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April 1, 2024

Westport Planning & Zoning Commission
110 Myrtle Avenue
Westport, CT 06880

Re: The Dangers of Artificial Turf

Dear Commissioners:

Based on comments at recent P&Z and other meetings, it seems that many residents, town officials, sports enthusiasts—and even a few Commissioners—are under the impression that artificial turf is safe as long as it doesn't contain "crumb rubber" infill, which Westport has already banned. The purpose of this letter is to debunk that myth.

The truth is that all artificial turf is bad for the environment and our health. In fact, it was a wide-ranging set of concerns over the negative impact artificial turf on our health and ecosystems that helped to convince residents in Wilton to reject a referendum last year that would have allowed the construction of a new artificial turf field in their town.

Set forth below is a summary of the four (4) most significant types of problems with artificial turf. Unless otherwise indicated, backup for this information can be found in the public service presentation ("The Hazards of Artificial Turf"; https://vimeo.com/803691477) sponsored last year by the Norwalk River Watershed Association and other concerned citizens—*which I urge you to watch*.[1]

Why artificial turf is bad:

1. Artificial turf leaches toxic PFAS (or "forever") chemicals into the water supply and marine environments. And this is true, as noted above, even for turf that does not use crumb rubber infill. Indeed, some scientists now say that, while the efforts to curb the use of crumb rubber were necessary and laudable, the focus on that one issue has regrettably created a mistaken belief that artificial turf is fine as long as it doesn't contain crumb rubber.

[1] See also: https://www.youtube.com/watch?v=w24A3Th8JDE; https://www.youtube.com/watch?v=C3nTqqFVqKc

In fact, as the Sierra Club[2] and Public Employees for Environmental Responsibility (PEER)[3] note in their literature, PFAS compounds are also found in other types of infill, including material that has been touted as "organic." For example, tests done for the town of Oak Bluffs in Martha's Vineyard showed that two PFAS compounds were present in so-called organic infill.[4] And researchers at Notre Dame University found similar results after Dr. Graham Peaslee and his team tested 38 types of artificial turf. (Dr. Peaslee testified about this research during the above-referenced presentation; his research has been submitted for publication and is expected to be generally available in the very near future.)

Moreover, as Dr. Sarah Evans (from Mt. Sinai) noted in her letter in January 2024 to the New Canaan Inland Wetlands and Planning and Zoning Commissions (see attached), even alternative infill material contains other hazardous substances: "Recent studies including one conducted by Mount Sinai and the Toxic Use Reduction Institute (TURI) found the **presence of known carcinogens and neurotoxins including polycyclic aromatic hydrocarbons (PAHs), lead, zinc, and black carbon in almost all alternative infill materials examined**."[5]

Equally important, **PFAS compounds have been found in the *blades* and *backing* of the turf**.[6] In 2019, two separate nonprofit groups (the Ecology Center and PEER[7]) tested a wide range of artificial turf samples and found that both the blades as well as the backing of the turf contained PFAS. Dr. Peaslee and his research team at Notre Dame found PFAS in the blades as well.[8] Lobbyists for the industry have tried to push back by claiming that the samples *may have been* contaminated, but, as Dr. Peaslee and others have explained, the research findings make sense given the way that artificial turf is manufactured. Specifically, the extrusion of the plastic—particularly the blades—would be too sticky without PFAS chemicals that reduce friction. In fact, patent applications filed by manufacturers confirm the use of PFAS chemicals.[9]

What's important to understand is that these PFAS compounds, which migrate from the turf and accumulate in marine life and the human body, are toxic, especially for children and pregnant women. In fact, **PFAS chemicals are carcinogenetic and can interfere with hormones, reproduction, immunity and cause developmental delays in children.**

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[2] https://www.sierraclub.org/massachusetts/artificial-turf
[3] https://peer.org/toxic-forever-chemicals-infest-artificial-turf/
[4] https://www.oakbluffsma.gov/DocumentCenter/View/7435/TetraTech-MVC-2021-02-26-TurfAnalysisReport_FINAL
[5]Massey *et al. New Solut*. 2020 May; 30(1):10-26. doi: 10.1177/1048291120906206
Armada et al. Sci *Total Environ*. 2022 Mar 15;812:152542.
[6] https://www.bostonglobe.com/metro/2019/10/09/toxic-chemicals-found-blades-artificial-turf/1mlVxXjzCAqRahwgXtfy6K/story.html; https://www.center4research.org/written-statement-regarding-artificial-turf-to-woodbridge-ordinance-committee/
[7] Public Employees for Public Responsibility, a nonprofit group based in Massachusetts.
[8]https://whova.com/xems/whova_backend/get_event_s3_file_api/?event_id=sopc_202003&file_url=https://d1keuthy5s86c8.cloudfront.net/static/ems/upload/files/dtxml_6April2022_NEWMOA_GP_KLM_PFAS_in_Artificial_Turf.pdf&eventkey=ad5b9325b33ddf90075c415919b946b4db08203e34443e6dc4f9c9107ff2d5bf
[9] https://peer.org/toxic-forever-chemicals-infest-artificial-turf/

As the EPA explicitly states on its website:

> Current peer-reviewed scientific studies have shown that exposure to certain levels of PFAS may lead to:
>
> - Reproductive effects such as decreased fertility or increased high blood pressure in pregnant women.
> - Developmental effects or delays in children, including low birth weight, accelerated puberty, bone variations, or behavioral changes.
> - Increased risk of some cancers, including prostate, kidney, and testicular cancers.
> - Reduced ability of the body's immune system to fight infections, including reduced vaccine response.
> - Interference with the body's natural hormones.
> - Increased cholesterol levels and/or risk of obesity.
>
> https://www.epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas

Moreover, other studies have noted that PFAS are associated with "increased incidence of gestational diabetes, childhood obesity, preeclampsia and fetal growth restriction."[10] In fact, the risk of birth defects from these chemicals (including, most notably, defects in the brain) is now a specific matter of concern.[11]

These chemicals are so dangerous that, in 2022, the EPA issued an interim advisory stating that there is virtually no safe level of PFAS in drinking water. Just weeks ago, in early February 2024, the EPA proposed adding PFAS compounds to the list of toxic materials that are deemed "hazardous substances" and harmful to human health under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the "Superfund" law.

I note that, in Westport, we need to be especially vigilant because two of our wells are already contaminated with PFAS[12]; we simply cannot afford to make the situation worse. Nor can we afford to install something that is likely to be classified as hazardous by the EPA and thus require extensive (and expensive) remediation and which expose us to litigation in the not-too-distant future. Put another way: Do we really want to wind up with Superfund sites in our town—and do we want them near our schools or children?

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[10] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7473499/; see also: https://www.nytimes.com/2020/09/23/parenting/pregnancy/pfas-toxins-chemicals.html

[11] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4117925/

[12] See page 5 of Aquarion's water quality report: https://www.aquarionwater.com/docs/default-source/water-quality/water-quality-reports/ct/2022/bridgeportmain_ccr_2022.pdf?sfvrsn=86b86ef0_5
See also page 7 of document in the class action suit against Aquarion (Westport is technically part of the Bridgeport/Main System but the Canal Street and Coleytown wellfields are in Westport: https://civilinquiry.jud.ct.gov/DocumentInquiry/DocumentInquiry.aspx?DocumentNo=26476245

Moreover, you should note that, in January 2024, the State of Connecticut sued DuPont and other manufacturers of PFAS chemicals, claiming that they knew that their PFAS products were toxic, highly persistent, and likely to spread to groundwater and contaminate the environment. Do we really want to be a defendant in a similar lawsuit when people discover that Westport *knowingly* contributed to the problem and put children at risk?

Aside from the Superfund and potential liability issues, the disposal of artificial turf at the end of its useful life (i.e., 10 years) presents an additional problem. Specifically, contrary to what the industry claims, there is no way to recycle it. The point is that tons and tons of this material will likely wind up in landfills, where it will continue to leach PFAS—and thus, continue to poison our water and the environment *forever*.

2. Artificial turf is a huge source of microplastics, both from the degradation of the infill and backing, as well as the breakdown of the blades. And this plastic, which is also a health hazard, is also winding up in our waterways, in our water supply, in our ecosystems, and in our bodies, where it wreaks havoc.

Exposure to even low concentrations of microplastics is associated with respiratory and cardiovascular diseases.[13] Microplastics can also "affect the human body by stimulating the release of endocrine disruptors. In addition, microplastics can carry other toxic chemicals such as heavy metals and organic pollutants during adsorption, which can adversely affect the human body."[14]

Moreover, it is now well established that artificial turf is a huge source of microplastics. Scientists estimate that one turf field sheds 480 pounds of microplastics per year. A recent report from Sweden confirms that artificial turf is a huge source of microplastic pollution, second only to rubber tires.

3. Artificial turf contributes to climate change.

a) **Artificial Turf Produces Massive Amounts of CO2**. Unlike natural grass, which absorbs carbon dioxide (CO2), artificial turf does the opposite: it releases CO2, as well as methane and other chemicals. It is now estimated that a 2-acre artificial turf field generates 55.6 metric tons of CO2 over its useful life (i.e., 10 years). By way of comparison, a natural grass field of the same size would result in a net *reduction* of 16.9 metric tons of CO2.[15] And keep in mind that these numbers assume that the material will be recycled at the end of its useful life, which we now know is impossible.

b) **Artificial turf heats things up—both on and off the field.** Artificial turf *significantly* raises the air temperature on the field, which makes it a dangerous environment on hot days. Some towns, for example, have found the temp on turf fields to be 40 to 70 degrees

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[13] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10151227/#:~:text=Regarding%20the%20effects%20on%20the,a%20low%20blood%20oxygen%20concentration.

[14] Id.

[15] https://climateactionmoreland.org/2021/02/28/natural-grass-or-synthetic-turf-what-are-the-total-life-cycle-emission-profiles/

higher than the surrounding air temperatures,[16] forcing them to cancel activities. Other towns have been forced to resort to watering the artificial turf, a practice that is not environmentally sustainable—especially since the cooling effect is short-lived.

In addition, the heat generated by artificial turf can increase temperatures in an entire neighborhood due to something called the "urban heat island effect." By contrast, vegetation can absorb heat through an evaporative cooling process, and thus, can help lower surrounding temperatures, in some cases by as much as 7 degrees.[17] In any event, this heat boosting effect is especially problematic as our Town already faces longer and more intense heat waves due to climate change.

c) **Artificial turf can create and/or exacerbate drainage issues.** Some manufacturers of artificial turf advertise that their products are permeable, but what they fail to tell the public is that the earth below the material is not.[18] Why is that? As explained by one expert, it's because,

> "Before installation, the ground is flattened, compacted, and covered with gravel and plastic to create a level surface for the turf. The compaction of the ground underneath and the turf itself causes higher volumes of stormwater runoff and lower infiltration rates, contributing to local flooding and stormwater pollution. Turf turns the remaining topsoil into an ecological wasteland, slowly cooked with high heat and starved of nutrients, air, and moisture. With no plant roots to create water-absorbing, spongy soil, the ground will become dry, damaged, and unable to filter and absorb rain. This contributes to more urban runoff, which pollutes our waterways and coasts."[19]

d) **Artificial turf is inhospitable to pollinators and other insects and wildlife.** Because lawns and natural turf fields are typically non-native monocultures and because they encourage the use of fertilizers, pesticides, and herbicides, they are generally considered bad for the environment.[20] When it comes to our pollinators, birds, and beneficial insects, however, artificial turf is even worse. As one environmental group describes it,

> "Fake grass is uninhabitable. Butterflies, hummingbirds, and our other pollinator friends needs nectar from native plants. They're not attracted to plastic grass, recycled or not."[21]

Or, as another environmental nonprofit has noted,

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[16] https://www.safehealthyplayingfields.org/heat-levels-synthetic-turf
[17] https://www.sciencedirect.com/science/article/pii/S2095311913605432?ref=pdf_download&fr=RR-2&rr=856f39f9dfd2437b
[18] https://beachapedia.org/Artificial_Turf
[19] https://www.surfrider.org/news/artificial-turf-why-we-shouldnt-choose-plastic-over-plants#:~:text=The%20compaction%20of%20the%20ground,local%20flooding%20and%20stormwater%20pollution.
[20] https://new.nsf.gov/news/are-our-lawns-biological-deserts
[21] https://www.treepeople.org/2015/03/25/skip-artificial-turf-native-plants-truth-fake-grass/

> "[Artificial turf] provides no food or habitat for birds, butterflies, bees or other wildlife critical to healthy ecosystems. Essential pollinators for flowers and food crops cannot find shelter, pollen, or plants that host larval stages."[22]

And, as another non-profit group explains,

> "Artificial turf harms local wildlife by blocking access to the soil beneath for burrowing insects, such as solitary bees, and the ground above for soil dwellers such as worms and small mammals."[23]

4. Artificial turf presents other health issues.

a) **Staph-Resistant Infections.** As one NIH-published study noted, "the surface characteristics of artificial turf can play a role in the spread of infections, as contact with the abrasive surface results in frequent burns and a 7-fold increase in MRSA infection risk over players without abrasions."[24]

b) **Heat Stroke and Burns.** Because artificial turf fields get extremely hot, they increase the risk of heat stroke and burns. And the heat risk for children is even greater, since, as a doctor from Mt. Sinai[25] (see attached) explains, children "are less able to regulate their body temperature than adults, making them particularly susceptible to conditions of extreme heat. In addition, children have a higher surface area to body mass ration, produce more body heat per unit mass, and sweat less than adults, all factors that increase susceptibility to heat injury."[26]

c) **ACL and Other Injuries.** Because artificial turf is generally firmer than natural grass, it allows players to run faster. This causes players to exert more torque on their joints, tendons, and ligaments when they stop or pivot. Some experts believe that that those aspects of artificial turf (combined with the way that certain cleats attach to the turf) may explain the significant increase in PCL and ACL injuries seen among athletes who play on artificial turf.[27] Indeed, one study found that "A soccer player, regardless of sex, was ~53 to 65% more likely to have an ACL injury on artificial turf than on natural grass."[28]

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[22] https://beachapedia.org/Artificial_Turf
[23] https://peer.org/commentary-artificial-turf-spreads-like-weeds-on-long-island/
[24] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7222665/#:~:text=The%20surface%20characteristics%20of%20artificial,risk%20over%20players%20without%20abrasions.
[25] https://mountsinaiexposomics.org/learning-hub/turf-sports/
[26] https://www.cga.ct.gov/2016/KIDdata/Tmy/2016HB-05139-R000216-Sarah%20Evans,%20Icahn%20School%20of%20Medicine%20at%20Mount%20Sinai-TMY.PDF
[27] https://www.center4research.org/injuries-related-to-artificial-turf/#:~:text=Knee%20Injuries&text=They%20found%20that%20posterior%20cruciate,they%20did%20on%20the%20grass For a meta-analysis on injury data, see: Xiao M, Lemos JL, Hwang CE, Sherman SL, Safran MR, Abrams GD. Increased Risk of ACL Injury for Female but Not Male Soccer Players on Artificial Turf Versus Natural Grass: A Systematic Review and Meta-Analysis. Orthop J Sports Med. 2022 Aug 12;10(8):23259671221114353. doi: 10.1177/23259671221114353. PMID: 35990873; PMCID: PMC9382072.
[28] https://www.sportsmedres.org/is-the-turf-worth-it/

> In fact, it was the worry over injuries that prompted the NFL Players Association last October to demand that the NFL switch to all-natural grass fields.[29] In making this demand, the NFL players are following the U.S. women's soccer team, which previously sued FIFA over the issue. As a result, **FIFA, the soccer world's governing body, now bans artificial surfaces in all World Cup tournaments**.[30]

As stewards of land use in Westport, I hope that you will take this information to heart and act to protect current—and future—residents from this health and environmental threat by imposing an **immediate moratorium on the installation of artificial turf**. Please let me know if you have any questions or if you would like to speak to professionals involved in this research.

Sincerely,

Enc. (Mt. Sinai letter)

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[29] https://apnews.com/article/nfl-nflpa-aaron-rodgers-achilles-injury-grass-fields-artificial-surface-0b6bd58da43d52b0a8578bd7e70228d3
[30] https://www.npr.org/2023/07/19/1188543442/debate-continues-over-whether-artificial-turf-is-good-for-soccer

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January 18, 2024

To the New Canaan Inland Wetlands and Planning and Zoning Commissions:

The Children's Environmental Health Center of the Icahn School of Medicine at Mount Sinai strongly discourages the installation of artificial turf playing surfaces and fields due to the uncertainties surrounding the safety of these products and the potential for dangerous heat and chemical exposures.

As pediatricians, epidemiologists, and laboratory scientists, recipients of numerous research grants from the National Institute of Health, and host to one of 10 nationally funded Pediatric Environmental Health Specialty Units, we receive frequent inquiries from communities regarding the wide-scale use of artificial turf surfaces on school grounds and in park properties. This led us to conduct a review of the risks and benefits of artificial playing surfaces, during which we found **significant gaps in the evidence supporting the safety of artificial turf products**. Our findings are summarized below and in our online resources accessible at https://sinaiexposomics.org/artificial-turf/ and https://www.healthyplayingsurfaces.org/ and via webinar on the Environmental Health Impacts of Synthetic Turf and Safer Alternatives.[1]

Studies to assess the safety of artificial turf are ongoing and inconclusive. The preponderance of existing data on artificial turf pertains to recycled tire infill, or "crumb rubber", which contains known carcinogens and neurotoxins. Concerns about the safety of recycled rubber playing surfaces have been raised by the federal government, based on a lack of comprehensive studies. In 2016, the United States Environmental Protection Agency (USEPA) announced the launch of an investigation into the safety of crumb rubber in partnership with the Centers for Disease Control and Prevention and the Consumer Product Safety Commission, stating **"existing studies do not comprehensively evaluate the concerns about health risks from exposure to tire crumb".**[2] In July 2019, USEPA published a portion of their findings from these studies, which confirmed the presence of chemicals linked to cancer, nervous system toxicity, and impaired reproductive development such as polycyclic aromatic hydrocarbons, benzene, lead, and phthalates.[3] The authors emphasize that the reported findings **do not constitute a risk assessment** and cannot be interpreted as evidence of safety.

Questions remain about the safety of alternatives to crumb rubber. Extremely few studies have examined the composition and safety of alternative infills including those purported to be "natural". A 2016 USEPA report found research supporting the safety of alternative infills such as EPDM, TPE, and plant-based infills "lacking or limited". [4] Recent studies including one conducted by Mount Sinai and the Toxic Use Reduction

[1] https://www.healthandenvironment.org/webinars/96595
[2] http://www.epa.gov/sites/production/files/2016-02/documents/us_federal_research_action_plan_tirecrumb_final_0.pdf
[3] https://www.epa.gov/sites/production/files/2019-08/documents/synthetic_turf_field_recycled_tire_crumb_rubber_research_under_the_federal_research_action_plan_final_report_part_1_volume_1.pdf
[4] https://www.epa.gov/chemical-research/december-2016-status-report-federal-research-action-plan-recycled-tire-crumb

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Institute (TURI) found the **presence of known carcinogens and neurotoxins including polycyclic aromatic hydrocarbons (PAHs), lead, zinc, and black carbon in almost all alternative infill materials examined**.[5,6]

Adequate safety assessment requires biomonitoring to determine chemical exposures under realistic play conditions. Importantly, no studies have addressed children's exposure to chemicals from artificial turf surfaces via oral and dermal routes, the two most likely ways that turf chemicals enter the body during play. These studies are underway at USEPA; until findings are available and conclusively demonstrate the safety of artificial surfaces, we recommend a moratorium on the use of these materials where children play.

Undisclosed chemicals of concern are present in plastic grass blades and turf pads and matting. A recent study identified per- and poly-fluoroalkyl substances (PFAS, aka "Teflon chemicals"), a class of more than 5000 chemicals linked to numerous health problems including cancer, nervous system toxicity, immune dysfunction, thyroid, and cardiovascular disease in the plastic grass blades and backing used on artificial turf fields and in adjacent bodies of water.[7,8,9,10] PFAS are considered "forever chemicals" because they persist in the body and the environment and are widespread drinking water contaminants. These findings raise concerns about PFAS groundwater and environmental contamination from turf field run off and emphasize the need for further examination of exposures that may occur from turf components other than infill.

Recent actions by the USEPA highlight increasing recognition that there is no safe level of PFAS exposure. On March 14, 2023, USEPA proposed National Primary Drinking Water Regulations for six PFAS, dramatically lowering the recommended levels of PFOA and PFOS and citing **scientific evidence of health impacts at drinking water levels close to zero**.[11] These guidelines also include advisories for newer PFAS chemicals PFNA, GenX, PFBS, and PFHxS. Both the federal government and the state of Connecticut have also taken steps to designate PFAS hazardous substances and to restrict their use in certain products.[12,13,14,15] **To allow the installation of PFAS-containing surfaces would be extremely short-sighted as further restrictions and regulations on these chemicals are likely to come.**

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[5] Massey *et al. New Solut*. 2020 May;30(1):10-26. doi: 10.1177/1048291120906206.
[6] Armada et al. Sci *Total Environ*. 2022 Mar 15;812:152542.
[7] https://www.atsdr.cdc.gov/pfas/PFAS-health-effects.html
[8] https://www.bostonglobe.com/metro/2019/10/09/toxic-chemicals-found-blades-artificial-turf/1mlVxXjzCAqRahwgXtfy6K/story.html
[9] https://sinaiexposomics.org/pfas-chemicals-and-your-health/
[10] https://www.turi.org/TURI_Publications/TURI_Chemical_Fact_Sheets/PFAS_in_Artificial_Turf_Carpet
[11] https://www.epa.gov/sdwa/and-polyfluoroalkyl-substances-pfas
[12] https://www.epa.gov/superfund/proposed-designation-perfluorooctanoic-acid-pfoa-and-perfluorooctanesulfonic-acid-pfos
[13] https://www.epa.gov/newsreleases/epa-proposes-stop-authorized-use-certain-pfas-pesticide-products
[14] https://portal.ct.gov/Office-of-the-Governor/News/Press-Releases/2021/07-2021/Governor-Lamont-Signs-Legislation-Banning-Use-Of-PFAS
[15] https://portal.ct.gov/DEEP/Remediation--Site-Clean-Up/PFAS-Task-Force/PFAS-Task-Force

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Risk of heat injury is elevated on artificial turf. On hot summer days, temperatures of over 160 degrees Fahrenheit have been recorded on recycled rubber play surfaces.[16] All artificial turf surfaces examined have been shown to have higher surface temperature and air temperature at head height compared with natural grass, regardless of infill type.[17] Vigorous play in these conditions conveys a very real risk of burns, dehydration, heat stress, or heat stroke. Children are less able to regulate their body temperature than adults, making them particularly susceptible to conditions of extreme heat.[18,19]

High temperatures and risk of heat illness lead to a loss of field usage even on hot days, which have become increasingly common due to climate change. Like asphalt, artificial turf fields contribute to the "heat island effect", in which communities close to the fields become hotter than surrounding areas.[20] Artificial turf contributes to the climate crisis throughout its lifecycle, requiring fossil fuels during production and emitting greenhouse gases during use and disposal.[21]

Children are uniquely vulnerable to harmful exposures from artificial turf surfaces because of their unique physiology and behaviors, rapidly developing organ systems, and immature detoxification mechanisms.[22] Children may be exposed to artificial turf chemicals through ingestion, inhalation, skin absorption, and open wounds or broken skin. Children and young athletes breathe faster than adults, putting them at greater risk for inhalation of chemicals that off-gas from turf fields. Small children put their hands and other objects in their mouths, increasing the risk of exposure via ingestion. In addition, youth have a higher surface area to body mass ratio, produce more body heat per unit mass, and sweat less than adults, all factors that increase susceptibility to heat injuries that have been observed on artificial turf fields.[14] Vulnerability to turf chemicals persists through the teen years as the reproductive and nervous systems continue to develop beyond the first two decades of life. Lastly, children have more future years of life over which chronic diseases linked to the chemicals in turf develop.

Chemical hazards escape from artificial turf surfaces to the environment. A number of the chemical components of artificial turf surfaces are soluble in water. When rain and snow fall on synthetic fields, these materials can leach from the surface to contaminate ground water and soil.[23] Recent studies find PFAS in wetlands adjacent to artificial turf suggesting that these chemicals may migrate from field components to contaminate the environment.[7] Runoff from turf fields releases microplastics into the environment, with studies suggesting that they may be a major source of plastic pollution in waterways.[24] Microplastic

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[16] Devitt, D.A., M.H. Young, M. Baghzouz, and B.M. Bird. 2007. *Journal of Turfgrass and Sports Surface Science.* 83:68-82

[17] https://plantscience.psu.edu/research/centers/ssrc/sportsturf-scoop/temperature

[18] https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Children-and-Disasters/Pages/Extreme-Temperatures-Heat-and-Cold.aspx

[19] Falk B, Dotan R. *Appl Physiol Nutr Metab.* 2008 Apr;33(2):420-7. doi: 10.1139/H07-185.

[20] Luz Claudio. *Environmental Health Perspectives*. Vol 116. No 3. March 2008.

[21] https://www.nrpa.org/parks-recreation-magazine/2019/may/synthetic-sports-fields-and-the-heat-island-effect/

[22] Bearer, CF. Neurotoxicology 21:925-934, 2000.

[23] Connecticut Department of Environmental Protection (2010) Artificial Turf Study: Leachate and Stormwater Characteristics. http://www.ct.gov/deep/lib/deep/artificialturf/dep_artificial_turf_report.pdf

[24] De Haan et al. *Environmental Pollution.* 334(2023)122094. Doi: 10.1016/j.envpol.2023.122094

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contamination is found in drinking water and wildlife throughout the globe and in human blood, lungs, and placenta.[25,26,27]

Turf materials are transported home. Over time, play surfaces break down into smaller pieces and fine particles that may be picked up on children's shoes, clothing, and skin. Infill and grass blades accumulate in shoes and stick to bodies of players, bringing these materials into cars and homes. Thus, exposure can continue for many hours beyond the time that a child spends in the play area.

Daily outdoor play and physical activity are essential components of a healthy childhood. Safe play areas are an essential component of any school environment. While it is important to maximize safe play time, we caution against the use of materials which carry risks of chemical and heat exposure and have not been comprehensively tested for safety.

For the reasons outlined above, the Children's Environmental Health Center recommends natural grass fields and playing surfaces as the safest option for areas where children play. For case studies that include data on cost, labor, and play time on organically managed natural grass athletic fields see https://www.turi.org/TURI_Publications/Case_Studies/Organic_Grass_Playing_Fields.

I would be happy to answer any questions that you might have.

Kind Regards,

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