STATE OF CALIFORNIA
REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION

Staff Report for Regular Meeting of July 18 – 19, 2019

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ITEM NUMBER: **9**

SUBJECT: **Perfluoroalkyl Substances (PFAS) – Emerging Issue**

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ACTION: **Information / Discussion**

KEY INFORMATION

Chemistry:	Fluorinated organic chemicals. Over 3,000 PFAS in production. Resistant to degradation; therefore, persistent in the environment.
Uses:	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, clothing and furniture fabric, carpet and dental floss.
Human Health:	There is evidence that exposure to PFAS can lead to adverse human health effects. Effects include increased cholesterol, effects on infant birth weights, the immune system, cancer, and thyroid hormone disruption. Nearly every human tested has PFAS contamination in their blood.
Industry Status:	Investigation and remediation of PFAS are emerging and developing fields. Investigation, analytical, and remediation techniques are being developed.
Investigations:	Landfills that accepted municipal waste and airports with fire training and fire response facilities are currently being investigated. Public water supply wells near these facilities are being tested for PFAS.

SUMMARY

Per- and polyfluoroalkyl substances (PFAS) are a group of man-made chemicals that include perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). 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, stain and water repellants, and even some dental floss products. 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 and Regional Water Boards are currently directing 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 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 manufacturing started in the 1940s. Under a PFOA Stewardship Program with the U.S. Environmental Protection Agency (USEPA), eight major PFAS producers have phased out PFOA and other PFAS substances from emissions and products. However, manufacturers are developing replacement technologies in the PFAS family by substituting longer-chain substances with shorter-chain substances.

Uses

PFAS are used in industrial and consumer products, such as carpets, rugs, 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 and PFOS 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, making PFAS resistant to degradation and highly persistent in the environment. There are an estimated 3,000 PFAS in production.

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 that are more mobile in water. In addition, long-chain PFAS, such as PFOA and PFAS, found in the environment have the propensity to break down to shorter-chain PFAS chemicals.

Analytical Testing Methods

Of the 3,000 known PFAS, validated analytical methods are only available for detecting 18 perfluorinated compounds, including PFOS and PFOA, in drinking water. The United States Environmental Protection Agency (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 substances with shorter-chain substances.

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 parts per trillion (ppt) in community water supplies. The lifetime health advisory is non-enforceable but provides guidance to states and offer a margin of protection for 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.

The branch within the California Environmental Protection Agency with responsibility for evaluating health risks from environmental chemical contaminants is the Office of Environmental Health Hazard Assessment (OEHHA). In June 2018, OEHHA recommended interim notification levels for PFOA (based on liver toxicity and cancer risks) and for PFOS (based on immunotoxicity). OEHHA made these recommendations following its review of currently available health-based advisories and standards and

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

supporting documentation. After an independent review of risk information, the Water Board Division of Drinking Water established notification levels at 13 ppt for PFOS and 14 ppt for PFOA, consistent with OEHHA's recommendations.

There currently is no public health goal or drinking water maximum contaminant level for these chemicals.

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 formulated or treated to make them stain- and 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.

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 and cooking utensils 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 3,000 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 3,000 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 can contaminate larger areas than other contaminants in the same hydrogeologic setting.

WATER BOARD PFAS INVESTIGATIONS

The State Water Resources Control Board Division of Water Quality (in coordination with regional boards) issued orders in March 2019 to landfills and airports across the state requiring investigations for PFAS in groundwater. Twelve landfill operators were issued orders in the Central Coast region; their workplans were submitted by a May 2019 deadline. Four commercial airports in the Central Coast region with fire training and fire response facilities known to use PFAS firefighting foams were also issued investigation orders, with due dates at the end of July 2019. 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.

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

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

These landfills and airports represent the Central Coast region portion of the first phase of a statewide PFAS investigation. Industrial facilities, refineries and bulk terminals, non-airport fire training facilities, and wastewater treatment and pre-treatment facilities are being considered for future investigation requirements.

PFAS REMEDIATION

We are in the early stages of determining the extent of PFAS contamination and the associated need for remedial actions in Central Coast region. Common approaches to remediate pollutants like petroleum hydrocarbons or chlorinated solvents in groundwater such as biodegradation and chemical oxidation 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, the development of other viable PFAS remediation technics is in the research and development stage and more technics will likely become available overtime.

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.

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, which will allow for informed decisions to promote 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.

DISADVANTAGED COMMUNITIES

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 investigation and 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 assist in directing these communities toward grant and technical assistance opportunities through Proposition 1, SB 445, and other funding opportunities, when appropriate.

SUMMARY

There is currently a high level of uncertainty associated with the extent and severity of PFAS related water quality impacts in the Central Coast region and the associated Water Board staff effort to address this emerging issue. The fate and transport of PFAS chemicals in the subsurface is only beginning to be understood and PFAS investigation, analytical testing, and remediation techniques are still in the early stages of

development. Early indications are that the estimated 3,000 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 Water Board's phased approach to site investigations first focuses on sites with a high probability of PFAS contaminated groundwater. This serves as an opportunity to develop effective techniques for the investigation and remediation of other PFAS contaminated areas going forward. Staff will be providing periodic updates to the Board as this effort progresses.