STATE OF CALIFORNIA
REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION

STAFF REPORT FOR REGULAR MEETING OF DECEMBER 12 – 13, 2019

Prepared on November 14, 2019

ITEM NUMBER: **6**

SUBJECT: **Perfluoroalkyl Substances (PFAS) in the Central Coast Region**

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ACTION: **Information / Discussion**

KEY INFORMATION

General:	PFAS have been used since the 1940s to make commercial and industrial products that resist heat, stains, grease, and water, such as fire-fighting foams, non-stick surfaces, fabric softeners, and carpet. They are resistant to degradation and persist in the environment.
Human Health:	PFAS exposure can lead to adverse human health effects, including increased cholesterol, effects on infant birth weights, the immune system, cancer, and thyroid hormone disruption.
Industry Status:	Investigation and remediation of PFAS are emerging and developing fields. Investigation, analytical, and remediation techniques are being developed.
Investigations:	Landfills that accept municipal waste, airports with fire training and fire response facilities, and metal plating shops are currently being investigated. Public water supply wells near the airports and landfill facilities are being tested for PFAS.

SUMMARY

Per- and polyfluoroalkyl substances (PFAS) are a group of man-made chemicals that include perfluorooctanoic acid (PFOA, also known as C8), perfluorooctane sulfonate (PFOS), and GenX chemicals. PFAS have been manufactured and used in a variety of industries around the globe, including in the United States since the 1940s. Both PFOA and PFOS chemicals are persistent in the environment and in human, fish, and other

animal bodies – meaning they don't break down and can accumulate over time. PFAS are found in many consumer products that people use daily, such as cookware, food containers, fabric softeners, and stain repellants. Because of their ubiquitous use and through improper disposal, spills, and other releases, PFAS have been introduced into the environment and are present in some food and drinking water sources.

The State Water Board and the Central Coast Water Board are currently conducting PFAS groundwater investigations in California using a phased approach. Landfills that accepted municipal waste and commercial airports with fire training and response facilities are being investigated during the first phase. Public water supply wells near these facilities are also being sampled for PFAS. The second phase of investigation has just been launched, focused on metal plating facilities. The occurrence and scale of PFAS related water quality impacts in the Central Coast are relatively unknown and the phased investigative approach may result in a significant number of additional cases requiring ongoing investigation and remediation efforts and associated Water Board regulatory and technical oversight.

BACKGROUND

Per- and polyfluoroalkyl substances (PFAS) are a group of anthropogenic chemicals that are resistant to heat, water, and oil. PFAS do not occur naturally and have been manufactured since the 1940s. Under a PFOA Stewardship Program with the U.S. Environmental Protection Agency (USEPA), eight major PFAS producers have phased out the production and use of PFOA and other PFAS. However, manufacturers are developing replacement products in the PFAS family by substituting longer-chain chemicals with shorter-chain chemicals, such as GenX chemicals. GenX is a trade name for a technology that is used to make high performance fluoropolymers (e.g., some nonstick coatings) without the use of perfluorooctanoic acid (PFOA).

Uses

PFAS are used in industrial and consumer products, such as carpets, rugs, fabric softeners, water-proof clothing, upholstery, food paper wrappings, non-stick products, cleaning products, fire-fighting foams, and metal-plating products (e.g., cookware, coated screws, etc.).

Chemistry

PFOA, PFOS, and GenX chemicals are fluorinated organic chemicals that are part of the PFAS group of chemicals. Their carbon-fluoride bond is one of the strongest bonds in chemistry, which is why PFAS are resistant to degradation and highly persistent in the environment. There are an estimated 5,000 PFAS.

PFOS compounds generally have low volatility and PFOA compounds are relatively volatile. The solubility of PFAS is higher than other organic compounds and is affected by factors such as salt content, pH, and redox conditions, among other factors.

As long-chain PFAS are being phased out of use in the U.S., they are being replaced by short-chain PFAS compounds, such as GenX chemicals, that are more mobile in water.

In addition, long-chain PFAS, such as PFOA and PFOS, found in the environment have the propensity to break down to shorter-chain PFAS chemicals.

Analytical Testing Methods
Of the estimated 5,000 PFAS, validated analytical methods are only available for detecting 18 perflourinated compounds, including PFOS and PFOA, in drinking water. The USEPA is in the early stages of developing additional PFAS analytical testing methods for groundwater, surface water, wastewater, and solids (including soils, sediments, and biosolids).

Human Health and Effects
PFOA and PFOS have been identified in the blood of nearly all people tested. USEPA reports that there is evidence that PFAS exposure can lead to adverse health outcomes in humans. If humans, fish, or other animals ingest food or drinking water containing PFAS, the PFAS get absorbed and can accumulate in their bodies. PFAS stay in the human body for long periods, which means that PFAS exposure over time can increase PFAS levels to a point where people suffer adverse health effects.

PFAS can cause reproductive and developmental, liver and kidney, and immunological effects in animals. PFOA and PFOS have both caused tumors in animal studies.

Increased cholesterol levels are the most consistent finding from human epidemiology studies, with more limited findings related to effects on infant birth weights, the immune system, cancer (for PFOA), and thyroid hormone disruption (for PFOS).

According to the Centers for Disease Control (CDC)[1], blood levels of both PFOA and PFOS steadily declined in U.S. residents from 1999 to 2014 by 60 to 80%, respectively, due to a reduction in PFAS production and use of some PFAS. However, manufacturers are developing replacement technologies in the PFAS family, including reformulating/substituting longer-chain chemicals with shorter-chain chemicals known as GenX.

REGULATORY STATUS
In May 2016, the USEPA issued a lifetime health advisory for PFOS and PFOA for drinking water, advising municipalities that they should notify their customers of the presence of PFAS levels over 70 nanograms per liter (ng/L) or 70 parts per trillion in community water supplies. The lifetime health advisory is non-enforceable but provides guidance to states to protect the public from adverse health effects from PFAS exposure in drinking water. The USEPA recommended that notifications include information on the increased risk to health, especially for susceptible populations.

At the State level, notification levels and response levels are non-regulatory health-based advisory levels established by the State Water Board Division of Drinking Water

[1] CDC study on PFAS in human blood: https://www.atsdr.cdc.gov/pfas/pfas-blood-testing.html

for chemicals in public water systems that lack a drinking water standard or maximum contaminant level.

Notification Level: If a public water system detects a contaminant at a concentration exceeding its notification level, the public water system is required to report exceedances to its local governing board (e.g., county) and is urged by the State Water Board Division of Drinking Water to inform its customers.

Notification levels exist for two distinct classes of PFAS chemicals, PFOA and PFOS. They were revised on August 22, 2019, to:

PFOA: 5.1 ng/L
PFOS: 6.5 ng/L

These values are based upon an Office of Environmental Health Hazard Assessment (OEHHA)[2] recommendation to set the notification levels at the lowest levels at which they can be reliably detected in drinking water.

There is no requirement that a public water system stop serving water to its customers if a notification level is exceeded.

Response Level: The response level for PFAS is:

PFAS: 70 ng/L (combined PFOA and PFOS)

Response levels are set higher than notification levels and represent a level above which public water systems should consider taking a water source out of service or provide treatment if that option is available.

The response level of 70 ng/L for combined PFOA and PFOS currently matches the USEPA's health advisory level that was established in May 2016. It is anticipated that the response level will be revised in the fall of 2019.

Public Health Goal and Maximum Contaminant Level: There currently is no public health goal or maximum contaminant level for PFAS.

EXPOSURE ROUTES

Consumer and Commercially Treated Products

Normal use or disposal of consumer products that contain PFAS can result in human exposure to PFAS. Many products are commercially treated to make them stain- and

[2] The branch within the California EPA with responsibility for evaluating health risks from environmental chemical contaminants is OEHHA. In June 2018, OEHHA recommended interim notification levels for PFOA (based on liver toxicity and cancer risks) at 13 ng/L and for PFOS (based on immunotoxicity) at 14 ng/L. These notification levels were updated on August 22, 2019, to 5.1 ng/L for PFOA and 6.5 ng/L for PFOS.

water-repellent or nonstick. Examples include carpet, leather and apparel, textiles, paper and packaging materials, and non-stick cookware.

Work
People employed at PFAS production facilities or at facilities that manufacture goods made from PFAS can be exposed in occupational settings or through contaminated air. For example, manufacturing of products that use Teflon coatings.

Food
People can get exposed to PFAS through ingestion of food, which can be contaminated with PFAS from contaminated soil and water used to grow food, food packaging containing PFAS, and contact with equipment that used PFAS during food processing. Living organisms, including fish and animals, can accumulate PFAS over time. Consumption of these organisms that bioaccumulate PFAS is another ingestion pathway.

Drinking Water
Another exposure pathway is through the consumption of water that is polluted with PFAS, including where PFAS chemicals have polluted drinking water supplies. This includes both surface water and groundwater supplies.

FATE AND TRANSPORT

There are an estimated 5,000 individual PFAS in existence. The fate, transport, and chemical transformation characteristics of PFAS chemicals are largely unknown and are areas of active scientific research. However, it is known that fate and transport properties can vary considerably for the estimated 5,000 individual PFAS.

Soil and Sediment
PFAS are found in soil and sediments due to atmospheric deposition, exposure to PFAS materials (e.g., landfill leachate or biosolids), and direct discharges. Soils and sediments can act as a secondary source of PFAS to groundwater and surface water through percolation and leaching processes. Site-specific soil conditions, such as total organic carbon and particle charges, and properties of individual PFAS are important factors affecting PFAS movement through soil and sediments.

Groundwater
PFAS are miscible in water and have surfactant-like properties, which means that PFAS will dissolve into groundwater readily and are generally mobile. Due to the mobility of PFAS in groundwater and their persistence in the environment, PFAS may exhibit larger plumes than other contaminants in the same hydrogeologic setting.

WATER BOARD PFAS INVESTIGATIONS

The State Water Board's Division of Water Quality (in coordination with regional boards) issued orders in March 2019 to landfills and airports across the state. The orders required investigations for PFAS in soil and groundwater. Twelve landfill operators were issued orders in the Central Coast region; their workplans were submitted by a May 2019 deadline. Commercial airports with fire training and fire response facilities known

to use PFAS firefighting foams were also issued investigation orders. The Central Coast region had orders issued to four airport operators. Public supply drinking water wells within two miles of airports and one mile of landfills are also being sampled for PFAS through orders issued to drinking water system owners by the State Water Board Division of Drinking Water (DDW).

Landfill Investigations
Landfills with PFAS investigation requirements in Region 3 include:

- Buena Vista Landfill
- Chicago Grade Landfill
- Cold Canyon Landfill
- John Smith Road Landfill
- Johnson Canyon Landfill
- Lompoc Solid Waste Site
- Monterey Peninsula Landfill
- Paso Robles Landfill
- Santa Cruz Landfill
- Santa Maria Landfill
- Tajiguas Landfill
- Watsonville Landfill

Landfill investigation workplans were approved between July and October 2019, except for the workplan for Monterey Peninsula Landfill, which is currently being evaluated.

Airport Investigations
Airports with PFAS investigation requirements in Region 3 include:

- Monterey Regional Airport
- San Luis Obispo County Regional Airport
- Santa Barbara Municipal Airport
- Santa Maria Public Airport

Workplans at each of the four airports have been submitted and reviewed by Site Cleanup Program staff. Airport inspections and meetings with airport management and their technical consultants have been conducted to work through revisions in the proposed scopes of work at each airport. A revised workplan for the San Luis Obispo County Regional Airport has been approved, with a requirement for a workplan to conduct additional airport groundwater sampling. The workplans for other airports were reviewed and are in various stages of requiring additional information about the scope of work to be performed.

Public Water System Well Sampling
Public water system drinking water supply wells within two miles of airports and one mile of landfills are being sampled for PFAS under directives from DDW. Sampling requirements were sent to operators of 612 public water system wells across the state. Of those, 68 public water system wells have been sampled in the Central Coast region. Results of the first round of sampling, done during April to June 2019, were published by DDW in October 2019. Interactive maps with analytical results and the full dataset for this sampling event are available online at:

https://www.waterboards.ca.gov/pfas
(Click on the “Drinking Water” tab and then “Public Water System Testing Results”.)

Selected maps produced from the interactive maps accompany this staff report showing PFAS detections across California, the Central Coast region and surrounding areas, and the San Luis Obispo County Regional Airport.

For the Central Coast region, the highest and majority of PFAS detections were near the San Luis Obispo County Regional Airport, with several wells exceeding the response level of 70 ng/L for PFOS + PFOA. The investigation underway at the San Luis Obispo County Regional Airport is intended to determine if the airport is the source of PFAS in the area's groundwater.

PFAS were also detected in public water system wells in Atascadero and Watsonville, at concentrations exceeding the notification levels for PFOS and PFOA, but below the response level of 70 ng/L for PFOS + PFOA.

Three additional quarterly rounds of sampling are anticipated under the current directive and DDW is considering expanding PFAS sampling to other public water system wells in 2020.

Additional Investigations

The landfills and airports represent Region 3's portion of the first phase of a statewide PFAS investigation. A second and concurrent phase of PFAS investigation began with the issuance of investigation orders on October 25, 2019, to hexavalent chromium electroplating facilities. These types of facilities commonly used PFOS and possibly other PFAS-based chemicals for fume suppression. Two facilities within the Central Coast Water Board jurisdiction are included in this plating facility phase of investigation:

- Joe's Plating Shop, Santa Barbara, Santa Barbara County
- Whittaker Ordnance Inc., Hollister, San Benito County

In 2015, the Department of Defense (DoD) initiated investigations at Former Fort Ord Army Base in Monterey County and at Vandenberg Air Force Base (AFB) in Santa Barbara County. Recently in 2019, the Army has initiated investigations at Army Garrison Fort Hunter Liggett in Monterey County and former Army (now California Army National Guard installation) Base Camp Roberts in Monterey and San Luis Obispo counties.

Refineries and bulk fuel terminals, non-airport fire training facilities, and wastewater treatment and pre-treatment plants are also being considered by the State Water Board for future investigation requirements.

Investigation Documents

Reports and correspondence related to PFAS investigations for specific sites are available from the State Water Board's GeoTracker website:

https://geotracker.waterboards.ca.gov

After locating a specific site[3] in GeoTracker, these documents are available under the "Site Maps / Documents" menu item.

OUTREACH EFFORTS

Central Coast Water Board staff issued a public notice[4] on September 9, 2019, to landowners and tenants of properties near known PFAS detections around the San Luis Obispo County Regional Airport. Central Coast Water Board staff mailed 361 notices to landowners with permitted domestic wells and their tenants. The public notice was also posted to the Central Coast Water Board website and mailed to subscribers of the Buckley Road Area TCE Investigation Lyris email list. A dedicated email address and telephone hotline for PFAS inquiries have been established and Central Coast Water Board staff have been responding to inquiries, which have mostly been about how to sample private domestic wells for PFAS. A Lyris email subscription service has also been established that interested parties can subscribe to for Central Coast Water Board notifications about PFAS as they emerge.

The State Water Board has created a website dedicated to PFAS, available at:

https://www.waterboards.ca.gov/pfas

This website provides general information about PFAS background, health effects, regulatory information, drinking water, non-drinking water, and treatment and remediation options.

DEPARTMENT OF DEFENSE SITES

The USEPA is the lead regulatory agency at all California Department of Defense (DoD) facilities on the National Priorities List (i.e. Superfund sites) with support from the regional water boards and the Department of Toxic Substances Control (DTSC). Former Fort Ord Army base is the only DoD Superfund site in the Central Coast region. Other DoD facilities with ongoing cleanup activities with Central Coast Water Board oversight include Vandenberg Air Force Base (AFB), Army Garrison Fort Hunter Liggett, California Army National Guard Camp Roberts, and former Lompoc Army US Disciplinary Barracks[5].

For DoD facilities in the United States where the DoD (Army, Air Force, and Navy) is the water purveyor, the DoD has sampled all public water systems for PFOS and PFOA. For those public water systems where the DoD is not the water purveyor, the DoD has reviewed the water purveyor's water system data for PFOS and PFOA to ensure the water quality does not exceed the response level of 70 ng/L. Where the total of PFOS

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[3] An example PFAS case is the San Luis Obispo County Regional Airport, viewable on GeoTracker at: https://geotracker.waterboards.ca.gov/profile_report?global_id=T10000012768.

[4] Public Notice: https://www.waterboards.ca.gov/centralcoast/public_notices/docs/2019-09-09_pfas_notification.pdf

[5] In the late 1950s, the Federal Bureau of Prisons took over the Army's correctional institution at Lompoc (a.k.a. USP Lompoc), which is now considered a formerly used defense site that is no longer under the Army's purview.

and PFOA concentrations exceeded the response level of 70 ng/L, the wells have been taken out of service and other water supplies are now being used.

PFOS and PFOA were not detected in DoD public water systems providing drinking water to former Fort Ord Army base, Vandenberg AFB, or Camp Roberts. PFOS was detected in a supply well at Fort Hunter Liggett at 330 ng/L in 2015. The Army shut down the supply well in 2015 and is relying on other water supply wells located in another portion of the base to provide drinking water for Fort Hunter Liggett.

Ongoing Army PFOS and PFOA Investigations

The Army has performed groundwater investigations for PFOS and PFOA at former Fort Ord. In 2015, the Army sampled groundwater monitoring wells for PFOA and PFOS in the former fire drill area adjacent to the airport, where aqueous film-forming foam (AFFF; "fire-fighting foam") was historically used. PFOA concentrations in groundwater ranged from 2 to 270 ng/L and PFOS concentrations in groundwater ranged from below laboratory detection limits to 72 ng/L. In March 2019, the Army sampled groundwater monitoring wells for PFOA and PFOS at the former landfill. PFOA concentrations in groundwater ranged from below the laboratory detection limit of 2 ng/L to 113 ng/L and PFOS concentrations in groundwater ranged from below the laboratory detection limit of 2 to 447 ng/L.

The water supply for the former Fort Ord community comes from wells in the northeastern part of former Fort Ord. The drinking water supply system at the former Fort Ord is operated by the Marina Coast Water District. Local drinking water supplied to communities on and around the former Fort Ord meets all drinking water standards. Marina Coast Water District supply wells are tested frequently to ensure water quality is maintained. The installation of new supply wells is restricted by Monterey County Health Department in areas which may influence Fort Ord groundwater contamination plumes. State Water Board and Central Coast Water Board staff will be meeting with the Army on November 21, 2019, to discuss the Army's ongoing PFOS and PFOA investigations and results at Fort Hunter Liggett and other Army facilities. The State Water Board plans to schedule additional meetings with the Air Force, Navy, and Army Corps of Engineers.

Water Board staff members plan to provide preliminary results on the Army's PFOS and PFOA investigation efforts in addition to other investigations conducted at Fort Hunter Liggett and Camp Roberts in a DoD program update during the January 2020 Board meeting.

Ongoing Air Force PFOS and PFOA Investigations

Vandenberg AFB, supports West Coast launch activities for the Air Force, DoD, National Aeronautics and Space Administration, national programs, and various private industry contractors. The Air Force performed base-wide review of existing information at Vandenberg AFB to identify areas of potential PFOS and PFOA releases that may have occurred specifically from AFFF use and storage in 2015. Five release locations were identified: three areas adjacent to the airfield/fire training area and two locations where tanker trucks overturned and fuel was spilled (corner of Highway 101 and

California Boulevard in 1992 and at Highway 101 and Santa Lucia Canyon Road in 2006).

From 2018 to 2019, the Air Force performed preliminary sampling at the five VAFB release locations previously identified. PFOS and/or PFOA compounds were found at all five locations in soil and/or groundwater and four locations warrant additional assessment. Vandenberg AFB had detections up to 150,000 ng/L PFOS and 8,200 ng/L PFOA in groundwater. However, these Vandenberg AFB detections do not pose significant risk to the public due to current land uses where PFAS is detected, distances to potential receptors, and where the release locations are relative to groundwater occurrence and groundwater flow direction.

In July 2019, the contractor that operates and maintains Vandenberg AFB's drinking water system sampled the water system's current source water and sampled wells that are used during prolonged drought conditions. The sampling and testing did not detect PFOS, PFOA, or related compounds in the water samples.

The Air Force is actively cleaning up approximately 80 other areas of groundwater contamination at Vandenberg AFB, which will be described in more detail in the DoD Program Update being prepared for the January 2020 Board meeting.

PFAS REMEDIATION

We are in the early stages of determining the extent of PFAS contamination and the associated need for remedial actions in the Central Coast region.

Common approaches to remediate pollutants such as petroleum hydrocarbons or chlorinated solvents in groundwater include biodegradation and chemical oxidation. These common remediation approaches are ineffective for PFAS. Groundwater pump-and-treat with activated carbon or resin adsorption and/or reverse osmosis is currently used at some PFAS groundwater remediation sites around the world. However, PFAS remediation is in an early and emerging phase and techniques for remediation of PFAS are still being developed.

CLIMATE CHANGE

Site Cleanup Program staff regularly consider carbon impacts from proposed investigation and remediation projects against the benefits that those proposed projects will provide relative to the carbon impacts. Staff will continue to make decisions during project reviews factoring in climate change effects. Sites that are in areas that are susceptible to flooding or sea level rise would be prioritized relative to other sites. Until PFAS workplans are implemented and the extent of PFAS pollution is determined, it is premature to evaluate climate change impacts due to PFAS related corrective actions.

HUMAN RIGHT TO WATER

California Water Code section 106.3, subdivision (a) states: It is a policy of the State of California "that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitation purposes." The investigations underway will begin to define where PFAS groundwater impacts are

present in the Central Coast region and inform this policy. Areas where unacceptable levels of PFAS are present in drinking water wells will be prioritized for investigation and cleanup over areas with lower PFAS impacts or areas where groundwater is not used for drinking water. Consistent with our ongoing outreach and education efforts regarding identified areas of drinking water risk, Water Board staff will notify at-risk residents so they can make informed decisions about their drinking water.

DISADVANTAGED COMMUNITY STATUS

PFAS investigations are targeting facilities with the highest likelihood of having PFAS impacts to groundwater, with additional phases planned to extend investigations to other types of facilities. Investigation and remediation solutions to any discovered PFAS impacts will be data-driven with priority cleanup efforts applied to areas that have the highest risk to human health.

If significant PFAS pollution to groundwater is discovered in disadvantaged communities, Central Coast Water Board staff will help facilitate outreach and education to inform these communities and assist them in identifying and securing grant and technical assistance opportunities through Proposition 1, SB 445, and other funding opportunities, when appropriate.

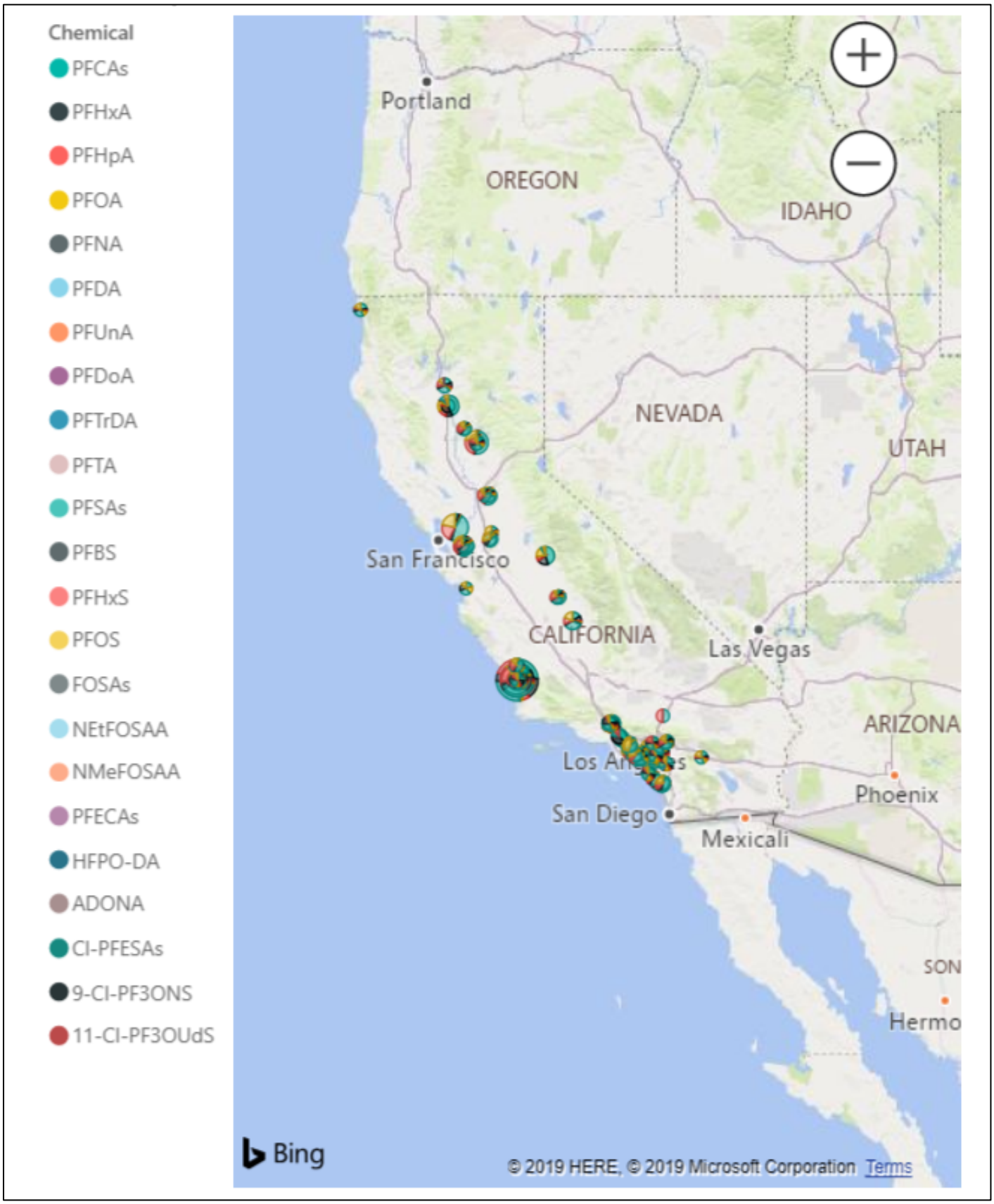
CONCLUSION

PFAS investigation activities and analytical and remediation techniques are in the early stages of being implemented and developed within the environmental industry. The fate and transport of PFAS chemicals in the subsurface is only beginning to be understood. Early indications are that the estimated 5,000 PFAS have substantially different fate and transport characteristics, which will be a significant challenge when investigating the extent of PFAS impacts in groundwater and evaluating remediation strategies.

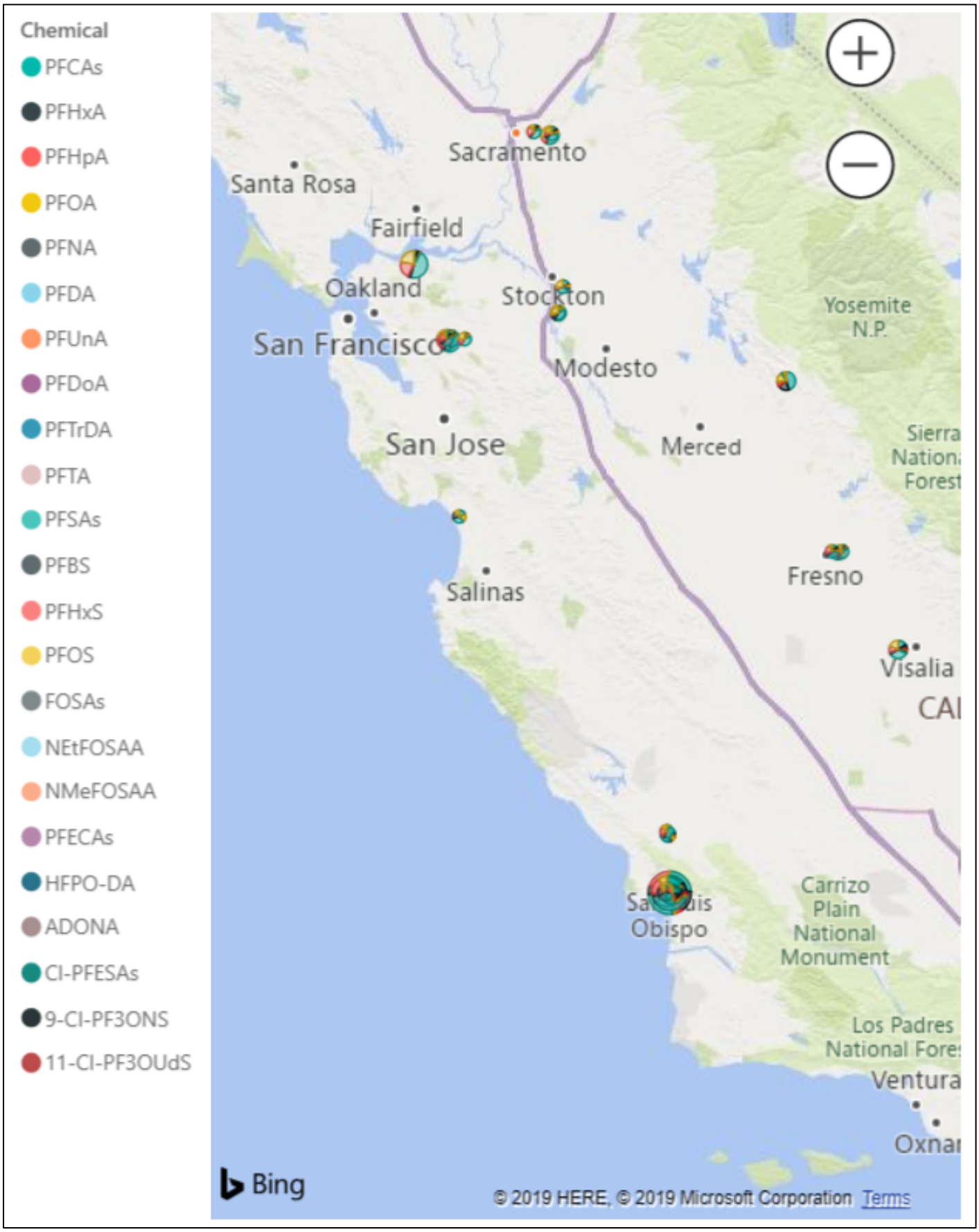
The phased risk-based approach to site investigations currently underway is focused on sites and public drinking water wells with a high probability of having PFAS groundwater pollution. This serves as an opportunity for our industry to develop accepted techniques for investigation and remediation to be used on other PFAS projects going forward.

Central Coast Water Board staff will continue to prioritize PFAS related work on the highest risk sites while ensuring the affected public are informed as the phased investigatory processes are implemented. We have created an internal core team of technical staff within the Site Cleanup Program to address PFAS to ensure consistency in how the data are evaluated and to allow the team to grow their knowledge base quickly and stay current with new information about PFAS as it becomes available. Additionally, consistent with the state's Human Right to Water Policy and focus on environmental justice issues, Central Coast Water Board staff will prioritize PFAS related work in disadvantaged communities in coordination with local and state entities, and nongovernmental organizations.

PFAS DETECTIONS – STATEWIDE



PFOA/PFOS DETECTIONS – CENTRAL COAST WATER BOARD AND NEIGHBORING AREAS



PFAS DETECTIONS – SAN LUIS OBISPO COUNTY REGIONAL AIRPORT AREA