this and prior to this investigation, we learned that there may have been some improper disposal. We had been assured that firefighting foam was only used in an accident and for specific training uses authorized by the FAA regulations. That was our understanding.

Chairperson Perez: Has Guam EPA consulted it with ATSDR to develop site-specific response actions to PFAS in the environment?

Mr. Leon Guerrero: Again, through the cooperation of USEPA and also the Navy, we made the request for them to come out. I did not speak to them directly. At this point I've not spoken to them directly. No.

Mr. Bearden: I would just like to add. We have spoken the USEPA about us receiving some ATSDR assistance in risk communication. That's one thing that they've always done. They have staff that are located in the EPA office in San Francisco. That's something they've helped with in the Pacific Islands for many years is risk communication. We have asked for that assistance as well. We can make sure that the public is receiving accurate information and not anything that would cause an unnecessary panic. That's something that ATSDR is very good at. I worked with them in the Northern Mariana Islands before doing that.

Chairperson Perez: Okay thank you. I think that's a list of questions I have.

Senator Therese Terlaje: So, there's testing set by DoD, as Senator Perez outlined. Monitoring is being done by GWA on the wells. Do you do any testing or monitoring in addition to those?

Mr. Leon Guerrero: Unfortunately, not yet Senator. We've had discussions about looking if this becomes a regulated contaminant. What are we going to do? Senator Perez's presentation was so thorough. We've had internal discussions. Exactly what her presentation is showing. What are we going to do about the biota that may be affected? What should we start looking at? We tried to discuss with the AG's office, to ask the Judge about increasing the sampling of the groundwater around Ordot, just to include PFOS, if it's not done already. Ordot is currently, under the monitoring plan, is being done under regulated contaminants. There needs to be a request through the AG's office to ask the Judge to include that as part of the monitoring requirements.

Senator Therese Terlaje: What about when the discovery of A-23 and A-25, that they were contaminated. Then I was reading WERIs report, I think this is from 2018. Back then, they had made some suggestions as to where they would go next to look for the source. We're looking for the source. I'm hoping. So, I'm wondering. Are you involved in looking for the sources of those contamination?

Mr. Leon Guerrero: I've been part of the discussions with WERI. I've tried to work with GWA. There's been a new potential source, but it's not been verified. Since GWA found it, I'd leave that to them to answer. There's a potential new source that may exist.

Senator Therese Terlaje: Why aren't you more adamant about these potential sources. Why aren't we aggressively ruling them out or pursuing whether they continue to contaminate?

Mr. Leon Guerrero: It's somewhat hard to, I know, it all lays on my shoulders. I need to re-budget if I wanted to do sampling out there. Because it's unregulated, I don't have authority to enforce anybody to do any investigative work. It has to be a cooperative agreement. We're looking to do this for the betterment of Guam. I can say that WERI and GWA have stepped up to the plate

on this emerging contaminant. What I would have to do is try to reallocate some of my budget or receive extra budget to start doing investigations of that sort.

Chairperson Perez: Just to kind of recap your position as a regulatory body on Guam. Are you waiting on the federal government to determine MCLs and whether it's listed as a hazardous substance? Are you taking extra actions to go beyond that?

Mr. Leon Guerrero: Definitely for MCLs, we would definitely wait for USEPA that would be our recommendation. As far as the CERCLA process and hazardous substance, I think PFAS and PFOA are contaminants that we should be concerned with. I think it needs to be addressed. I do feel it is being addressed by the federal government. I do think there is a strong possibility that it's going to be part of the hazardous substances list of CERCLA. Most of the issues that we have on Guam will be addressed. What makes me more comfortable is the cooperation at GWA. GWA should not give this as a potential contaminant in the drinking water. Again, being unregulated it's tough for me to thoroughly address it. Working with the Navy at this point, I know that they know it's something coming. It's just a matter what the cleanup goals are going to be.

Mr. Bearden: I would just like to add. On the drinking water side of things. Guam EPA and GWA did take some very proactive action when they found out about the EPA health advisory. On the issue of waiting for an MCL or not we know that you've proposed that bill or you've put out that bill to establish an MCL. Our feeling on that is, that an MCL tends to imply that we're a lot more certain of the science than we are. We agree that action is being taken. We would like to propose as an alternative to call it something other than an MCL. Call it something like an action level, or a response level. Then specify what those responses would be. That we don't allow water to be served to the public that exceeds those limits. Then that would get us the same effect as an MCL without us sticking our neck out there where we don't have the confidence to actually establish an MCL.

Senator Therese Terlaje: Who's responsible for ponding basins? Who tests the ponding basin? Does anyone?

Mr. Bearden: We have an underground injection control regulatory program. It doesn't test ponding basins. It only tests underground injection wells, which would be the under-pavement style ponding basin. If you've got an infiltration basin, that's under the pavement, it has to meet certain criteria. We require those to be tested. It's us. If it's an aboveground open ponding basin there are no testing requirements. We have stormwater design standards that were developed. I worked on that back in the early 2000s with CNMI and Guam. That requires certain types of treatment techniques before it gets into that. We don't do any testing. That would be prohibitively expensive for the public of Guam. It would be almost every establishment in northern Guam that would have to run such tests.

Senator Therese Terlaje: What about the test you're doing on the dry injection sites?

Mr. Leon Guerrero: Can I just clarify that? For ponding basins, we do regulate the building and construction of the ponding basin, but we do not regulate anything post-construction, except for these underpayments differently from the fall injection well program.

Senator Therese Terlaje: Those under pavement. Do you test for PFOS?

Mr. Bearden: No, we do not. We test for a variety of things, oil and grease. Things that we would expect to see in a parking lot. We received quite a bit of a push back from the regulated community on the expense of that. PFAS testing is well over a thousand dollars per sample. It would be very difficult to try to enforce unless we knew that there is a source in that location. That might be something different, but at this point the only sources were aware of. Not something we typically find in a commercial parking lot.

Senator Therese Terlaje: They suggest some sources related to the A23 and A25 wells that lead me to believe. They talk about ponding basins and dry injection wells that were developed because of flooding. This is the same source of water that they're suspicious of. I don't know I'm going to hear from them. It just seems to me that at least in those areas, we can narrow it down. If there's any ponding basin or dry injection well that is contaminated. We are closer to the source, right?

Mr. Bearden: I think what you're talking about there is an investigation. That's a different matter. If we're investigating a potential release, then absolutely, we would want to sample those locations. As a general practice, I wouldn't recommend it for all of Guam.

Senator Therese Terlaje: I'm talking about pursuing the source for A23 and A25.

Mr. Bearden: We have heard unsubstantiated stories that may very much validate that it could have gone through those ponding basins from a different source.

Senator Therese Terlaje: I hope you will investigate those. Thank you.

Chairperson Perez: Thank you so much. No further questions at this time. I appreciate you're being here today. I would like to call up, Senator Hope Cristobal. I apologize you've been waiting for so long, and I appreciate if you can come up to the table. Also, Angel Marquez. We have our community people that are going to provide some information or testimony.

Hope Cristobal, *Former Senator*: *Si Yu'us ma'åse*, Senator and the Committee on Environment, Revenue and Taxation and all the above. *Si Yu'us Ma'ase* for this informational hearing. For the record. I am Hope Alvarez Cristobal. I'm from Tamuning, and I want to extend a *dangkolu na Si Yu'os Ma'ase* to the *Mina'trentai Singko na Liheslaturan Guåhan* for holding this important informational hearing on this very serious topic of PFAS, a dangerous and toxic chemical that has contaminated our municipal drinking water supply. One of the five that were identified as contaminated is back on the grid. The public does not have much information to explain what, if any type of PFAS filtration or treatment system has been implemented, or guidelines recommended to prevent its recontamination. I want to make clear at this point though, that I am not a scientist. I'm not a chemist, nor do I pretend to be one. I am however, an interested and concerned member of our community learning and educating myself about water and soil contamination and one who is currently medicated for cancer. It has been an uphill battle in the past year and a half just trying to obtain existing data currently dispersed across many sources in government agencies to make sense of current and historic levels of water and soil contamination

on this island. When the news broke out a year or so ago, about the central municipal wells found to have high levels of PFAS chemical, it was important to learn more about the safety of our drinking water. The former NAS at Tiyan was my focus, because the source of toxic chemicals is basically found where past military activities occurred. Of course, we all realize that a great majority of contaminated sites on our entire island are within and outside US Navy and US Air Force bases. Senator, I would greatly encourage your committee to expand the breadth of your research to cover all toxic contamination on Guam not just the family of PFAS. By the way, just to share with you, I was able to download from the ATSDR. They have flyers that we can use for the general public to educate on PFAS. I've provided you some copies. I was hoping your staff would be able to provide that for those in attendance here today. I would like to elaborate my concern about contaminations not just for PFAS and I have stated this before here in this legislature that there have been many environmental assessments performed over the years by the military. US Navy and US Air Force, either directly or through private contracts. It is important that the government of Guam in developing good public policy, identify potential and current contaminations with chemicals involved, and educate our public on prevention of health impacts. When enumerated by each of their separate locations. You will find at least a hundred of these sites on Guam. They include Superfund sites. The FUD sites. The Formerly Used Defense sites and Installation Restoration Program sites. For over 75 years of military activity, Guam shares a history of contaminations with other base communities in the States. The difference is that contamination in Guam is more severe than at and around many US domestic basis for a variety of reasons. In Guam there is a high concentration of military bases per square mile. Guam non-sovereign and colonial status, and its effect on attitudes towards our people's health and well-being. Guam having been a battlefield in World War II in a central launching pad for the Vietnam War in particular. Our lack of visibility in U.S. National media, which has helped expose contamination problems in the US and elsewhere. The chemical footprint of the US military is highly predictable and consistent. It includes the use of extremely high volumes of petroleum fuels, including jet fuel, diesel, gasoline, benzene, perchlorate, and their combustion byproducts. The US military used 86 million barrels of fuel in FY 2016, for operational purposes. Air Force bases are the heaviest consumer of these fuels. Extensive use of herbicides to create perimeters around bases and training areas, and to defoliate areas from which, enemy exclusion is sought including Agent Orange. Extensive use of pesticides and military buildings particularly in foreign and tropical environments including, in the past DDT and chlordane. Use of strong solvents to wash down jets, ships, and tanks include trichloroethylene (TCE) or perchloroethylene, also known as VOC volatile organic chemicals. Their health effects include damage to the nervous system and skin especially. These chemicals are easily converted to gas from liquid form and when inhaled damage the lungs. They cause cancer and birth defects. Heavy metals with high toxicity including such things, as arsenic and lead, used in ammunition training ranges, can use rounds, millions of rounds a year. Only some of which is or was collected after it is spent. Radioactive materials using munitions from depleted uranium, to nuclear missiles many of these are used in domestic civilian context of course. What makes their toxicity and impact on human health more severe in military applications, are several things including the idea that national security institutions' needs trump all other institutional and human needs. It allows for less democratic openness. More secrecy in its operations. The related intense investment in military institutions, which allows for higher rates of consumption of the toxins that would otherwise be the case in more resource limited context. The inequality that exists in places like Guam, where the military has chosen to place its facilities. They tend to be in poorer rather than wealthier areas, where residents have more clout in Washington,

for example. The military operates its bases in Guam with the impunity. That comes with its colonial situation, while military personnel are also exposed to contaminants on the bases, and as workers with those substances, often more extremely exposed in those short periods of their deployment, presumably creating incentives to control contamination. Those personnel have limited time on island and exposure to the contaminants, in comparison to Guam residents, lifetime residents of Guam. Between extensive Navy basing around Apra Harbor and Andersen in the north, there is an underground path along the roads and over the northern Guam lands aquifer that runs the oil pipeline that takes fuels from the harbor to the jets and vehicles at Andersen Air Force Base. Off to the side of virtually every road on this island are sites of military contamination. These sites have been variously categorized, military dubs the FUDs, Formerly Used Defense sites. These include sites in use from US invasion and reoccupation of Guam in 1944, after a brief but brutal Japanese occupation. The program was instituted in 1986 to deal with protests of the lethal contamination of land the Department of Defense has owned and operated in the past. I have a reason for bringing these things up. The FUD properties have been found whole tanks, planes, mustard gas canisters, construction debris, household waste, drums of various oil, and other chemical contents, dropped empty, or full in areas throughout the island. Some hazardous wastes are buried. Others bulldozed over cliff sites. Others simply left on the surface to eventually be swallowed by vegetation.

The Department of Defense lists 17 sites of toxic waste or possible buried munitions. Many more have not received recognition. Soil and water tests required and funded by the FUDs program have found extremely high levels of the chemicals that I've just mentioned. Another set of contaminated properties are in areas returned to the Government of Guam or private landowners in the last several decades of the BRAC closures beginning in 1988. These areas of contamination must, by law, be cleaned or more commonly referred to euphemistically remediated with BRAC funds. There we have some precedence. Security fencing or access limiting action, alternate water supplies, relocation of individuals, excavation of contaminated materials, installation of controls on contaminant migration, and other actions consistent with the final remedy. The DoD lists 51 such sites on Guam. Contaminated areas and existing bases fall under the DERP or the Defense Environmental Restoration Program established in 2001. The DoD lists 157 sites in that category, sites on Guam bases, as well as 25 base sites requiring response by the MMRP the Military Munitions Response Program. Andersen Air Force Base has so much toxicity that it is a Superfund site that still is un-remediated completely after over 25 years. A number of areas are considered impossible or too expensive to restore to even limited industrial use and have been cordoned off, presumably, permanently. These dead zones occur throughout the US, but as well as on Guam, though at much higher rates per square mile on Guam. What existing programs do not do however, is require an overview of the entire island's chemical contamination; require study of the cumulative and interactive effect of exposures to multiple chemicals over both short- and long-term periods; require biological studies of accumulation of contaminants in the human body, in the food chain, and other biota of the island; require the DoD present data on how much additional contamination should be expected, as a result of the military buildup, and the live-fire training range complex. While there are a set of processes by which the Department of Defense or the services themselves are supposed to keep affected populations aware of contamination, and cleanup, the data are so vast in scale, so complex, and the incentives to widely disseminate the contamination status of each of these many sites are so low. The people of Guam have been barely informed or not at all informed about this contamination or about the status of any cleanup efforts.

The result is a widespread sense of insecurity, fear of the environment, and particularly of the water and fish of our island. I get the sense that our local officials in charge with caring for the environment and the health of our island community do not always push for more transparency or more action to deal with contamination. After all, how do you hold the US military accountable when we are powerless to prevent their contamination. Last year I was invited to participate in a call for action by the Green Science Policy Institute in Berkeley. More than 6 million people are drinking water polluted with highly fluorinated chemicals. These substances used as stain, water-repellent, and in fighting aviation fires, are associated with serious health problems, including kidney and testicular cancer, thyroid disease, decreased sperm quality, high cholesterol, and decreased response to vaccines.

My dear Senators, there is great need for coordination among Guam government agencies to protect the health of our people. Cancer is racing to the top of the list, as causes of deaths in Guam. After the closure of water wells A23 and A25, located going up the hill to *Sinajana*, GWA no longer monitored the levels of PFAS there. Why? WERI seems all too glad to study the paper trails of contaminations in their annual reports. GEPA and Public Health have not had much to say to the community. We need a coordinated plan, and one has yet to take shape to protect our community and to clean up and to prevent further contamination by fluorinated chemicals, for that matter, any of the toxic substances affecting our health, rendering our soil and water polluted, and poisoned from military activities, were largely responsible for most all contaminations on this island. Education is lacking, in regard to prevention and cleanup of contaminations. We need good government policies. It must always provide a seat at the table for the community voices. We thank this Legislature for continuing to allow our community to come be front and center, in decisions that are important, especially, to our health as you have done today. Senators Perez and Terlaje, I thank you for this informational hearing. What we want to know is what is the government of Guam doing? What is the plan to protect the people from dangerous chemicals, toxic contamination, being perpetrated on a colonial people, by the continued militarization, and contamination of our lands? Where can the people of Guam learn about all the technical information of chemical contamination that is killing us? As you can see there is great need for increased transparency. Guam is an impacted community of PFAS.

We need better testing of our drinking water. We need analytical methods for identifying all PFAS. We need technical assistance for cleanup. We need information on PFAS use. We need support for changing the Milspecs on use of these insidious contaminants. We need a Guam enforceable drinking water standard, that are positive, protective of infants, children, and our most vulnerable community, for the combined total of all detectable PFAS. We need homeowner kits, so we can test our water coming out from faucets for PFAS. The Government of Guam must deem PFAS a hazardous material or substance. Our agencies need clear authority for cleanup. We definitely need more information from the manufacturers and more independent research on PFAS, besides PFOA and PFOS. Guam needs a cleanup plan, not mitigation. I am appalled by some of the answers to questions. Attitudes about we are not toxicologists. There is enough research out there. As a matter of fact, in today's paper, across the US, there are companies now rushing to try to find ways to get rid of PFAS chemically. I don't know how, but it's absurd to hear our own government agency administrators. The attitude in today's paper, which I just received. In Washington DC, Senator Jeanne Shaheen from New Hampshire. She's a senior member of the Senate Armed Services Committee, who has issued a statement in response to the Department of Defense announcement

that the DoD will establish a per and polyfluoroalkyl substance, or PFAS task force, to combat the pervasive problem of PFAS contamination in water supplies throughout the nation that has impacted New Hampshire. With help from these kinds of Senators, I think we need to listen more carefully about what they are doing. Apparently, the new panel will compel substantial changes in DoD's approach to combating PFAS contamination. Confronting the issue requires a multi-faceted approach, which we really should be looking at because it's not just the PFAS that we're struggling against and the contamination and health effects that it has caused to our community. I think all agencies should be part of a team approach. A multi-faceted approach to end exposure, to remediate contaminated sites, and to accelerate research development of fluorine-free firefighting foam, delivering urgently needed answers to the families who are affected about their potential health implications, related to their exposure to PFAS.

I would like to see a more comprehensive approach to address the PFAS exposure for our drinking water. Two wells are too much. The NAS-1. I drive there every now and then, just to watch the people that are around that well. I have quite a few friends that live in that area that are in severe stages of cancer. I'm not able to get the populations that are served by these wells. PFAS is in the water at these two wells. It travels very fast and they must have been there for decades. People were exposed to PFAS or PFOS before it was discovered. We need to have health studies. It seems to me like the Department of Defense has been made to pay for some of these remediations. The Governor says we need to have status, it seems like we could bear on Congress and include Guam. There were 36 scientists at the Green Policy Institute in Berkeley. I was contacted by one to participate in the call for action in Congress. Apparently, they are fully aware of all the contaminations on Guam. A result of that call to action was a 10-million-dollar appropriation out of the NDAA for health studies, for the PFAS health impact study, as well as, some other evasive measures that are being done for those that were impacted, which is unfortunate Guam was included in that NDAA study but it was up to our representative to vie for the money. That did not happen. That was in FY2018 NDAA. It's unfortunate, but I think we owe it to our people to continue gathering information as much as possible and to take it to the higher level. Senators because there's a lot of information in the US. Yesterday, I went to the webinar July 16, 2019. I looked at the notes of USEPA, the Office of Groundwater and Drinking Water webinar. I was looking at the Unregulated Contaminant Monitoring Rule number five. That's where they are at right now. I find out that much of the work is voluntary. For example, the Administrator of our Guam EPA it's up to him to decide where to take our issues. That has to do with the UCMR number five. That process is still ongoing. We'll see what the final rule is in 2021. They anticipated proposal this next summer. The whole process of getting the unregulated contaminant monitoring rule. It seems to me like we have our work cut out. I highly encourage EPA. It's voluntary. The Legislature should be able to make direction with regard to that. *Si Yu'us ma'åse'.*

Chairperson Perez: I thank you for your testimony. I think it's so important that we take more action inserting ourselves in federal discussions, when it comes to these draft reports. We're missing opportunities to really strengthen regulations here, I believe, if we are not part of those discussions, I would like to definitely have a follow-up discussion with Guam EPA, to see where we're at in these federal discussions and see how we can make this stronger here in Guam. How do we address the cumulative effects? What your testimony brings to light. I remember growing up we never drank the water. We drank bottled water. I think that was just from this sense of knowing that our water could potentially be contaminated from all the activity that's taking place

above ground. Anderson Air Force Base is atop of our aquifer. A lot of the sources of water are connected, and we'll talk a little bit more about that. This is something that needs to be addressed. I know PFAS is just a new emerging contaminant but what about the other contaminants that are there. We definitely need to follow up with this discussion as far as what do we do with this. All these contaminants that we've been exposed to and have yet to be cleaned up. Now, we're dealing with one that's increasing. It's gaining more focus. There're more chemicals being produced in this family of chemicals. Thank you so much for your words, research, and bringing this to the forefront. I understand that you're one of the first ones to bring this to light within the community. We thank you for a for following up with us. The next community representative we have Angel Marquez. He has a distinction of working for Guam EPA. He retired recently.

Angel Marquez, *Former Guam EPA Employee:* My name is Angel Marquez. I worked for Guam EPA for more than three decades, mostly in the drinking water. Thank you, Senator for inviting me. What I'm going to share today is my opinion and my purview of the issue. It has nothing to do with my former employer, although I learned this mostly while I was working at Guam EPA. The UCMR3 requires PWC to monitor the source, if more than 10,000 people population. In other words, there were three systems that were not required to monitor the PFOS and PFAS like the Airport, the US Airports, PWSS in the southern GWA water system, because their population are less than 10,000 people. The Airport has more than 12 wells that are vulnerable for this kind of contaminants. There must be a leak requirement, local law, or authority for Guam EPA to enforce mandatory monitoring of this requirement. One-time monitoring for a mobile contaminant is not adequate. As you'll notice it in the result. Sometimes it gives like a hundred, sometimes none detected, sometimes 200 because it's very mobile. It requires a minimum of four quarters monitoring to categorize the status of that particular contaminant, especially, a mobile contaminant. Guam EPA true doesn't have the authority, because there's no MCL to adopt. However, like in many other rules. The lead and copper rule. The MCL is not an MCL, but they call it an action level. The reason is for that is that particular contaminant is required to monitor the contaminants, to prevent or to protect the public health. This particular contaminant, there are so in many ways. They can adopt it as secondary parameter, which they have authority to enforce it or not. What I'm saying here is a mandatory monitoring is a must. Right now, I don't think we know exactly how many wells are contaminated just based on one monitoring. The source of this contaminant. WERI is here on the island that supports us. WERI had been supportive in the implementation of the lead and copper rule on this island. Because of the role that this legislature, this government had passed during that time, Guam, I believe, is one of the states that contain or had the leading copper that is contaminating our drinking water. WERI had helped us. They have their laboratory to do the analysis. Also, the law that you pass prevents the importation of this illegal material to come to Guam. They are being prevented to be used in the drinking water. That's all Senator.

Chairperson Perez: What would you recommend for drinking water for contaminated sites pertaining to drinking water? You were mentioning something in a conversation. You recommend pump and treat.

Mr. Marquez: That's correct—pump and treat. There should be an authority for Guam EPA. I understand there are more than two wells that are being secured, because the public water system chooses not to pump from that well. To protect the groundwater lens, those contaminants might

migrate to other sources or to near wells. Guam EPA doesn't have the authority to require the system to pump and treat, if it was found that a well or that source is contaminated.

Chairperson Perez: Okay, thank you so much for providing your testimony. We're going to have the next group come up. Guam Waterworks Authority and we'll have WERI too come up to the table. If you can introduce yourselves for the record.

Miguel Bordallo, *General Manger, Guam Water Works Authority*: Good morning, Senator Perez and Senator Terlaje. My name is Miguel Bordallo. I'm the General Manager of the Guam Waterworks Authority.

Chairperson Perez: Thank you for being here. When was GWA first made aware of PFOS and PFOA as emerging contaminants?

Mr. Bordallo: Sorry, Senator before we get to your questions. Can I just address a comment on some of the information that was previously presented in your slide, I think Senator Terlaje might be interested in? The information on the *Agana* Heights tank and the sample result. That sample results were not for water that entered the distribution system. That number was above the health advisory level of 70, but when we ran that sample, we were attempting to see if we could dilute water from one of the A-series wells. A-23 and A-25. We isolated that tank from the distribution system and pumped from one of the contaminated wells and blended the water with other wells that had no PFOS in it. The result of that test was the 120, but it was not released into the distribution system. The tank was then diluted further. The well that had the PFOS was isolated. Then we filled the tank until the levels were below the 70 parts per trillion. Then it was released into the distribution system. I just wanted to clarify that. I know that you had expressed some concern about that result. I wanted to correct it.

Chairperson Perez: Thank you for actually reminding me about the results. Going back to the test, the wells that tested positive for PFAS chemicals. What are the current levels now? Have they been tested recently, or what's the frequency of their testing?

Mr. Bordallo: We continue to test quarterly for the wells that are active. Right now, that's just NAS-1 on our system. It's come back at 50 on the raw water, but non-detect after the treatment system. Contrary to what was previously presented, we do occasionally sample and monitor A-25 in support of the WERI study on fate and transport of PFOS in the environment. We chose A-25, because it was the higher concentration of the two wells. That's the one that we've been sampling frequently. A-23 we do not monitor, because the well is offline. We will stipulate that there it's still in the ground there. We find no value in wasting a thousand dollars and conducting the sampling for something we know is there. We're not running into the distribution system anyway. Until we get a treatment system up and running for A-23 and A-25, the sampling will remain as needed to support WERI's study.

Chairperson Perez: The other wells that tested positive. For those six chemicals, there was a perfluorohexanesulfonic acid (PFHxS). Are you testing that as well? Are you continuing to follow that for the wells that tested positive back in 2014-15?

Mr. Bordallo: When we did the initial round of testing in 2015, we did two rounds. Multiple wells tested positive. In 2016, we did some follow-up sampling and the number had reduced. I think we had five wells that tested positive in 2016. The ones that were of most concern, when the EPA lowered the advisory level were A-23, A-25, and NAS-1. Those are the ones that for which we provided the public notice for. The customers who receive water from that system, we did publish and send out a notice to those customers based on their receipt of that water. Then we also posted a notice on our website. There was public notification at that time. Subsequent to that, those are the ones that we have continued to monitor on a quarterly basis. We were operating them, the ones that we shut down as I mentioned. We tested those to support WERI study occasionally, but we did not continue that quarterly monitoring. The only ones that we have been monitoring quarterly after 2018 or after 2016 rather, were the ones that were impacted NAS-1, A-25, and a couple other of the A-series wells. It ended up being non-detects.

Chairperson Perez: That was strictly for PFOS?

Mr. Bordallo: Whatever is in EPA method 537.

Chairperson Perez: The other wells that have tested below the advisory levels, are they still being tested? Are we still detecting PFOS presence?

Mr. Bordallo: We are not, the ones that went below and went to non-detect. USEPA and Guam EPA concurred that we do not need to sample those any further. We did not and we have not detected anything. However, I did instruct staff to prepare to do a comprehensive round of sampling on all the wells that previously tested positive. So, we can get a status check on where we are.

Chairperson Perez: So, we're waiting on those results to see what's present. Is that what you're saying?

Mr. Bordallo: We have not taken those samples yet. We're coordinating with the laboratory. We have to find the money, of course, to do the extra sampling. We've purchased the containers. We had them send the containers to us, but we are anticipating that will happen before the end of the quarter.

Chairperson Perez: Which communities are served by these wells?

Mr. Bordallo: The wells that initially were above the advisory limit, those were the *Tiyan*, *Agana*, *Asan*, and areas of *Piti*.

Chairperson Perez: What about *Sinajana* and *Agana* Heights?

Mr. Bordallo: For A-23 and A-25, the water from those wells goes down the hill and down Marine Drive. It doesn't go up the hill. *Sinajana* was not affected by those wells.

Chairperson Perez: My understanding is that you sent out advisories to these communities.

Mr. Bordallo: Yes, we did, as required and in conjunction and coordination with Guam EPA and USEPA, who helped craft the language for those notices.

Chairperson Perez: If the MCL was, let's say down, to 20, I would like to know what communities would be impacted, if we lower the MCLs.

Mr. Bordallo: We were in support of establishing the current advisory level that doesn't change anything we're currently doing. If it was to be reduced, then we might have to reevaluate, whether or not other wells needed to be provided with treatment systems. At this point, I do not suspect that any would. If you lowered it to 20, I can't be certain, until, we get the results of the sampling back. If an MCL was to be established or an action level was to be established, in accordance with the current health advisory level, which is by USEPA's own admission conservative and protective, we would not be doing anything differently, because we're already treating to that level. We've been very proactive in our approach to dealing with this issue. If it was to go down, I could tell you that there would be cost impacts.

If we did have to put in additional treatment systems, I would look at alternative options to see if we could use other means: if other wells needed to be put online, whether we could isolate those on the transmission line and then provide a central treatment system, as opposed to a distributed treatment system, one at each well site. We would look at measures like that, if there were to be a reduction in the level to which we are treating. At this point, if it was left at 70 parts per trillion in accordance with the health advisory level, we would not be doing anything differently. There would be no additional impact.

Chairperson Perez: Are surface waters being tested from *Fena* and *Ugum*?

Mr. Bordallo: The *Fena* water was tested as part of the UCMR at the point of entry into our distribution system. There was non-detect for PFAS.

Chairperson Perez: Are there plans to do further testing on those waters?

Mr. Bordallo: Only as part of what I previously mentioned about us doing more comprehensive testing in our system.

Chairperson Perez: Can you clarify what non-detect level is?

Mr. Bordallo: So, my understanding of the non-detect level is the level at which an analysis method cannot reliably repeat a quantitative result. It's the lowest point at which, you can get repeatable results. If you don't get reliable, repeatable, results below that level, then it's considered a non-detect. I think currently, it's 2.5 parts per trillion for the current EPA method, that we're using for PFAS compounds.

Chairperson Perez: Just to clarify for the public that doesn't mean it's zero. It's just the level that we can detect it to make that distinction it's not zero.

Mr. Bordallo: That is correct. It is based on the method and the science in the method.

Chairperson Perez: Are there areas that you plan on testing besides drinking water? Let's say biosolids.

Mr. Bordallo: We do not have any plans for the testing of biosolids at this point. We've not been asked to test biosolids at this point. I may have requested our compliance and safety AGM to start looking at that. We have not made any plans to do so.

Chairperson Perez: I've heard of practices where drinking water has been diluted to meet the MCL levels. Is that a practice that GWA engages in?

Mr. Bordallo: Currently, we're not engaging in any dilution. I want to be clear. When we first coordinated with USEPA and Guam EPA in the summer of 2016, regarding the PFAS levels, when they reduced their health advisory level, that was presented to us as a potential remedy to bring the levels down below the health advisory limit. As I mentioned, we did run a test to see if that would work with A-23 and A-25. It did not. The levels were too high. We were hoping to maintain the production level, so that our pressures and our customers would not be adversely affected by pressure levels. We elected to disconnect them from the distribution system completely, because we could not dilute it down.

Chairperson Perez: Thank you. Have you consulted with Guam EPA regarding discharging these chemicals in the sewage system? PFAS chemicals.

Mr. Bordallo: No, we've not had any substantive discussions about that.

Chairperson Perez: What was the determination that was made to allow discharge from Andersen Air Force Base, regarding PFAS chemicals, in the sewage system in 2018.

Mr. Bordallo: I'm not sure. We've received requests from Andersen Air Force Base before to discharge various things into our sewer system. Under our current protocols, we have a pretreatment requirement. We will review the information for the substance that they plan to discharge and determine whether or not it will upset our treatment process, based on our current permit requirements, NPDES permit requirements at the receiving wastewater treatment plant. If the AGM of compliance and safety determines in consultation with our treatment manager, wastewater treatment manager, that there will be no disruptions to the plant, we'll be able to meet our permit limits, we will allow the discharge with conditions. The most recent case, Senator, of foam that was discharged into our sewer system from Andersen Air Force Base, did not contain any PFOS or PFAS. It was the alternative, the newer foam material that was being tested, in one of their hangar systems. As part of the testing procedure, they were required to dispose of this new foam that met was PFAS free. That is the most recent discharge of foam into our sewer system, from Andersen.

Chairperson Perez: Is the sewage system on Guam capable of handling industrial waste? Is it designed for that?

Mr. Bordallo: It is not designed for industrial waste to be directly discharged. We do have a requirement for pretreatment. If industrial wastes are to be discharged into the sewer system. We have requirements that we will make, depending on what the proposed discharge is. We are currently developing a pretreatment program formally, which will require changes to our authorizing enabling legislation. We have drafted those changes that we need. As I mentioned to you in our previous meetings, Senator. We will be providing a copy of that to you once we're closer to getting it finalized.

Chairperson Perez: Would you be able to develop a cost estimate, should the MCL be lowered in the same ballpark as New Jersey of 14 parts per trillion. Would you be able to provide a cost estimate for testing and treatment?

Mr. Bordallo: I think we can develop a cost estimate. The testing would depend on if it was established. How many additional wells might be subject to the testing requirements, number one? Number two, how frequently testing requirements would be if they're more than we're currently testing? I have numbers based on our current operations, but if you were to reduce it, I would need some additional information in order to develop the estimates. Currently, if we were to put in a treatment system, we're estimating right now for A-23 and A-25, the treatment system construction would cost around $700,000 to $1,000,000. Operating the current treatment system, we have at NAS-1, we're estimating between a $100,000 and $200,000 a year for that treatment system. These include estimates of disposal costs, which are also impacted by what the potential regulations might be. These are just estimates.

Chairperson Perez: I appreciate if you can combine a provide a report as far as the estimates, for what it would take for lower MCL. What type of interagency actions have you undertaken with Department of Defense, in regard to these family of chemicals?

Mr. Bordallo: I guess the first interactions we've undertaken is when the National PFAS summit was held with the former USEPA Administrator. I was encouraged by the administrator of Guam EPA to attend that summit. We both attended. We both raised questions as to why in the report that was submitted to Congress that the DoD installations on Guam were listed as no further action required. We questioned that. And at that summit, we also engaged representatives from USEPA that dealt with specifically DoD to request if there were impacts to our local drinking water system. We provided some assistance in dealing with it, in terms of treatment costs and capital costs if treatment systems need to be put into place. We established a dialogue that continued in subsequent phone calls. We continue to have phone calls with various parties, especially in relation to NAS-1. Guam EPA, USEPA, and DoD to try and work out some solution on how we can move forward with covering those costs for treatment.

Chairperson Perez: Thank you.

Senator Therese Terlaje: Just to follow up on that last question. The current testing that DoD's required to do, I think it was reported earlier. They're doing testing. Are you involved in that at all?

Mr. Bordallo: I think we were provided the results of the testing but, we've not been involved in anything beyond being provided the results.

Senator Therese Terlaje: What are the results? Are there any results of concern to you?

Mr. Bordallo: Establishing the source and the removal is of concern to us. We continue to provide treatment at NAS-1. We've seen the levels at NAS-1 dropped to non-detect. We're hopeful that if we continue the treatment and pumping at NAS-1, eventually this will naturally attenuate, and we won't have an issue anymore with that particular well. Outside of that, I have don't have enough detailed knowledge of the results. How extensive the testing program has been we do not have any other concerns.

Senator Therese Terlaje: Did you say that you found the source of contamination for NAS-1?

Mr. Bordallo: No, I said finding the source would, similar with A-23 and A-25, we're doing what we can to treat the water, but until we remove the source, we will continue to have to treat the water. So, if it's possible for us to put some effort into finding the source and removing it. that would help us with A-23 and A-25. That would be a priority for us. It's one of the things that we've been pushing for. We know WERI has presented a proposal for a three-year program to investigate and identify potential sources. We are looking at how we can support that. We can provide some funding in order to do that. I've made appeals to the other entities that we've been discussing this issue with. To see if they could also provide some funding to support the study.

Senator Therese Terlaje: Haven't you over the past few years allowed additional wells to be built on Andersen Air Force Base.

Mr. Bordallo: The permitting process for construction of new wells goes through Guam EPA.

Senator Therese Terlaje: Well aren't you working with them on new wells up there? Are there new wells being built?

Mr. Bordallo: Not in terms of production wells. We did receive grant funding from the Department of Defense to install and to support USGS and WERI in their groundwater monitoring program of northern Guam lens. We did receive grant funding to put in additional deep observation wells. We're in the process of getting those permitted. Construction of those will begin shortly. As soon as we can get all the proper permits.

Senator Therese Terlaje: Deep observation wells. How many?

Mr. Bordallo: Seven new wells and were rehabilitating twelve existing wells in their network of observation monitoring wells. That's the extent of the project that we're currently undertaking using that DoD grant funding. As part of our coordination, we've also undertaken the maintenance of all of the observation wells that are outside of the DoD fence line. We're encouraging them. They've agreed to take over the maintenance of the observation wells inside the fence line. I think Dr. Jensen might agree, previously, there has not been a whole lot of resources put into the maintenance of those wells. We see the importance of them to the natural resource and our

stewardship and management of that natural resource. So, we're undertaking the maintenance of those of the wells outside the fence. So, that we can continue and enhance the program that's already been started.

Senator Therese Terlaje: Do you receive reports on what's monitored in those wells?

Mr. Bordallo: We received the information that WERI and USGS provide.

Dr. John Jensen, *Director, Water and Environmental Research Institute of the Western Pacific*: I can respond. I'm John Jensen and Director of WERI. The purpose of those wells. The deep observation wells is to monitor the volume of fresh water and the salinity of fresh water and its responses to natural changes in the recharge. Droughts, storms, and that sort of thing. It's our window into the aquifer, for identifying how much water is there, and what the quality is, in terms of salinity. They're not there for monitoring chemical contamination. They're not routinely sampled for that. There we get quarterly data. We get quarterly data on the thickness of the lens and the profile of the salinity in the lens, a recent study just we concluded that showed some interesting results.

Senator Therese Terlaje: It was my understanding from earlier presentations that there is monitoring going on Andersen Air Force Base for chemicals. Are any of you privy to those?

Mr. Bordallo: I don't receive any. I don't believe I receive any data on that, Senator.

Senator Therese Terlaje: EPA, do you receive data on any monitoring in Andersen Air Force Base for chemicals?

Chairperson Perez: If you don't mind coming to the table, so we can hear your response. Thank you so much.

Mr. Leon Guerrero: The studies that the Navy are doing up at Andersen? Correct. We would be receiving them. We received some of the initial data. To be quite honest, I'm kind of shocked at it. If I could ask Dr. Jensen, what could be going on. I do know Andersen, much like NAS-1 or Tiyan has firefighter training pits that the Navy has acknowledged that they used AFFF that has PFOS and PFOA. They're non-detects up at Anderson that they've presented so far. I'm skeptical of why. I just need to look into how they took their sampling plans were put out.

Senator Therese Terlaje: So, they're all non-detect so far.

Mr. Leon Guerrero: The ones that they've reported to us. Correct. Those are their production wells. They're still going to be working on doing a sampling of some of their monitoring well systems.

Senator Therese Terlaje: There are wells like a Leo Palace. Is that right? Private well.

Mr. Leon Guerrero: It might be a private well. We have the entity that has them monitored and we receive results. Yes.

Senator Therese Terlaje: Are we aware today of all the wells that contain PFAS?

Mr. Leon Guerrero: I can address with production wells that we've monitored, GWA, and the Navy monitored we got results in. We are very confident, especially on the GWA side of where they exist. We've not done a lot of sampling. We've just monitoring those systems.

Mr. Leon Guerrero: Is that possible or is it helpful?

Mr. Bordallo: To sample from monitoring wells? I think not for GWA purposes, but I think it would be helpful for purposes of identifying or investigations, to support it. If the monitoring wells were existing. I believe that would be helpful, but I'm kind of out of my depth on that.

Senator Therese Terlaje: Dr. Jensen, I know that's an arrangement that was made with your WERI and USGS, I think you said. Is it still possible to get that to be part of the arrangement that those wells would be monitored for chemicals also?

Dr. Jensen: The deep observation wells? They're designed for monitoring the thickness of the lens. They go all the way down to saltwater. They're designed to monitor the effects of changes in recharge and changes in pumping. They're not they're not optimally place to monitor chemical contamination. Generally, a monitoring well is placed for a specific purpose. To monitor a specific threat that's already been identified. They're expensive to maintain. Generally, you want to put it in a place that minimizes the expense of maintaining it. It wouldn't be really practical to use the deep observation wells for a chemical monitoring.

Senator Therese Terlaje: How long has A-23 been offline?

Mr. Bordallo: A-23 and A-25 have both been offline since about August, third quarter of 2016.

Senator Therese Terlaje: What's the earliest detection of PFOS in those wells? From this WERI report, I'm reading it looks like 2015. Do you have anything earlier?

Mr. Bordallo: No, 2015 is when we did the first round of sampling under the UCMR3. That would be the earliest data that we have.

Senator Therese Terlaje: What was in the notice that was sent out? I'm just curious. You said you sent out a notice to those customers who would be receiving water from those well?

Mr. Bordallo: It was a statement that they may have that the EPA has established it in the health advisory level. The water that they received may have exceeded that level. It had some information on the effects, what was known at the time of the compound that was potentially in the water. It was standard language that was provided to us by USEPA and Guam EPA. We coordinated the language in the notice before it was sent out.

Senator Therese Terlaje: I've heard you say either today or at the hearing we had in the Session Hall these wells have very good production levels. You'd like to get them back online if it's

feasible. Then I heard you say today that you were going to do another round of testing on all the wells that had tested positive previously. Not on all wells on Guam. Just those.

Mr. Bordallo: I have to balance how much extra cost that is. What seems prudent is to go back to the ones that have previously tested positive. Take a look at where they are.

Senator Therese Terlaje: Going back to the two wells. Getting them back online. So, WERI had proposed potential sources of the PFOS. I heard you say today that they have a plan. I think I heard them say that before that they also have a plan. They're looking for resources from GWA. Is that what's going on? I want to know some of these things looks like they could have been done before. What has GWA done to investigate the source of contamination for A-23, A-25, and NAS-1. What is the source of, do you know?

Mr. Bordallo: Our role is primarily to make sure that we're treating the water to a safe level. I don't view our role as the investigation authority on this. We have an interest in finding out what the source is, so that we can remove it obviously. So, that we can reduce the amount of time that we would have to treat and get rid of the source of contamination. My staff and myself, we've tried to be of assistance to both WERI and to Guam EPA in trying to come up with information about what the potential sources might be and in consulting with Dr. Jensen would it be feasible in terms of the hydrogeology whether the contaminants might flow in that certain direction. So, that's the extent to which we've investigated. We did receive some anecdotal accounts of a potential source for A-23 and A-25 that was in the 80s. Apparently, there were some public outreach activities that were conducted at the *Agana* Shopping Center, which included the use of the foam use of firefighting foam as a demonstration during fire prevention week. We heard anecdotes from two different sources. We then attempted to see if we could get any archived information about those events. We did manage to obtain some photographs, which show a fire prevention event at the *Agana* Shopping Center with a handwritten inscription on the page in a photo album that said treasure hunt through the foam, which indicates that there would be some foam that was used at that time. That might be a potential source. We've presented that information and I've advised doctor Johnson of that. With the idea that in the study that has been proposed to identify the sources, this might narrow it down to an area that we could actually do some testing, results, and facts out of that information.

Mr. Leon Guerrero: Senator, if I could interject please? You asked about NAS-1. There may be other potential sources. Navy has agreed that during their firefighting operations up at the NAS they did use AFFF. That is why they agreed that the environment was exposed to it. They've agreed that they are a responsible party for the groundwater up there.

Senator Therese Terlaje: Dr. Jenson can I follow that with you? In this report that was done in about 2018, there were a couple ideas. One was to do a very quick test of the soil up at the where the Korean Air flight. Had that been done?

Dr. Jensen: Let me defer to my colleague Dr. Kim, who is our PFOS expert. He has taken over the line of research that Dr. Denton did until he retired. He is the person who is in charge of our current research program.

Dr. Barry Kim, *Assistant Professor, Water and Environmental Research Institute of the Western Pacific*: My name is Barry Kim, Assistant Professor at WERI. WERI has conducted two PFAS research projects. We launched the first project in 2017 to monitor well A-25 on a monthly basis to identify the relationship between a rainfall event and PFAS level. Based on this research, we found there is high correlation between a high rainfall event and higher PFAS level. Based on this preliminary result, we concluded some PFAS is impacted somewhere around well A-25. After that we prepared another research in collaboration with the University of Rhode Island. After a literature review and a hydrogeological survey around well A-25, we selected a total of 22 potential PFAS contamination sites. In case of PFAS, what we know PFAS is usually found at firefighting training centers or a PFAS manufacturing site. We didn't find any of these sites around well A-25. So, the alternate way was to find some incident extent area, like the Korean Air crash site. Based on a literature review, we knew that there was a wastewater leaking in GWA wastewater pump station near *Chaot* River. We defined these two sites as points to search for potential PFAS source points. That was not enough. So, based on other literature reviews, we selected other nonpoint source points, like ponding basins and some river channels. Based on these ideas, we selected 22 potential PFAS contamination sites.

Chairperson Perez: Can you clarify? So, you detected PFAS in sewage?

Dr. Kim: After we collected soil and sediment samples, we found PFAS from *Chaot* River and one ponding basin in *Agana* River just behind well A-25. So, PFOS level was around 4.5 micrograms per kilogram. Kilogram means the soil weight.

Senator Therese Terlaje: All right, the other ones that were in this report are ruled out? For example, the site of the Korean Air flight crash, the *Sinajana* fire station, and *Agana* Swamp. Those were ruled out as potential sources?

Dr. Jensen: Well, they're not entirely ruled out. Those are hypotheses. The places to look. There's a lot more looking that needs to be done. As Mr. Bordallo mentioned, we don't know much about the history. The usage in these areas. If there were releases of firefighting foam in the *Agana* Swamp, it's entirely feasible that these wells are down there on the edge of that swamp could be drawing material into what we call the radius of influence of the well.

Senator Therese Terlaje: Where is the A-25 well located? It looks like it's on Route 4.

Mr. Bordallo: It's on Route 4. It's at the bottom of the hill. A-23. If you're driving up just past McDonald's. If you're driving up the hill. A-23 is on the left-hand side and A-25 is on the right-hand side.

Senator Therese Terlaje: So, you've confirmed that *Chaot* River.

Dr. Kim: I do not say are we confirmed. We just took soil samples just one time. That's why we say it's a preliminary study. To conclude if these sites are fully contaminated, we need to conduct further investigation. Taking more samples.

Senator Therese Terlaje: Somebody had said that the testing is $1,000 a shot. What kind of testing and what kind of prices?

Dr. Kim: WERI has spent around $130,000 for these two researches. Our main problem is we don't have the instrument, we call liquid chromatography mass spectrometry. PFAS analysis cost is about $500 per sample. Its cost is very high. We have around $100,000 Research Fund. So far, we only analyzed around 50 samples because of limited funding. That's the main difficulty.

Senator Therese Terlaje: I appreciate your answers. Thank you very much. Walter, you confirmed about NAS-1. WERI is not doing any research in regard to NAS-1?

Dr. Kim: I mentioned before that's because of limited funding. The reason why we focused on well A-25 is because it is the most contaminated well.

Senator Therese Terlaje: GWA is there an observational well on *Tiyan*?

Mr. Bordallo: I'm not certain of that, Senator.

Mr. Leon Guerrero: There are monitoring well systems. One specifically for the dumpsite that exists up there and the other just to continue to look at the groundwater. It is for the previous TCPC contamination that was existing there.

Senator Therese Terlaje: Can we add PFOS testing to that if you're already testing there.

Mr. Leon Guerrero: That's just in the works.

Chairperson Perez: Is there anything that we didn't cover? As far as your studies and your proposal to do more testing.

Mr. Leon Guerrero: Guam EPA paid their contractor to do a work plan. The work plan wasn't passed through GWA, but we got their concurrence to do it. We're looking at some of their sludge to see what exists for doing a compost pilot project that would include sewage sludge. We needed to make sure the sludge is at least acceptable. We did test for metals and PFOS in it. We can give you the data on that when we get it.

Chairperson Perez: Thank you so much. I have a couple questions for WERI. Thank you GWA and Guam EPA for coming back. What are the challenges of identifying the source of PFOS? Knowing what you know about the hydrogeology of Guam and the properties of these chemicals being mobile. What are the challenges in identifying the sources?

Dr. Jensen: Well it's a process of elimination. For any given place where you find it there could be any number of places upstream or the ground waters flowing from, where a given contaminant could enter the system. You have to look at all of those. The more fundamental question is how to identify the footprint of the material, as it's traveling through or where it is starting out in the system. I'll defer to Dr. Kim to give you a little summary of the work, that he's doing now. He has a student working on a project related to this. I'll Let him explain some of the details of that.

Dr. Kim: WERI approaches research based on fact that is the reason why we have focused on PFOS contaminated well, mostly, well A-25, because we have data from USEPA. If we can get more information, for example, firefighting stations if they used firefighting foam, then if there is some data, then we can easily find potential contamination sites. As I said, it's based-on facts and what we found from literature review and then open data. We heavily researched.

Chairperson Perez: You're talking about footprint. Let's just talk about the different sub-basins within the aquifer. You're talking about the *Agana* Swamp what are the boundaries of that sub-basin?

Dr. Jensen: We brought a map. We could break that out and show you. The six basins in the aquifer are separate watersheds. For instance, the flow in the *Upi* Basin, where the Air Force Base resides is entirely independent from the flow down south in the *Hagatna* Basin. Actually, the *Hagatna* Basin. We're thinking of dividing into two separate basins, because some of the water goes to the Pacific side and the other water goes to Philippine Seaside. About the boundaries, the boundaries of the basins are the heavy blue lines there. You can think of those just like the *Talofofo* Watershed in the South is different from the *Ilig* Watershed. The water doesn't cross over from one to the other. That's pretty much the case of these groundwater basins.

Chairperson Perez: Specifically, about the A-23 and A-25 wells. We're focusing on the *Hagatna* Basin, sub-basin area. What is the highpoint in that watershed or sub-watershed? Sorry do you mind, if we just take a brief recess, so, we can set up the map. It's time to have a break too as well. Thank you.

Chairperson Perez: Okay, thank you. We're back on from recess. Thank you for your patience, for those that have stayed to finish the hearing. We left off with talking about footprints regarding the A-23 and A-25 wells. We're just going to try to focus in on the map. If we can continue that discussion as far as A-23 and A-25 wells? Dr. Jensen can you just highlight possible footprints considering that PFAS is mobile? How would it flow within that sub-basin?

Dr. Jensen: Well, let me start by getting a little bit of background. The flow pathways in this aquifer are complex, because it's a karst aquifer. There are three types of permeability, we call matrix permeability, which is the inter-granular permeability. Then there are fractures through that. There are conduits and cave systems that are formed around some of those fractures. So, the plumbing can be complex. The contribution that WERI can make to the discussion here is that our work can help identify the mobility, the persistence, pathways, and responses to natural phenomenon, such as rainfall. One of the interesting things that came out of the study with the A-25 contamination levels was that after heavy rain it goes up, but it takes about a month before it goes up. When it's dry, it decreases. We don't know what's going on there, and we learn more about the plumbing in the aquifer by studying those sorts of things. It's a process of elimination. You have to understand the system. The other thing that stands out is that the history of the responses of these wells is different. Even though A-23 and A-25 are fairly close to one another, they show a difference in contamination levels and difference in behavior.

Dr. Kim: There are two hypotheses. Groundwater generally flow from *Agana* Heights toward *Agana* Basin. That means if PFOS is impacted in *Agana* Heights area, then that's a reasonable assumption, PFOS by high rainfall event, then PFOS is dissolved and migrate towards well A-25. Based on hydrogeologic analysis in the ponding swamp area, the actual hydraulic gradient is very low. That means, depending on tide effect, or if the pump was operating, then there is a water draw down in the well. Then, there can be some reversed groundwater flow from *Agana* Swamp or *Agana* Mall area toward well A-25. Based on two hypotheses, we are approaching how to find the contamination site. Based on the analysis of the PFAS level at well A-25. There should be PFAS contamination sites. Right now, we don't know whether there is only one, two, or multiple contamination sites, they should be around well A-25.

Dr. Jensen: It's made further complicated, by the fact that there could be more than one source, or more than one location, which could have been deposited at different times in the history. This goes back decades. There could be one source that's mobilized when there's a heavy rainfall. Then it sits there and doesn't do anything. Then another source that is somewhere else is responsive to the reverse hydraulic gradient, when you're pumping. That can change when the tide level changes. It can change, if there's a long dry period and the gradient shifts a little bit. It's very complicated.

Chairperson Perez: If you can just talk about the details of that study? What sites were sampled in that study?

Dr. Kim: We chose two points of service on GWA wastewater pump station, near *Chaot* River. The other site was the Korean Air crash site. We didn't find any PFAS from Korean Air crash site, based on just one-time sampling. In the case of the GWA wastewater pump station, we found sewage hole next to the pump station, we found a high level of PFOA. The level was 6 microgram per kilogram. For other nonpoint sources, we collected samples from *Chaot* River, *Fonte* River and an *Agana* ponding basins. We sampled near the contaminated wells. For example, stormwater drains in front of McDonald's. Then there is also the parking lot for Guam Auto Spot. We collected some samples from there. We also collected sediment samples from the *Agana* Swamp and the *Agana* River. After collecting all samples always, we shipped this samples to University of Rhode Island. They analyzed all samples. The contaminated was shown from the *Chaot* River sample. We found the PFOS level up to 4.37 ug/kg. The other site was a ponding basin in *Agana Heights*. The level was 4.75ug/kg.

Chairperson Perez: So, it can potentially support your first hypothesis. That it's coming from?

Dr. Kim: Some ponding basin. One ponding basin just behind well A-25. That's my hypothesis, but like I said. It was just one sampling. We need to do more research to confirm.

Chairperson Perez: That's interesting because you found PFOA. In the water wells they tested positive it's PFOS.

Dr. Kim: It is interesting because we haven't tested, using wastewater before. What we can assume is, when wastewater was leaking ten years ago. Wastewater might flow toward *Chaot* River. It may affect but we don't know exactly why PFOA was detected from the sample, right now.

Chairperson Perez: Where the other chemicals as detected as well? Like PFOS? PFHxS?

Dr. Kim: Yes, from GWA wastewater pump station. PFHxS was detected and the level was 5.5 micrograms per kilogram.

Chairperson Perez: There seems to be an inconsistency, because the wells didn't test positive for PFOA. Then we're seeing that in your soil sampling we don't see PFOS, which we see in the water. We do see in both sources PFHxS. That's another mystery. I think that needs to be solved as far as the source.

Dr. Jensen: Once you start digging into this, it becomes more and more complicated.

Chairperson Perez: Is there a connection as far as breakdown product between PFHxS and PFOS?

Dr. Kim: There are two different groups perfluoroalkyl acid and perfluoroalkyl sulfonate. That means the terminal group is different. Many researchers are conducting breakdown studies. Finally, many researchers say, PFOA and PFOS are the final product of the breaking down from higher carbon molecular.

Chairperson Perez: What about perfluorohexane sulfonic acid?

Dr. Kim: Based on the carbon chain, PFHxS has six carbon chains. That means the number of carbon chains are lower than PFOS. That means PFOS can break down further. Based on research, the fluorine and carbon bond are very strong. We don't know whether this chemical came from the original product or the result of breaking down from other chemicals.

Chairperson Perez: PFHxS has less carbons than PFOS? Potentially that could be a break down product from PFOS? Right. There are no studies to show that.

Dr. Kim: I have not read many papers about this research. So far, many researchers have focused on PFOS and PFOA. Researches are talking to other PFAS chemicals.

Chairperson Perez: What can you tell us about PFOS and its interactions with the environment? Does it aggregate with let's say soil easily or just it pretty much flows with water?

Dr. Kim: Based on my basic understanding about the organics, PFAS easily interact with organic soil. I assume the rich organic soil are in ponding basins or some river channels. These sediments can be a good source of holding these chemicals. In the case of limestone, I don't think limestone has a high capability of holding these organic chemicals. We need to conduct more research on that.

Chairperson Perez: What are your recommendations for testing PFAS in the environment?

Dr. Kim: So far, I have collaborated with the University of Rhode Island. Currently, the sampling method is to collect a water sample or sediment sample and use a chemical instrument to analyze.

In the case of soil samples, they extract using solvent and then analyze it using mass spec. WERI is collaborating with the University of Rhode Island. They are developing some field PFAS samplers. Right now, we are testing these samplers on Guam. We haven't got any result, but eventually if we have to measure PFAS concentration from some environment like a river channel or of ponding basin then we can apply that technique to Guam.

Chairperson Perez: What are the challenges for gathering information regarding PFAS? We kind of touched upon this.

Dr. Kim: We always conduct research based on the open resource. If local agencies or federal agencies don't open any information, we can't utilize that kind of information. That's the limitation.

Dr. Jensen: Let me add. I think one important constraint is the fact that we have to send these samples off island and pay $500 to $1000 for the testing. Where we to expand the laboratory at WERI and be able to add the additional instrumentation and staffing, which we are right now writing into our strategic plan, we would be able to process that stuff right here on the island with our own local talent and labor. That would be a big step forward. Contributing to the volume of material that we cover.

Dr. Kim: For two years we have conducted this research. Getting analysis data from off Island. that was the most difficult part. Although, we have collaborated with the University of Rhode Island. Depending on their schedule, data could be delayed. The best option for PFAS research is to set up LC/MS lab on Guam. Then, we can actively conduct PFAS research. Thank you so much for being here and for your testimony.

Chairperson Perez: Thank you very much. If I can call back, Administrator Walter Leon Guerrero, I have a question actually regarding bottled water. Are there any attempts to standardize testing of bottled water in the US and what are some of the challenges of testing bottled water?

Mr. Leon Guerrero: So, for the consumable bottled waters that you buy at the store, the small ones, even the gallon ones that aren't processed on Guam, we do not have any regulatory authority. Maybe, Public Health might have for the facilities that actually use Guam water and bottled that. We have started our sanitary surveys into their facilities to ensure that they are providing safe and drinkable water. We weren't doing that in the past and we just started it up in the last three years for the small bottling companies.

Chairperson Perez: Is PFAS going to be tested?

Mr. Leon Guerrero: Unfortunately, I will take the blame. I have not had that mandated yet and I will do that when we move forward.

Chairperson Perez: By setting a maximum contaminant level would that require that it be done?

Mr. Leon Guerrero: Again, Senator, instead of using the word MCL, I would prefer to use the term regulatory level and we could enforce it as an MCL. Just to use the term MCL, I do not think

would be appropriate. We can do a regulatory goal or regulatory level, which would serve the same purpose, as what an MCL does. Until we have the validated data, to actually say this should be the MCL.

Chairperson Perez: Thank You for coming back. I would like to call up Guam International Airport Authority and Guam Fire Department. For the record, we did ask Department of Defense. We invited them to come to this hearing. We did provide them questions in advance. They did respond and that would be a part of the record. We are going to proceed with questioning with our local entities with the intention of identifying the origins, uses, and management of PFAS in order to reduce exposure to our community.

Ray Santos, *Assistant Fire Chief, Guam International Airport Authority*: My name is Ray Santos. I'm an Assistant Fire Chief for the Airport Fire Department.

Paul Packbier, *President, PCR Environmental:* My name is Paul Packbier. I'm the president for PCR Environmental, a local environmental consulting company and consultant to the Airport Authority. I'm a chemical engineer by education. Thirty-three years ago, in the not-so-great state of New Jersey, I got my degree. I've been almost 30 years on Guam. I've been running the NAS-1 treatment system for the Airport for approximately 15 years. We've been implementing long term monitoring for groundwater underneath Tiyan to look for contamination there.

John Quinata, *Deputy Executive Manager, Guam International Airport Authority:* Good afternoon Senator, I'm John Quinata. I am the Deputy Executive Manager for the Airport.

Chairperson Perez: Thank you for being here. I'm going to ask a series of questions and you can respond separately. My concern is the use of firefighting foam that contains PFAS. To your knowledge, what was the origin of these firefighting foams that was used? Have you used these compounds or are they in your inventory currently?

Mr. Santos: Yes, they are.

Chairperson Perez: How far back has it been used and what types? Has it changed in the period of time, because there has been changes to the formulations? What type of firefighting foam did you use and are currently using?

Mr. Santos: Since 1995, since GIAA first took over NAS, it's been the original MIL-SPEC form of AFFF, which was the longer chain of the fluoro-chemical. Within the last six years, I suppose. the FAA had referred to a shorter chain MIL-SPEC, which is enviro-minded. From that point on, we've been using that particular version.

Chairperson Perez: The older legacy foam, did it contain PFOS, just to clarify? The first foam that you use in 1995, did it contain PFOS?

Mr. Santos: Yes, in order for foam to be considered film forming it's going to have to have PFOS.

Chairperson Perez: Okay and do you still have that in your inventory?

Mr. Santos: Not the legacy. The majority of the foam would be the new MIL-SPEC.

Chairperson Perez: That the modern version?

Mr. Santos: Yes, the C6 version.

Mr. Packbier: If I may add, all the manufacturers are going towards the shorter chain PFAS. However, the manufacturing facilities are the same. They don't tear down the factory to start a new process. This particular group of chemicals we're looking at are in extremely low levels parts per trillion. Industry thinks that we're going to find larger PFOS and PFOA chains in the newer generation foams for probably years to come. Yes, we're using an enviro-minded formula right now, but they're probably going to be some molecules of the older stuff still in there, before it gets out of the system industry-wide.

Chairperson Perez: Through that time period has your management of using this foam, management and disposal have the procedures changed since 1995?

Mr. Santos: As far as disposal, we don't dispose of foam. Foam is discharged on an annual basis for testing. It's hard to keep an inventory to keep it to the level to where the FAA requires us to have it. Disposing of it is not a thing that we do. Buying foam on an annual basis, is only to replenish what we use for testing.

Chairperson Perez: When you test, you're releasing it, but where is it released?

Mr. Santos: It's discharged on through the into the environment. Outside on the on the ground.

Chairperson Perez: There hasn't been any type of procedures as far as to contain it when it's discharged?

Mr. Santos: No, we don't have the capability to contain it. It's an emerging chemical. The environmental issues have not been brought to light until recently. As far as us keeping it to a point to where we contain it, has not been an issue.

Mr. Packbier: The Airport has requirements. FAA promulgated ones, mandated once. We are a certified Airport. They have to use this foam. There's no other option available. As far as stormwater management and infiltration into the ground, because it's an emerging chemical not necessarily a contaminant at this point, we're looking into different ways how can we meet the testing requirements the mandated requirements, as well as keep this family of chemicals from entering our environment. There's some equipment retrofitting that may be able to be installed on some of the fire engines that would eliminate the need to discharge the foam onto the ground. The Airport is pursuing that. When there is a need to use the foam during an accident how can we as best as possible contain it and recover it. When possible drum it and ship it off Island. We're looking at what's referred to as best management practices in the industry.

Chairperson Perez: Okay, that's great. You're working on improving your practices, as far as containing. How much of the volume has been discharged? Can you estimate how much has been discharged into the environment over the period of time?

Mr. Santos: Each vehicle is tested to a certain discharge rate. Each vehicle discharges about 1,000 gallons of product. However, to put it into perspective, only 3% of that is AFFF, because it's discharged at a proportion rate of 3%. The concentrate in that 1,000 gallons would be only 3%.

Chairperson Perez: How often is that done?

Mr. Santos: Annual testing. Once a year. Yes.

Chairperson Perez: Okay. As far as volume is concerned. How many?

Mr. Santos: 3,000 gallons a year. Yes.

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Mr. Packbier: 3,000 gallons of foam. Then 3% of that 90 gallons of AFFF.

Chairperson Perez: What year was the legacy foam discontinued in use?

Mr. Packbier: The original version. I don't know the year. I know the shorter chain, that's being brought online now, as the Captain here mentioned. They started bringing it in eight years ago. That's industry wide. There are about 49,000 airports in the world, that use AFFF. However, AFFF is the 3% number that keeps coming up. Only 3% of all PFAS manufactured are used for AFFF. 97% of PFAS chemicals end up in other types of products, like consumer products that we use every day.

Chairperson Perez: Is there a way to minimize the amount of releases, when you're doing the annual trainings? Is there a move to reduce that amount?

Mr. Santos: There is, like he was saying, from this point forward, there's this a new tester called an input base tester, which involves no foam. From this point on, we should be able to test our systems without discharging any kind of foam at all. It'll be measuring water as a medium versus what was foam before.

Chairperson Perez: That's good to hear. Would you be able to identify any drains, ditches, or ponding areas that might have migrated upon discharge?

Mr. Packbier: The Airport has two very distinct stormwater management systems. The terminal what we call North Tiyan, as well as, the East Sunset Boulevard. The runways pretty much all drain, water collects and gets discharged into the Harmon Sink. If you go down Airport Road towards Marine Drive, this big ditch on the side of the road that's the storm drain for the Airport. That system is permitted by USEPA under the NPDES system. We talked about that with Guam Waterworks before. This South Tiyan site, where ARF is, that area is mainly serviced by ponding basins in conjunction with underground injection control wells, when storm water flows through ditches or larger areas allowing the water to percolate down, then into actual wells, that have been

drilled down to about 100 feet below surface level to increase the percolation rate at South Tiyan site. We know every single storm drain, catch basin, drainage area. It is well mapped out and laid out.

Chairperson Perez: If we were to clean up those areas, how do you see that taking place?

Mr. Packbier: The exposure pathway for PFAS, or some of the PFAS is mainly through drinking water. That's the largest potential risk. So, that's groundwater that's produced as drinking water. Of course, we have NAS-1 well. Then the airport has three additional production wells. One of which has been taken offline for a long time fortunately because of previous contamination. At the airport, it was caused by the Navy at that time, TCE and PCE, two chlorinated solvents. The NAS system has been operating through a GAC, Granulated Activated Carbon treatment system. The new production wells were built with a treatment system. So, all groundwater is treated prior to becoming drinking water. The question is knowing that there are areas where AFFF has been discharged, there may be remnants of these chemicals in this soil. These chemicals are very different from any other contaminant that we as an industry have been tracking, tracing, and mitigating for years. It adheres to certain soils. It's soluble in water. Although, it's also very resistant to water and oil. It moves really fast, but then also sticks around for a very long time. Are we going to focus on trying to dig soils out and ship them off island, or we're going to look at what is the risk and keep treating the groundwater? Do what's referred to as a pump and treat, as a remedial effort.

Chairperson Perez: Do you have any procedures as far as disposal or emptying out holding ponds, tanks, or other containment areas, regarding PFAS?

Mr. Packbier: I'm guessing you mean if ponding basins were sampled or the sediment? If PFAS were identified, how to remove those?

Chairperson Perez: Yes, that's correct.

Mr. Packbier: At this point, the only way really would be dig it out and haul it away. You move it to a permanent solid waste facility on Guam, landfill, hardfill area, or you would have to ship it off Island. It is the only two options.

Chairperson Perez: What is the status of your investigation? There was a July 8, 2019 article in the Post. There was a barrel that was shown dumped some sort of chemical in the storm drain. What is the status of that and the response? What actions are being taken currently?

Mr. Quinata: It is still ongoing with EPA. That is still an ongoing investigation. It has not been closed yet.

Mr. Packbier: The Airport did meet with EPA. We believe it wasn't foam or chemical, necessarily being disposed. It was at most it was an empty drum that is kept on hand to store the AFFF when needed, but it was used to store water for training purposes. That water was drained into that drain and unfortunately it appears that it may of have some AFFF remnants in it. Unfortunately. not a huge risk issue, because there wasn't a lot of product in that particular drum.

Chairperson Perez: Thank you. We will be hearing from EPA about the results of that. Are you in the process of developing an action plan for transitioning to non-fluorinated foam in anticipation of the requirement under the 2018 FAA Reauthorization Act?

Mr. Santos: Because of that reauthorization act, it's October of 2021 to where the FAA will start referring to a PFO free foam. Until then, is when we would start transitioning to it. To our knowledge, with communication with the supplier for our foam, it's a challenge, because the whole world is looking at purchase it now. However, when the FAA does mandate it, we will comply, and the entire inventory would have to be swapped out.

Chairperson Perez: Do you have any estimated cost as far as cleanup is concerned, regarding this chemical, or even replacement of what you have in stock to this non-fluorinated foam?

Mr. Santos: There isn't even a value on it yet. That's how new it is. However, a barrel of the stuff that we have could be anywhere from $15,000 to $2,000 depending upon the time. We don't know what it's going to be with the non-PFO foam.

Mr. Packbier: Then the treatment of the groundwater at this point, which Guam Waterworks is operating, the wells for the airport authority, they are incurring that cost at this time for the GAC replacement. Whenever the carbon gets used up, new carbon has to be put in it, and then the old carbon has to be taken someplace at this point. That's being borne by Guam Waterworks as a cost for operating in the system. We have been in talks between the Airport and the Navy for historical use off AFFF. The Navy has verbally committed that they will assist in some of the cost for the treatment of the groundwater.

Chairperson Perez: Is there potential to do filtering of the ponding basins before it even gets to the wells? Has that been studied or at least looked into?

Mr. Packbier: No. We don't know if the ponding basins are a source for contamination of the groundwater, because we don't shoot foam into the ponding basins. The AFFF for the PFAS chemicals, may never make it to the ponding basin, if it gets absorbed into soil, and make their way down to ground. It's not just one particular source.

Chairperson Perez: I think it's important that you are actually working towards not releasing this chemical. There's a move to phase PFOS out. I think that would definitely help, considering it's very impervious surfaces that we're dealing with. It's connected. A lot of these areas are connected. I think that's very important. Then, in light of the recent article, I think it's important to look at improving ways in which these chemicals are managed, as as we're currently using them. I look forward to hearing more updates on this and seeing improvements in the system. Thank you. I think that's all for Guam Airport Authority. Last, but not least definitely, not least, Guam Fire Department. We had sent questions to the Chief Stone prior. My understanding is that you were not made aware of these questions ahead of time.

Joey A. Manibusan, *Acting Fire Chief and Fire Marshal, Guam Fire Department*: Good afternoon. Guam Fire Department Chief Manibusan, Acting Fire Chief and Fire Marshal. Go ahead and ask me questions and I will answer them to the best of my ability.

Chairperson Perez: There are similar questions that I've asked of Airport Authority. Are you currently using any of the firefighting foams that contain PFAS?

Mr. Manibusan: At this time, we do not keep AFFF on inventory. However, if in the event there's a fire that involves hazardous substances and hydrocarbons, we do use AFFF. We get donations from the federal government or any other organization on Guam that is willing to give us. At this time, we do not have any on inventory and we don't have any on our vehicles.

Chairperson Perez: Okay. From this discussion there is a move away from PFAS containing chemicals. You just mentioned that you get donations. Are there procedures in place to scrutinize what type of chemicals are being donated?

Mr. Manibusan: That is a very good question. The research has been shown and the presentations that you also provided, the AFFF that is being used does contain the PFAS and there is a movement in the industry to reduce the amount to find substitute foam to replace the more hazardous versions of AFFF. At this time there is a movement in the industry that also includes the fuel industry, the aircraft rescue, and firefighting industry, and the overall firefighting industry for structural firefighting. That's the best answer I can give Ma'am. There is a movement it's being recognized. As a result of being assigned to come down here, I started research last night myself, and I found that the industry is being looked at. It's known now, that if they contain ground contaminants and the advisories are out.

Chairperson Perez: Just to clarify. Will Guam Fire Department accept foam that has PFAS in it?

Mr. Manibusan: At this time, the best answer can give you is, we use the best foam that is recommended for effectively fighting any type of hazard that we're facing. At this given time AFFF is the most effective means of fighting hydrocarbon fires. They are our largest hazard on Guam. At our ports of entry, having the fuel that is coming in. The raw fuel that's also converted to gasoline, treated here on Guam, and sold out to the industry. AFFF is the most efficient way. Now, they are looking into better ways of fighting these types of fires and replacing them. There are best management practices that was discussed earlier. On minimizing the use of AFFF for training purposes. The majority of the AFFF.

Chairperson Perez: I can interject here? The question was, will Guam Fire Department except PFOS containing foam? If it's a donation.

Mr. Manibusan: Yes, we accept it, but it has to be properly stored. We only use it for emergency firefighting. If we do get it unless there's a law that says that we cannot use it or store it.

Chairperson Perez: We just heard from our colleagues here. They're using the modern ones that don't have PFOS. What you're saying is that Guam Fire Department will accept PFOS containing foam?

Mr. Manibusan: Ma'am they mentioned that the modern technology foam does contain PFOS, but a shorter chain PFOS. It still hazardous. The modern form of AFFF does still contain PFOS, but a shorter chain version. That is the industry today. I would like to say that most of the industry now does use the modern shorter chain version of PFOS.

Chairperson Perez: I'm sorry. I need to clarify. The PFOS that I'm mentioning is, perfluorooctane sulfonic acid. So, you're saying you're using that foam currently?

Mr. Packbier: The difference is PFOS or PFAS. PFAS is the chemical. PFOS is the longer chain one that is currently being minimized.

Chairperson Perez: Are you using that foam?

Mr. Packbier: No.

Chairperson Perez: Will you accept that type of foam?

Mr. Manibusan: I was mistaken that you're saying PFAS. No, we will not accept that Ma'am. The industry is moving away from that. Most of the industry does not use PFOS anymore. They all are moving towards PFAS. We will accept the PFAS. The short shorter chain.

Chairperson Perez: Do you have procedures in place for the fire department. Are there procedures in place to ensure that you're not going to be accepting donations of foam, that contains this PFOS?

Mr. Manibusan: We don't have any set procedures, but with this movement of course, we would be checking on it? We would ask for the material safety data sheets. We will talk to our partners that are out there. As a result of the critical concern, we will take that into consideration, and we will not accept PFOS. We would accept what the industry has out there that is the safest using best management practices.

Chairperson Perez: Just to reiterate. You currently don't have any?

Mr. Manibusan: We do not have any foam at all. We have no form at all in stock, or on inventory.

Chairperson Perez: Historically, has Guam Fire Department had this firefighting foam? Did they use this firefighting foam?

Mr. Manibusan: Yes ma'am. We've used foam in the past for major hydrocarbon fires at the Port Authority of Guam and in many other places on Guam, throughout the history in my 29 year in the Guam fire Department.

Chairperson Perez: Is there any record of how much was released?

Mr. Manibusan: We don't have a record of exactly how much was used.

Chairperson Perez: Just to reiterate what vicinities did they use it? You said the Port Authority was one.

Mr. Manibusan: We've used them for major fires that involve the gas leaks, gas fields, and things of that nature, mostly fuel.

Chairperson Perez: Can you identify locations where it was used?

Mr. Manibusan: I can identify some. For example, the Port Authority, gas stations, and things of that nature.

Chairperson Perez: Does Guam Fire Department have any procedures to manage it? Contain it? Or minimize its use?

Mr. Manibusan: Yes. The major way for minimizing the spread of any type of foam is minimizing the spread of any fuel. When we deploy the use of foam, we use portable dikes, like snakes. We spread out the snakes around the fuel. That is to contain the foam and the actual fuel. When it comes to fuel, fire code requires secondary containment. That also helps out. After the deployment of foam whether it's deployed or not, we would actually require that they do proper cleanup procedures using an approved environmental cleanup company.

Chairperson Perez: Do you know how its disposed of? Where is it disposed once it's cleaned up?

Mr. Manibusan: They probably try their best to clean up as much as they can. Based on my recent research the most effective way of disposing of PFOS is the use of an incinerator. Much of that discussion was covered already in terms of proper disposal.

Chairperson Perez: Okay, thank you. No further questions. Thank you so much for being able to be here and to be able to respond on behalf Guam Fire Department. This concludes our informational hearing. The time is now is 1:25. If there are no further questions, the Committee of the Environment, Revenue and Taxation, and Procurement is now adjourned.

Written Testimonies:

- Water and Environmental Research Institute of the Western Pacific
- Guam Water Works Authority
- Guam International Airport Authority
- Hope Cristobal, *Former Senator*

III. FINDINGS AND RECOMMENDATIONS

The Committee on Environment, Revenue and Taxation, and Procurement finds the following recommendations for the Department of Revenue and Taxation based on the testimony submitted at the public hearing:

- WERI finds that PFOS is present in the NAS-1, A-23 and A-25 water wells.
- WERI has been taking soil sample in and around the well sites.
- WERI indicated that testing has been conducted but is expensive and further testing is needed to locate PFOS contamination sources.
- WERI would like to construct a lab to test for PFOS locally.
- GWA indicates that they have taken proactive actions after finding PFOS in wells NAS-1, A-23, and A-25. They have taken the wells offline and are treating the well water with GAC treatment systems.
- GIAA currently has a shorter chain of PFOS containing Aqueous Film Forming Foam (AFFF) in stock as required by the FAA.
- GIAA uses the AFFF an annual basis as part of the FAA testing requirements.
- GIAA applies AFFF at a rate of 3% of 1,000 gallons.
- GIAA annually discharges 90 gallons of AFFF containing PFOS, but there is alternate equipment which would allow FAA testing requirements and not use AFFF.
- Mrs. Cristobal wants an MCL requirement for all PFAS chemicals.
- Mrs. Cristobal wants GEPA to locate and remove PFAS contamination sources which contaminate Guam's waters.

No uniform federal regulation for PFAS

By **Joycelynn Atalig** July 25, 2019

Guam Waterworks Authority General Manager Miguel Bordallo said GWA would not need to do anything more than what they are already doing, with or without a universal MCL.

With GovGuam now in pursuit of compensation via a multi-district litigation against manufacturers of PFAS-laced products, a revelation was made by stakeholders during Thursday's informational briefing at the Legislature that there's no uniform federal regulation monitoring the maximum contaminant levels of PFAS in our waters. A lag in policy that plagues many, nationwide.

Shayna Casper, the director of the State Toxic Action Center in Vermont and New Hampshire, a non-profit group that organizes with communities on the frontlines of local and environmental health threats, said there is no federal drinking water standard for PFAS and without standards, there is no requirement for communities to test for PFAS or to clean them up.

"The more we learn about this family of chemicals, the more toxic we learn that it has, even in extremely small amounts, really significant health impacts," Casper said.

This is a concern for Guam Environmental Protection Agency Administrator Walter Leon Guerrero and his Chief Engineer and Water Division Director Brian Bearden, who says that because Guam lacks the technical expertise to establish a maximum contaminant level or MCL, Guam EPA is forced to rely on the USEPA, which has yet to establish a uniformed MCL. This makes it difficult of Guam EPA to address the issue.

"At the end of 2020, USEPA must move forward with its regulatory determination which is basically a go or no go decision by the administrator of the United States EPA on whether to regulate PFOS and PFAS components. So it could be as many as four to six years before we see an actual MCL from the USEPA," he said.

In the absence of a uniform regulation for PFAS, its use is still apparent at the Guam International Airport, according to ARFF Assistant Chief Ray Santos.

Although in much lower PFAS levels than what was initially used in 1995, it appears that in

order for the foam used to be considered film-forming, it has to have the PFAS component.

ARFF Acting Chief Santos said the airport is now faced with the dilemma of maintaining FAA fire-fighting foam annual testing requirements while also keeping the harmful chemical from entering the environment.

Despite the lack of an MCL, it appears that Guam's waters distributed through the system are PFAS-free, according to Guam Waterworks Authority's General Manager Miguel Bordallo, hence his statement that GWA would not need to do anything more than what they are already doing, with or without a universal MCL.

Meanwhile, what initiated the PFAS conversation — the pursuit of the multi-district litigation — is one step closer, according to Attorney General Leevin Camacho who announced that his office has selected six subject matter expert law firms to aid GovGuam in its pursuit of compensation for those affected by the harmful PFAS chemical.

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