San Francisco Department of Public Health
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City and County of San Francisco
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MEMORANDUM

Date: May 27, 2026

To: San Francisco Health Commission

From: Susan Philip MD, MPH, Health Officer and Director, Population Health Division

Re: Synthetic Turf

Executive Summary

At the request of the San Francisco Health Commission, the San Francisco Department of Public Health (DPH) conducted an in-depth assessment on synthetic turf and has prepared a memorandum to summarize the health and environmental considerations associated with synthetic turf. The assessment supports San Francisco Recreation & Parks' practice of expanding its testing requirements for new synthetic turf products to include testing for additional leachable per- and polyfluoroalkyl substances (PFAS). The assessment also identifies areas where additional data—particularly concerning children's exposures, data on various infill materials, and heat-related effects—would enhance future evaluation. DPH plans to monitor new scientific findings and coordinate with partner agencies to ensure that evolving evidence informs future policy and installation decisions.

Background

Synthetic turf is an engineered surface system comprised of artificial grass fibers. Of the 57 permitted athletic fields maintained by San Francisco Recreation & Parks (RPD), approximately 21% (12) use synthetic turf. A typical synthetic turf field is built in a sequence of layers:

- The **base foundation** is typically made of gravel or other crushed rock
- A **shock pad** may be placed on top of the base to absorb impact
- The **turf pile**—the layer of grass blades themselves—is made of fibers that are usually polyethylene, polypropylene, or nylon.
- A **backing layer** usually anchors the turf pile so that the synthetic grass blades remain attached and evenly spaced.

- Then, a material called **infill** is distributed between the blades to add cushioning, keep the blades upright and improve playability. Traditional systems use rubber-based infills sourced from recycled tires, while newer generations of synthetic turf use less processed materials such as cork and/or sand, or other composite material.

The peer-reviewed literature has examined each constituent of synthetic turf—fibers, backing, infill, shock pad, and base—individually and in combination. Accordingly, the Department's review examined both the individual components of synthetic turf and the cumulative health and environmental considerations associated with the final synthetic turf products. This memorandum offers a focused synthesis of some of the studies reviewed, emphasizing the key themes that emerged.

California Environmental Protection Agency 10-Year Study on Synthetic Turf with Crumb Rubber Infill

In March 2026, the California Office of Environmental Health Hazard Assessment (OEHHA), a division of the California Environmental Protection Agency (EPA), released a final risk assessment following the culmination of a 10-year study focused on turf infill (the material distributed between synthetic grass blades to improve playability).[1] The OEHHA study ranks among the longest longitudinal investigations on this topic. OEHHA investigators first conducted a comprehensive literature review, then identified key evidence gaps, and—guided by that information gap analysis—designed a multi-year study with input from a panel of environmental experts.

OEHHA Investigators:

- sampled 35 synthetic turf fields in California, requesting and receiving access to San Francisco's permitted fields (however, the study authors did not disclose the final list of sampled sites to the San Francisco Recreation & Parks Department, other than noting that at least one San Francisco–based field was included in the final analysis).
- surveyed more than 1,000 Californian soccer players (ages 7–71), including participants from San Francisco.
- video-recorded athletes to quantify the frequency of contact with synthetic turf.
- collected chemical vapor (air) samples over fields during active play and rest.
- estimated health risks for players and spectators following recorded exposure.

Investigators reported that various chemicals were present as expected; however, the detection of these chemicals did not translate to any modeled increased cancer risk based

[1] Office of Environmental Health Hazard Assessment. (2026). Synthetic Turf Study: Assessment of health risks from exposure to chemicals in crumb rubber infill—Final Report. California Environmental Protection Agency.

on the study's cancer risk prediction models.[2]

For instance, investigators detected polycyclic aromatic hydrocarbons (PAHs) in synthetic turf material. Many PAHs have been found to be carcinogenic in animal studies, and one PAH, benzo[a]pyrene, is formally categorized as "carcinogenic to humans" by the International Agency for Research on Cancer.[3] The authors concluded the following for benzo[a]pyrene and other chemicals detected: "Overall, the cancer risk associated with field-related exposures was much less than from exposure to non-field-related chemicals (i.e., common air pollutants). Further, the calculated average cancer risk levels across all fields for all age groups of athletes, coaches, referees and spectators (on-field and off-field) were below the de minimis risk level of 1 in a million."[4] Additionally, study investigators concluded that, under the multiple conditions studied, "there were no significant health risks to players, referees, coaches, or spectators from on-field or off-field exposure to chemicals in crumb rubber infill."[5] In summary, the investigators found that the chemical exposures associated with synthetic turf fields were far lower than everyday exposures most people already experience from common air pollutants and did not pose meaningful health risks under the conditions studied.

The study centered on fields with crumb rubber infill (often sourced from recycled tires); comparable, comprehensive analyses have not yet been conducted for cork or sand infills, which are viewed as less-processed alternatives.

On Per- and polyfluoroalkyl substances (PFAS)

PFAS in synthetic turf remain a prominent concern. These human-made chemicals, introduced in the 1940s for their oil- and water-repellent and heat-resistant properties, occur frequently in products from food packaging to non-stick cookware and some turf components.[6] Widespread contamination first drew national attention in Parkersburg, West Virginia, prompting formation of an independent Science Panel that identified probable links between PFAS exposure and several health outcomes, including pregnancy-induced hypertension (preeclampsia), kidney and testicular cancer, thyroid disease, ulcerative colitis, and high cholesterol.[7]

Subsequent research and regulatory action followed: the U.S. EPA finalized enforceable-

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[2] Office of Environmental Health Hazard Assessment, 2026.
[3] Bukowska, B., Mokra, K., & Michałowicz, J. (2022). Benzo [a] pyrene—environmental occurrence, human exposure, and mechanisms of toxicity. *International journal of molecular sciences*, *23*(11), 6348.
[4] Office of Environmental Health Hazard Assessment. (2026). Synthetic Turf Study: Assessment of health risks from exposure to chemicals in crumb rubber infill—Final Report. California Environmental Protection Agency.
[5] Office of Environmental Health Hazard Assessment, 2026.
[6] National Academies of Sciences, Engineering, and Medicine. (2022). *Guidance on PFAS exposure, testing, and clinical follow-up.* https://www.nationalacademies.org/read/26156/chapter/1
[7] National Academies of Sciences, Engineering, and Medicine, 2022.

drinking-water standards for 6 types of PFAS, thought the EPA has acknowledged that there are thousands of PFAS variants requiring further investigation.[8] Reflecting concerns about PFAS, California has also recently enacted AB 2771 (banning intentionally added PFAS in cosmetics) and AB 1817 (restricting regulated PFAS in textile articles).[9]

Since DPH's participation in the City's Synthetic Playfields Task Force in 2008—during which DPH staff reviewed and vetted existing scientific research on synthetic turf playfields and contributed to recommendations regarding synthetic turf—Recreation & Parks has adopted a practice to expand its testing requirements for new synthetic turf products to include testing for additional leachable PFAS. DPH affirms this practice and supports the requirement of also requesting Material Safety Data Sheets from manufacturers when purchasing new turf, as outlined by RPD's Synthetic Turf Policy Program.[10]

Injury Risk Evidence from Professional Sports and Remaining Data Gaps

Our assessment also included peer-reviewed analyses from national professional athletic leagues, whose extensive athlete participation data enable especially robust injury and safety findings. For instance, a peer-reviewed, four-year study focused on National Football League data reported greater lower-extremity injury rates on synthetic turf compared with natural grass.[11] On each play, players were about 16% more likely to have a leg, ankle, or foot injury on synthetic turf than on natural grass. The authors reported an incidence rate ratio (IRR) of 1.16 per play with a 95% confidence interval of 1.10–1.23, indicating a best estimate of a 16% increase in risk, with the true increase likely between 10% and 23%.[12]

Evidence Gap: Limited Real-World Comparative Injury Data in Recreational Sports

Several other studies evaluated the surface hardness and safety of synthetic turf systems using two criteria: G-max, which measures the surface's shock-absorbing capacity, and the Head Injury Criterion, which estimates the likelihood of head injury upon falling head-first onto the turf. Both G-max and the Head Injury Criterion are calculated by dropping a weighted missile onto the field. The Recreation & Parks Department's policy also includes regular testing for

[8] Post, G. B. (2021). Recent US state and federal drinking water guidelines for per-and polyfluoroalkyl substances. *Environmental Toxicology and Chemistry*, *40*(3), 550-563

[9] Yu, R. S., Yu, H. C., Yang, Y. F., & Singh, S. (2025). A global overview of per-and polyfluoroalkyl substance regulatory strategies and their environmental impact. *Toxics*, *13*(4), 251.

[10] Recreation & Parks Resolutions Number 2602-009. (2026) https://sfrecpark.org/DocumentCenter/View/28600/Item-9-Synthetic-Turf-Program-Resolution-021926

[11] Mack, C. D., Hershman, E. B., Anderson, R. B., Coughlin, M. J., McNitt, A. S., Sendor, R. R., & Kent, R. W. (2019). Higher rates of lower extremity injury on synthetic turf compared with natural turf among National Football League athletes: epidemiologic confirmation of a biomechanical hypothesis. The American journal of sports medicine, 47(1), 189-196.

[12] Mack, et al., 2019.

G-max and the Head Injury Criterion on fields, which represents a constructive step toward monitoring field safety. However, because these criteria are derived from simulation-based testing, they cannot replace real-world data collected by observing athletes on the field. [13] Notably, there is insufficient real-world data on injury risk in recreational sports, and it is unclear whether professional injury data can be extrapolated to youth and recreational sports.[14]

Heat Effects of Synthetic Turf

In direct sun, synthetic turf commonly exceeds natural-grass surface temperatures, with differences up to 33.7 °C.[15] Field measurements collected in February 2026 by DPH staff at Ocean Beach Chalet and Amazon Crocker fields confirmed higher near-surface temperature readings on synthetic turf than on adjacent natural grass. Given the increased risk to children experiencing thermal burns from hot surfaces, extreme heat advisories may consider adding advisory language on synthetic fields when appropriate. Because ambient temperature and sun exposure drive heat buildup, burn risk from synthetic turf is generally higher in hotter regions than in San Francisco's mild climate, though elevated surface temperatures could still occur locally.

RPD's policy to include selection for cork and sand infills may be relevant: In Seattle, a field monitoring study recorded cooler air over a mixed cork-and-sand infill than over crumb rubber.[16] It may be beneficial to consider instituting periodic surface-temperature measurements comparing synthetic turf and adjacent natural grass during hot, sunny conditions, to enhance evidence to what extent alternative infills like cork can mitigate heat.

Groundwater and San Francisco Public Utilities Commission Engagement

In addition to reviewing academic data, DPH also reviewed local testing that simulated the effects of rainfall on synthetic turf. Because PFAS chemicals comprise a very large class of compounds, focused test panels may underrepresent totals, and manufacturers generally

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[13] Theobald, P., Whitelegg, L., Nokes, L. D., & D. Jones, M. (2010). The predicted risk of head injury from fall-related impacts on to third-generation artificial turf and grass soccer surfaces: a comparative biomechanical analysis. *Sports biomechanics*, *9*(1), 29-37.

[14] Gould, H. P., Lostetter, S. J., Samuelson, E. R., & Guyton, G. P. (2023). Lower extremity injury rates on artificial turf versus natural grass playing surfaces: a systematic review. *The American journal of sports medicine*, *51*(6), 1615-1621.

[15] Singh, G., Peterson, B., Jay, O., & Stevens, C. J. (2024). The effect of synthetic grass sports surfaces on the thermal environment: A systematic review. *International journal of biometeorology*, *68*(7), 1235-1252.

[16] Herrera Environmental Consultants, Inc. (2019). Environmental monitoring report: Bobby Morris Playfield renovation pilot program. Seattle Department of Parks and Recreation: Results. https://www.herrerainc.com/wp-content/uploads/2025/07/Environmental-Monitoring-Report-Bobby-Morris.pdf

should avoid the intentional addition of PFAS as a best practice.

The San Francisco Recreation and Parks Department has previously consulted experts from the San Francisco Public Utilities Commission (SFPUC) on sampling protocols and testing related to synthetic turf. As part of our assessment, DPH staff also conferred with staff from SFPUC to understand the nature of ongoing discussions regarding any potential impact on groundwater quality. We have confirmed that SFPUC remains available to the RPD to provide recommendations on ensuring that turf installations do not impact groundwater in monitored areas.

End-of-Life Considerations for Synthetic Turf

A report by the California Department of Resources, Recycling and Recovery discovered that about 20-50% of crumb rubber infill is reused or recycled.[17] Due to the poor degradation of plastic, the European Union has voted to restrict intentionally-added microplastics—including crumb rubber infills—starting around 2031, while synthetic turf overall will remain permitted.[18]

The shift away from crumb rubber infill may yield environmental benefits.[19] Cork is harvested by stripping cork oak bark periodically without cutting trees. Cork oak landscapes also support exceptional biodiversity, including globally endangered species such as the Iberian lynx, Iberian imperial eagle, and Barbary deer.[20] However, demand for natural cork has declined with the rise of plastic stoppers and screw caps, threatening the industry.[21] Without regular cork harvesting, cork oak forests also may become more vulnerable to wildfire, land-use conversion, and ecological degradation.[22]

Overall, still more characterization is needed on the character of cork-and-sand infill composite infill material, more data on microbial environments of synthetic turf, and the Department also seeks further data characterizing overall animal–turf interactions, including potential impacts of synthetic turf on wildlife and domestic animals.

Engagement with San Francisco Recreation & Parks (RPD) Staff

[17] Louis Berger Group (2016) Recycling and Reuse of Crumb Rubber Infill Used in Synthetic Turf Athletic Fields, Report for CalRecycle, March 2016. https://www2.calrecycle.ca.gov/Docs/Web/110952

[18] European Union Commission. *Regulation 2023/2055–Restriction of microplastics intentionally added to products*. https://single-market-economy.ec.europa.eu/sectors/chemicals/reach/restrictions/commission-regulation-eu-20232055-restriction-microplastics-intentionally-added-products_en

[19] European Union Commission, 2023.

[20] World Wildlife Fund Mediterranean Program Office. (2006). *Cork screwed? Environmental and economic impacts of the cork stoppers market* [Report]. https://wwfeu.awsassets.panda.org/downloads/cork_rev12_print.pdf

[21] World Wildlife Fund Mediterranean Program Office, 2006.

[22] World Wildlife Fund Mediterranean Program Office, 2006.

In 2014, San Francisco voters supported an amendment to the City's Park Code authorizing the RPD to serve as the lead designated agency to select and approve certain park renovations when those renovations are expected to double public use.[23]

As part of our assessment, DPH thus sought to convey the most recent studies related to assessing the health impacts of synthetic turf directly to RPD staff. In those discussions, RPD staff conveyed a strong interest in developing a sound understanding of health-related assessment findings.

They also conveyed that their analyses project lower maintenance needs for synthetic turf, shared future field playability estimates indicating increased and more consistent public use following the planned renovation, and conveyed anecdotal feedback they have received from parents underscoring the health benefits of increased physical activity made possible through well-maintained, playable synthetic turf fields. On all matters involving children, DPH values the insights shared by parents and guardians, and we affirm that physical activity and access to recreational sports support children's overall health.[24]

Representatives from Recreation & Parks indicated that they will be reviewing the data carefully, retaining a technical environmental consultant, and holistically evaluating the health information alongside operational considerations.

Summary

Despite the long-term use of synthetic turf, data on newer generations of synthetic turf are nascent. While the most recent comprehensive analysis by the California EPA's Health Risk Assessment Office on synthetic turf with crumb rubber infill determined no short-term or long-term exposure-related health hazards from synthetic turf, scientific knowledge in this field is growing, and we are committed to reviewing new evidence as it emerges. Also, the assessment underscored the need for additional data in several areas, particularly more data focused on youth.

As San Francisco Recreation & Parks engages the public on future park renovations, we affirm a steadfast commitment to monitoring new evidence, evaluating emerging health data, and sharing evaluations promptly with partner City agencies and interested stakeholders.

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[23] San Francisco Park Code, § 14.02, "Increasing Playground, Trail and Field Capacity" (Rev. latest amendments from Prop. I, Nov. 4, 2014). In *Code of Ordinances and Municipal Code* (n.d.). American Legal Publishing. https://codelibrary.amlegal.com/codes/san_francisco/latest/sf_park/0-0-0-46906

[24] McCurdy, L. E., Winterbottom, K. E., Mehta, S. S., & Roberts, J. R. (2010). Using nature and outdoor activity to improve children's health. *Current problems in pediatric and adolescent health care*, *40*(5), 102-117