Report to the Legislature and Governor Children's Environmental Health Center

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Office of Environmental Health Hazard Assessment

California Environmental Protection Agency

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Executive Summary

Protecting the health and future of our children is important to all Californians. In recognition of the fact that children are often impacted by environmental contaminants in different ways than adults, the Children's Environmental Health Center was established in the California Environmental Protection Agency (CalEPA) by the Children's Environmental Health Protection Act (Escutia, Chapter 731, Statutes of 1999) (the Act). The Center is responsible for ensuring that CalEPA's programs specifically protect children's health in California. The Act requires biennial reporting on activities that inform or protect children's environmental health at CalEPA. This report to the Legislature and Governor describes some of the work over the past two years by the CalEPA boards, departments and office to help ensure that children are adequately protected from environmental contaminants. We highlight:

- New chemical assessments that incorporate the latest methods to include children's susceptibilities to environmental chemicals.
- Education of scientists, health professionals and others about the effects of chemicals on children's health.
- Scientific investigations that provide information on the impacts of air pollution and heat from a warming climate on children's health.
- Assessment of the pesticide chlorpyrifos as a Toxic Air Contaminant.
- Community air pollution monitoring implementation (AB 617).
- Measuring and mitigating lead in school drinking water.
- Study of chemical exposures to children from synthetic turf fields.
- Clean up of lead-contaminated soils around the Exide facility in Vernon (Los Angeles County).
- Progress on the Safer Consumer Products program in relation to children's health hazards.

Introduction

Children can be more affected by environmental chemicals than adults. They eat, drink, and breathe more than adults do for each pound of body weight. Thus, a child's exposures to contaminants in our air, water, and food are higher than an adult's exposures in the same setting. Because children are still growing and developing, they can be more sensitive than adults are to the adverse health effects of chemicals. In some cases, the effects are irreversible, and exposures to chemicals and other stressors early in life can affect adult health. Thus, the work of CalEPA to reduce children's exposures to environmental chemicals benefits Californians throughout their lives.

In recognition of the fact that children are often differentially impacted by environmental contaminants, the Children's Environmental Health Center was established in the California Environmental Protection Agency (CalEPA) by the Children's Environmental Health Protection Act (the Act) (Escutia, Chapter 731, Statutes of 1999). In January 2012, the CalEPA Secretary delegated the operation of the Children's Environmental Health Center to the Office of Environmental Health Hazard Assessment (OEHHA). The program is responsible for ensuring that CalEPA's existing expertise and programs specifically protect children's health in California. The Children's Environmental Health Center serves as a resource for CalEPA and the State of California. The Center performs outreach and education for the medical and public health community as well as for the general public, and coordinates with the CalEPA boards and departments to promote policies and efforts that protect children's health.

Since the last report in February 2017, there have been several important accomplishments in the area of children's environmental health by the boards and departments in CalEPA:

- California Air Resources Board (CARB)
- Department of Resources, Recycling and Recovery (CalRecyle)
- Department of Pesticide Regulation (DPR)
- Department of Toxic Substances Control (DTSC)
- Office of Environmental Health Hazard Assessment (OEHHA)
- State Water Resources Control Board (Water Board)

Here we describe a selection of these accomplishments.

Ensuring adequate protections for children from toxic chemicals in our environment - OEHHA

The Children's Environmental Health Protection Act requires OEHHA to ensure that the health risk assessments conducted for air toxics explicitly account for infants and children. OEHHA is responsible for the risk assessment guidelines that are used statewide to assess the health impacts of emissions of air toxics, specifically chemicals listed under the Air Toxics Hot Spots Act. The methodology is also applied to developing Public Health Goals for drinking water contaminants. In 2015, OEHHA completed a multi-year project revising risk assessment guidelines to incorporate new data on children's exposures and more explicitly account for their sensitivity to chemical toxicity. Since then, the Air Resources Board has been working with the local Air Quality Management Districts in consultation with OEHHA to implement the new risk assessment guidance when assessing facility emissions of air toxics.

Since the previous legislative report, using the latest methods, OEHHA has finalized Reference Exposure Levels for ethylene glycol butyl ether and carbonyl sulfide, and is in the final stages of finalizing Reference Exposure Levels for toluene and hexamethylene diisocyanate. These chemicals are listed under the Air Toxics Hot Spots Act and are emitted by facilities in California. Further, OEHHA has finalized a re-evaluation of the cancer potency of perchloroethylene, and a new assessment of the cancer potency of tertiary butyl acetate, a chemical listed under the Air Toxics Hot Spots Act. These new assessments will help the air districts evaluate risks to the surrounding communities, including children, from emissions of these chemicals, applying the new method for estimating cancer risk across the lifespan.

In the last two years, OEHHA has also finalized Public Health Goals for drinking water using methods that account for children's sensitivities to toxic chemicals and their increased exposure compared to adults. OEHHA finalized the PHG for nitrate, which is based on preventing illness in infants due to reduced ability to carry oxygen in the blood. OEHHA also finalized the required updates of PHGs for cis and trans-1,2-dichloroethylene and for five pesticides. These updates utilized the latest methods that account for susceptibility of children.

OEHHA is responsible for maintaining the list of reproductive and developmental toxicants and carcinogens under Proposition 65. The list provides information to the public about the hazards of chemicals in our environment, including chemicals in everyday products we all use. Thus, the list allows people and

product manufacturers to choose to avoid those chemicals, which leads to a reduction in exposure to children and pregnant women. Since the previous report to the Legislature, OEHHA has listed six chemicals as known to the state to cause developmental toxicity, including the long-lived and persistent PFOA (perfluorooctanoic acid) and PFOS (Perfluorooctane sulfonate). OEHHA also developed Maximum Allowable Dose Levels (MADLs) for eight reproductive toxicants. MADLs are exposure levels that do not adversely affect reproduction and development, and help businesses and the public determine whether exposures to the listed chemicals require a warning under the law. These MADLs will further the protection of children's health.

Educating health professionals and risk assessors about environmental risks to children - OEHHA

The scientific knowledge generated by studies on the effects of chemicals in young animals or in children needs to be disseminated broadly to educate physicians, other health professionals, and scientists involved in risk assessment. Dissemination of such knowledge is necessary to ensure risks are properly assessed, and to educate health professionals about risks so that they can better communicate with their patient populations. The Children's Environmental Health Program does outreach and education for scientists and physicians as well as collaborating with others on outreach to communities.

Children's Environmental Health Symposia

One mechanism used by the Children's Environmental Health Program for training CalEPA and other scientists is conducting symposia on important children's environmental health issues. OEHHA has been conducting symposia for many years, inviting researchers in children's health and related fields to present the latest findings and providing a forum for discussion and education. This unique forum brings cutting-edge science to CalEPA scientists to help them identify and understand the latest research and scientific methods for assessing the risks of environmental chemical exposures to children. In addition to the in-person venue, these symposia are webcast, reaching other California programs, other states' and countries' regulatory scientists, and academics and healthcare professionals across the country. Recordings of the symposia can be accessed at https://oehha.ca.gov/risk-assessment/childrens-health.

Environmental Justice and Children's Health

In 2017, OEHHA conducted one of the first symposia specifically addressing "Environmental Justice and Children's Health". This meeting brought together leading researchers and policy makers on the combined effects of pollution and stress resulting from social and economic factors on children's health. CalEPA's efforts to evaluate risks of environmental chemical exposures must adequately account for any susceptibility of children. At this symposium, researchers reported that many children live in poverty, and that poor communities often have higher exposure to environmental chemicals than the general population. In these communities, children also experience higher psychosocial stressors related to poverty and racial bias. It is generally accepted that such stress results in release of stress hormones and other important biochemicals that alter our physiology. There are serious health effects associated with chronic stress, including heart and lung disease. Further, research in animals and human studies have demonstrated synergistic effects between chronic stress and chemical exposures, and that early-life is an especially susceptible period of exposure to their combined effects. It can result in dysregulation of important physiological and developmental processes. One example provided by researchers at this symposium is that the risk of asthma associated with traffic-related air pollution is higher in children who live in homes with high parental social stress (Clougherty et al., 2007). Researchers also reported that stressful home environments alone, measured as either stress of the the mother while the child is developing or maternal stress after birth, is a risk for chronic wheeze (Rosa et al., 2016; Magnus et al., 2018). Yet another example is related to higher susceptibility to the adverse cognitive effects of exposure to lead in children living with chronic social stress (Tamayo Y Ortiz et al., 2017). Thus, social inequality may amplify the health effects of environmental pollutants (Cushing et al, 2015). Furthermore, researchers at this conference reported data showing that mitigation of social stress reduces environmentally related disease in children.

OEHHA is moving toward understanding whether our current methods of chemical risk assessment adequately capture effects of social stress, for example, whether our methods currently used to account for differences among people adequately account for the added effects of social stress.

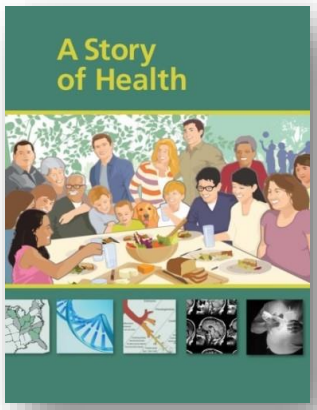
Early-in-life exposure to air pollution and neurological health

OEHHA's 2018 symposium dealt with the impacts of exposure to air pollutants on neurological health across the lifetime. An increasing body of scientific evidence is emerging that indicates exposure to combustion-related air pollution adversely impacts neurological health and development.

In experimental animals, exposure during pregnancy to ultrafine particles concentrated from urban air resulted in inflammation in and altered structure of the brain of the offspring (Allen et al., 2014). These effects lasted into the animals' adulthood. A number of epidemiological studies (but not all) have found associations between exposure to air pollution in late pregnancy and early childhood to development of autism in the child. Autism is understood to be a multi-factorial disease, meaning there are many factors that contribute to autism. Air pollution may be one of those factors. In an animal experiment, exposure to diesel exhaust particles caused inflammation in the brains of pups whose mothers were exposed (Bolton et al., 2017). Immune cells important to the development of the brain were altered by the diesel exhaust particles causing this inflammation. Biochemical changes were measured in the brains of the pups, including changes involved in creating connections between cells in the brain. These cellular and biochemical changes appear to be associated with the antisocial behavioral changes in the male pups observed following maternal exposure to diesel exhaust. Further, when the mothers were stressed, there was a synergistic effect between the stress and the exposure to diesel exhaust particles, meaning the neurological effects observed were greater than calculated by adding up the effect of the stress and the effect of the diesel exposure.

Studies in humans have associated exposure to fuel combustion-related air pollution during pregnancy with lower IQ, behavioral problems including anxiety and depression, ADHD and decreased ability to regulate emotions (Harris et al., 2015; Harris et al., 2016). Changes in the physical structure of the brain have also been measured in children whose mothers were exposed to higher levels of air pollution, including decreased white matter in some parts of the brain (Guxens et al., 2018). Some of these studies measured polycyclic aromatic hydrocarbons (PAHs), which are common air contaminants resulting from combustion of fuels, including PAHs bound to the DNA in the mothers' and in the newborns' blood. Other effects noted included changes in biochemicals in the brain including a decrease in factors that are needed for brain development. Other studies have associated nitrogen dioxide, particulate matter, or measures of traffic-related air pollution exposure with cognitive and behavioral changes in children who were

directly exposed or were exposed via their mothers during pregnancy (Newman et.al., 2013; Sentis et al., 2017).



The Multi-Media e-Book *A Story of Health*

OEHHA and the Children's Environmental Health Center have partnered with the Agency for Toxic Substances and Disease Registry (ATSDR), the Western States Pediatric Environmental Health Specialty Unit at UCSF, the Collaborative for Health and the Environment, and the Science and Environmental Health Network to create *A Story of Health*. This multi-media e-book and continuing education course is designed to harness the power of storytelling to increase environmental health literacy for physicians and other health professionals, policy makers, health advocates, parents and other lay readers, and encourage inclusion of anticipatory guidance in professional medical practice. Research shows that clinicians feel ill-equipped to meet needs of patients with questions about how exposure to chemicals in our environment impacts their health. The course was designed to augment the limited education in environmental health during clinical training. This eBook uses videos, infographics and articles by experts to illustrate the ways in which where and how we live, work, and play from childhood to adult life can influence health. The *Story of Health* received an award for "excellence in communication" from the US Centers for Disease Control and Prevention (CDC) in 2016.

New Chapter Released Fall 2017
Reiko & Toshio's Story: Infertility/Reproductive health

A new chapter in the e-book released in 2017 tells the story of Reiko and Toshio, a fictional Japanese-American couple in their early 30's who met in college and later married. They have been trying to have a child for about a year and feel frustrated that Reiko is not yet pregnant. They are not alone – infertility is not uncommon.

Reiko and Toshio explore what may be contributing to their infertility and their options for interventions. This chapter was written to highlight environmental influences on reproductive health, a healthy pregnancy, and ultimately healthy children. The story includes links to additional resources and scientific references on each page. Links to OEHHA's fact sheets on reproductive toxicants on its Proposition 65 Warnings website are included.

Topics covered in the new chapter include endometriosis, thyroid function, endocrine disrupting chemicals, healthy eating, pesticides, and preconception health for men and women.

More than 7,500 health professionals, including physicians, nurses, and health educators, have registered for the online course resulting in more than 12,000 hours of continuing education credits granted by the CDC. Evaluations have been overwhelmingly positive. In an analysis of responses, more than 95 percent said these courses filled a gap in their skills or knowledge, and more than 89 percent said they will apply the new knowledge to develop strategies and interventions in their practices. A Story of Health is available at http://oehha.ca.gov/public_info/public/kids/storyofhealth.html.

Studies of air pollution, temperature and newborn and child health inform possible solutions - OEHHA

OEHHA conducts epidemiological studies evaluating the impacts of air pollution and excess ambient temperature (heat) on health. The OEHHA studies have contributed to an understanding of the potential effects of environmental contaminants on the health of infants and children. In the last two years, OEHHA has published six studies that have evaluated the health effects of early-in-life exposure to air pollutants and heat. Specifically OEHHA examined the impacts of heat and air pollution alone or in combination on stillbirth, preterm delivery, low birthweight, and other important health outcomes for infants and children. Preterm delivery and low birth weight are important health effects to study because they increase the risk of infant illness and death, and can result in developmental delay and cognitive impairment into adulthood. OEHHA studies are being conducted that will, in the future, be able to shed light on sources of air pollution that are most important to control to protect children's health.

OEHHA studies on temperature alone and in combination with air pollution are improving our scientific understanding of the health effects related to climate change. They may be used to guide policy-makers in considering efforts to mitigate the effects of heat on pregnant women and their infants.

The OEHHA studies made the following findings:

- ***Fine particulate matter and certain constituents of particulate matter were associated with preterm delivery*** *(Basu et al. 2017)*. Those constituents with the strongest associations are found in particulate matter from motor-vehicle traffic and/or biomass combustion (such as wildfire and fireplace smoke). A second study that OEHHA scientists participated in found that, while preterm birth is the result of many factors, analyses indicate that air pollution is an independent risk factor for premature births (Benmarnhia et al., 2018).

- ***An increase in preterm delivery was associated with elevated temperatures during the warm season in California***, in a study by OEHHA scientists, in conjunction with Kaiser Permanente researchers. The impact was relatively large -- an 11.6% increase for every 10 degree Fahrenheit increase in weekly average temperature. A second study by this team showed an effect of maternal ethnicity, age, and illness on increased numbers of premature births with elevated temperatures during the warm

season. This implies that some populations are especially susceptible to this effect of high temperatures. Preterm delivery is a major cause of health problems and death in infants during the neonatal period. This impact may be exacerbated as we experience warmer temperatures due to climate change. (Basu et al., 2017; Avalos et al., 2017)

- ***For babies born full term, an increase in low birth weight was observed when women experienced higher ambient temperatures during the third trimester*** (Basu et al., 2018). In this study apparent temperature - heat combined with humidity – was used as the measure of temperature. The increased risk was especially noted in older women and in black women during the warm season. The study accounted for some other key factors and showed that high temperature is an independent risk factor for delivering low birth-weight babies.

- ***An increased risk of low birth weight in full-term babies was associated with exposure to particulate matter with a diameter less than 2.5 micrometers ("PM2.5").*** The effect was associated with particular sources of PM - formed in the atmosphere from sulfur dioxide and nitrogen dioxides (from fuel burning) and ammonia (from sources such as livestock), and re-suspended road dust. This work was done by OEHHA scientists in collaboration with the University of Southern California and UC Berkeley (Ng et al., 2017).

- ***Some constituents of particulate matter, including chemicals related to traffic pollution and road dust, are associated with stillbirth due to obstetric complications or impaired fetal growth*** (Ebisu et al., 2018). OEHHA's study of stillbirth in relation to particulate matter was the first study to evaluate different constituents of particulate matter and the relationship to different causes of stillbirth.

New controls on chlorpyrifos in California – DPR and OEHHA

Chlorpyrifos is a toxic organophosphate pesticide widely used in agriculture. In 2016, more than 900,000 pounds were applied in California, mainly on citrus, nuts, cotton, and grapes[1]. The scientific evidence from both animal toxicology and human studies identifies this pesticide as a developmental neurotoxicant, that is, a chemical able to alter brain development. CalEPA announced in May 2019 that DPR will act to ban chlorpyrifos use in California by initiating cancellation of the pesticide.

OEHHA listed chlorpyrifos under Proposition 65 as a developmental toxicant in December 2017. The listing was made following the unanimous vote of the Developmental and Reproductive Toxicity Identification Committee. The committee evaluated available scientific data, including animal and human data, and concluded that chlorpyrifos causes developmental toxicity.

DPR evaluated the scientific evidence on the toxicity of chlorpyrifos and conducted analyses of exposure and health impacts to the general public to chlorpyrifos from its application in agricultural settings. This health assessment was reviewed by the state's Scientific Review Panel on Toxic Air Contaminants. The Panel found that chlorpyrifos exposure is associated with developmental neurotoxicological effects documented in both human epidemiological studies and laboratory animal studies. Based on its review, the Panel recommended that the Director of DPR list chlorpyrifos as a Toxic Air Contaminant (TAC).

In August 2018, DPR proposed listing chlorpyrifos as a TAC, based on its health-risk assessment and the Panel's findings. The identification of chlorpyrifos as a

[1] Pesticide Use Report, 2018, available at https://www.cdpr.ca.gov/docs/pur/pur16rep/chmrpt16.pdf

TAC will allow DPR to adopt mitigation measures to decrease exposure of the public, including children, to this pesticide. These measures will help protect infants and children, and the adults they will become, from the effects of chlorpyrifos on brain development.

In November, 2018, DPR recommended new interim restrictions on the use of chlorpyrifos. The new measures will provide increased protections from potential exposure to the pesticide while DPR completes a formal regulatory process to list chlorpyrifos as a TAC and develops permanent restrictions on its use. The department recommended that county agricultural commissioners begin implementing the interim measures on January 1, 2019.

The interim measures include:

- Banning all aerial applications of chlorpyrifos.
- Discontinuing its use on most crops. Chlorpyrifos will be restricted to "critical uses" on crops for which there are few if any alternative pesticides, as determined by the University of California Cooperative Extension. These critical uses are listed on DPR's website.
- Requiring a quarter-mile buffer zone during all allowed applications of the pesticide and for 24 hours afterwards.
- Requiring a 150-foot setback from houses, businesses, schools and other sensitive sites at all times, regardless of whether the site is occupied at the time of application.

New protections: Community air pollution protection program – CARB

In response to Assembly Bill (AB) 617 (C. Garcia, Chapter 136, Statutes of 2017), the California Air Resources Board (CARB) established the Community Air Protection Program. The Program's goal is to reduce air pollution and improve public health in communities that experience disproportionate burdens from exposure to air pollutants. The Program will prioritize disadvantaged communities and locations where sensitive populations such as children, older adults, and individuals with preexisting health conditions live, work, or attend school.

CARB adopted a Blueprint for Community Air Protection in September 2018. The Blueprint outlined the process for identifying impacted communities, statewide strategies to reduce emissions of criteria air pollutants and toxic air contaminants, and criteria for development and implementation of community emissions reduction programs and community air monitoring systems. The Board also selected the first 10 communities that will be the focus of additional targeted actions. The selected communities, which have faced disproportionate impacts from multiple sources of air pollution and high levels of poverty and unemployment, will now have community air monitoring systems and clean air programs focused on cutting emissions from local pollution sources.

Various components of the Program will lower air pollution exposure for children throughout the state. Implementation of community emission-reduction programs will reduce air pollution exposure for the children living in the most heavily burdened communities. Community air monitoring will help identify air pollution sources and provide real-time data to support notification systems for parents and educators to protect children by warning against outdoor activity when ambient air pollution reaches unsafe levels. In addition to the community monitoring and emission-reduction programs, CARB will also develop statewide strategies to improve air quality at the community level. These strategies include new regulations, incentive funding, and resources to help community members engage with local agencies to develop land-use and transportation approaches to reduce emissions.

Lead in school drinking water - Water Board

Lead in drinking water continues to be a health concern and challenge for public water systems. While California has fewer issues with lead in drinking water than some other states, the State Water Resources Control Board's Division of Drinking (DDW) water recognizes the need for more safety measures to ensure that children are protected. Lead can affect almost every organ and system in the body. The central nervous system is the area that is most sensitive to lead exposure, particularly in children. Lead also damages kidneys and the reproductive system. The effects are the same whether lead is inhaled or swallowed.

Most lead gets into drinking water after the water leaves the local well or treatment plant and comes into contact with corroded plumbing materials containing lead. These include lead pipe and lead solder (commonly used until 1986) as well as faucets, valves, and other components made of brass. Because California tends to have newer infrastructure and less-corrosive water than many other parts of the country, lead problems at the tap are not common in our state.

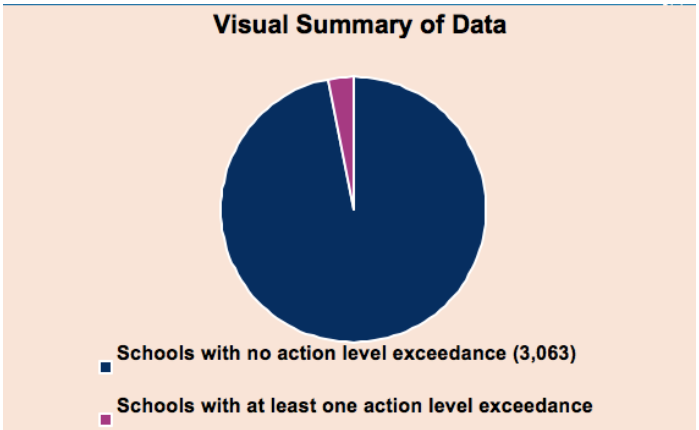
The DDW, in collaboration with the California Department of Education, has taken the initiative to begin testing for lead in drinking water at all public K-12 schools in the state. In early 2017, DDW and Local Primacy Agencies issued amendments to the domestic water supply permits of approximately 1,200 community water systems. The amendments allowed schools (both public and private) that are served by a public water system to request assistance from their public water system to conduct water sampling for lead and receive technical assistance if an elevated lead sample is found. To further safeguard water quality in California's K-12 public schools, Assembly Bill 746, which took effect in January 2018, requires community water systems to test lead levels by July 1, 2019 in drinking water at all California public K-12 school sites that were constructed before January 1, 2010.

Under AB 746, water systems are responsible for contacting schools in their service area. After initial contact, the schools and the water systems work

together to develop a sampling plan and conduct sampling. If a water system receives a sample result indicating lead levels that exceed the action level of 15 parts per billion (ppb), it must contact the school. The water system and the school will then decide what follow-up action to take, which can include removing the fixture in question from service, resampling, or replacing/adding a filter to the fixture. Water systems and their contracted labs will submit data through an online portal per DDW guidelines. DDW staff tracks the data using a database and regularly posts summaries of the data on the DDW website, https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/leadsamplinginschools.html.

For schools that have an action level exceedance, the Drinking Water for Schools Grant Program is an option for funding improvements to their fixtures. Senate Bill 828 appropriated a sum of $9.5 million from the General Fund to be used for the grant program. Projects that are eligible to receive funding include but are not limited to:

- Installation or replacement of water bottle filling stations or drinking water fountains,
- Installations of point-of-entry (POE) or point-of-use (POU) treatment devices for water bottle filling stations, and
- Provisions of interim alternative water supplies for applicants in the process of implementing a permanent solution, including purchases of temporary transfer water, hauled water, and bottled water.



As of June 2018, as shown in the figure to the right, 3,162 of approximately 13,000 schools have submitted drinking water samples to the Water Board, and 3,063 samples had been analyzed. Of these samples, 99 (about 3%) had an action level exceedance.

Assessing risks to children playing on synthetic turf – OEHHA and CalRecyle

Crumb rubber manufactured from recycled tires has been used for more than two decades as infill material in synthetic turf fields across the US and other countries. Crumb rubber is made by grinding up waste tires. The resulting crumbs have complex chemical composition, which can vary by the type of tire used in making the crumb rubber. Manufacturers have claimed the product has health, environmental and economic benefits, including reduced sports-related injuries, lower watering requirements and less-expensive maintenance. However, concerns have been raised by the public about exposures of athletes (including school-age children and teenagers) and other field users to potentially harmful chemicals present in the crumb rubber infill, and the incidence of certain types of cancers. There have been similar health concerns about playground mats containing crumb rubber that are used by very young children.

OEHHA is working under contract with the Department of Resources, Recycling and Recovery (CalRecycle) to evaluate the complex chemical composition of crumb rubber infill material, the pathways of exposure and the potential health effects from the use of synthetic turf fields. When completed, this will be the most extensive health assessment of synthetic turf conducted in the United States. The findings will also be used to assess potential health impacts associated with exposures to chemicals in playground mats. The study will help guide future decisions concerning the recycling and use of tire materials in synthetic turf and playground mats.

The study is designed to further understanding of the chemicals that may be released from crumb rubber and artificial grass blades under various environmental conditions, and to assess human exposures to these chemicals and the associated health hazards and risks. This multi-year study is being performed in collaboration with researchers at the Lawrence Berkeley National Laboratory, UC Berkeley and the University of Arizona.

To ensure the study uses the most appropriate scientific approach and technology, OEHHA has established a Scientific Advisory Panel (SAP) of academic experts to provide advice and input to the study. Meetings were held in February 2016, March 2017, May 2018, and June 2019. OEHHA has consulted

with several federal agencies as well as other academic research institutions in the US and overseas. In response to a request from OEHHA, the federal National Toxicology Program is performing toxicology studies of crumb rubber materials.

OEHHA has posted a number of materials related to this study on its website. The materials can be accessed at: https://oehha.ca.gov/risk-assessment/synthetic-turf-studies.

To date, OEHHA has collected crumb rubber and airborne particle samples from 35 fields of various ages from four climate regions across California. Highly advanced instruments at the Lawrence Berkeley National Laboratory are analyzing these samples to determine the chemicals present in the samples and study their ability to be taken up into the body following exposure. Many of the chemical analyses have now been completed, but this work is ongoing. OEHHA has also worked with academic collaborators to gather information through surveys, videotaping and on-site study, on how children and others playing soccer on the fields may be exposed to chemicals in crumb rubber. Information gathered includes the types, frequency and duration of activities that occur on and off the field, and how often players play on synthetic turf fields (as opposed to natural turf fields). OEHHA also observed soccer practices and games to gather micro-level activity information about players' interactions with the field itself, such as how often players slide or dive onto the field.

OEHHA expects to complete the full study assessment Winter 2019/2020.

Cleaning up lead contaminated soil – DTSC

The former Exide Technologies, Inc. (Exide) facility located in Vernon, California is a Resource Conservation and Recovery Act (RCRA) mitigation site, with the Department of Toxic Substances Control (DTSC) serving as the lead regulatory agency. From 1922 to 2014, lead smelting and metals processing operations (mostly in the form of lead-acid battery recycling) occurred at the facility, which Exide acquired in 2000. As a result of these activities, lead was emitted both onsite and into the surrounding communities. Lead is a neurotoxic chemical, and impacts the developing fetus and child.

In early 2015, DTSC informed Exide it would not grant the facility a permit to operate and ordered it to permanently cease operations. The former Exide facility is currently undergoing closure and cleanup, pursuant to RCRA requirements. DTSC is overseeing Phase 1 of the closure and cleanup, as described in DTSC's Closure Plan dated December 2016 and the Closure Implementation Plan approved by DTSC in October 2017. Although DTSC is the lead agency for the closure, the South Coast Air Quality Management District (SCAQMD) also has authority to ensure that all closure activities are compliant with air quality requirements specified in Exide's Title V permit. Phase 1 of the closure and cleanup is anticipated to be completed by fall of 2020. RCRA Corrective Action of the former Exide facility is performed under a 2002 Corrective Action Consent Order issued by DTSC. In addition to DTSC overseeing extensive mitigation activities for Exide's on-site contamination, DTSC also oversees addressing the contamination of off-site industrial and residential areas from past facility operations and emissions.

In April 2016, the Legislature approved a request by the Governor for $176.6 million to fund expediting and expanding the testing of the approximately 10,000 sensitive land-use properties (such as residential properties, schools, parks, day care centers and childcare facilities) in the area within an approximately 1.7-mile radius of the former Exide Facility. These funds are also being used to:

- Oversee the cleanup of up to 2,500 properties with the highest concentration of lead in soil representing the greatest potential for exposure to sensitive populations;
- Expand community engagement, and create a workforce development and job training program for community residents to perform sampling and clean-up.

A total of 8,505 parcels have been sampled as part of the Exide residential cleanup. Sampling data and an associated online live map, located on DTSC's website, were released to the public on March 2, 2018. The map can be accessed at https://www.dtsc.ca.gov/HazardousWaste/Projects/pia-sampling-data.cfm

A Cleanup Plan (Removal Action Plan) and associated Environmental Impact Report were finalized in July 2017. The Cleanup Plan establishes the criteria for DTSC to prioritize the next approximately 2,500 properties for cleanup; the owners of the first 2,123 prioritized properties were notified in September and October 2017.

As of May 2018, a total of 330 parcels have been cleaned up. The clean-up of the parcels will lead to lower lead exposures of pregnant women and children living in those homes.

DTSC has partnered with two academic and workforce training providers -- the Los Angeles Trade Technical College (LATTC), and the University of California Los Angeles Labor Occupational Safety and Health Program (UCLA-LOSH) -- for Phase I of its Workforce for Environmental Restoration in Communities (WERC) Program. As part of any contract for cleanup work, DTSC will include a 40 percent local hire requirement for trained residents from communities near the former Exide facility to perform sampling and assessment fieldwork. Forty-nine students have graduated from the WERC Program as Certified Lead Sampling Technicians. DTSC's soil sampling contractors hired 45 of the students. The WERC Program continues with training on soil cleanup, lead hazard control, interior home cleaning, landscaping, and health education. Educating a local workforce will help create an informed community and provide additional protection for children living in the community.

Reducing children's exposure to toxic chemicals from consumer products - DTSC

One of the primary goals of the Safer Consumer Products Program (SCP), which results from the passage of the Green Chemistry Law in 2008, is to reduce toxic chemicals in consumer products. The ultimate objective is to reduce exposure to the general public, including children at schools, daycares, and homes.

Through an open regulatory process, DTSC identifies a priority product containing toxic chemicals. Following the completion of the regulation, DTSC then requests the manufacturer to conduct an alternatives assessment that discusses whether or not there is a need for the chemical in the product and whether there is a safer alternative. An Alternatives Analysis compares the Priority Product containing the chemical of concern with potential alternatives, including chemical substitution, product redesign or other innovations. DTSC reviews the alternatives assessment, and can take a number of actions to reduce people's exposures to the chemical in the product.

The goals of the Safer Consumer Products Program include striving to protect children, women of childbearing age, and pregnant women from exposures to harmful chemicals, especially carcinogens, mutagens, reproductive toxicants, neurotoxicants, developmental toxicants, and endocrine disruptors. On July 1, 2017, one of the first priority products identified through regulation was children's foam padded sleeping products containing the toxic flame retardants (Tris(1,3-dichloro-2-propyl) Phosphate (TDCPP) or Tris(2-chloroethyl) Phosphate (TCEP)).

These chemicals are associated with a number of hazards, including developmental toxicity, carcinogenicity, neurotoxicity and endocrine disruption. Eliminating these flame retardants in products such as nap mats, play pens, and pillows is intended to decrease the concentrations of these carcinogenic chemicals in homes, day care centers, and schools, and in children's bodies. The manufacturers of such products have 180 days to provide an Alternatives Analysis for DTSC's review or to provide a notice of intention to remove or replace the chemicals of concern. DTSC will be evaluating the analyses to determine whether the chosen alternative reduces the potential for harm from the product.

In early 2018, DTSC proposed carpets and rugs containing perfluoroalkyl substances (PFAS) as priority products. This class, which includes at least 3,000 different chemicals, contains many toxic chemicals whose hazards include not

only developmental toxicity but many other toxicities. They are persistent in the environment, found in drinking water, and are in our bodies. There is particular concern for in utero and early life exposure to this class of chemicals. By evaluating the use of these chemicals, which are used to impart stain resistance in carpeting, DTSC will be able to move the market toward less-toxic carpeting and reduce children's exposures.

DTSC issued its next three-year priority product work plan in May 2018. Priority product categories, from which DTSC will choose priority products, include:

- Beauty, Personal Care, and Hygiene Products
- Cleaning Products
- Household, School, and Workplace Furnishings and Décor
- Building Products and Materials Used in Construction and Renovation
- Consumable Office, School, and Business Supplies

References

Avalos LA, Chen H, De-Kun L, and Basu R. (2017) The impact of high apparent temperature on spontaneous preterm delivery: a case-crossover study. Environ Health 16:5-18.

Basu R, Hong C, De-Kun L, Avalos LA. (2017) The impact of maternal factors on the association between temperature and preterm delivery. Environ Res 154:109-114.

Basu R, Pearson D, Ebisu K, and Malig B. Associations between PM2.5 and PM2.5 constituents and preterm delivery in California, 2000-2006. (2017) Pediatric and Perinatal Epidemiol doi: 10.1111/ppe.12380

Basu, R, Rau R, Pearson D, and Malig B. (2018) Temperature and low term birth weight in California. Am J Epidemiol 1-9. Jun 12. doi: 10.1093/aje/kwy116. [Epub ahead of print]

Benmarhnia T, Huang J, Basu R, Wo J, and Bruckner TA. (2017) Decomposition analysis of black-white disparities in birth outcomes: the relative contribution of air pollution and social factors in California. Environ Health Perspect. 2017 Oct 4;125(10):107003. doi: 10.1289/EHP490.

Bolton JL, Marinero S, Hassanzadeh T et al. (2017) Gestational exposure to air pollution alters cortical volume, microglial morphology, and microglia-neuron interactions in a sex-specific manner. Front Synaptic Neurosci 9:10. doi: 10.3389/fnsyn.2017.00010. eCollection.

CARB (2019) California Air Resources Board. Refinery Emergency Air Monitoring Assessment Report. Objective 2. Evaluation of Air Monitoring Capabilities, Gaps, and Potential Enhancements.

Clougherty JE, Levy JI, Kubzansky LD et al. (2007) Synergistic effects of traffic-related air pollution and exposure to violence on urban asthma etiology. Environ Health Perspect 115:1140-1146.

Cushing L, Morello-Frosch R, Wander M, and Pastor M. (2015) The haves, the have-nots, and the health of everyone: the relationship between social inequality and environmental quality. Ann Rev Public Health 36:193-209.

Ebisu K, Malig B, Hasheminassab S, Sioutas C, Basu R. (2018) Cause specific stillbirth and exposure to chemical constituents and sources of fine particulate matter. Environ Res 160:358-364.

Eskenazi B, Kogut K, Huen K, Harley KG et al. (2014) Organophosphate pesticide exposure, PON1, and neurodevelopment in school-age children from the CHAMACOS study. Environ Res 134:149-157.

Exley E, Norman A, and Hyland M. (2015) Adverse childhood experience and asthma onset: a systematic review. Eur Respir Rev 136:299-305. doi: 10.1183/16000617.00004114.

Green AJ, Graham JL, Gonzalez EA, et al. (2017) Perinatal triphenyl phosphate exposure accelerates Type 2 diabetes onset and increases adipose accumulation in UCD-Type 2 Diabetes Mellitus Rats. Reprod Toxicol 68:119-129.

Harris MH, Gold DR, Rifas-Shiman SL, et al. (2016) Prenatal and childhood traffic-related air pollution exposure and childhood executive function and behavior. Neurotoxicol Teratol 57:60-70.

Harris MH, Gold DR, Rifas-Shiman SL et al. (2015) Prenatal and childhood traffic-related air pollution exposure and childhood cognition in the Project Viva cohort. Environ Health Perspect 123:1072-1078.

Guxens M, Lubczynska MJ, Muetzel RL et al. Air pollution exposure during fetal life, brain morphology, and cognitive functions in school-age children. (2018) Biol Psychiatry 84:295-303.

LaMerrill M and Birnbaum LS. (2011) Childhood obesity and environmental chemicals. Mt. Sinai J Med 78:22-48 doi:10.1002/msj.20229.

Magnus MC, Wright RJ, Roysamb E, et al. (2018) Association of maternal psychosocial stess with increased risk of asthma development in offspring. American J Epidemiol 187:1198-1209.

Matelski L, Van de Water J (2016) Risk factors in autism: thinking outside the brain. J Autoimmun 67:1-7 doi:10.1016/j.jaut.2015.11.003.

Metayer C, Dahl G, Wiemels J and Miller M. (2016) Childhood leukemia: a preventable disease. Pediatrics 138 Supplement 1 DOI: 10.1542/peds.2015-4268H

Ng C, Malig B, Hasheminassab S, et al. (2017) Source apportionment of fine particulate matter and risk of term low birth weight in California: exploring modification by region and maternal characteristics. Science of the total Environment 605-606:647-654.

Newman NC, Ryan P, Lemasters G, et al. (2013) Traffic-related air pollution exposure in the first year iof life and behavioral scores at 7 years of age. Environ Health Perspect 121:731-736.

Ranciere F, bougas N, Viola M, and Momas I. (2017) Early exposure to traffic-related air pollution, respiratory symptoms at 4 years of age, and potential effect modification by paternal allergy, stressful family events, and sex: A prospective follow-up study of the PARIS birth cohort. Environ Health Perspect 125:737-745

Rosa MJ, Just AC, Tamayo y Ortiz M et al. (2016) Pre- and postnatal wheeze in Mexican children: sex-specific differences. Ann Allergy Asthma Immunol 116:306-312 doi:10.1016/j.anai.2015.12.025.

Rowe, C, Gunier R, Bradman A, et al. (2016) Residential proximity to organophosphate and carbamate pesticide use during pregnancy, poverty during childhood, and cognitive functioning in 10-year old children. Environ Res 150:128-137
doi:10.1016/j.envres.2016.05.048.

Sentis A, Sunyer J, Dalmau-Bueno A et al. (2017) Prenatal and postnatal exposure to NO2 and child attentional function at 4-5 years of age. Environ Int 106:170-177.

Tamayo y Ortiz M, Tellez-Rojo MM, Trejo-Valdivia B et al. (2017) Maternal stress modifies the effect of exposure to lead during pregnancy and 24-month old children's neurodevelopment.