PUBLIC SUBMISSION

As of: 4/28/16 11:22 AM
Received: April 15, 2016
Status: Posted
Posted: April 22, 2016
Tracking No. 1k0-8p39-1hhr
Comments Due: May 02, 2016
Submission Type: Web

Docket: ATSDR-2016-0002
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ

Comment On: ATSDR-2016-0002-0003
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill ATSDR-2016-0002

Document: ATSDR-2016-0002-0024
Comment on FR Doc # 2016-03305

Submitter Information

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General Comment

I am a physician trained in pathology with boards in anatomic pathology, clinical pathology and blood banking. I have been following the controversy over tire crumb rubber for several years and have reviewed a number of the published studies on this matter.

I congratulate the governmental agencies for taking up this important matter to establish whether ground up tires used on artificial grass fields in the form of crumb rubber is a suitable for children to play on.

After reviewing a number of studies I must conclude that, thus far, the studies are totally inadequate to establish the safety of tire crumb rubber for artificial grass playing fields.

Background:

A recent study at Yale University was done on shredded tires and tire crumb rubber by Gaboury Benoit, Professor of Environmental Chemistry, Professor of Environmental Engineering, Co-Director of the Hixon Center for Urban Ecology, Director of the Center for Coastal and Watershed Systems.

Crumb rubber from tires is a very heterogeneous material coming from tires that have many different chemical compositions so it is legitimate to include shredded tires that are used on

playgrounds as well as crumb rubber that is used in artificial grass to see to what chemicals children will be exposed. Professor Gaboury's findings were quite shocking.

96 chemicals were found in 14 samples analyzed. Half of those chemicals had no government testing on them - so we have no idea whether they are safe or harmful to health! Of those chemicals found that have had some government testing done on them, there were 12 carcinogens, and 20 irritants.

There is no dispute over the fact that there are carcinogens and toxic compounds in tires and products made from tires. The claims of safety rely upon assumptions about whether exposure to these chemicals (and metals) are within levels recognized as safe.

There are number of reasons why I believe the studies thus far are totally inadequate.

1) When the determination is made that the exposure to toxins and irritants is within safe levels it is based on studies of the toxicity of each individual chemical. If all the chemicals are shown to be within safe levels of exposure the conclusion is made that there is minimal if any risk.

This conclusion is totally unjustified because it does not take into account that the exposure is to many of these chemicals simultaneously. It is well established that when toxic chemical substances are combined together (termed the combination effect) they can cause adverse effects to human health, even if the individual chemical substances are within levels considered safe. It is my hope that you will take this into account when you do your safety assessments.

2) To my knowledge, there have been no in vivo studies regarding frequent and close contact with tire crumb rubber. There is a requirement for these kinds of studies for pharmaceuticals and for pesticides. But apparently not for tire crumb rubber. Instead of assuming that exposure levels are safe, Particularly when the exposure is to a complex mixture of toxic agents and irritants, it only makes sense to do toxicity studies with living systems that are actually exposed to the complex mixture to which children will be exposed.

I find it a serious flaw even in pesticide testing that only the active agent in the pesticide is tested for in vivo toxicity when, in actuality, the way the pesticide is used is in combination with a mixture of chemicals designed to enhance the pesticides toxic effect and, in many cases in combination with other pesticides.

When such studies are conducted, it should be kept in mind that crumb rubber fields can reach very high temperatures in the sun and give off larger amounts of volatile organic compounds.

In there is to be any confidence in your study, in vivo toxicity testing needs to be done with the crumb rubber to which children and athletes are actually exposed.

3) Amy Griffin a goalkeeper for the U.S. National team has been informally tracking American soccer players with cancer since 2009, when she noticed a number of young athletes who'd played soccer on artificial fields were getting sick.

In 2014 Griffin, had heard from 38 soccer players who'd been diagnosed with cancer (mainly non-Hodgkin's lymphoma). That tally has climbed to 220 athletes - 166 of them soccer players. Of the soccer players, 102 were former goalkeepers who spent more time on the ground and

were more exposed to crumb rubber than their teammates.

This points to the need of a epidemiological study to see if there is indeed an abnormal increase in cancers among athletes that play regularly on artificial turf with crumb rubber infill. Important to note is that lymphomas often have a long lag time between exposure and manifestation of the disease.

Thank you for this opportunity to comment.

Respectfully,

Jerome A. Silbert, M.D.

PUBLIC SUBMISSION

As of: 5/3/16 6:18 PM
Received: April 29, 2016
Status: Posted
Posted: April 29, 2016
Tracking No. 1k0-8pcg-82s1
Comments Due: May 02, 2016
Submission Type: Web

Docket: ATSDR-2016-0002
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ

Comment On: ATSDR-2016-0002-0003
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill ATSDR-2016-0002

Document: ATSDR-2016-0002-0045
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ Comment on FR Doc # 2016-03305

Submitter Information

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General Comment

The Delaware Riverkeeper Network submits the attached comment for your consideration.

In addition to the attached comment we would like to request that Maya van Rossum, the Delaware Riverkeeper, on behalf of the Delaware Riverkeeper Network, be identified as a stakeholder for participation in your process. Ms. van Rossum has engaged in a significant amount of research and community education and advocacy around the issue of synthetic turf fields, particularly those with crumb rubber infill, and would bring an important environmental and community perspective to your deliberations. Ms. van Rossum is the primary author on the documents we are submitting today.

Ms. van Rossum can be reached at:

keepermaya@delawareriverkeeper.org

or by phone at 215 369 1188 ext 102

Respectfully submitted and requested.

(p.s. the action alert document submitted previously was submitted in error and need not be entered for the record.)

Attachments

Comment 4.29.16 ATSDR & EPA re Art Turf study

April 29, 2016

Leroy A. Richardson, Information Collection Review Office
Centers for Disease Control and Prevention
1600 Clifton Road NE., MS-D74
Atlanta, Georgia 30329.

Federal eRulemaking Portal: Regulation.gov

Re: Docket No. ATSDR-2016-0002

Dear Mr. Richardson,

Conducting additional research into the health and environmental impacts synthetic turf fields with crumb rubber infill is essential. Crumb Rubber turf fields are proliferating quickly through communities with schools and municipalities constructing crumb rubber fields to accommodate kids playing sports of all ages from elementary level on up. In every instance school district and town officials cite industry funded research as a primary demonstration of safety. Inadequate Government documents are of little help in countering such assertions or information the decisionmaking process as, to the degree they exist, they are very limited in scope, they often rely on industry-provided information, and they often rely on an absence of information as somehow supporting a demonstration of no harm. A thorough and independent investigation is essential if we are to protect children, adults and the environment from the harms of crumb rubber artificial turf.

The Delaware Riverkeeper Network would also like to suggest that research into the impacts of other artificial turf infill materials is important given that they too are the subject of a multitude of claims of safety backed by little but industry marketing materials and industry funded research.

I believe it will be important to include an organization like the Delaware Riverkeeper Network among your stakeholders. We have had to engage in significant research into, and advocacy about, artificial turf, its environmental and health impacts on a number of occasions over the past 8+ years. As a result we have a significant and healthy understanding of the science and the issues that have been and need to be evaluated.

I include with this comment a series of fact sheets and informational materials created by my organization to help inform local debates regarding the construction or expansion of artificial turf

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fields. In these materials we cite a number of scientific and government materials that assess the environmental and health impacts of crumb rubber artificial turf. We would like to submit them for the record and your consideration.

Synthetic turf is generally made with rubber from waste tires. Recycled rubber varies considerably in its chemical composition, even when from the same manufacturer.[1] Hazardous substances found in tires may persist in the environment including polycyclic aromatic hydrocarbons (PAHs), phthalates and certain metals. These substances may be bioaccumulative, carcinogenic, reprotoxic, mutagenic and/or endocrine disrupting.[2]

- Most PAHs are persistent, bioaccumulative and carcinogenic.[3]
- Phthalates are generally used as solvents and plasticisers in plastics. Phthalates are not chemically bound to the rubber and as a result can leach from the infill material.[4]
- Phenols likewise are not chemically bound to the rubber and so can leach. Phenols too are persistent and bioaccumulative and can have long-term effects on the environment.[5]
- Among the metals found in tires that may be of concern are zinc, lead, copper, chromium and cadmium. While zinc and copper are essential for living organisms, when absorbed at high levels they become harmful. Lead can affect reproduction, development of the nervous system leading to poor cognitive development, and is a particular threat to fetuses and young children. Chromium is carcinogenic and mutagenic. Cadmium is toxic to humans and if taken in can contribute to poor liver and kidney function, as well as osteoporosis. [6]

Playing on Artificial Turf brings threats of exposure to hazardous substances through a variety of pathways.

Direct human exposure to the hazardous substances contained in the rubber in-fill of artificial turf is believed to occur via three pathways: inhalation, skin contact, and/or ingestion including by children who come into contact with the material.[7]

A 2012 study focused on the threat of lead ingestion from artificial turf noted that lead, in the "case of chronic exposure in early childhood, can induce cell necrosis, nerve behavioral abnormalities and developmental disability, and in the case of long-term exposure it can induce cell necrosis, blood pressure, cancer, and kidney tumor."[8] In this study researchers considered the impacts for lead exposure from children who ingest rubber powder resulting from exposure to crumb rubber infill artificial turf. The research showed elementary school children had a hazard index that exceeded 0.1,

[1] T. Kallqvist, Norwegian Institute for Water Research (NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 7.
[2] KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.
[3] KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.
[4] KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.
[5] KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.
[6] KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.
[7] Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007.
[8] Kim, S., Yang, J.-Y., Kim, H.-H., Yeo, I.-Y., Shin, D.-C., & Lim, Y.-W. (2012). Health Risk Assessment of Lead Ingestion Exposure by Particle Sizes in Crumb Rubber on Artificial Turf Considering Bioavailability. Environmental Health and Toxicology, 27, e2012005. http://doi.org/10.5620/eht.2012.27.e2012005.

a level that is considered a "potential for hazard".[9] Middle and high school children were also found to have exposure levels.

In 2011, research conducted for the New Jersey Department of Environmental Protection began investigation into the potential for players on artificial turf fields to be exposed to lead, chromium, arsenic and cadmium as a respirable/inhalable aerosol.[10] In air samples collected from the turf during various levels of activity, researchers detected arsenic, cadmium, chromium and lead, all metals with known human toxicity.[11] "The findings of this study, although limited in scope, raise some concerns with regard to the potential hazards that may exist for individuals and in particular children who engage in sports activities on artificial turf fields."[12] The research demonstrated that activity by players on the fields could suspend contaminated particulates into the air that could be inhaled. "The findings show that both inhalable PM [particulate matter], as well as inhalable lead (when present) are resuspended from even minor physical activity on an artificial surface. These data therefore indicates that human exposure from lead-containing artificial turf fields is not just limited to dermal, but also to inhalation route of exposure."[13] The three potential avenues for lead from artificial turf are the blades of artificial grass, the pigment used for the field markings and lines, and the infill material. Even studies that have not found exposure levels to lead high enough to be of concern in the context of the study conducted are careful to point out: "some health scientists believe that *any* Pb [lead] is harmful to children's neurocognitive development, and that *no* new Pb should be added to their surroundings"[14] and that "…physicians should be aware of synthetic turf as pone potential source of exposure for young children. Health officials investigating elevated blood lead in children should also be aware of synthetic turf as a potential source of lead exposure."[15]

Furthermore, a 2008 study that looked at a variety of contaminants associated with artificial turf did find that the lead present in the rubber granules, while at low levels, was "highly bioaccessible" to synthetic gastric fluid used in their research. This study also found a "slightly worrisome" level of chromium in an artificial turf fiber sample and "high bioaccessible fractions of lead in both synthetic gastric and intestinal fluids.[16]

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[9] Kim, S., Yang, J.-Y., Kim, H.-H., Yeo, I.-Y., Shin, D.-C., & Lim, Y.-W. (2012). Health Risk Assessment of Lead Ingestion Exposure by Particle Sizes in Crumb Rubber on Artificial Turf Considering Bioavailability. Environmental Health and Toxicology, 27, e2012005. http://doi.org/10.5620/eht.2012.27.e2012005.

[10] S.L. Shalat, Sc.D., "An Evaluation of Potential Exposures to Lead and Other Metals as the Result of Aerosolized Particulate Matter from Artificial Turf Playing Fields, Final Report", submitted to NJ Department of Environmental Protection, July 14, 2011.

[11] S.L. Shalat, Sc.D., "An Evaluation of Potential Exposures to Lead and Other Metals as the Result of Aerosolized Particulate Matter from Artificial Turf Playing Fields, Final Report", submitted to NJ Department of Environmental Protection, July 14, 2011.

[12] S.L. Shalat, Sc.D., "An Evaluation of Potential Exposures to Lead and Other Metals as the Result of Aerosolized Particulate Matter from Artificial Turf Playing Fields, Final Report", submitted to NJ Department of Environmental Protection, July 14, 2011.

[13] S.L. Shalat, Sc.D., "An Evaluation of Potential Exposures to Lead and Other Metals as the Result of Aerosolized Particulate Matter from Artificial Turf Playing Fields, Final Report", submitted to NJ Department of Environmental Protection, July 14, 2011.

[14] J. Zhang, I. Han, L. Zhang, W. Crain, "Hazardous Chemicals in synthetic turf materials and their bioaccessibility in digestive fluids," Journal of Exposure Science and Environmental Epidemiology (2008)

[15] G. Van Ulirsch et. al, Evaluating and Regulating Lead in Synthetic Turf, Commentary, Environmental Health Perspectives, Vol 118, No. 10, Oct. 2010.

[16] J. Zhang, I. Han, L. Zhang, W. Crain, "Hazardous Chemicals in synthetic turf materials and their bioaccessibility in digestive fluids," Journal of Exposure Science and Environmental Epidemiology (2008)

In October 2006 and January 2007, respectively, two sites in New York where synthetic turf has been used (a large, then 3 year old, Parade Ground in Brooklyn; a relatively small then 5 month old Sara D. Roosevelt Park in Manhattan) were analyzed. This testing found PAHs at hazardous levels (as per New York standards) at each of the sites. At both sites dibenzo (a.h)anthracene, a probable human carcinogen, was found at hazardous levels, with two other PAH forms, both possible human carcinogens, found at hazardous levels at the Parade Ground site. A 2008 study also found that the rubber granules found in artificial turf fields had PAH levels above health-based soil standards, that there was "low" but not "no" bioaccessibility, and that while levels appear to decline over time this can be altered by the fact that new rubber can be added periodically to compensate for the loss of infill material.[17] Additional research is needed into the pathways by which these substances may be absorbed into the bodies of children and athletes via skin contact, ingestion or other pathways[18] - but the need for additional research does not displace the concerns raised by these findings.

Analyses conducted at the Environmental and Occupational Health Sciences Institute of Rutgers University found the crumb rubber from artificial turf to contain high levels of PAHs, as well as zinc and arsenic.[19] PAHs found to be contained in the crumb rubber "were above the concentration levels that the New York State Department of Environmental Conservation (DEC) considers sufficiently hazardous to public health to require their removal from contaminated soil sites. It is highly likely that all six PAHs are carcinogenic to humans." [20] "The analyses also revealed levels of zinc in both samples that exceed the DEC's tolerable levels." [21] The researchers associated with these findings were careful to state "We want to emphasize that the findings are preliminary. PAHs in rubber might not act the same way as in soil, and we do not yet have information on the ease with which the PAHs in these rubber particles might be absorbed by children or adults -- by ingestion, inhalation, or absorption through the skin. However, the findings are worrisome. Until more is known, it wouldn't be prudent to install the synthetic turf in any more parks." [22]

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[17] J. Zhang, I. Han, L. Zhang, W. Crain, "Hazardous Chemicals in synthetic turf materials and their bioaccessibility in digestive fluids," Journal of Exposure Science and Environmental Epidemiology (2008)

[18] Rachel's' Democracy & Health News #992, Hazardous Chemicals in Synthetic Turf, Follow-up Analyses, April 12, 2007.

[19] Junfeng Zhang, professor and acting chair, Department of Environmental and Occupational Health, the School of Public Health, the University of Medicine and Dentistry of New Jersey and Rutgers University & William Crain, professor of psychology at The City College of New York, president of Citizens for a Green Riverside Park, Hazardous Chemicals in Synthetic Turf, 2006, analyses conducted at at the Environmental and Occupational Health Sciences Institute of Rutgers.

[20] Junfeng Zhang, professor and acting chair, Department of Environmental and Occupational Health, the School of Public Health, the University of Medicine and Dentistry of New Jersey and Rutgers University & William Crain, professor of psychology at The City College of New York, president of Citizens for a Green Riverside Park, Hazardous Chemicals in Synthetic Turf, 2006, analyses conducted at at the Environmental and Occupational Health Sciences Institute of Rutgers.

[21] Junfeng Zhang, professor and acting chair, Department of Environmental and Occupational Health, the School of Public Health, the University of Medicine and Dentistry of New Jersey and Rutgers University & William Crain, professor of psychology at The City College of New York, president of Citizens for a Green Riverside Park, Hazardous Chemicals in Synthetic Turf, 2006, analyses conducted at at the Environmental and Occupational Health Sciences Institute of Rutgers.

[22] Junfeng Zhang, professor and acting chair, Department of Environmental and Occupational Health, the School of Public Health, the University of Medicine and Dentistry of New Jersey and Rutgers University & William Crain, professor of psychology at The City College of New York, president of Citizens for a Green Riverside Park, Hazardous Chemicals in Synthetic Turf, 2006, analyses conducted at at the Environmental and Occupational Health Sciences Institute of Rutgers.

A study by the California Office of Environmental Health Hazard Assessment (OEHHA) summarized 46 studies that identified 49 chemicals which are released from tire crumb. Of the 49, "seven of the chemicals leached from tire shreds were carcinogens. OEHHA calculated a cancer risk of 1.2 in 10 million based on a ***one-time*** ingestion of the tire crumb rubber over a lifetime."[23] While there are limited studies which assert that recycled tire crumb are stable in the gastrointestinal tract and that therefore this is not a pathway for exposure, there are other studies which contradict these findings.[24]

Concerns have been raised about the potential implications of recycled tire in-fill for individuals with latex allergies and that inhalation could result in a systemic response, as opposed to a contact response.[25]

Asserted one analysis, while, "the status of the information about human exposures to recycled tire crumb rubber in-fill … is not sufficient to determine the safety of the use of the product in situations that involve continuous episodes of human exposure;" [26] "the available information is sufficient and strong enough to raise plausible questions with respect to acute toxicity for susceptible persons, and for cancer risks."[27]

Chrysene, a PAH and carcinogen, was found to be ingested as the result of hand-to-surface-to-mouth transfer from playground surfaces made with recycled tires. Assuming playground use for an 11 year period (from age 1 to 12) there was found to be an increased cancer risk of 2.9 in one million (2.9×10^{-6}). This risk is greater than the general cancer risk gauge of one in one million ($1X10^{-6}$).[28] This research would seem to suggest that repeat exposure over time to the chemicals released from artificial turf increases the associated increase in cancer risk.

The hot temperatures create additional concern for exposing players to dangerous toxins. As well explained by a well cited petition to the Consumer Product Safety Commission for rulemaking: "When tires are shredded and pulverized, their surface area increases exponentially, as does the particulate and gas yield from the tire material. Since tires are made of very harmful materials, including 24 gases found to be harmful to humans, carbon black, (a carcinogen which makes up 30% of tires), latex, benzothiazoles, phthalates, lead, mercury, cadmium, zinc and many other known toxins, when the fields heat up, they become increasingly dynamic. Of primary concern is the interaction of particles and gases, 'because when particles adsorb onto the surface of gases, they become 10-20 times more toxic than the materials themselves.' The fields yield continuously, but become more dynamic and more toxic as they heat up."[29]

A Case Study conducted by a group of "physicians and public health professionals working with the U.S. Environmental Protection Agency's Region Pediatric Environmental Health Specialty Unit" found

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[23] Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007 citing California Office of Environmental Health Hazard Assessment (OEHHA), Evaluation of Health Effects of Recycled Waste Tires in Playground and Track Products, January, 2007.
[24] Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007.
[25] Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007.
[26] Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007.
[27] Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007.
[28] Office of Environmental Health Hazard Assessment, Evaluation of Health Effects of Recycled Waste Tires in Playground and Track Products, January 2007. Note -- the 1.2 in 10 million cancer risk found in the OEHHA study was considered by the authors to be an acceptable level of risk as it falls below the general cancer risk gauge of one in one million ($1X10^{-6}$).
[29] Petition for a Rulemaking on Surface Heat from Artificial Turf, Submitted by PEER to Consumer Product Safety Commission, Sept 6, 2012.

that they could not secure the research and information necessary to establish the safety in use with children of tire crumb used as playground surface.[30] "The use of recycled tire crumb products on playgrounds has had little health investigation. The major unresolved concern is the potential for latex allergy with short-term dermal exposure." [31] "No published information is available specifically regarding exposure to crumb rubber constituents from use of the product on playgrounds." [32]

Excessive heat is a major health threat for those that play on artificial turf.
Extreme heat is a health concern – high surface temperatures found on artificial turf fields can contribute to physiological stress and cause "serious heat-related illnesses".[33] Heat stress, heat stroke and burns are all of concern. In fact, the "New York City Department of Health and Mental Hygiene recognizes excessive surface temperatures as the most important health concern associated with infilled synthetic turf." [34] Studies document that the surface temperature on artificial turf is dramatically increased as compared to surrounding land uses including asphalt – so much so that it is a genuine health threat for players.

Concerns regarding the excessive temperatures range from the implications for players who are already exerting themselves playing in such excessively high temperatures, to the implications for burns when players or pedestrians come into contact with the hot surfaces, to the implications for small children who may come into contact with the extremely hot surfaces during non-sporting events. Research has also concluded that the "heat transfer from the surface to the sole of the individual's foot" could contribute to physiological stress of players. [35]

In a 2002 study it was found that "the surface temperature of the synthetic turf was 37° F higher than asphalt and 86.5° F hotter than natural turf." [36] A study published in the Journal of Health and Physical Education and Recreation showed "surface temperatures as much as 95 to 140 degrees Fahrenheit higher on synthetic turf than natural turf grass when exposed to sunlight." [37] Random sampling at Brigham Young University identified temperatures ranging from 117.38 to 157 degrees on artificial turf while neighboring natural grass areas were in the range of 78.19 to 88.5 degrees Fahrenheit. "Two inches below the synthetic turf surface was 28.5° F hotter than natural turf at the surface."[38] Another study comparing temperatures on artificial turf temperatures with air temperature found that artificial turf ranged from 58 to 75 degrees hotter than measured air temperature.[39] And yet another study considering found ranges of 155.3 to 173.4 degrees on the turf

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[30] M.E. Anderson et al, A Case Study of tire Crumb Use on Playgrounds: Risk Analysis and Communication When Major Clinical Knowledge Gaps Exist, Environmental Health Perspectives, Vol 114, No. 1, January 2006.
[31] M.E. Anderson et al, A Case Study of tire Crumb Use on Playgrounds: Risk Analysis and Communication When Major Clinical Knowledge Gaps Exist, Environmental Health Perspectives, Vol 114, No. 1, January 2006.
[32] M.E. Anderson et al, A Case Study of tire Crumb Use on Playgrounds: Risk Analysis and Communication When Major Clinical Knowledge Gaps Exist, Environmental Health Perspectives, Vol 114, No. 1, January 2006.
[33] T.J. Serensits, A.S. McNitt, D.M. Petrunak; Human health issues on synthetic turf in the USA, Dept of Crop and Soil Sciences, The Pennsylvania State University, IMechE Vol 225 Part P: J. Sports Engineering & Technology, Jan 6, 2011.
[34] T.J. Serensits, A.S. McNitt, D.M. Petrunak; Human health issues on synthetic turf in the USA, Dept of Crop and Soil Sciences, The Pennsylvania State University, IMechE Vol 225 Part P: J. Sports Engineering & Technology, Jan 6, 2011.
[35] T.J. Serensits, A.S. McNitt, D.M. Petrunak; Human health issues on synthetic turf in the USA, Dept of Crop and Soil Sciences, The Pennsylvania State University, IMechE Vol 225 Part P: J. Sports Engineering & Technology, Jan 6, 2011.
[36] Dr. C. Frank Williams and Dr. Gilbert E. Pulley, Synthetic Surface Heat Studies, Brigham Young University.
[37] SportsTurf Managers Association, A Guide to Synthetic and natural Turfgrass for Sports Fields, Selection, Construction and Maintenance Considerations.
[38] Dr. C. Frank Williams and Dr. Gilbert E. Pulley, Synthetic Surface Heat Studies, Brigham Young University.
[39] T. Sciacca, The Thermal Physics of Artificial Turf, January 2008.

fields when air temperatures were in the 76 degree range; and 104.2 to 159.3 degrees when air temperatures were in the 77 degree range. [40]

Research has not found good solutions for the excessive heat levels of turf. Irrigation of excessively hot artificial turf surfaces only provides cooling benefits for about 20 minutes. [41] While irrigation provides cooling for the synthetic turf, in one seminal study lowering the temperature from 174° F to 85° F, after only 5 minutes the temperature quickly rose again to 120°F; after 20 minutes it rose to 164°F.[42] In another important body of work by Penn State, it was found again that irrigation is only successful in reducing temperatures for about 20 minutes, with a rebound to within 10 degrees of the pre-irrigation temperature within 3 hours. [43] The use of white crumb rubber as the infill does not resolve the heat issue. [44] In fact, according to Penn State as part of a study which looked at various color options for infill and temperature, "[w]hile marketing materials may claim lower surface temperatures, no scientific reports exist that substantiate such claims."[45]

Natural grass, by comparison, provides a natural cooling affect and helps to dissipate heat from neighboring developed areas.[46] "The temperature of natural grass rarely rises above 85 degrees Fahrenheit, regardless of air temperature." [47]

The heat impacts of artificial turf need to be considered in the context of today's changing climate. Global climate change is expected to dramatically increase the number of days over 100 degrees in many communities. Depending on how aggressively global warming gasses are reduced in coming years, communities nearby Philadelphia will begin to experience in the range of 10 days (in lower emission scenarios) to 30 days (if higher emission scenarios continue to prevail) over 100 degrees.[48] By later in this century seasonable temperatures are projected to rise 6^{o}F to 14^{o}F in summer (depending again on emission reductions achieved in the future). [49]

Concerns for increased head injuries and bacterial infections as the result of playing on turf are justified.

There is great concern that the increased level of abrasions and burns which result from playing on an artificial turf field as compared to natural grass increases the pathways by which bacterial infections, such as MRSA (methicillin-resistant staphylococcus aureus), can enter the body. As explained in a 2011 Penn State study, "It is important to note that synthetic turf is more abrasive than natural turf grass and, as a result, breaks in the skin are more common, creating a pathway for infection when in

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[40] Penn State's Center for Sports Surface Research, Synthetic Turf Heat Evaluation – Progress Report, January 2012.

[41] T.J. Serensits, A.S. McNitt, D.M. Petrunak; Human health issues on synthetic turf in the USA, Dept of Crop and Soil Sciences, The Pennsylvania State University, IMechE Vol 225 Part P: J. Sports Engineering & Technology, Jan 6, 2011.

[42] Dr. C. Frank Williams and Dr. Gilbert E. Pulley, Synthetic Surface Heat Studies, Brigham Young University.

[43] T.J. Serensits, A.S. McNitt, D.M. Petrunak; Human health issues on synthetic turf in the USA, Dept of Crop and Soil Sciences, The Pennsylvania State University, IMechE Vol 225 Part P: J. Sports Engineering & Technology, Jan 6, 2011.

[44] T.J. Serensits, A.S. McNitt, D.M. Petrunak; Human health issues on synthetic turf in the USA, Dept of Crop and Soil Sciences, The Pennsylvania State University, IMechE Vol 225 Part P: J. Sports Engineering & Technology, Jan 6, 2011.

[45] Penn State's Center for Sports Surface Research, Synthetic Turf Heat Evaluation – Progress Report, January 2012.

[46] James B. Beard & Robert L. Green, The Role of Turfgrasses in Environmental Protection and Their Benefits to Humans, J. Environ Qual. 23:452-460 (1994).

[47] SportsTurf Managers Association, A Guide to Synthetic and natural Turfgrass for Sports Fields, Selection, Construction and Maintenance Considerations.

[48] Union of Concerned Scientists, Confronting Climate Change in the U.S. Northeast ● New Jersey, 2007.

[49] Union of Concerned Scientists, Confronting Climate Change in the U.S. Northeast ● New Jersey, 2007.

contact with an infected surface." [50] There are studies to indicate that turf burns may be facilitating infection by acting as a pathway for infection.[51] Study has found that turf burns increased the risk of infection regardless of the type and timing of care provided the burn. [52]

Older turf fields have been found to have higher microbial populations, as well as higher levels in the higher traffic areas such as the sidelines, thereby suggesting to researchers that microbial populations can accumulate in synthetic turf over time.[53]

Concussions (formally described as Mild Traumatic Brain Injury or MTBI) resulting from sports has, according to the US Centers for Disease Control, reached "epidemic proportions."[54] "'Mild' head traumas, and especially a series of such minor concussions can have long term, negative effects on cognitive function." [55] Study has documented that artificial turf increases the risk of MTBI over natural turf, approximately doubling that risk, as well as causing a greater degree of trauma.[56] According to study, artificial turf presents a 5 times greater risk of the more severe head injury than natural turf, although it is still unknown the particular characteristics of the two surfaces that cause the difference in head injury incidence. [57] Only 31% of the playground surfaces made of recycled tires tested in one research study passed the California State mandated Head Impact Criterion (HIC) of ≤1,000. In this same study 100% of the playground surfaces made of wood chips passed the same standard. [58]

Research shows there are adverse environmental impacts resulting from crumb rubber infill artificial turf; it is also clear that additional study for water and other natural resources is needed.

While it seems well recognized that there is a limited level of assessment and investigation into the environmental impacts associated with artificial turf, a growing body of scientific analysis is

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[50] T.J. Serensits, A.S. McNitt, D.M. Petrunak; Human health issues on synthetic turf in the USA, Dept of Crop and Soil Sciences, The Pennsylvania State University, IMechE Vol 225 Part P: J. Sports Engineering & Technology, Jan 6, 2011.

[51] A High Morbidity Outbreak of Methicillin-Resistant *Staphylococcus aureus* among Players on a College Football Team, Facilitated by Cosmetic Body Shaving and Turf Burns, study conducted 2004 for Connecticut Dept of Public Health, Student Health Services of Sacred Heart Univ, Centers for Disease Control and Prevention, Minnesota Dept of Public Health, Los Angeles County Dept of Health Svces; Dr. S.V. Kazakova et.al., A Clone of Methicillin-Resistant *Staphylococcus aureus* among Professional Football Players, The New England Journal of Medicine, Vol 352:468-475 No. 5, Feb. 3, 2005.

[52] A High Morbidity Outbreak of Methicillin-Resistant *Staphylococcus aureus* among Players on a College Football Team, Facilitated by Cosmetic Body Shaving and Turf Burns, study conducted 2004 for Connecticut Dept of Public Health, Student Health Services of Sacred Heart Univ, Centers for Disease Control and Prevention, Minnesota Dept of Public Health, Los Angeles County Dept of Health Svces.

[53] J.J. Bass, D.W. Hintze, (2013) "Determination of Microbial Populations in a Synthetic Turf System," Skyline – The Big Sky Undergraduate Journal, Vol. 1, Iss. 1, Art. 1.

[54] Dr. M. Shorten, J.A. Himmelsbach, BioiMechanica, Sports Surfaces and the Risk of Traumatic Brain Injury citing the US Centers for Disease Control.

[55] Dr. M. Shorten, J.A. Himmelsbach, BioiMechanica, Sports Surfaces and the Risk of Traumatic Brain Injury.

[56] Dr. M. Shorten, J.A. Himmelsbach, BioiMechanica, Sports Surfaces and the Risk of Traumatic Brain Injury.

[57] Dr. M. Shorten, J.A. Himmelsbach, BioiMechanica, Sports Surfaces and the Risk of Traumatic Brain Injury. See also K.M. Guskiewica, N.L. Weaver, D.A. Padua, W.E. Garrett Jr., Epidemiology of Concussion in Collegiate and High School Football Players, Sep-Oct 2000 & Does the Use of Artificial Turf Contribute to Head Injuries, The Journal of Trauma-Injury, Infection and Critical Care, Oct 2002 for the finding that artificial turf increases the level of injury in comparison to natural grass fields.

[58] Office of Environmental Health Hazard Assessment, Evaluation of Health Effects of Recycled Waste Tires in Playground and Track Products, January 2007. Please note that in this study 32 recycled tire playground surfaces were tested as compared to only 5 wood chip playground surfaces.

documenting a concerning level of environmental threat and harm and is further demonstrating the need for more research regarding artificial turf and its ramifications for the environment.

The Connecticut Agricultural Experiment Station conclusively found four compounds which out-gassed and leached into water from synthetic turf rubber crumb under ambient temperatures:

- Benzothiazole (a skin and eye irritant),
- Butylated hydroxyanisole (a "recognized carcinogen, suspected endocrine toxicant, gastrointestinal toxicant, immune toxicant, neurotoxicant, skin and sense-organ toxicant"),
- n-hexadecane (a severe irritant) &
- 4-(t-octyl) phenol ("corrosive and destructive to mucous membranes").[59]

As rubber degrades it can leach toxic substances which can contaminate soil, plants and aquatic ecosystems.[60] Study has concluded that the use of tires in artificial turf has the potential to pollute our environment with PAHs, phenols and zinc[61] and that runoff from an artificial turf field draining to a local creek can pose "a positive risk of toxic effects on biota in the water phase and in the sediment."[62] Other metal contaminants found to leach from tire crumb rubber include zinc, selenium, lead and cadmium.[63] Zinc has also been shown to leach from the artificial turf fibers.[64] Extreme temperatures or solvents are not needed to release these metals, volatile organic compounds or semi-volatile organic compounds from the rubber in-fill of artificial turf into the air or water – release takes place in ambient air and water temperatures.[65]

"Runoff with high Zn [zinc] from synthetic turf fields may produce adverse effects to plants and aquatic life. This is of particular concern given that the leaching rate of Zn [zinc] from rubber granules can be up to 20 times greater than the leaching rate of Zn from agricultural applications of manure and pesticides."[66] Leaching of substances as the result of surface water runoff from precipitation has, by some researchers, been predicted to be the greatest risk for the environment from artificial turf.[67] Study shows there is a risk of local effects for aquatic and sediment dwelling

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[59] The Connecticut Agricultural Experiment Station, Examination of Crumb Rubber Produced from Recycled Tires, August 2007; Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007.

[60] Quoting Dr. Linda Chalker-Scott, Washington State University -- Turfgrass Resource Center, Facts About Artificial Turf and Natural Grass; T. Kallqvist, Norwegian Institute for Water Research(NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 17.; Connecticut Agricultural Experiment Station, Examination of Crumb Rubber Produced from Recycled Tires.

[61] T. Kallqvist, Norwegian Institute for Water Research(NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 5; T. Edeskar, Lulea University of Technology, Technical and Environmental Properties of Tyre Shreds Focusing on Ground Engineer Application, 2004 as cited in KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.

[62] T. Kallqvist, Norwegian Institute for Water Research (NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 6.

[63]Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007.

[64] T. Kallqvist, Norwegian Institute for Water Research (NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 17.

[65] Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007.

[66] J. Zhang, I. Han, L. Zhang, W. Crain, "Hazardous Chemicals in synthetic turf materials and their bioaccessibility in digestive fluids," Journal of Exposure Science and Environmental Epidemiology (2008)

[67] T. Kallqvist, Norwegian Institute for Water Research (NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 5; NIVA (The Norwegian Institute for Water Research), Evaluation of the Environmental Risks of Synthetic Turf, 2005; KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.

organisms in impacted water courses.[68] Recycled rubber, and associated leachate, has been found to contain a variety of metals (including lead, cadmium, copper, mercury and zinc), as well as organic pollutants such as PAHs, phthalates, 4-t-octylphenol and iso-nonyphenol.[69] The leaching of zinc has been determined to be of major environmental concern.[70] The leaching of zinc increases as the rubber infill weathers over time,[71] it is likely this is the same for other contaminants. While Zinc contributes the most risk, phenols (specifically octylphenol) and PAHs are also of concern.[72] Of the organic compounds at issue, Octylphenol represents the greatest risk, and possibly could occur at levels where hormone disrupting effects are a concern.[73] The varying content of tires makes this threat a moving target.

The Norwegian Institute for Water Research has determined that it is "appropriate to perform a risk assessment which covers water and sediments in watercourses which receive run-off from artificial turf pitches."[74]

While recycled rubber is a greater source of pollution, newly manufactured rubber also contains levels of hazardous substances; in the case of zinc and chromium the levels of recycled and newly manufactured rubber are comparable.[75]

It is predicted that chemicals leaching from synthetic turf materials occurs slowly, and as a result the environmental harms may take place over many years.[76]

Leaching may not be the only source of water contamination from artificial turf. As the artificial turf is used there is a level of "erosion" that takes place and can result in fine particles that could be carried to local waterways. This source of contamination needs study.[77]

The synthetic grass fibers can also be a significant source of pollution, particularly zinc, albeit significantly lesser amounts leach from the synthetic grass than the rubber infill.[78]

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[68] T. Kallqvist, Norwegian Institute for Water Research(NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 5; NIVA (The Norwegian Institute for Water Research), Evaluation of the Environmental Risks of Synthetic Turf, 2005, as cited by KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007; KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007

[69] T. Kallqvist, Norwegian Institute for Water Research (NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 7.

[70] INTRON, Environmental and Health Risks of Rubber Infill, rubber crumb from car tyres as infill on artificial turf, February 9, 2007.

[71] INTRON, Environmental and Health Risks of Rubber Infill, rubber crumb from car tyres as infill on artificial turf, February 9, 2007.

[72] NIVA (The Norwegian Institute for Water Research), Evaluation of the Environmental Risks of Synthetic Turf, 2005, as cited by KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.

[73] T. Kallqvist, Norwegian Institute for Water Research (NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 17.

[74] T. Kallqvist, Norwegian Institute for Water Research (NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 8.

[75] Byggforsk, SINTEF Building and Infrastructure, Potential Health and Environmental Effects Associated with Synthetic Turn Systems, 2004, as referenced in KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.

[76] T. Kallqvist, Norwegian Institute for Water Research(NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 5; NIVA (The Norwegian Institute for Water Research), Evaluation of the Environmental Risks of Synthetic Turf, 2005, as cited by KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.

[77] T. Kallqvist, Norwegian Institute for Water Research (NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 18.

When talking about the use of ground rubber as a supplement to planting soils the North Carolina Department of Agriculture and Consumer Services sent out a notice identifying the risk that zinc leaching from the rubber causes a decline in plant growth "directly attributable to zinc toxicity."[79]

One Norwegian assessment/presentation reported that "recycled rubber was the major source of potentially hazardous substances. An exposure scenario where the runoff from a football field is drained to a small creek showed a positive risk of toxic effects on biota in the water phase and in the sediment. The risk was mainly attributed to zinc, but also for octylphenol the predicted environmental concentrations exceeded the no environmental effect concentration."[80] The hazardous leaching could result in local environmental effect.[81]

Conclusion

Given all of the science on the record that demonstrates artificial turf is a threat to health and the environment, the precautionary principle dictates that artificial turf with crumb rubber infill be recognized as a threat to public health and safety and the environment and that the ongoing expansion and construction of crumb rubber turf fields should be prohibited and those fields that have already been installed should be removed and properly disposed of.

When a community installs a crumb rubber artificial turf field it is forcing children who want to participate in sports to be forced to expose themselves to its hazards. It is simply neither right nor fair for communities, with the support or false sense of security given by an acquiescing government agency, to be making investments that take from parents and kids the ability to decide for themselves what health hazards they are willing to be exposed to if they want to participate in sports. Advancing in anyway the construction and expansion of crumb rubber artificial turf fields is forcing an unfair choice on kids and parents: play sports or protect your health, but you are not allowed to have both.

Respectfully,

Maya K. van Rossum
the Delaware Riverkeeper

P.S. I note, that as a result of my work on this issue, as a parent I have had to pull my son from the township lacrosse team because they started playing on artificial turf this past year. The health impacts of artificial turf are too significant and concerning for me, as a parent, to allow my 10 year old son to play on crumb rubber artificial turf.

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[78] Byggforsk, SINTEF Building and Infrastructure, Potential Health and Environmental Effects Associated with Synthetic Turn Systems, 2004, as referenced in KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.
[79] M. Ray Tucker, Agronomist, Ground Rubber: Potential Toxicity to Plants, Media Notes for North Carolina Growers, North Carolina Dept of Agriculture & Consumer Services, April 1997.
[80] Dr. Christine Bjorge, Norwegian Institute of Public Health, Artificial turf Pitches – an assessment of the health risks for football players and the environment, Presentation at the ISSS Technical meeting 2006, Dresden.
[81] Dr. Christine Bjorge, Norwegian Institute of Public Health, Artificial turf Pitches – an assessment of the health risks for football players and the environment, Presentation at the ISSS Technical meeting 2006, Dresden.

Attachments:
Submitted as part of this comment are fact sheets and an annotated bibliography that discuss the research detailed above as well as additional research speaking about the environmental and public health threats posed by crumb rubber infill artificial turf.

Summary of Research
Assessing the Impacts of Artificial Turf

Updated 4/29/2016

Heat: Research has documented that the surface temperature on artificial turf is dramatically higher than the surrounding land uses including asphalt. Concerns regarding the excessive temperatures range from the implications for players who are already exerting themselves to the implications for burns when players or pedestrians come into contact with the hot surfaces.

1. Petrass, L. A., et al. (2014). Comparison of surface temperatures of different synthetic turf systems and natural grass: Have advances in synthetic turf technology made a difference. *Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology*.
    a. A comparison of surface temperatures of third-generation synthetic turf with a cool climate product that claims to reduce surface temperatures to surface temperatures of natural grass.
    b. Although surface temperatures were lower for the cool climate field compared to other synthetic turf, both types of artificial turf fields were considerably hotter than natural grass with temperatures that were between 12° C (53° F) and 22° C (72° F) hotter.
2. Reasor, E. H. (2014). Synthetic Turf Surface Temperature Reduction and Performance Characteristics as Affected by Calcined Clay Modified Infill. Master's Thesis, University of Tennessee. Available at: http://trace.tennessee.edu/utk_gradthes/2750
    a. Surface temperatures of artificial turf were between 31° C (88° F) and 57° C (135° F).
    b. Although irrigation reduced surface temperatures of artificial turf, increases of 74 to 102% of the pre-irrigation temperature were observed within 30 minutes after irrigation.
    c. Surface temperatures returned to pre-irrigation temperature on all of the treatments between 60 and 120 minutes after irrigation. Therefore, the cooling effect of irrigation will not last the entire length of an athletic competition.
3. Thoms, A. W. et al. (2014). Models for Predicting Surface Temperatures on Synthetic Turf Playing Surfaces. *Procedia Engineering*, *72*, 895-900. Available at: http://www.sciencedirect.com/science/article/pii/S1877705814006699
    a. Artificial turf surface temperatures ranged from -9.8 to 86.4° C (14 to 188° F) to when ambient air temperatures ranged from -0.4 to 37.1° C (31 to 99° F).
    b. Absorption of solar radiation results in increased temperatures on artificial turf surfaces, and high rates of solar radiation are absorbed with minimal light reflectance. Therefore, air temperature in conjunction with solar radiation explained most of the variation in artificial turf surface temperatures.
4. Penn State's Center for Sports Surface Research (2012). Synthetic Turf Heat Evaluation- Progress Report. January 2012. Available at: http://plantscience.psu.edu/research/centers/ssrc/documents/heat-progress-report.pdf

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a. This study measured surface temperatures of artificial turf fields between 140.2 and 173.4° F when air temperatures were between 73 and 79° F.
b. Looking at various color options for infill and temperature, no product significantly reduced surface temperatures. Small reductions in temperature are insignificant when surface temperatures still exceed 150° F. This study concluded that "[w]hile marketing materials may claim lower surface temperatures, no scientific reports exist that substantiate such claims."
c. Research has not found a good solution for excessive heat levels of turf.

5. Serensits, T. J. et al. (2011). Human health issues on synthetic turf in the USA. *Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology*, *225*(3), 139-146.
   a. High surface temperatures found on artificial turf fields can contribute to physiological stress and cause "serious heat-related illnesses" including heat stress, heat stroke, and burns.
   b. The "New York City Department of Health and Mental Hygiene recognizes excessive surface temperatures as the most important health concern associated with infilled synthetic turf."
   c. Irrigation of excessively hot artificial turf surfaces only provides cooling benefits for about 20 minutes, with a rebound to within 10 degrees of the pre-irrigation temperature within 3 hours.
   d. The use of white crumb rubber as the infill does not resolve the heat issue.
6. Sciacca, T (2008). The Thermal Physics of Artificial Turf. SynTurf.org. Available at: http://www.synturf.org/sciaccaheatstudy.html
   a. A study comparing temperatures on artificial turf temperatures with air temperature found that artificial turf ranged from 58 to 75° hotter than measured air temperature.
7. SportsTurf Managers Association (STMA) (2008). A Guide to Synthetic and Natural Turfgrass for Sports Fields: Selection, Construction and Maintenance Considerations. 2nd edition. Available at: http://www.stma.org/sites/stma/files/STMA_Synthetic_Guide_2nd_Edition.pdf
   a. Artificial turf gets dramatically hotter than surrounding land uses including asphalt with surface temperatures as much as 95 to 140° F hotter than natural grass fields whereas the temperature of natural grass rarely rises above 85° F, regardless of air temperature
8. Williams, C. F., & Pulley, G. E. (2002). Synthetic surface heat studies. *Brigham Young University*. Available at: www.wellesleyma.gov/pages/WellesleyMA_SpragueResources/Synthetic%20Surfaces%20Heat%20Study.doc
   a. Temperature measurements were taken at the surface, above the surface, and below the surface of artificial turf, natural turf, bare soil, asphalt, and concrete.
   b. Surface temperatures of synthetic turf were 37° F higher than asphalt and 86.5° F hotter than natural turf.
   c. Two inches below the surface, synthetic turf was 28.5° F hotter than natural turf.
   d. Although irrigation of synthetic turf resulted in a reduction of close to 90°F, temperatures rose 35° within five minutes and returned to the starting temperature within 20 minutes.
   e. "The hottest surface temperature recorded was 200º F on a 98º F day. Even in October the surface temperature reached 112.4º F."
   f. Brigham Young University has set a surface temperature guideline which restricts play on synthetic turf fields when surface temperatures are potentially hazardous to athletes. This reduces the playing season and eliminates any continuous play benefit that is typically mentioned in favor of artificial turf.
9. Beard, J. B., & Green, R. L. (1994). The role of turf grasses in environmental protection and their benefits to humans. Journal of Environmental Quality, 23(3), 452-460. Available at: https://www.landcarenetwork.org/legislative/TheRoleofTurfgrassesinEnvironmentalProtection.pdf
   a. Synthetic surfaces can be up to 39° C (102° F) hotter than natural turf. Natural turf grass provides a natural cooling affect and helps to dissipate heat from neighboring developed areas.

Health: The impacts of inhalation or ingestion of chemicals continues to be a concern for those playing on artificial turf. Direct human exposure to the hazardous substances contained in the rubber in-fill of artificial turf is believed to occur via inhalation, skin contact, and/or ingestion. Furthermore, there are concerns for increased injuries and bacterial infections when playing on artificial turf.

1. Kim, S., Yang, J.-Y., Kim, H.-H., Yeo, I.-Y., Shin, D.-C., & Lim, Y.-W. (2012). Health Risk Assessment of Lead Ingestion Exposure by Particle Sizes in Crumb Rubber on Artificial Turf Considering Bioavailability. Environmental Health and Toxicology, 27, e2012005. http://doi.org/10.5620/eht.2012.27.e2012005.
    a. Researchers considered the risks for lead exposure from children ingesting rubber powder resulting from exposure to crumb rubber infill artificial turf and found that elementary school students had a hazard index that exceeded 0.1, a level that is considered a "potential for hazard", with middle and high school students also suffering exposure levels.

2. Balazs, G. C., et al. (2014). Risk of Anterior Cruciate Ligament Injury in Athletes on Synthetic Playing Surfaces A Systematic Review. *The American journal of sports medicine*, 0363546514545864.
    a. A systematic review of available literature on the risk of ACL rupture on natural grass versus artificial turf found that there is an increased rate of ACL injury on synthetic playing surfaces for football players.
3. Celeiro, M., Lamas, J. P., Garcia-Jares, C., Dagnac, T., Ramos, L., & Llompart, M. (2014). Investigation of PAH and other hazardous contaminant occurrence in recycled tyre rubber surfaces. Case-study: restaurant playground in an indoor shopping centre. *International Journal of Environmental Analytical Chemistry*, *94*(12), 1264-1271.
    a. The presence of a large number of hazardous substances were found in both the runoff and vapor phase of recycled tire playground surfaces.
    b. Nine polycyclic aromatic hydrocarbons (PAHs) were detected in the runoff/ cleaning water with total PAH concentrations in the ppm (parts per million) range.
    c. The most toxic PAH, benzo[a]pyrene was detected in extracts from playground surfaces.
    d. "The presence and the high concentration of these chemical compounds in playground should be a matter of concern owing to their high toxicity."
4. Laible, C., & Sherman, O. H. (2014). Risk Factors and Prevention Strategies of Non-Contact Anterior Cruciate Ligament Injuries. *Bulletin of the Hospital for Joint Diseases*, *72*(1), 70-5. Available at: http://www.nyuhjdbulletin.org/mod/bulletin/v72n1/docs/v72n1_7.pdf
    a. Since shoe-surface interaction is important for injury prevention, "the optimal surface to prevent injury is outdoors on natural grass."
    b. Artificial turf has a higher friction coefficient and greater ground reaction force, both conditions that increase the risk for injury.
    c. Furthermore, as temperature increases the shoe-surface friction interaction increases and exposes athletes to greater risk of injury.
5. Bass, J. J., & Hintze, D. W. (2013). Determination of Microbial Populations in a Synthetic Turf System. Skyline-The Big Sky Undergraduate Journal, 1(1), 1. Available at: http://skyline.bigskyconf.com/cgi/viewcontent.cgi?article=1000&context=journal
    a. Abrasions, even insignificant ones, from artificial turf can create an entry site for pathogens.
    b. The higher abrasion rate for synthetic turf increases the risk of infection, and the microbial populations found within synthetic turf are a source of pathogens when abrasions occur.
    c. Older turf fields have higher microbial populations, as well as higher levels in the higher traffic areas such as the sidelines. These results indicate that artificial turf poses a greater risk for the spread of pathogens and infections among student athletes.
6. Llompart, M., Sanchez-Prado, L., Lamas, J. P., Garcia-Jares, C., Roca, E., & Dagnac, T. (2013). Hazardous organic chemicals in rubber recycled tire playgrounds and pavers. *Chemosphere*, *90*(2), 423-431. Available at: http://www.elcorreodelsol.com/sites/default/files/chemosphere_maria_llompart.pdf

a. An analysis of surfaces containing recycled rubber tires confirmed the presence of hazardous substances including PAHs, phthalates, antioxidants (e.g. BHT, phenols), benzothiazole, derivatives, and other chemicals.
b. The vapor phase above the samples confirmed volatilization of many organic compounds demonstrating that these chemicals can enter the human body through inhalation.
c. The use of recycled rubber tires for play areas, especially facilities for children, should be restricted or prohibited.

7. Serensits, T. J., McNitt, A. S., & Petrunak, D. M. (2011). Human health issues on synthetic turf in the USA. *Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology*, *225*(3), 139-146.
    a. Synthetic turf is more abrasive than natural turf grass, therefore, "breaks in the skin are more common, creating a pathway for infection when in contact with an infected surface."
8. Shalat, S.L. (2011). An Evaluation of Potential Exposures to Lead and Other Metals as the Result of Aerosolized Particulate Matter from Artificial Turf Playing Fields, Final Report. Submitted to NJ Department of Environmental Protection, July 14, 2011. Available at: http://www.nj.gov/dep/dsr/publications/artificial-turf-report.pdf
    a. In air samples collected from artificial turf during various levels of activity, researchers detected arsenic, cadmium, chromium and lead, all metals with known human toxicity.
    b. This research demonstrates that activity by players on the fields could suspend contaminated particulates into the air that could be inhaled and therefore, human exposure from artificial turf fields is not limited to dermal.
    c. These results "raise some concerns with regard to the potential hazards that may exist for individuals and in particular children who engage in sports activities on artificial turf fields."
9. Van Ulirsch, G. et al. (2010). Evaluating and regulating lead in synthetic turf. *Environmental health perspectives*, *118*(10), 1345. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2957910/pdf/ehp-118-1345.pdf
    a. Artificial turf can degrade to form lead containing dust at levels that pose a health risk to children.
    b. Due to the lack of research, "…physicians should be aware of synthetic turf as one potential source of exposure for young children…" and "Health officials investigating elevated blood lead in children should also be aware of synthetic turf as a potential source of lead exposure."
10. Center for Disease Control and Prevention. (2008). CDC Health Advisory. Potential exposures to lead inartificial turf: Public health issues, actions, and recommendations. June 18, 2008. Available at: http://www.dhhr.wv.gov/oeps/disease/Documents/Advisory_00275.pdf
    a. Artificial turf made of nylon or nylon/ polyethylene blend fibers contain lead and pose a potential public health concern.
    b. The risk for lead exposure is higher for artificial fields that are old, frequently used, exposed to the weather, or demonstrate signs of abraded, faded, or broken fibers. As turf ages, lead is released in dust that could then be ingested or inhaled.
    c. CDC does not know how much lead the body will absorb. However, lead can cause neurological development symptoms and behavioral problems. Children less than 6 years old are more affected by lead than adults and absorb lead more easily.
    d. CDC does not understand the potential risks associated with lead exposure from artificial turf but recommends precautions including aggressive hand and body washing after playing on fields, washing clothes immediately to avoid tracking contaminated dust to other places, and discouraging eating and drinking while on turf products.
11. Han, I. K., Zhang, L., & Crain, W. (2008). Hazardous chemicals in synthetic turf materials and their bioaccessibility in digestive fluids. Journal of Exposure Science and Environmental Epidemiology, 18(6), 600-607. Available at: http://www.nature.com/jes/journal/v18/n6/pdf/jes200855a.pdf

a. Samples from rubber granules and from artificial grass fibers were taken at fields of different ages and analyzed for polycyclic aromatic hydrocarbons (PAHs), zinc, chromium, arsenic, cadmium, and lead. These samples were then analyzed to determine their bioaccessibility in synthetic digestive fluids.
b. The rubber granules found in artificial turf fields had PAH levels above health-based soil standards. Although levels appear to decline over time, this trend can be altered by the fact that new rubber can be added periodically to compensate for the loss of infill material.
c. There was a "slightly worrisome" level of chromium found in artificial turf fiber samples.
d. Lead in artificial fields can come from the blades of artificial grass, the pigment used for the field markings and lines, and the infill material. Although there were relatively low concentrations of lead measured, the researchers were careful to point out: "some health scientists believe that any Pb [lead] is harmful to children's neurocognitive development, and that no new Pb should be added to their surroundings." Furthermore, the lead present in the rubber granules, while at low levels, was "highly bioaccessible" to synthetic gastric fluid.

12. Brown, D.R. (2007). Artificial Turf: Exposures to Ground-up Rubber Tires. Environment & Human Health, Inc. (EHHI). Available at: http://www.ehhi.org/reports/turf/turf_report07.pdf
    a. Direct human exposure to the hazardous substances contained in artificial turf occurs via three pathways: inhalation as chemicals off gas from the turf, skin contact, or ingestion including by children or infants who come into contact with the material. In the case of allergies (i.e. latex allergies), inhalation could result in a systemic response, as opposed to a contact response.
    b. Extreme temperatures or solvents are not needed to release metals (including zinc, selenium, lead and cadmium), volatile organic compounds, or semi-volatile organic compounds from the rubber in-fill of artificial turf into the air or water – release takes place in ambient air and water temperatures.
    c. While, "the status of the information about human exposures to recycled tire crumb rubber in-fill … is not sufficient to determine the safety of the use of the product in situations that involve continuous episodes of human exposure;" "the available information is sufficient and strong enough to raise plausible questions with respect to acute toxicity for susceptible persons, and for cancer risks."
13. California Office of Environmental Health Hazard Assessment (OEHHA) (2007). Evaluation of Health Effects of Recycled Waste Tires in Playground and Track Products. Report prepared for the Integrated Waste Management Board. Available at: http://www.calrecycle.ca.gov/publications/Documents/Tires%5C62206013.pdf
    a. Based on a review of 46 studies, 49 chemicals that are released from tire crumb were identified.
    b. Of the 49 chemicals identified, "seven of the chemicals leached from tire shreds were carcinogens."
    c. OEHHA calculated a cancer risk of 1.2 in 10 million based on a one-time ingestion of the tire crumb rubber over a lifetime.
    d. Chrysene, a PAH and carcinogen, was found to be ingested as the result of hand-to-surface-to-mouth transfer from playground surfaces made with recycled tires. Assuming playground use for an 11 year period (from age 1 to 12) there was found to be an increased cancer risk of 2.9 in one million from the general cancer risk gauge of one in one million
    e. Only 31% of the playground surfaces made of recycled tires tested passed the California State mandated Head Impact Criterion (HIC) of <1,000. In this same study 100% of the playground surfaces made of wood chips passed the same standard.
14. Crain, W. and Zhang, J. (2007). Rachel's Democracy and Health News #992: Hazardous Chemicals in Synthetic Turf, Follow-up Analyses, April 12, 2007. Available at: http://www.precaution.org/lib/07/prn_synthetic_turf.070405.htm

a. Testing on two sites in New York where synthetic turf has been used (the large, 3 year old, Parade Ground in Brooklyn; the relatively small 5 month old Sara D. Roosevelt Park in Manhattan) found PAHs at hazardous levels (as per New York standards). Dibenzo (a.h)anthracene, a probable human carcinogen, was also found at hazardous levels, with two other PAH forms, both possible human carcinogens, found at hazardous levels at the Parade Ground site.
b. Research into the pathways by which these substances may be absorbed into the bodies of children and athletes via skin contact, ingestion or other pathways, is very limited with additional research needed.

15. Epstein, V. (2007). Texas Football Succumbs to Virulent Staph Infection from Turf. Bloomberg Press, December 21, 2007. Available at: http://www.bloomberg.com/apps/news?pid=newsarchive&sid=alxhrJDn.cdc
    a. Artificial turf is linked with serious and potentially life threatening staph infections including MRSA (methicillin-resistant staphylococcus aureus). MRSA can exploit minor skin injuries such as turf burn, and therefore, MRSA infection rate among players is 16 times higher than the national average.
16. KEMI, Swedish Chemicals Agency (2007). Facts: Synthetic Turf. April 2007. Available: http://www2.kemi.se/upload/trycksaker/pdf/faktablad/fbsyntheticturf.pdf.
    a. Tires contain up to 60 different substances which may be bioaccumulative, carcinogenic, reprotoxic, mutagenic and/or endocrine disrupting.
    b. Most PAHs are persistent, bioaccumulative and carcinogenic.
    c. Among the metals found in tires that may be of concern are zinc, lead, copper, chromium and cadmium. Zinc and copper are harmful when absorbed at high levels. Lead can affect reproduction and development of the nervous system leading to poor cognitive development. Chromium is carcinogenic and mutagenic. Cadmium is toxic to humans and can contribute to poor liver and kidney function, as well as osteoporosis.
17. Mattina, M. I., Isleyen, M., Berger, W., & Ozdemir, S. (2007). Examination of crumb rubber produced from recycled tires. *The Connecticut Agricultural Experiment Station, New Haven, CT.* Available at: http://www.ct.gov/caes/lib/caes/documents/publications/fact_sheets/examinationofcrumbrubberac005.pdf
    a. Multiple compounds out-gas and leached into water from synthetic turf rubber crumb under ambient temperatures including benzothiazole (a skin and eye irritant), butylated hydroxyanisole (a "recognized carcinogen, suspected endocrine toxicant, gastrointestinal toxicant, immune toxicant, neurotoxicant, skin and sense-organ toxicant"), n-hexadecane (a severe irritant), and 4-(t-octyl) phenol ("corrosive and destructive to mucous membranes").
18. Anderson, M. E. et al. (2006). A case study of tire crumb use on playgrounds: risk analysis and communication when major clinical knowledge gaps exist. Environmental health perspectives, 114(1), 1. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1332647/pdf/ehp0114-000001.pdf
    a. A Case Study conducted by a group of physicians and public health professionals working with the U.S. Environmental Protection Agency's Region Pediatric Environmental Health Specialty Unit found that the research and information necessary is not available to establish "the safety in use with children" of tire crumb used as playground surfaces.
    b. "The use of recycled tire crumb products on playgrounds has had little health investigation. The major unresolved concern is the potential for latex allergy with short-term dermal exposure."
19. Crain, W. and Zhang, J. (2006). Rachel's Democracy and Health News #871: Hazard Chemicals in Synthetic Turf. September 7, 2006. Available at: http://www.precaution.org/lib/06/prn_toxins_in_synthetic_turf.060831.htm

a. Analyses conducted at the Environmental and Occupational Health Sciences Institute of Rutgers University found the crumb rubber from artificial turf to contain high levels of PAHs, as well as zinc and arsenic.
b. PAHs found to be contained in the crumb rubber "were above the concentration levels that the New York State Department of Environmental Conservation (DEC) considers sufficiently hazardous to public health to require their removal from contaminated soil sites. It is highly likely that all six PAHs are carcinogenic to humans."
c. "The analyses also revealed levels of zinc in both samples that exceed the DEC's tolerable levels."
d. The researchers associated with these findings were careful to state "We want to emphasize that the findings are preliminary. PAHs in rubber might not act the same way as in soil, and we do not yet have information on the ease with which the PAHs in these rubber particles might be absorbed by children or adults -- by ingestion, inhalation, or absorption through the skin. However, the findings are worrisome. Until more is known, it wouldn't be prudent to install the synthetic turf in any more parks."

20. Kazakova, S. V. et al. (2005). A clone of methicillin-resistant Staphylococcus aureus among professional football players. New England Journal of Medicine, 352(5), 468-475. Available at: http://www.nejm.org/doi/pdf/10.1056/NEJMoa042859
    a. In a study of professional football players from the St. Louis Rams team, all MRSA infections developed at sites of turf burns.
    b. Players reported a higher frequency of abrasions when playing on artificial turf compared to natural grass.
21. Begier, E. M. et al. (2004). A high-morbidity outbreak of methicillin-resistant Staphylococcus aureus among players on a college football team, facilitated by cosmetic body shaving and turf burns. *Clinical infectious diseases*, *39*(10), 1446-1453. (a study conducted for the Connecticut Department of Public Health, Student Health Services of Sacred Heart Univ, Centers for Disease Control and Prevention, Minnesota Department of Public Health, and the Los Angeles County Department of Health Services).
    a. In a study of MRSA outbreaks involving college football players, infection was associated with turf burns from artificial grass. Turf burns increased the risk of infection regardless of the type and timing of care provided the burn. Turf burns may be facilitating infection by acting as a pathway for infection.
22. Shorten, M. R., & Himmelsbach, J. A. (2003). Sports surfaces and the risk of traumatic brain injury. Sports surfaces. University of Calgary, Calgary, 49-69. Available at: http://biomechanica.com/docs/publications/docs/Shorten%20-%20Head%20Injury%20Risk.pdf
    a. There is double the risk of head traumas such as concussions associated with artificial turf compared to natural turf, and artificial turf presents a 5 times greater risk of more severe head injury.
    b. Concussions (formally described as Mild Traumatic Brain Injury or MTBI) resulting from sports has, according to the US Centers for Disease Control, reached "epidemic proportions," and these 'mild' head traumas, especially a series of concussions, can have long term, negative effects on cognitive function.
23. Naunheim, R., et al. (2002). Does the use of artificial turf contribute to head injuries?. *Journal of Trauma-Injury, Infection, and Critical Care*, *53*(4), 691-694.
    a. The impact-attenuating properties of two artificial fields were compared to a grass outdoor practice field. Both artificial surfaces were harder compared to the outdoor grass field. It was concluded that the low impact attenuation of the artificial turf may be contributing to the high incidence of concussion.
24. Guskiewicz, K. M., et al. (2000). Epidemiology of concussion in collegiate and high school football players. The American Journal of Sports Medicine, 28(5), 643-650.

a. In a survey of both high school and collegiate certified athletic trainers representing over 17,000 football players, contact with artificial turf was associated with more serious concussion than contact with natural grass.

Environment: The pollutant substances found in artificial turf contribute to contamination of soil, plants and aquatic ecosystems and pose a risk of toxic effects for aquatic and sediment dwelling organisms. The resulting environmental harm is on-going and long-term, happening over many years. The varying content of tires used for infill of turf systems makes this threat a moving target. A growing body of scientific analysis is documenting a concerning level of environmental threat and harm and is further demonstrating the need for more research regarding artificial turf and its ramifications for the environment.

1. Public Employees for Environmental Responsibility (PEER) (2012). Petition for a Rulemaking on Surface Heat from Artificial Turf, Submitted by PEER to Consumer Product Safety Commission, Sept 6, 2012. Available at: http://www.peer.org/assets/docs/doc/9_6_12_PEER_Petition_heat_rulemaking.pdf
    a. As well explained by an oft cited petition to the Consumer Product Safety Commission for rulemaking: "When tires are shredded and pulverized, their surface area increases exponentially, as does the particulate and gas yield from the tire material. Since tires are made of very harmful materials, including 24 gases found to be harmful to humans, carbon black, (a carcinogen which makes up 30% of tires), latex, benzothiazoles, phthalates, lead, mercury, cadmium, zinc and many other known toxins, when the fields heat up, they become increasingly dynamic. Of primary concern is the interaction of particles and gases, 'because when particles adsorb onto the surface of gases, they become 10-20 times more toxic than the materials themselves.'"
    b. Furthermore, artificial turf becomes more toxic as it heats up.
2. Sadiktsis, I., et al. (2012). Automobile Tires A Potential Source of Highly Carcinogenic Dibenzopyrenes to the Environment. Environmental science & technology, 46(6), 3326-3334. Available at: http://www.locchiodiromolo.it/blog/wp-content/uploads/2012/03/Sadiktsis-et-al-Automobile-Tires-Potential-Source-of-Highly-Carcinogenic-2012.pdf
    a. The variability in PAH concentrations between different tires is large.
    b. Due to "leaching of PAHs from recycled tire rubber material, tires are a source of environmental pollution of PAHs through their entire lifecycle."
3. Connecticut Department of Environmental Protection (2010). Artificial Turf Study: Leachate and Stormwater Characteristics, Final Report. Available at: http://www.ct.gov/deep/lib/deep/artificialturf/dep_artificial_turf_report.pdf
    a. Stormwater runoff from artificial turf contained zinc, manganese, and chromium at levels toxic to aquatic organisms.
    b. Therefore, there is a potential risk to surface waters from the installation of artificial turf. Zinc levels could cause exceedance of acute aquatic toxicity criteria. This risk is especially high for smaller watercourses.
    c. Best management practices and treatment (i.e. wetlands, wet ponds, infiltration structures, compost filter, sand filters, or biofiltration structures) should be used for stormwater runoff from artificial turf fields that discharge to surface waters.
4. Yaghoobian, N., et al. (2010). Modeling the thermal effects of artificial turf on the urban environment. *Journal of Applied Meteorology and Climatology*, *49*(3), 332-345.
    a. An urban temperature model showed an increase in local atmospheric temperatures of up to 4° C (39° F) in areas where natural grass cover had been replaced with artificial turf.
5. Han, I. K., et al. (2008). Hazardous chemicals in synthetic turf materials and their bioaccessibility in digestive fluids. Journal of Exposure Science and Environmental Epidemiology, 18(6), 600-607. Available at: http://www.nature.com/jes/journal/v18/n6/pdf/jes200855a.pdf

a. Zinc was found to exceed soil limits and the leaching rate from rubber granules was up to 20 times more than the leaching rate from agricultural applications of manure and pesticides. "Runoff with high Zn [zinc] from synthetic turf fields may produce adverse effects to plants and aquatic life."

6. KEMI, Swedish Chemicals Agency (2007). Facts: Synthetic Turf. April 2007. Available: http://www2.kemi.se/upload/trycksaker/pdf/faktablad/fbsyntheticturf.pdf.
    a. Hazardous substances found in tires may persist in the environment including polycyclic aromatic hydrocarbons (PAHs), phthalates, phenols, and certain metals.
    b. Most PAHs are persistent, bioaccumulative and carcinogenic.
    c. Phthalates and phenols are not chemically bound to the rubber and as a result can leach from the infill material. These chemicals are persistent and bioaccumulative and can have long-term effects on the environment.
7. Meil, J., & Bushi, L. (2006). Estimating the Required Global Warming Offsets to Achieve a Carbon Neutral Synthetic Field Turf System Installation. *Athena Institute. Ontario Canada.* Available at: http://sfrecpark.org/wp-content/uploads/AthenaICarbonOffsets.pdf
    a. Artificial turf systems have a carbon footprint due to the greenhouse gases emitted during the life cycle of synthetic turf systems compared to natural grass surfaces.
    b. To achieve a 10-year carbon neutral synthetic turf installation, 1861 trees would need to be planted to offset the field's carbon footprint.
8. Källqvist, T. (2005). Environmental risk assessment of artificial turf systems. *Norwegian Institute for Water Research*, 19.
    a. Recycled rubber varies considerably in its chemical composition, even when from the same manufacturer.
    b. Leaching of contaminants from artificial turf as the result of surface water runoff from precipitation is a great risk for the environment. It is predicted that chemicals leaching from synthetic turf materials occurs slowly, and as a result the environmental harms may take place over many years. There is also a level of "erosion" that takes place and can result in fine particles that could be carried to local waterways. Chemicals have even been shown to leach from the artificial turf fibers.
    c. The leachate from artificial turf can contain a variety of metals (including lead, cadmium, copper, mercury and zinc) and organic pollutants (including PAHs, phthalates, 4-t-octylphenol and iso-nonyphenol).
    d. The runoff from an artificial turf field poses "a positive risk of toxic effects on biota in the water phase and in the sediment."
    e. Of the organic compounds at issue, octylphenol represents the greatest risk, and possibly could occur at levels where hormone disrupting effects are a concern.
    f. The Norwegian Institute for Water Research has determined that it is "appropriate to perform a risk assessment which covers water and sediments in watercourses which receive run-off from artificial turf pitches."
9. Thale, S.W. et al. (2004) Potential Health and Environmental Effects Associated with Synthetic Turf Systems-final report. Byggforsk, Norwegian Building Research Institute. Available at: http://www.isss-sportsurfacescience.org/downloads/documents/vskyslv2qq_nbiengelsk.pdf
    a. While recycled rubber is a greater source of pollution, newly manufactured rubber also contains levels of hazardous substances; in the case of zinc and chromium the levels of recycled and newly manufactured rubber are comparable.
    b. The synthetic grass fibers can also be a significant source of pollution, albeit significantly lesser amounts leach from the synthetic grass than the rubber infill

10. Tucker, M.R. (1997). Ground Rubber: Potential Toxicity to Plants. Media Notes for North Carolina Growers, North Carolina Dept. of Agriculture & Consumer Services, April 1997. Available at: http://www.ncagr.gov/agronomi/pdffiles/rubber.pdf
    a. When talking about the use of ground rubber as a supplement to planting soils, the North Carolina Department of Agriculture and Consumer Services sent out a notice identifying the risk that zinc leaching from the rubber causes a decline in plant growth "directly attributable to zinc toxicity."
11. Quoting Dr. Linda Chalker-Scott, Washington State University - Turfgrass Resource Center, Facts About Artificial Turf and Natural Grass. (n.d.) Available at: http://plasticfieldsfornever.org/ArtificialTurfBooklet.pdf
    a. "There is no question that toxic substances leach from rubber as it degrades, contaminating the soil, flora, and fauna and aquatic systems."
12. Turfgrass Resource Center (n.d.) Facts About Artificial Turf and Natural Grass. Available at: http://plasticfieldsfornever.org/ArtificialTurfBooklet.pdf
    a. Part of artificial turf maintenance is the regular replenishment of the infill. Some of the infill is merely settling, but some of it is washing away or literally "walking away" with players after use. The effects of this "runaway" infill are unknown and more research is needed to draw conclusions– where is it going and what impacts is it having?
    b. Maintenance of artificial turf can include application of algaecides or disinfectants to keep the surface clean and application of fabric softener to mask the odor of the artificial turf. What is the final destination of these chemicals and their implications for the environment and those coming into contact with them while playing on the fields?
    c. There is no indication that artificial turf drains more effectively for purposes of a stormwater infiltration system than natural grass. In addition, infiltration systems are designed to work with whatever surface coating they receive from natural grass to porous paving. Although there is no assumed benefit from an infiltration perspective of natural turf or artificial turf, in many cases the complex systems designed for artificial turf fields have experience problems, work incorrectly, or inefficiently.

DELAWARE RIVERKEEPER NETWORK™

Fact Sheet

Artificial/Synthetic Turf

While professional sports are turning away from artificial turf, it is gaining ground and use at the local level at schools and community fields. Producers of artificial turf make claims of environment, health and safety benefits associated with artificial turf – when they make these blanket claims they are not giving the full picture.

In terms of environment, health and safety, the jury is still very far out on artificial turf. There continues to be information documenting harm in each of these arenas. Most of all, there is a widespread demonstration and recognition that in terms of environmental, health and safety threats from artificial turf, much more study, analysis and consideration is needed. And whatever the final outcome of the research, manufacturers neglect the reality that as much as they try to mimic natural grass, artificial turf is not grass, and cannot provide the same natural feel, natural look, natural smell and environmental benefits that natural grass provides.

Artificial Turf is generally comprised of plastic fibers (generally made of polyethylene, polypropylene or nylon) attached to a polypropylene or polyester plastic webbing. A combination of sand and rubber, or sometimes rubber alone, fills between the fibers. The source for the rubber infill is generally recycled tires. Sometimes newly manufactured rubber granulate is used but the cost is so much greater than the recycled tire form that it is generally not the substance used. New developments in artificial turf technology seem continually in the works.

Water Quality:

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While it seems well recognized that there is a limited level of assessment and investigation into the environmental impacts associated with artificial turf, a growing body of scientific analysis is documenting a concerning level of environmental threat and harm and is further demonstrating the need for more research regarding artificial turf and its ramifications for the environment.

Synthetic turf is generally made with rubber from waste tires. Recycled rubber varies considerably in its chemical composition, even when from the same manufacturer.[1]

Hazardous substances found in tires may persist in the environment including polycyclic aromatic hydrocarbons (PAHs), phthalates and certain metals. These substances may be bioaccumulative, carcinogenic, reprotoxic, mutagenic and/or endocrine disrupting.[2] The chemicals in waste tires are of such concern that a report published by the Swedish Chemicals Inspectorate recommends: "waste tyres should not be used for synthetic turf surfaces." [3]

- Most PAHs are persistent, bioaccumulative and carcinogenic.[4]
- Phthalates are generally used as solvents and plasticisers in plastics. Phthalates are not chemically bound to the rubber and as a result can leach from the infill material.[5]
- Phenols likewise are not chemically bound to the rubber and so can leach. Phenols too are persistent and bioaccumulative and can have long-term effects on the environment.[6]
- Among the metals found in tires that may be of concern are zinc, lead, copper, chromium and cadmium. While zinc and copper are essential for living organisms, when absorbed at high levels they become harmful. Lead can affect reproduction, development of the nervous system leading to poor cognitive development, and is a particular threat to fetuses and young children. Chromium is carcinogenic and mutagenic. Cadmium is toxic to humans and if taken in can contribute to poor liver and kidney function, as well as osteoporosis. [7]

The Connecticut Agricultural Experiment Station conclusively found four compounds which out-gassed and leached into water from synthetic turf rubber crumb under ambient temperatures:

- Benzothiazole (a skin and eye irritant),

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[1] T. Kallqvist, Norwegian Institute for Water Research (NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 7.
[2] KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.
[3] KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.
[4] KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.
[5] KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.
[6] KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.
[7] KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.

- Butylated hydroxyanisole (a "recognized carcinogen, suspected endocrine toxicant, gastrointestinal toxicant, immune toxicant, neurotoxicant, skin and sense-organ toxicant"),
- n-hexadecane (a severe irritant) &
- 4-(t-octyl) phenol ("corrosive and destructive to mucous membranes").[8]

As rubber degrades it can leach toxic substances which can contaminate soil, plants and aquatic ecosystems.[9] Study has concluded that the use of tires in artificial turf has the potential to pollute our environment with PAHs, phenols and zinc[10] and that runoff from an artificial turf field draining to a local creek can pose "a positive risk of toxic effects on biota in the water phase and in the sediment."[11] Other metal contaminants found to leach from tire crumb rubber include zinc, selenium, lead and cadmium.[12] Zinc has also been shown to leach from the artificial turf fibers.[13] Extreme temperatures or solvents are not needed to release these metals, volatile organic compounds or semi-volatile organic compounds from the rubber in-fill of artificial turf into the air or water – release takes place in ambient air and water temperatures.[14]

Leaching of substances as the result of surface water runoff from precipitation has, by some researchers, been predicted to be the greatest risk for the environment from artificial turf.[15] Study shows there is a risk of local effects for aquatic and sediment dwelling organisms in impacted water courses.[16] Recycled rubber, and associated

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[8] The Connecticut Agricultural Experiment Station, Examination of Crumb Rubber Produced from Recycled Tires, August 2007; Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007.

[9] Quoting Dr. Linda Chalker-Scott, Washington State University -- Turfgrass Resource Center, Facts About Artificial Turf and Natural Grass; T. Kallqvist, Norwegian Institute for Water Research(NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 17.; Connecticut Agricultural Experiment Station, Examination of Crumb Rubber Produced from Recycled Tires.

[10] T. Kallqvist, Norwegian Institute for Water Research(NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 5; T. Edeskar, Lulea University of Technology, Technical and Environmental Properties of Tyre Shreds Focusing on Ground Engineer Application, 2004 as cited in KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.

[11] T. Kallqvist, Norwegian Institute for Water Research (NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 6.

[12] Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007.

[13] T. Kallqvist, Norwegian Institute for Water Research (NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 17.

[14] Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007.

[15] T. Kallqvist, Norwegian Institute for Water Research (NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 5; NIVA (The Norwegian Institute for Water Research), Evaluation of the Environmental Risks of Synthetic Turf, 2005; KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.

[16] T. Kallqvist, Norwegian Institute for Water Research(NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 5; NIVA (The Norwegian Institute for Water Research), Evaluation of the Environmental Risks of Synthetic Turf, 2005, as cited by KEM, Swedish Chemicals

leachate, has been found to contain a variety of metals (including lead, cadmium, copper, mercury and zinc), as well as organic pollutants such as PAHs, phthalates, 4-t-octylphenol and iso-nonyphenol.[17] The leaching of zinc has been determined to be of major environmental concern.[18] The leaching of zinc increases as the rubber infill weathers over time,[19] it is likely this is the same for other contaminants. While Zinc contributes the most risk, phenols (specifically octylphenol) and PAHs are also of concern.[20] Of the organic compounds at issue, Octylphenol represents the greatest risk, and possibly could occur at levels where hormone disrupting effects are a concern.[21] The varying content of tires makes this threat a moving target.

The Norwegian Institute for Water Research has determined that it is "appropriate to perform a risk assessment which covers water and sediments in watercourses which receive run-off from artificial turf pitches."[22]

While recycled rubber is a greater source of pollution, newly manufactured rubber also contains level of hazardous substances; in the case of zinc and chromium the levels of recycled and newly manufactured rubber are comparable.[23]

It is predicted that chemicals leaching from synthetic turf materials occurs slowly, and as a result the environmental harms may take place over many years.[24]

Leaching may not be the only source of water contamination from artificial turf. As the artificial turf is used there is a level of "erosion" that takes place and can result in

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Agency, Facts: Synthetic Turf, April 2007; KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007

[17] T. Kallqvist, Norwegian Institute for Water Research (NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 7.

[18] INTRON, Environmental and Health Risks of Rubber Infill, rubber crumb from car tyres as infill on artificial turf, February 9, 2007.

[19] INTRON, Environmental and Health Risks of Rubber Infill, rubber crumb from car tyres as infill on artificial turf, February 9, 2007.

[20] NIVA (The Norwegian Institute for Water Research), Evaluation of the Environmental Risks of Synthetic Turf, 2005, as cited by KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.

[21] T. Kallqvist, Norwegian Institute for Water Research (NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 17.

[22] T. Kallqvist, Norwegian Institute for Water Research (NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 8.

[23] Byggforsk, SINTEF Building and Infrastructure, Potential Health and Environmental Effects Associated with Synthetic Turn Systems, 2004, as referenced in KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.

[24] T. Kallqvist, Norwegian Institute for Water Research(NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 5; NIVA (The Norwegian Institute for Water Research), Evaluation of the Environmental Risks of Synthetic Turf, 2005, as cited by KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.

fine particles that could be carried to local waterways. This source of contamination needs study.[25]

The synthetic grass fibers can also be a significant source of pollution, particularly zinc, albeit significantly lesser amounts leach from the synthetic grass than the rubber infill.[26]

Concerns about the environmental and health effects of synthetic turf in European countries is so great that standards and/or guidelines have been set or are under consideration. For example: Germany has set standards for the use of synthetic turf including a maximum allowable level of pollution or contamination of water and soil, with a requirement of regular sampling to ensure these standards are not exceeded. Allowable pollution levels include: lead 0.04 mg/l, cadmium 0.005 mg/l; chromium 0.05 mg/l, mercury 0.001 mg/l and zinc 3.0 mg/l or 0.5 mg/l depending on the testing method used.[27] Holland has also suggested appropriate language for a standard applicable to use of synthetic turf including a ban on the use of carcinogens, mutagenic, reprotoxic, persistent, bioaccumulative and toxic, or very persistent and very bioaccumulative substances in the surface layer of the turf and a limitation on the level of substances in the rubber infill that may cause cancer, may cause heritable genetic damage, may cause cancer by inhalation, are toxic or harmful to aquatic organisms or may cause long term affects on the aquatic environment, that may impair fertility or cause harm to unborn children. Sweden has set guidelines and limiting values for some of the substances that are present in synthetic turf, specifically as it relates to air pollution, soil contamination and water pollution.[28] And because vehicle tires contain levels of several substances of "very high concern", the recycling and use of tires in synthetic turf is apparently in conflict with the Swedish environmental objective of A Non Toxic Environment.[29]

Part of artificial turf maintenance is the regular replenishment of the infill. There is a need for research into the loss of existing infill – where is it going and what impacts is it having?[30]

Maintenance of artificial turf can include application of algaecides or disinfectants to keep the surface clean.[31] Maintenance could also include application of fabric

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[25] T. Kallqvist, Norwegian Institute for Water Research (NIVA), Environmental Risk Assessment of Artificial Turf Systems, December 2005, p. 18.

[26] Byggforsk, SINTEF Building and Infrastructure, Potential Health and Environmental Effects Associated with Synthetic Turn Systems, 2004, as referenced in KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.

[27] KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.

[28] KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.

[29] KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.

[30] Turfgrass Resource Center, Facts About Artificial Turf and Natural Grass.

softener to mask the odor of the artificial turf. [32] What is the final destination of these chemicals and their implications for the environment and those coming into contact with them while playing on the fields? More information is needed on this subject as well.

Stormwater:

There is no indication that artificial turf drains more effectively for purposes of a stormwater infiltration system than natural grass. In addition, infiltration systems are designed to work with whatever surface coating they receive from natural grass to porous paving. It should be noted that while generally there can be no assumed benefit from an infiltration perspective of natural turf or artificial turf, there are instances where schools have experienced problems with the drainage of their artificial turf fields. [33]

Natural grass provides a level of evapotranspiration, pulling water out of the soil and subsurface and releasing it to the air, providing benefits in reducing the volume of runoff that results from a site and/or needs to be addressed by other stormwater management strategies. Artificial turf has no evapotranspiration capabilities.

Grass does provide a level of pollution filtering and therefore water quality protection for nearby waterways. While this filtering may be limited in the case of turf grass; such filtering is nonexistent with artificial turf.

Heat Island Effect – for Human Health and Surrounding communities:

Extreme heat is a health concern. Studies document that the surface temperature on artificial turf is dramatically increased as compared to surrounding land uses including asphalt.

In a 2002 study it was found that "the surface temperature of the synthetic turf was 37° F higher than asphalt and 86.5° F hotter than natural turf." [34] A study published in the Journal of Health and Physical Education and Recreation showed "surface temperatures as much as 95 to 140 degrees Fahrenheit higher on synthetic turf than natural turfgrass when exposed to sunlight." [35] Random sampling at Brigham Young University identified temperatures ranging from 117.38 to 157 degrees on artificial turf while neighboring natural grass areas were in the range of 78.19 to 88.5 degrees Fahrenheit. "Two inches below the synthetic turf surface was 28.5° F hotter than

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[31] Turfgrass Resource Center, Facts About Artificial Turf and Natural Grass.
[32] Turfgrass Resource Center, Facts About Artificial Turf and Natural Grass.
[33] Turfgrass Resource Center, Facts About Artificial Turf and Natural Grass.
[34] Dr. C. Frank Williams and Dr. Gilbert E. Pulley, Synthetic Surface Heat Studies, Brigham Young University.
[35] SportsTurf Managers Association, A Guide to Synthetic and natural Turfgrass for Sports Fields, Selection, Construction and Maintenance Considerations.

natural turf at the surface."[36] And still another study comparing temperatures on artificial turf temperatures with air temperature found that artificial turf ranged from 58 to 75 degrees hotter than measured air temperature.[37] While irrigation provided significant cooling for the synthetic turf (lowering the temperature from 174° F to 85° F) after only 5 minutes the temperature quickly rose again to 120°F; after 20 minutes it rose to 164°F.[38]

Concerns regarding the excessive temperatures range from the implications for players who are already exerting themselves playing in such excessively high temperatures, to the implications for burns when players or pedestrians come into contact with the hot surfaces, to the implications for small children who may come into contact with the extremely hot surfaces during non-sporting events. Particularly when installed in already built up areas, what affect does the extreme heat associated with artificial turf have on the surrounding community in terms of temperature?

Natural grass, by comparison, provides a natural cooling affect and helps to dissipate heat from neighboring developed areas.[39] "The temperature of natural grass rarely rises above 85 degrees Fahrenheit, regardless of air temperature." [40]

The heat impacts of artificial turf need to be considered in the context of today's changing climate. Global climate change is expected to dramatically increase the number of days over 100 degrees communities in our region experience. Depending on how aggressively global warming gasses are reduced in coming years, communities nearby Philadelphia will begin to experience in the range of 10 days (in lower emission scenarios) to 30 days (if higher emission scenarios continue to prevail) over 100°.[41] By later in this century seasonable temperatures are projected to rise 6°F to 14°F in summer (depending again on emission reductions achieved in the future). [42] Educators and decisionmakers selecting artificial turf based on its long-term viability and community impacts should consider the affect of global climate change to magnify the heat impacts of artificial turf.

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[36] Dr. C. Frank Williams and Dr. Gilbert E. Pulley, Synthetic Surface Heat Studies, Brigham Young University.
[37] T. Sciacca, The Thermal Physics of Artificial Turf, January 2008.
[38] Dr. C. Frank Williams and Dr. Gilbert E. Pulley, Synthetic Surface Heat Studies, Brigham Young University.
[39] James B. Beard & Robert L. Green, The Role of Turfgrasses in Environmental Protection and Their Benefits to Humans, J. Environ Qual. 23:452-460 (1994).
[40] SportsTurf Managers Association, A Guide to Synthetic and natural Turfgrass for Sports Fields, Selection, Construction and Maintenance Considerations.
[41] Union of Concerned Scientists, Confronting Climate Change in the U.S. Northeast ● New Jersey, 2007.
[42] Union of Concerned Scientists, Confronting Climate Change in the U.S. Northeast ● New Jersey, 2007.

Health Issues:

Direct human exposure to the hazardous substances contained in the rubber in-fill of artificial turf is believed to occur via three pathways: inhalation, skin contact, or ingestion including by children or infants who come into contact with the material.[43]

In October 2006 and January 2007, respectively, two sites in New York where synthetic turf has been used (the large, 3 year old, Parade Ground in Brooklyn; the relatively small 5 month old Sara D. Roosevelt Park in Manhattan) were analyzed. This testing found PAHs at hazardous levels (as per New York standards) at each of the sites. At both sites dibenzo (a.h)anthracene, a probable human carcinogen, was found at hazardous levels, with two other PAH forms, both possible human carcinogens, found at hazardous levels at the Parade Ground site. Research into the pathways by which these substances may be absorbed into the bodies of children and athletes via skin contact, ingestion or other pathways, is very limited with additional research needed.[44]

A study by the California Office of Environmental Health Hazard Assessment (OEHHA) summarized 46 studies that identified 49 chemicals which are released from tire crumb. Of the 49, "seven of the chemicals leached from tire shreds were carcinogens. OEHHA calculated a cancer risk of 1.2 in 10 million based on a ***one-time*** ingestion of the tire crumb rubber over a lifetime."[45] While there are limited studies which assert that recycled tire crumb are stable in the gastrointestinal tract and that therefore this is not a pathway for exposure, there are other studies which contradict these findings.[46]

Concerns have been raised about the potential implications of recycled tire in-fill for individuals with latex allergies and that inhalation could result in a systemic response, as opposed to a contact response.[47]

While, "the status of the information about human exposures to recycled tire crumb rubber in-fill … is not sufficient to determine the safety of the use of the product in situations that involve continuous episodes of human exposure;"[48] "the available

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[43] Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007.
[44] Rachel's' Democracy & Health News #992, Hazardous Chemicals in Synthetic Turf, Follow-up Analyses, April 12, 2007.
[45] Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007 citing California Office of Environmental Health Hazard Assessment (OEHHA), Evaluation of Health Effects of Recycled Waste Tires in Playground and Track Products, January, 2007.
[46] Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007.
[47] Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007.
[48] Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007.

information is sufficient and strong enough to raise plausible questions with respect to acute toxicity for susceptible persons, and for cancer risks."[49]

There is great debate about whether artificial turf can increase exposure to, and infection from, MRSA (methicillin-resistant staphylococcus aureus). Reports including a December 21, 2007 article in the Bloomberg Press reporting the affliction of an 18 year old football player from MRSA as the result (according to the boy's doctor) of an abrasion he received from playing on artificial turf, and citing other findings linking MRSA infections with artificial turf,[50] are a great concern for parents and sports players alike. Defenders of artificial turf often refer to studies like that of the Penn State Department of Crop and Soil Sciences which finds that *Staphylococcus aureus* is commonplace in the human environment, including on both artificial turf and natural grass fields.[51] But even this study acknowledges that there is no conclusive evidence currently available that the source of bacteria causing the infections of sports players is not artificial turf. In addition, the study does not consider the link between burns sustained while playing on artificial turf and available bacteria as a pathway for infection. New studies are emerging that demonstrate that turf burns may be facilitating infection by acting as a pathway for infection.[52] Study has found that turf burns increased the risk of infection regardless of the type and timing of care provided the burn. [53]

Concussions (formally described as Mild Traumatic Brain Injury or MTBI) resulting from sports has, according to the US Centers for Disease Control, reached "epidemic proportions."[54] "'Mild' head traumas, and especially a series of such minor concussions can have long term, negative effects on cognitive function." [55] Study has documented that artificial turf increases the risk of MTBI over natural turf,

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[49] Environment & Human Health, Inc., Artificial Turf, Exposures to Ground-Up Rubber Tires, 2007.
[50] *Texas Football Succumbs to Virulent Staph Infection from Turf*, December 21, 2007, Bloomberg Press.
[51] Penn State Department of Crop and Soil Sciences, A Survey of Microbial Populations in Infilled Synthetic Turf Fields.
[52] A High Morbidity Outbreak of Methicillin-Resistant *Staphylococcus aureus* among Players on a College Football Team, Facilitated by Cosmetic Body Shaving and Turf Burns, study conducted 2004 for Connecticut Dept of Public Health, Student Health Services of Sacred Heart Univ, Centers for Disease Control and Prevention, Minnesota Dept of Public Health, Los Angeles County Dept of Health Svces; Dr. S.V. Kazakova et.al., A Clone of Methicillin-Resistant *Staphylococcus aureus* among Professional Football Players, The New England Journal of Medicine, Vol 352:468-475 No. 5, Feb. 3, 2005.
[53] A High Morbidity Outbreak of Methicillin-Resistant *Staphylococcus aureus* among Players on a College Football Team, Facilitated by Cosmetic Body Shaving and Turf Burns, study conducted 2004 for Connecticut Dept of Public Health, Student Health Services of Sacred Heart Univ, Centers for Disease Control and Prevention, Minnesota Dept of Public Health, Los Angeles County Dept of Health Svces.
[54] Dr. M. Shorten, J.A. Himmelsbach, BioiMechanica, Sports Surfaces and the Risk of Traumatic Brain Injury citing the US Centers for Disease Control.
[55] Dr. M. Shorten, J.A. Himmelsbach, BioiMechanica, Sports Surfaces and the Risk of Traumatic Brain Injury.

approximately doubling that risk, as well as causing a greater degree of trauma.[56] According to study, artificial turf presents a 5 times greater risk of the more severe head injury than natural turf, although it is still unknown the particular characteristics of the two surfaces that cause the difference in head injury incidence. [57]

Costs:

It is generally agreed that artificial turf costs more to install than natural grass, while natural grass costs more to maintain. Installation and maintenance costs for each must be assessed on a case by case basis depending on site specific conditions. But generally speaking, when the installation and maintenance costs of artificial turf are assessed for the life span of the turf, particularly when the cost of disposal is added, the cost of installing and maintaining natural grass is far less. The guaranteed life and/or lifespan of artificial turf is 8 to 10 years.[58] Some attempt to claim a longer life in order to assert a lower annual cost.[59] Comparative cost figures for artificial turf and natural grass include:

	Artificial Turf	Natural Grass
Source: San Francisco Rec and Parks[60]		
Installation	$800,000	$260,000
Annual Maintenance	$6,000	$42,000
Cost of Disposal	Unknown but significant as a hazardous waste	$0
Average annual cost for guaranteed life of 8 years.	$106,000	$74,500
Average annual cost for life of 10 years	$86,000	$68,000
Average annual cost for life of 15 years (maximum life span seen asserted in the	$59,333	$59,333

[56] Dr. M. Shorten, J.A. Himmelsbach, BioiMechanica, Sports Surfaces and the Risk of Traumatic Brain Injury.

[57] Dr. M. Shorten, J.A. Himmelsbach, BioiMechanica, Sports Surfaces and the Risk of Traumatic Brain Injury. See also K.M. Guskiewica, N.L. Weaver, D.A. Padua, W.E. Garrett Jr., Epidemiology of Concussion in Collegiate and High School Football Players, Sep-Oct 2000 & Does the Use of Artificial Turf Contribute to Head Injuries, The Journal of Trauma-Injury, Infection and Critical Care, Oct 2002 for the finding that artificial turf increases the level of injury in comparison to natural grass fields.

[58] Turfgrass Resource Center, Facts About Artificial Turf and Natural Grass.

[59] San Francisco Recreation & Parks, Natural and Synthetic Turf: A Comparative Analysis, December 20, 2005.

[60] San Francisco Recreation & Parks, Natural and Synthetic Turf: A Comparative Analysis, December 20, 2005.

literature)		
Source: Facts About Artificial Turf and Natural Grass[61]		
Cost of construction and maintenance per sq. ft.	$7.80 – $10.75	With high quality soil amendments $6.50 – $7.95 With native soils $2.50 – $5.25
Cost of disposal per sq. ft.	$1.75 - $2.25	$0
Springfield College case study installation and maintenance average annual cost during 8 year guaranteed life of artificial turf – no disposal costs included	$105,000 ($800,000 install & annual maintenance of $5,000) For a 10 year life the figure is $85,000; for 15 years it is $58,377	$78,000 ($400,000 install & $28,000 annual maintenance) For a 10 year life the figure is $68,000; for 15 years it is $54,666
Source: A Guide to Synthetic and Natural Turfgrass for Sports Fields.[62]		
Cost of installation per square foot	$7.80 to $10.75	$2.50 to $5.25 if done with native soils $3.50 to $5.25 if done with combination of native soils and sand. $6.50 to $7.95 if done with sand and drainage
Annual Maintenance	$5,000 to $25,000	$4,000 to $11,000 as per the case studies provided
Disposal per square foot – note this cost does not include the cost of transportation or landfill	$1.75 to $2.25	$0

[61] Turfgrass Resource Center, Facts About Artificial Turf and Natural Grass.

[62] SportsTurf Managers Association, A Guide to Synthetic and natural Turfgrass for Sports Fields, Selection, Construction and Maintenance Considerations. While the cost figures in this document focus on the southeast, the figures provide a sound comparative for the relative cost figures provided.

surcharges for environmentally controlled products		

Artificial turf made from rubber contains a number of hazardous substances. As a result disposal is neither easy nor cheap. It is important to identify and consider the cost of disposal when considering an investment in artificial turf. The life expectancy of artificial turf generally ranges from 8 to 10 years[63] – therefore disposal of artificial turf should be amortized over this time frame.

Miscellaneous:

Artificial Turf is available for use immediately upon installation. Natural Turf generally requires 2 growing seasons before it should be heavily used.[64]

One of the biggest supporting assertions for artificial turf is the increased level of playing time it provides. While natural grass may not equal artificial turf in playing time, natural soil and grass science has progressed significantly, greatly increasing its durability for sports. Modern natural grass sports fields include sand in their soil profile to resist compaction and a combination of grass varieties. Natural grass is becoming the preferred surface for a number of professional sports teams.

Natural grass fields require regular maintenance including, mowing and watering, and may also result in the use of fertilizers and potentially herbicides. But there are less environmentally harmful alternatives available for maintenance including electric mowing equipment and environmentally sensitive lawn care strategies that do not rely on environmentally harmful chemicals. A number of schools, including Radnor Township, Delaware County, PA, have successful policies that prevent the use of dangerous chemicals on school grounds.

Artificial turf also requires regular maintenance. Artificial turf maintenance includes sweeping, dragging and watering to provide a clean and uniform appearance.[65] In addition, as the result of wear, the infill may need periodic replenishment. [66] Management of an artificial turf field requires special knowledge inseam repair and snow removal. [67] Special solvents and cleansers are needed to remove tough debris. [68]

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[63] Turfgrass Resource Center, Facts About Artificial Turf and Natural Grass.
[64] Communication with Nancy Bosold, Extension Educator, Turfgrass Management, Penn Stat Cooperative Extension, Berks County, Aug 15, 2007.
[65] SportsTurf Managers Association, A Guide to Synthetic and natural Turfgrass for Sports Fields, Selection, Construction and Maintenance Considerations.
[66] SportsTurf Managers Association, A Guide to Synthetic and natural Turfgrass for Sports Fields, Selection, Construction and Maintenance Considerations.
[67] SportsTurf Managers Association, A Guide to Synthetic and natural Turfgrass for Sports Fields, Selection, Construction and Maintenance Considerations.

Artificial turf is at risk of damage from plastic bottles, cigarettes and/or gum as well as general trash thrown on the field. When damaged special repairs may be needed. Artificial turf also becomes a recipient of a variety of bodily fluids which cannot be cleansed by natural action as is the case with natural grass. Maintenance can include application of algaecides and fabric softener to mask the odor of the artificial turf. [69]

Artificial turf systems that claim chemical treatment is not required do not seem to provide a mechanism for handling the germs associated with the bodily fluids on the turf when there is an absence of rain or when it is captured and reused in newly emerging artificial turf cooling systems.

It is important to note that the environmental, health and safety impacts of artificial turf are in need of further study by independent experts. Until such time as there are conclusive findings regarding the environmental, health and safety impacts of artificial turf the Precautionary Principle would direct decisionmakers away from artificial turf and towards the traditional use of natural grass for sports and public play fields.

Updated: February 25, 2008
Dated: September 9, 2007

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[68] SportsTurf Managers Association, A Guide to Synthetic and natural Turfgrass for Sports Fields, Selection, Construction and Maintenance Considerations.
[69] Turfgrass Resource Center, Facts About Artificial Turf and Natural Grass.

Artificial Turf Fact Sheet Temporary Addendum.

Chrysene, a PAH and carcinogen, was found to be ingested as the result of hand-to-surface-to-mouth transfer from playground surfaces made with recycled tires. Assuming playground use for an 11 year period (from age 1 to 12) there was found to be an increased cancer risk of 2.9 in one million (2.9×10^{-6}). This risk is greater than the general cancer risk gauge of one in one million ($1X10^{-6}$).[1] This research would seem to suggest that repeat exposure over time to the chemicals released from artificial turf increases the associated increase in cancer risk.

Only 31% of the playground surfaces made of recycled tires tested in one research study passed the California State mandated Head Impact Criterion (HIC) of $\leq$1,000. In this same study 100% of the playground surfaces made of wood chips passed the same standard.[2]

When talking about the use of ground rubber as a supplement to planting soils the North Carolina Department of Agriculture and Consumer Services sent out a notice identifying the risk that zinc leaching from the rubber causes a decline in plant growth "directly attributable to zinc toxicity."[3]

A Case Study conducted by a group of "physicians and public health professionals working with the U.S. Environmental Protection Agency's Region Pediatric Environmental Health Specialty Unit" found that they could not secure the research and information necessary to establish the safety in use with

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[1] Office of Environmental Health Hazard Assessment, Evaluation of Health Effects of Recycled Waste Tires in Playground and Track Products, January 2007. Note -- the 1.2 in 10 million cancer risk found in the OEHHA study was considered by the authors to be an acceptable level of risk as it falls below the general cancer risk gauge of one in one million ($1X10^{-6}$).

[2] Office of Environmental Health Hazard Assessment, Evaluation of Health Effects of Recycled Waste Tires in Playground and Track Products, January 2007. Please note that in this study 32 recycled tire playground surfaces were tested as compared to only 5 wood chip playground surfaces.

[3] M. Ray Tucker, Agronomist, Ground Rubber: Potential Toxicity to Plants, Media Notes for North Carolina Growers, North Carolina Dept of Agriculture & Consumer Services, April 1997.

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children of tire crumb used as playground surface.[4] "The use of recycled tire crumb products on playgrounds has had little health investigation. The major unresolved concern is the potential for latex allergy with short-term dermal exposure." [5] "No published information is available specifically regarding exposure to crumb rubber constituents from use of the product on playgrounds." [6]

Analyses conducted at the Environmental and Occupational Health Sciences Institute of Rutgers University found the crumb rubber from artificial turf to contain high levels of PAHs, as well as zinc and arsenic.[7] PAHs found to be contained in the crumb rubber "were above the concentration levels that the New York State Department of Environmental Conservation (DEC) considers sufficiently hazardous to public health to require their removal from contaminated soil sites. It is highly likely that all six PAHs are carcinogenic to humans." [8] "The analyses also revealed levels of zinc in both samples that exceed the DEC's tolerable levels." [9] The researchers associated with these findings were careful to state "We want to emphasize that the findings are preliminary. PAHs in rubber might not act the same way as in soil, and we do not yet have information on the ease with which the PAHs in these rubber particles might be absorbed by children or adults -- by ingestion, inhalation, or absorption through the skin. However, the findings are worrisome. Until more is known, it wouldn't be prudent to install the synthetic turf in any more parks." [10]

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[4] M.E. Anderson et al, A Case Study of tire Crumb Use on Playgrounds: Risk Analysis and Communication When Major Clinical Knowledge Gaps Exist, Environmental Health Perspectives, Vol 114, No. 1, January 2006.

[5] M.E. Anderson et al, A Case Study of tire Crumb Use on Playgrounds: Risk Analysis and Communication When Major Clinical Knowledge Gaps Exist, Environmental Health Perspectives, Vol 114, No. 1, January 2006.

[6] M.E. Anderson et al, A Case Study of tire Crumb Use on Playgrounds: Risk Analysis and Communication When Major Clinical Knowledge Gaps Exist, Environmental Health Perspectives, Vol 114, No. 1, January 2006.

[7] Junfeng Zhang, professor and acting chair, Department of Environmental and Occupational Health, the School of Public Health, the University of Medicine and Dentistry of New Jersey and Rutgers University & William Crain, professor of psychology at The City College of New York, president of Citizens for a Green Riverside Park, Hazardous Chemicals in Synthetic Turf, 2006, analyses conducted at at the Environmental and Occupational Health Sciences Institute of Rutgers.

[8] Junfeng Zhang, professor and acting chair, Department of Environmental and Occupational Health, the School of Public Health, the University of Medicine and Dentistry of New Jersey and Rutgers University & William Crain, professor of psychology at The City College of New York, president of Citizens for a Green Riverside Park, Hazardous Chemicals in Synthetic Turf, 2006, analyses conducted at at the Environmental and Occupational Health Sciences Institute of Rutgers.

[9] Junfeng Zhang, professor and acting chair, Department of Environmental and Occupational Health, the School of Public Health, the University of Medicine and Dentistry of New Jersey and Rutgers University & William Crain, professor of psychology at The City College of New York, president of Citizens for a Green Riverside Park, Hazardous Chemicals in Synthetic Turf, 2006, analyses conducted at at the Environmental and Occupational Health Sciences Institute of Rutgers.

[10] Junfeng Zhang, professor and acting chair, Department of Environmental and Occupational Health, the School of Public Health, the University of Medicine and Dentistry of New Jersey and Rutgers University & William Crain, professor of psychology at The City College of New York, president of Citizens for a Green Riverside Park, Hazardous Chemicals in Synthetic Turf, 2006, analyses conducted at at the Environmental and Occupational Health Sciences Institute of Rutgers.

Connecticut is currently considering legislation to provide $250,000 of funding for a study into the toxicity of artificial turf athletic fields.[11]

One Norwegian assessment/presentationconcluded that while indoor artificial turf fields were not generally an elevated health risk, studies to date could not eliminate the concerns associated with development of airway allergies and made a point of noting "a link between exposure to phthalates and the development of asthma/allergies".[12] Phthalates is one of the contaminants of concern found in artificial turf crumb rubber.[13]

The Norwegian assessment/presentation also reported that "recycled rubber was the major source of potentially hazardous substances. An exposure scenario where the runoff from a football field is drained to a small creek showed a positive risk of toxic effects on biota in the water phase and in the sediment. The risk was mainly attributed to zinc, but also for octylphenol the predicted environmental concentrations exceeded the no environmental effect concentration."[14] The hazardous leaching could result in local environmental effect.[15]

Of interest – William Carin, OpEd, NY Times, ***Turf Wars***, September 16, 2007.

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[11] *An Act Concerning a Study of the Toxicity of Artificial Turf Athletic Fields*, Raised Bill No. 361, February Session 2008.

[12] Dr. Christine Bjorge, Norwegian Institute of Public Health, Artificial turf Pitches – an assessment of the health risks for football players and the environment, Presentation at the ISSS Technical meeting 2006, Dresden.

[13] KEM, Swedish Chemicals Agency, Facts: Synthetic Turf, April 2007.

[14] Dr. Christine Bjorge, Norwegian Institute of Public Health, Artificial turf Pitches – an assessment of the health risks for football players and the environment, Presentation at the ISSS Technical meeting 2006, Dresden.

[15] Dr. Christine Bjorge, Norwegian Institute of Public Health, Artificial turf Pitches – an assessment of the health risks for football players and the environment, Presentation at the ISSS Technical meeting 2006, Dresden.

PUBLIC SUBMISSION

As of: 5/3/16 6:19 PM
Received: May 02, 2016
Status: Posted
Posted: May 02, 2016
Tracking No. 1k0-8pe9-f189
Comments Due: May 02, 2016
Submission Type: Web

Docket: ATSDR-2016-0002
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ

Comment On: ATSDR-2016-0002-0003
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill ATSDR-2016-0002

Document: ATSDR-2016-0002-0046
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ Comment on FR Doc # 2016-03305

Submitter Information

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General Comment

California Safe Schools, a children's environmental health and environmental justice coalition would like to comment on Docket No. ATSDR-2016-0002, which proposes two studies that will investigate the chemical composition, and use of crumb rubber infill in synthetic turf, including the potential for exposure, and links between tire crumb rubber exposure and human health.

We respectfully request that the study consider including research to determine when chemicals in tire crumb rubber may be released under various environmental conditions. We also would like the studies to identify, and examine the exposure pathways and health risks these potential releases may pose to athletes and other individuals who come in contact with tire crumb rubber playing, working, or participating in events on these fields and play areas.
To date, existing research and information on tire crumb rubber has been incomplete and based largely on an unsupported theory that there is limited exposure. We are requesting that these two studies please consider an analysis of all health and environmental risks from tires, tire crumb rubber, and their various proposed uses which include, but may not be limited to: athletic fields, playgrounds, play mats, gardens, driveways, sidewalks, and pathways.
We would like the studies to please include detailed accounts of athletes, parents, soccer coaches and other individuals regarding their personal experience and health effects that they

believe were directly related to interacting with tire crumb rubber.

Examples include, but are not limited to: allergic reactions such as asthma, nasal, eye, ear and throat irritation when swallowing the material, rashes related to the off gassing and dust generated from the materials disintegrating, various cancers, hormonal and neurological disorders, and burns sustained when temperatures on the fields rise, often exceeding 140 degrees on hot days.

We request the two studies be full, comprehensive, and that they address new questions and concerns, tackle the gaps in research, and include the synergistic and cumulative impacts to health.

Because of the tire shredding process into crumb rubber, there are unique mixtures of tire crumb at each field, and the tires are manufactured throughout the world. As a result, the unique cumulative impacts and synergistic effects of exposures are especially important to both human health and the environment.

California has discovered more than thirty hazardous chemicals in tire crumb rubber. Of particular concern is carbon black, a substance that has been classified as a cancer-causing chemical by the state. Other tire ingredients can include but are not limited to; arsenic, cadmium, chromium, mercury and dangerous hydrocarbons.

Studies have also found that crumb rubber can emit gases that can be inhaled. Athletes, children, and other individuals playing on these fields and areas where tire crumb rubber are installed or used are often exposed to these materials for years.
According to one parent whose child has played for more than a decade, parents and coaches are urged to bring sterilized tweezers to the games played on fields with tire crumb rubber in order to physically remove tire crumb pellets from abrasions.
The tire crumb rubber exposure is not only on the fields where it enters their clothing, shoes socks, hair, ears, eyes, nose, ears mouth and often ingested. Leaving the fields, it remains in their clothing, in the seats and floors of vehicles transporting the individuals to and from the fields, and in their showers.
Given all of the above, we hope that there will be a moratorium placed on installing any new fields with tire crumb rubber, and exposure to already installed fields with tire crumb rubber should require posting advising individuals of the known chemicals in tire crumb rubber.
We urge you to discourage the continued funding for installation of tire crumb rubber fields while the studies are being conducted. Many of these proposed fields are being placed in environmental justice communities who already have a disproportionate amount of environmental concerns. These communities in particular, deserve a Right to Know about the materials being used and chemicals they are being exposed when playing.

We ask that you consider epidemiology studies, and include studying particulates from tire crumb rubber released in the air, water, and soil.

Our children and athletes should not be treated as lab rats or guinea pigs and we cannot forget that tires are considered to be too toxic to be placed landfills, yet continue to be used in areas where athletes and children play.

Thank you for this opportunity to comment.

Respectfully,

Robina Suwol
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Attachments

MAY 1 FINAL CALIFORNIA SAFE SCHOOLS COMMENTS TIRE CRUMB STUDY

May 1, 2016

May 1, 2016

Docket No. ATSDR-2016-0002

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PUBLIC SUBMISSION

As of: 5/3/16 6:20 PM
Received: May 02, 2016
Status: Posted
Posted: May 02, 2016
Tracking No. 1k0-8pe9-yfcg
Comments Due: May 02, 2016
Submission Type: Web

Docket: ATSDR-2016-0002
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ

Comment On: ATSDR-2016-0002-0003
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill ATSDR-2016-0002

Document: ATSDR-2016-0002-0047
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ Comment on FR Doc # 2016-03305

Submitter Information

Name: Nicholas Baker
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General Comment

Collections Related to Synthetic Turf Fields with Crumb Rubber Infill
Docket # ATSDR-2016-0002

Thank you. I appreciate the ability to comment. For more than a decade our government has permitted tire waste, a material that is considered to be so toxic that it'
not allowed in landfills, to be shredded and placed on athletic fields, kids play areas, gardens, driveways and other
recreational areas.

We know from numerous credible studies, that tires contain carbon black, benzene, arsenic, mercury, hydrocarbons,
and heavy metals, that have been linked to cancer. We know when people are playing sports on these fields, it's common
for these materials to be swallowed, caught in ears, nose, clothing, hair, under skin, and in floor or seats of cars, showers,
tubs, etc.

Tire crumb and it's by products are harmful to our environment, water. soil, and our eco-system. Anecdotal evidence of

hundreds of individuals who have played on fields using this material, who have died or become seriously ill should be enough
to stop the use of these materials once and for all. If your studies will move this toxic material out of areas where harm
can occur, then please let's move forward quickly. In the meantime, stopping any further fields from using this material should
be mandated .

Sincerely,

Nicholas Baker

PUBLIC SUBMISSION

As of: 5/3/16 6:24 PM
Received: May 01, 2016
Status: Posted
Posted: May 02, 2016
Tracking No. 1k0-8pdw-u7hh
Comments Due: May 02, 2016
Submission Type: Web

Docket: ATSDR-2016-0002
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ

Comment On: ATSDR-2016-0002-0003
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill ATSDR-2016-0002

Document: ATSDR-2016-0002-0052
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ Comment on FR Doc # 2016-03305

Submitter Information

Name: Steven Gilbert
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General Comment

My very you young 3-4 year old granddaughters plays soccer or at least kicks the ball around - How do you intend ti keep her from eating the crumb rubber ? She is very curious about thus black stuff and naturally wants to taste it.

also a few other questions

Why is the CPSC not already testing and regulating this material as a children's product given the pervasive and targeted use for children's play areas? (See recent reports from Duluth MN on tire crumb playgrounds as examples of what is going on all over).
Will the study be looking at combinations of personal exposures low to the surface directly with tire crumb on under active use?
Why are they not studying child exposure on tire crumb playgrounds? Why are they leaving it to the CPSC to (maybe) do?
How will the study, as planned, help answer the question, "Are synthetic turf fields and playgrounds with crumb rubber infill safe for children of all ages to play on?"
What are the plan and the timeline for gathering all of the data to answer the above safety question to a reasonable degree of certainty?
How do the agencies plan to obtain toxicity data that would be needed for a components based health risk assessment model?

Do they plan on conducting toxicity testing for all the components for which toxicity data is currently missing? Where will they get the data for interaction effects? Do the agencies plan on testing the toxicity of crumb rubber as a whole?
Why isn't an epidemiological study the first priority? Are there plans for one? If so, when will it be done?
What about the effects of small rubber particles on the eco-system? Are there plans to study the effects of run-off on marine life?

why not use the precautionary principle - test before it is used with kids ?

PUBLIC SUBMISSION

As of: 5/3/16 6:35 PM
Received: May 02, 2016
Status: Posted
Posted: May 03, 2016
Tracking No. 1k0-8pem-rune
Comments Due: May 02, 2016
Submission Type: Web

Docket: ATSDR-2016-0002
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ

Comment On: ATSDR-2016-0002-0003
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill ATSDR-2016-0002

Document: ATSDR-2016-0002-0069
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ Comment on FR Doc # 2016-03305

Submitter Information

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General Comment

See attached file(s)

Attachments

ME comment re federal review of AT

MONTGOMERY COUNTY COUNCIL
ROCKVILLE, MARYLAND

Comment on "Collections Related to Synthetic Turf Fields with Crumb Rubber Infill"

From: Montgomery County, Maryland Councilmember Marc Elrich (At-large)

Date: May 2, 2016

As an elected official, I have been confronted with the issue of whether artificial turf playing fields are safe and whether public funds should be used to construct and maintain these fields. I represent the almost one million residents of Montgomery County, Maryland; our county is one of the wealthiest and best-educated counties in the country. My staff and I have grappled with questions surrounding artificial turf for years, and the more we have examined the issue, the more we realize how little is known and how few questions can be adequately answered.

I appreciate the attempt by the federal agencies to tackle this issue, and on behalf of many of my constituents and based on years of reviewing research and conversations with scientists, parks managers, school administrators, elected officials, residents and other concerned individuals, I make the following comments, observations and requests. I have five major points and then follow them with additional information to support those points.

1. Clarify that the questions and goals outlined in this study will not answer the question of the true safety/toxicity of AT with tire crumb infill. Characterizing chemical composition and "exposure potential" are insufficient tools. This study will not satisfactorily answer the question: are artificial turf fields safe for children to use over the long-term? An epidemiological study is necessary. Only a long-term controlled epidemiological study could provide meaningful answers about human safety. University of Washington soccer coach Amy Griffin continues to collect names of soccer players, other athletes and other frequent users of artificial turf fields (like marching band participants). This information raises serious concern, and the federal agencies need to consider how they can collect information that could analyze actual uses and outcomes.

2. Any and all toxicity studies must address and examine cumulative and combined effects of toxic chemicals. Artificial turf contains a variety of chemicals that interact with each other and in the body. Without studying their synergistic effects, the study will exclude some important considerations. (See below for scientific comment on this issue.)

3. All potential health impacts should be viewed specifically and separately for children. Studies should examine exposure for **children.** "Environmental exposure for children is quite different. They take in much more of everything than adults. Their brains and nervous systems are developing quite rapidly – referred to as **"unique windows of vulnerability."** (Joel Forman, MD, Mt. Sinai Medical School, Program Director of the Pediatric Residency

Program, Children's Environmental Health Center) Towards that end, I urge you to consult extensively with Dr. Forman, Dr. Phillip Landrigan and other researchers associated with the Childrens Environmental Health Center at Mt. Sinai Medical School.

4. For a federal study to be useful to local jurisdictions and residents, it must acknowledge and address the myriad of issues and concerns that are inextricably intertwined. The chemical composition of crumb rubber infill is an important issue, but it is not the only issue. The blades, carpet, carpet backing and the color of the blades are all integral to any meaningful assessment. Other issues should be examined and acknowledged: the heat impact for the field users as well as serious environmental concerns, including the "heat island" effect and impacts on waterways, aquatic life and wildlife.

5. Every step of the way, the involved federal agencies must be mindful of their possible biases. I would refer you to the EPA website announcing this study: "Limited studies have not shown an elevated health risk from playing on fields with tire crumb, but the existing studies do not comprehensively evaluate the concerns about health risks from exposure to tire crumb." (https://www.epa.gov/chemical-research/federal-research-action-plan-recycled-tire-crumb-used-playing-fields) Such a statement is misleading and should be deleted. Results from "limited studies" have been mixed. If "limited studies" refers to EPA's prior studies, it should be noted that they were not simply limited but also quite possibly flawed, and therefore, not an appropriate basis for any general statements. (http://www.peer.org/news/news-releases/epa-retracts-synthetic-turf-safety-assurances.html)

Additional information and commentary:

Regarding points 1 and 2 above:

How we think about levels of concern of chemicals is changing and evolving.

A recently published scientific paper, "What Can Epidemiological Studies Tell Us about the Impact of Chemical Mixtures on Human Health?" explains:

> "Although there is growing concern that exposure to chemical mixtures during critical periods of human development could increase the risk of adverse health effects including allergic diseases, cancer, neurodevelopmental disorders, reproductive disorders, and respiratory diseases, researchers primarily study chemicals as if exposure occurs individually. This one-chemical-at-a-time approach has left us with insufficient knowledge about the human health effects of exposure to chemical mixtures." [Emphasis added.] http://ehp.niehs.nih.gov/15-10569/

Another study from 2015 suggests that the **combination** of "safe" chemicals may increase cancer risk:

> "Our analysis suggests that the cumulative effects of individual (non-carcinogenic) chemicals acting on different pathways, and a variety of related systems, organs, tissues and cells could plausibly conspire to produce carcinogenic synergies." [Emphasis added.] http://carcin.oxfordjournals.org/content/36/Suppl_1/S254.full?sid=db47f5ec-47a2-4879-bf30-6da9c076003d#ref-8

In commenting on the above study, the director of the National Institute of Environmental Health Sciences, Linda Birnbaum (who was not involved in the study), said "….We live in a chemical soup,…Considering the safety of individual chemicals is a lot like looking at the trees, but missing the forest, Birnbaum said. When doing research to determine chemical safety, "we've got to start thinking more about what reality is," she said. This could mean sweeping changes in rules about the levels of chemicals considered safe in drinking water, food, and air. **I'd like to see regulators and policy makers start looking at the totality of the exposure instead of one chemical at a time," she said.** [Emphasis added.] ("Combinations of 'safe' chemicals may increase cancer risk, study suggests," *Los Angeles Times*, by Sasha Harris-Lovett, 7/1/15 http://www.latimes.com/science/sciencenow/la-sci-sn-chemical-combinations-safety-cancer-20150626-story.html)

While the 2015 report is important and significant, this general idea and information is not new. As the President's Cancer Panel pointed out in its 2008-2009 annual report, federal environmental laws not only leave many known carcinogens completely unregulated, they also "fail to address the potential hazards of being exposed to combinations of chemicals". [Emphasis added] (Environmental Working Group, http://www.ewg.org/research/rethinking-carcinogens/executive-summary)

The true impact of chemical exposure could take decades to be measured.
A telling example is a study of 9,300 daughters born to mothers who had been exposed to the pesticide DDT, which was banned in 1972 because of its effects on the environment, especially the eggs of the bald eagle. EPA labeled DDT as a probable carcinogen, and multiple studies linked DDT exposure to breast cancer, but then a 2014 meta-analysis found no significant association. But then this mother-daughter study showed that the prior studies were looking at the wrong generation – the daughters of women exposed to DDT - were associated with almost a fourfold increase in breast cancer, independent of the mother's history of breast cancer. The study, which covered a span of 54 years, also determined that those with higher levels of exposure were diagnosed with more advanced breast cancer. The study results are dramatic, but they took ***54 years***. ("Startling link between pregnant mother's exposure to DDT and daughter's risk of breast cancer," by Ariana Eunjung Cha, *The Washington Post*, 6/17/15 https://www.washingtonpost.com/news/to-your-health/wp/2015/06/16/ddts-breast-cancer-legacy-pregnant-mothers-exposure-linked-to-four-fold-increase-in-daughters-risk/ and http://press.endocrine.org/doi/10.1210/jc.2015-1841)

You will not have "safety" answers in 2016 or one or two years later. Please acknowledge this fact and address epidemiological questions.

Further points to consider:

Federal agencies should not reference "prior studies" without including and acknowledging the following studies, which raise serious concern about artificial turf. One study raises the possibility of inhalable lead.

> The study states "…if the lead is present to any appreciable extent in the wipes it will likely be present in the breathing zone of players who are active on these fields, and that furthermore, these levels potentially exceed ambient EPA standards. ("An Evaluation of

Potential Exposures to Lead and Other Metals as the Result of Aerosolized Particulate Matter from Artificial Turf Playing Fields Submitted to:Alan Stern, Dr.P.H. New Jersey Department of Environmental ProtectionSubmitted by: Stuart L. Shalat, Sc.D. (July 14, 2011) http://www.nj.gov/dep/dsr/publications/artificial-turf-report.pdf) Note that many facilities would not allow testing.

Other studies have raised serious concerns about tire crumb and lead exposure.
A 2014 study found lead and other toxins in the both the plastic rug and tire crumb infill. Lead was also was found in simulated body fluids meaning there is little or no protection of any kind against the lead getting out of the material into the body. "Since it is possible that children may be exposed to potentially high concentrations of lead while using artificial turf fields we recommend, at a minimum, all infill and fibers should be certified for low or no lead content prior to purchase and installation."
("Bio-accessibility and Risk of Exposure to Metals and SVOCs in Artificial Turf Field Fill Materials and Fibers" Brian T. Pavilonis, Clifford P. Weisel, Brian Buckley, and Paul J. Lioy http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4038666/pdf/nihms565643.pdf 2014)

No two fields are alike because each field contains 30,000 to 40,000 ground up tires, which come from a multitude of manufacturers.

> **"Every turf field has to be analyzed in detail to be sure it doesn't have a problem,'** said Paul Lioy, a professor of environmental and occupational medicine at the Robert Wood Johnson Medical School in New Jersey." [Emphasis added.] ("Feds promote artificial turf as safe despite health concerns," by Thomas Frank *USA Today*, 3/16/2015 http://www.usatoday.com/story/news/2015/03/15/artificial-turf-health-safety-studies/24727111/)
>
> "Not surprisingly, the shredded tires contain a veritable witch's brew of toxic substances," Gaboury Benoit, Ph.D., Yale Professor of Environmental Chemistry and Engineering. ("Study: Artificial turf contains carcinogens," by Tony Spinelli, 7/3/15 http://www.theridgefieldpress.com/48210/study-artificial-turf-contains-carcinogens/#ixzz47WNF1FSf)

Additionally, the information required from field managers around the country is time-intensive as outlined in the Federal Register, and the attempt to reach a maximum of 40 fields nationally is insufficient. So the time required from the individuals is large and the amount of information collected will not be much more than anecdotal.

The fields heat is a health hazard. It is hotter than asphalt and much hotter than grass.
At the Women's World Cup in Edmonton, Canada, in June 2015, the air temperature was 75 degrees, and **"the heat from the carpet approaching 120 degrees at kickoff**…Research, partly funded by the city of Las Vegas, found artificial turf above 122 degrees is considered unsafe for sustained athletic use and that, **depending on the air temperature, turf can get as hot as 180 degrees**…This was a temperature where if you put your hand down on it, you could only hold it for five seconds or so before it would burn," Dale Devitt, director of the Center for Urban Water Conservation at the University of Nevada Las Vegas told the Vegas Sun. [Emphasis added.]

("The artificial turf at the Women's World Cup was reportedly 120 degrees at kick off," by Marissa Payne, *The Washington Post*, 6/6/2015 http://www.washingtonpost.com/news/early-lead/wp/2015/06/06/the-artificial-turf-at-the-womens-world-cup-was-reportedly-120-degrees-at-kick-off/)

Environmental impacts of artificial turf should also be noted.

Artificial turf fields create "heat islands" – an environmental hazard.

The extreme heat "is not only a hazard for users, but also can contribute to the 'heat island effect,' in which cities become hotter than surrounding areas because of heat absorbed by dark man-made surfaces such as roofs and asphalt." ("Synthetic Turf: Health Debate Takes Root" by Luz Claudio, Environmental Health Perspectives 2008 March; 116(3): A116–A122. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2265067/

"Columbia University climate researcher Stuart Gaffin analyzed thermal images generated from NASA satellite maps of New York City. He wanted to figure out how urban trees may help cool down neighborhoods. When **Gaffin noticed a bunch of hot spots on the maps, he assumed they were rooftops**…two turned out to be turf fields" says Gaffin. In retrospect, he says he should have realized that, because they're a perfect sunlight-absorbing system." ("High Temps On Turf Fields Spark Safety Concerns," by Allison Aubrey, National Public Radio, 8/7/2008 http://www.npr.org/templates/story/story.php?storyId=93364750)

Artificial turf appears to contribute to elevated levels of zinc in the water.

"There is a potential risk to surface waters and aquatic organisms associated with whole effluent and zinc toxicity of stormwater runoff from AT fields." ("Artificial Turf Study, Leachate and Stormwater Characteristics," July 2010 Conn. Department of Environmental Protection

"Crumb rubber derived entirely from truck tires may have an impact on aquatic life due to the release of zinc. For the other three types of crumb rubber, aquatic toxicity was found to be unlikely." Pg. 2

"Zinc concentrations are higher than the surface water standards." Pg. 29

("An Assessment of Chemical Leaching, Releases to Air and Temperature at Crumb-rubber Infilled Synthetic Turf Fields" May 2009 from staff at NY State Department of Environmental Conservation)

Plastic artificial turf blades will likely disintegrate and degrade with some ending up in bodies of water and in the food of wildlife either directly or via landfills; plastics of various sizes are already threatening aquatic life. The impacts of larger sized plastics is more widely known, but now more is being discovered about the serious effects of microplastics. ("Ingested microscopic plastic translocates to the circulatory system of the mussel, Mytilus edulis (L)." by Browne MA1, Dissanayake A, Galloway TS, Lowe DM, Thompson RC, *Environmental Science & Technology*, 7/1/2008 http://www.ncbi.nlm.nih.gov/pubmed/18678044) "As plastic breaks into smaller pieces, it is more likely to infiltrate food webs. In laboratory and field studies, fish, invertebrates and microorganisms ingest micrometer-sized particles…" ("Classify plastic waste

as hazardous," by Chelsea M. Rochman, Mark Anthony Browne, Eunha Hoh, Hrissi K. Karapanagioti, Lorena M. Rios- Mendoza, Hideshige Takada, Swee Teh, Richard C. Thompson. *Nature*, 2/14/13.)

Confusion over focus of the undertaking:
While the official federal register announcement does not mention playgrounds, the EPA's website explaining this study refers to "this coordinated Federal Research Action Plan on Recycled Tire Crumb Used on Playing Fields and Playgrounds…" (https://www.epa.gov/chemical-research/federal-research-recycled-tire-crumbs-used-playing-fields) It would be better to included playgrounds, especially since children are particularly vulnerable to toxic chemicals, but at a minimum the information disseminated should be consistent between postings.

Conclusion:
As should be apparent from the above information and comments, my staff, constituents and I have spent numerous hours reviewing these issues. I am deeply concerned that the study as designed will offer the false hope of absolute answers. We may not know for many years the true and complete impacts of artificial turf fields. I have concluded that we should adhere to the precautionary principle and minimize use of artificial turf fields. Instead, we need to focus our research and energy on improving natural grass fields, which already can be designed to withstand heavy rains and avoid rain-outs. Increasing knowledge and experience is helping expand the usage of these fields. The public focus should be on the best practices that give the greatest use of natural grass fields with the least amount of fertilizers, pesticides and water.

PUBLIC SUBMISSION

As of: 5/3/16 6:39 PM
Received: May 02, 2016
Status: Posted
Posted: May 03, 2016
Tracking No. 1k0-8peo-o930
Comments Due: May 02, 2016
Submission Type: Web

Docket: ATSDR-2016-0002
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ

Comment On: ATSDR-2016-0002-0003
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill ATSDR-2016-0002

Document: ATSDR-2016-0002-0074
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ Comment on FR Doc # 2016-03305

Submitter Information

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General Comment

Attached are my comments regarding Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ
FR Doc # 2016-03305

Thank you for your consideration.

Jean B Barish, Esq., MS

Attachments

FR Doc # 2016-03305

JEAN B BARISH, Esq., MS
jeanbbarish@hotmail.com
212-249-5060

May 2, 2016

Leroy A. Richardson
Information Collection Review Office
Centers for Disease Control and Prevention
1600 Clifton Road NE, MSD-74
Atlanta, GA 30329

Re: Docket No. 2016-03305

Dear Mr. Richardson:

Thank you for this opportunity to comment on the proposed Federal research on the toxicity of synthetic turf athletic fields with rubber tire crumb infill. I have worked as a research scientist, a consumer advocate, and an attorney specializing in health care law. I am also affiliated with several environmental organizations that have been concerned about this issue. One of these organizations, *Action for Nature*, recognized Claire Dworsky as an AFN Eco-Hero for her study on the toxicity impact of synthetic turf with rubber tire crumb. (http://actionfornature.org/2011_winners.aspx; http://www.scgh.com/featured/success-stories/4th-graders-research-reveals-dangers-of-artificial-turf/nggallery/image/image-463)

Rubber tires are a complex blend of materials and chemicals, many of which are carcinogenic, neurotoxic, eye and throat irritants, and toxic to many organ systems. These chemicals include but are not limited to polynuclear aromatic hydrocarbons (PAHs); phthalates; volatile organic compounds (VOCs); heavy metals including lead, zinc, iron, manganese, and mercury; nanoparticles such as carbon black; and dioxin. Additionally, a great deal of dust and particulate matter, including nanoparticles, are created during play on an artificial turf field. All of this harmful material can enter the body by inhalation, ingestion, dermal contact and eye contact. Other health and safety concerns include sports injuries; infections from methicillin-resistant Staphylococcus aureus (MRSA); overheating of the fields; and; disposal problems. Finally, the use of artificial turf with rubber tire crumb also raises environmental concerns.

Many cities and school districts have chosen not to install turf with rubber tire crumb after considering the health and environmental risks. For example, the City of New York Parks and Recreation and Department has not used rubber tire crumb infill since 2008. And in 2009 the Los Angeles Unified School District served manufacturers of artificial turf with Proposition 65 Notices claiming that artificial turf with SBR infill contains unacceptable levels of lead and carbon black. LAUSD no longer uses turf with rubber tire crumb. Several school districts in Sonoma County in Norther California have also decided not to use rubber tire crumb infill, and the San Francisco Recreation and Parks Department is planning to replace worn out fields with safer, organic infill. These are just a few examples of schools and municipalities throughout the country that no longer use synthetic turf with rubber tire crumb.

In view of the growing concern about the health and environmental hazards of these fields, your research should be done rigorously and thoroughly. To assure the studies will provide meaningful information, please consider the following recommendations:

Study Recommendations

It is important that samples of rubber tire crumb are taken from an adequate number of fields throughout the country. There are many variables that must be considered to assure adequate sampling, including but not limited to the following: age of the fields; weather conditions to which the fields are exposed such as temperature, humidity, precipitation; use of the fields; age of the fields; source of the tire crumb; location on the field from which the samples are taken. Rubber tire crumb comes from a huge variety of tires that have been manufactured all over the world. This lack of homogeneity of the rubber tire crumb must be accounted for in your research.

Numerous studies have identified several categories of chemicals found in rubber tire crumb, including but not limited to: polyaromatic hydrocarbons; phthalates; dioxins; semivolatile compounds; nitrosamines, and; heavy metals. These should all be measured.

Rubber tires contain nanotubules. These should be measured.

There is also off-gassing of volatile compounds on synthetic turf fields, as well as the dispersal of particulates into the air. These volatiles and particulates should also be measured on indoor and outdoor fields under various ambient and play conditions when the fields are in use.

There is growing concern about the health risks of exposure to nanoparticles and carbon black. These particles are able to cross biological membranes such as the blood-brain barrier and access cells, tissues and organs. The risk of exposure to nanoparticles and carbon black should be studied. (Nanoparticles – known and unknown health risks. Peter HM Hoet, Irene Brüske-Hohlfeld and Oleg V Salata. *Journal of Nanobiotechnology* 20042:12. http://jnanobiotechnology.biomedcentral.com/articles/10.1186/1477-3155-2-12). See also: "Understanding the mechanism of toxicity of carbon nanoparticles in humans in the new millennium: A systemic review," Mukesh Sharma. *Indian Journal of Occupational and Environmental Medicine,* vol. 14(1), 2010, web publication June 24, 2010, abstract available at http://www.ijoem.com/article.asp?issn=0019-5278;year=2010;volume=14;issue=1;spage=3;epage=5;aulast=Sharma ; Peter Gehr "Nanoparticles can penetrate brain tissue," on the website of the Federal Office for the Environment (FOEN) (also BAFU in German), March 2010, available at http://www.bafu.admin.ch/dokumentation/umwelt/10649/10659/index.html?lang=en ; "Toxic Potential of Materials at the Nanolevel," Mädler,and Ning Li, *Science*, 3 February 2006: 622- 627, abstract at http://www.sciencemag.org/cgi/content/abstract/311/5761/622.

In addition to surveying field representatives to determine facility use and characteristics, please survey players, coaches, and spectators. This will provide more reliable information regarding field uses and conditions.

In addition to air monitoring, dermal sampling, and urinalysis, mucous membranes such as the oral cavity, nasal passages, and conjunctiva of players should also be sampled. Dermal sampling should include all exposed areas of the body, including the face and scalp.

Exposure characterization should also include contact with clothing and shoes, and the impact that has on the spread of material off-site. This is especially important since many people report that rubber tire crumb is tracked into cars and homes, and that players' clothing is covered with black dust after a game.

The risk of increased skin, muscular and joint injury caused by synthetic turf versus natural turf should be studied.

All impact studies should account for demographic variations in users of the fields, including age, gender, and race.

One of the adverse health impacts of artificial turf fields is related to the fact that the fields get much hotter than natural grass fields. Synthetic surface undesirably absorbs, retains and emanates heat at temperatures and rates that can be dangerous. (https://www.pitchcare.com/magazine/concerns-over-heat-stress-on-3g-surfaces.html) The health hazards of playing on these hot fields should be studied.

Analysis of the health hazards of rubber tire crumb must also analyze the cumulative risk of exposure to the synthetic turf with rubber tire crumb, defined in the US EPA document "Framework for Cumulative Risk Assessment" as "the combined risks from aggregate exposure (i.e., including all relevant routes) to multiple agents or stressors." (U.S. EPA 2003. Framework for Cumulative Risk Assessment. PA/630/P-02/001A. Washington, DC)

Please review the Material Safety Data Sheets (MSDS) for the manufacturer of rubber tire crumb and evaluate these for information about health and safety hazards.

In addition to an analysis of the constituents of rubber tire crumb and exposure levels, the synthetic turf fibers also contain chemicals of concern, including but not limited to phthalates, quaternary ammonium bocides, BPA, acetone, elastomers, and heavy metals. A chemical analysis of a representative sample of turf fibers should be done.

Other Considerations

The following comments are also submitted for your consideration:

Epidemiological Studies

There is a growing data base of soccer players exposed to fields with rubber tire crumb that have developed cancer. Notably, there is a disproportionate number of young people lymphomas in this population. (http://www.ehhi.org/turf/cancer_patterns_1114.shtml) Epidemiological research is necessary to more accurately assess the health impacts of playing on artificial fields with rubber tire crumb. This research should study the incidence of cancer, as well as allergies, asthma and other respiratory disorders, gastrointestinal disorders, autoimmune diseases, neurological conditions, skin conditions, and the like. There is already a great deal of information about the components of rubber tire crumb. Epidemiological research is the next step that should be taken to determine whether exposure to these toxins on the playing field increases the risk of cancer and other health problems.

The testing your agency proposes will never capture what is really going in the real life exposures of a generation of young people. A national agency such as NCI or CDC has the resources to do the necessary epidemiological research. It should begin as soon as possible in order to protect a the young people who are now playing on these fields.

Animal Studies

Several experts I have spoken to have recommended that your research includes animal studies in order to better assess exposure risks. Please include animal studies in this project or explain why you do not plan to include it.

Environmental Impacts

Rubber tire crumb can also impact the environment, especially if the field is built above an aquifer. Chemicals from rubber tire crumb can leach into this underlying aquifer, as well as spill into waste water, poisoning drinking water and impacting aquatic life. Additionally, synthetic turf fields with rubber tire crumb can impact the ecosystems where they are installed. Accordingly, please address the following issues in your research:

Include consideration of the impact of these fields on rainwater and other waters that flow through the turf that will pick up particulates that could then enter the public water system or adjoining waterways.

Include consideration of the impact of these fields on all animal species in the surrounding ecosystems.

Disposal

The environmental impact of disposal of the fields and the rubber tire crumb infill should also be studied. It is important to understand the regulatory control of the disposal of these fields. Do they end up in landfills? Can they be recycled? What is the impact of the particulates on the environment when they must be removed at the end of their lifespan or the repurposing of the fields?

Precautionary Principle

The Precautionary Principle stands for the proposition that when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. (http://unesdoc.unesco.org/images/0013/001395/139578e.pdf) Much has been written about the Precautionary Principle, but in its simplest terms it means that there is a social responsibility to protect the public from exposure to harm when scientific investigation has found a plausible risk. These protections can be relaxed only if further scientific findings emerge that provide sound evidence that no harm will result.

You are encouraged to apply the Precautionary Principle in analyzing the data from your studies.

Thank you for your consideration of these comments.

Sincerely,

Jean B Barish, Esq., MS

PUBLIC SUBMISSION

As of: 5/3/16 6:42 PM
Received: May 02, 2016
Status: Posted
Posted: May 03, 2016
Tracking No. 1k0-8per-nvit
Comments Due: May 02, 2016
Submission Type: Web

Docket: ATSDR-2016-0002
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ

Comment On: ATSDR-2016-0002-0003
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill ATSDR-2016-0002

Document: ATSDR-2016-0002-0077
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ Comment on FR Doc # 2016-03305

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General Comment

See attached file(s)

Attachments

Comments on ASTDR 2016-0002

Comments on ASTDR 2016-0002-0003

Federal Research Action Plan on

Recycled Tire Crumbs Used on Playing Fields and Playgrounds

Submitted to Federal Register May 2, 2016

Washington Alliance for Non-Toxic Play and Athletic Fields

The overarching public health question surrounding crumb rubber is, "Is crumb rubber safe to use on play fields and playgrounds?" Not only has it been established that the carcinogens and other toxicants from crumb rubber off-gas into the air, but research has also proven that they leach into water and simulated body fluids as well (1) (2) (3) (4) (5) (6). Coach Amy Griffin has already compiled a self-reported list of hundreds of athletes whose cancers may be related to crumb rubber exposure (7), and millions of children and young adults are currently exposed to crumb rubber on a daily basis. Therefore, a timely, accurate, and reliable estimate of the risks associated with crumb rubber exposure is of utmost importance.

Given the current state of relevant toxicity data, the planned exposure study is insufficient to provide reliable, timely estimates of the health risks associated with the use of crumb rubber. In the April 14, 2016 webinar for this study, one of the presenters stated that study researchers intended to combine exposure data from the federal study with existing toxicology data to predict health risks and make recommendations. There are no toxicity studies on crumb rubber as a complete mixture. Further, even if EPA guidelines didn't clearly state that component-based methods were useless for estimating the toxicity of complex mixtures, the toxicity information on the components of crumb rubber is too incomplete to be usable (8). For example, the recent EHHI/Yale study identified 96 chemicals in crumb rubber, almost half of which had not undergone any government toxicity testing (9). Until there is a reliable, scientifically defensible estimate of the carcinogenicity of crumb rubber, there can be no reliable health risk assessment.

It is not even clear that an estimate of the carcinogenicity of crumb rubber is technically feasible because crumb rubber is not a standardized product. It is a waste product. The chemical composition of the waste stream used to produce it is highly heterogeneous, may contain chemical hot spots, and may change at any time in significant and unpredictable ways with no notice, ever.

Predicting the health risks posed by crumb rubber is a formidable challenge. However, measuring any harm already caused should be relatively straightforward.

Prior formal studies on crumb rubber have provided the scientific basis to ascertain not only that crumb rubber may cause cancer, but also predict what types of cancer it would be likely to cause on the basis of its chemical components. However, it is the list of athletes who have contracted cancer compiled by Coach Amy Griffin that gives research on the safety of crumb rubber urgency. Crumb rubber has only

been commonly used in playgrounds and playfields for about 15 years, but there is already a self-reported list of hundreds of suspected cancer cases in young people. The list is remarkable not only for the age of the cancer patients, but also for how quickly cancers related to crumb rubber exposure seem to be appearing. Cancer is typically slow to develop, often only appearing decades after exposure. Further, parents have been repeatedly reassured that any carcinogens in crumb rubber are present at minute doses that pose virtually no risk. If cancers are appearing in unexpectedly large numbers now, then either exposures are much higher than believed or crumb rubber may be a potent carcinogen and the long-term cancer risk may be far greater than originally thought.

Amy Griffin's List

While the list of athletes diagnosed with cancer collected by Coach Amy Griffin does not constitute an epidemiologic study, what the list reveals is as instructive as it is frightening. The distribution of cancers by type on the list does not reflect the distribution in the general population for individuals aged 5-29. There is an excess rate of leukemia, lymphoma, and lung cancer relative to thyroid, brain, and testicular cancer on the list. Further, the risk may be concentrated in certain areas or with certain teams.

If a self-reported cancer list is just the product of public fears, then the reported cancers should display a distribution that reflects the distribution of cancer in the underlying population. A failure to display this pattern either reflects a significant reporting bias or an underlying difference in cancer rates in the reference population, or both. Standard population cancer incidence rates are easily available from the SEER dataset as shown in Table 1 below (10).

Table 1. Age-Specific SEER Incidence Rates By Cancer Site, All Ages, All Races, Both Sexes, 2004-2013

Cancer Site Age at Diagnosis

	5-9	10-14	15-19	20-24	25-29
Leukemia	4.18	3.22	3.08	2.66	2.74
Lymphoma	1.50	2.52	4.82	6.89	7.54
Thyroid	0.15	0.65	2.36	5.24	9.25
Brain and Other Nervous System	3.41	2.61	2.20	2.26	2.82
Lung and Bronchus	--	0.05	0.12	0.32	0.60
Testis*	0.04	0.11	1.88	5.13	7.20

Rates are per 100,000 persons. *Rates for testicular cancer are for 100,000 persons assuming 50,000 males.

An age 5-29 age adjusted cancer rate for each of the cancers can be calculated using the standard 2000 US population distribution (not shown) from the SEER database. The age adjusted cancer rates are shown in Table 2.

At last report, the individuals on Amy's list range in age from 5 to 29 years and were diagnosed at least as far back as 2007. The list contains data through March of 2016, so it covers at least 9.25 years (11). The numbers included in Table 2 only include individuals that self-reported as playing soccer. Sixteen cases of sarcomas and 9 cases of other rare cancers in soccer players are not included in Table 2. Sarcomas were not included in the list because the SEER database breaks down cancers by site, not

type. Fifty-four individuals that only reported playing sports other than soccer are on Amy's list but are not included in Table 2.

While the numbers on Amy Griffin's list do not represent the cases for a defined population, they could be assumed to do so for purposes of illustration. Assume the actual cancer cases in Table 2 represent cases from a defined population of unknown size x. If it is assumed that the rate of thyroid cancer in the theoretical population is the same as the rate in the U.S. population, then the size of the theoretical population can be calculated as 12*100,000/(3.37*9.25)= 38,548 individuals. Given a population of 38,548 individuals at risk for 9.25 years, it is possible to calculate the expected number of cases for each of the other cancers on Amy's list. Then the ratio of actual to expected cases can be calculated. As can be seen in Table 2, the number of leukemia, lymphoma and lung cancer cases are elevated relative to thyroid, brain and testicular cancer.

Table 2. Expected Number of Cancer Cases Versus Actual Number on Amy Griffin's List

	Age-adjusted incidence in 5-29 year olds	Expected number of cases	Actual number of soccer players	Ratio Actual to Expected Cases
Leukemia	3.19	11.39	41	3.60
Lymphoma	4.55	16.21	64	3.95
Thyroid	3.37	12	12	1
Brain and Other Nervous System	2.66	9.49	11	1.16
Lung and Bronchus	0.21	0.74	4	5.41
Testis	2.73	9.73	9	0.92

The incidence of lymphoma cases in soccer goalkeepers in Washington State was investigated based on Amy Griffin's list. Washington was selected because the author and Ms. Griffin live in Washington and a significant percentage of the names on the list are from Washington. Goalkeepers were examined because of their elevated exposure and high rates of appearance on the list. Lymphoma was examined because many of the carcinogens in crumb rubber are believed to cause blood cancers and because of the number of lymphoma cases on the list as a whole.

Based on private communications with Amy Griffin, her list includes 7 goalkeepers from Washington State, aged 12-24 who were diagnosed with lymphoma between 2008 and 2015. By estimating the number of goalkeepers in this age group, it is possible to estimate incidence.

There are approximately 1,552 boys and girls high school soccer teams in Washington State. Per Amy Griffin, approximately an additional 10% of high school age soccer players play on select teams instead of high school teams. This yields a total estimate of 1,707 teams of high school age players, and an estimated 3,414 14-17 year old goalkeepers. Assuming goalkeepers are spread equally over the age range, this yields 854 goalkeepers per age, or 4,268 goalkeepers per 5 year age spread. Although athletes may stop playing after graduation from high school, their exposure during their youth can never be erased. Thus, they remain in the risk pool. Additionally, goalkeeper is such a specialized position that it is highly unlikely that a player who was not a goalkeeper in high school would become one after

high school. Thus, once a cohort completes high school, the number of people in that cohort who are exposed to crumb rubber while playing goalkeeper should remain stable over time.

Estimating the number of goalkeepers in the 12-13 age range is difficult. There are likely more 12-13 year old children playing soccer, but 12-13 year olds are less likely to be set in the position they play at that age. Therefore, to provide a conservative estimate, it is assumed that there are twice as many goalkeepers per age for 12-13 year olds as there are for 14-24 year olds. The estimate of the at-risk population is a back of the envelope estimate, and there are additional unstated assumptions in play. However, it provides a useful, reasonably conservative, estimate of the at-risk population.

Based on the estimated numbers of goalkeepers and age-specific rates for lymphoma for individuals aged 10-14, 15-19, and 20-24 years, there should have been approximately 5.6 lymphomas in goalkeepers between the ages of 12 and 24 in Washington between 2007 and 2015. There are 8 on Amy's list, approximately 43% more than expected. It is a disturbing finding given that Amy's list is entirely self-reported and should only represent a fraction of the actual number of cases. This provides support to the theory that soccer players are at an elevated risk of leukemia, lymphoma, and lung cancer and the proportions of cancers on Amy's list are due to elevated risks of certain cancers in soccer players and not reporting bias.

Amy Griffin testified before the Washington State House Environment Committee on January 26, 2016 that her list contained five different groups of two or more players with cancer from the same team (7). Thus, at least 5% of the names on Amy Griffin's list come from mini clusters. Some clustering of cancer cases will occur by random chance, but the proportion of the cases on Amy's list that come from individual teams is clearly excessive. Either players from teams with multiple cases are more likely to self-report, or something is placing players on certain teams at elevated risk, or both. Given the concerns about crumb rubber, it is entirely possible that players on teams with high levels of exposure to crumb rubber, either due to extended seasons, or practicing on indoor fields, are at elevated risk. It is also possible that certain fields pose much higher risk than other fields.

The data on Amy's list raise grave concerns. Many of these concerns can be answered by a thorough epidemiologic study. Fortunately, the necessary data exist, and the CDC has epidemiologists that are fully capable of doing the type of research that is necessary to protect the health of our children.

Epidemiology

It should be fairly straightforward to design an epidemiologic study that would at least be able to determine if soccer players, or goalkeepers in particular, are at an elevated risk of developing certain cancers such as Hodgkin's lymphoma or lung cancer.

For example, epidemiologists could model the incidence of selected specific cancers for all athletes who played NCAA soccer between 2000 and 2013.

Cancer registries are already in place. The NCAA should have a list of all college athletes complete with basic demographic data as well as information on sports and positions played. Hopefully, the NCAA will be willing to cooperate in the name of public health and athlete health. While there are always concerns about privacy, the NCAA would not necessarily need to reveal any information that isn't

already publicly available. Further, cooperation in a government study designed to protect athlete health could be portrayed as positive and proactive. Failure to cooperate could be publicly portrayed as a sign that the association has something to hide or that it does not put the well-being of its student athletes first.

If the NCAA is unwilling to cooperate, it is likely that the necessary information will be available from big data brokers. Failing that, there are always sites such as TopDrawerSoccer.com that display the name, college, home town, and position of 69,802 college soccer players in the US right now (12). Sites such as this likely have archives of data from previous years as well.

Without a measure of athlete exposure to crumb rubber, a comparison of cancer incidence rates in soccer players to rates in the general population can underestimate the risks associated with crumb rubber. When soccer players are mixed together in the same data set with nothing to indicate exposure level, the resulting risk estimate is a function of both the risk associated with exposure to crumb rubber and the average level of exposure. However, the average level of exposure remains unknown, and if it is assumed that all practices and games are spent on artificial turf, then the risk associated with crumb rubber will be greatly underestimated.

However, adding proxy measures of exposure could improve estimates of any increased cancer risk associated with exposure to crumb rubber and provide an estimate of any potential dose response. NCAA data should include both the location of the athletes' colleges and their home towns or high schools. The average high temperatures in the summer and fall months might be one proxy measure of exposure since the outgassing of toxic chemicals increases exponentially with temperature.

Adding annual US crumb rubber market penetration data to the model would increase the precision of the model. Obviously, if exposure to crumb rubber causes cancer, then cancer rates should increase as market penetration increases and as the number of years athletes are exposed to it increases. College athletes in 2005 were exposed to crumb rubber for a relatively short period of time and a much smaller percentage were exposed. College athletes in 2013 may have played on it for 13 years, and a relatively large percentage probably played on it since high school.

Adding annual market penetration to the model for each athlete's home town/ home state would increase the precision of the model. Adding in the type of field present at each athlete's college or annual market penetration of crumb rubber in each athlete's college town / state would also increase the precision of the model.

Although the EPA no longer participates in the Scrap Tire Workgroup, it may have historical market penetration data. Otherwise, the Synthetic Turf Council, or major turf retailors such as FieldTurf, may have the data. Since this study has explicitly stated that it will include representatives from the synthetic turf industry in this research, it is only reasonable to expect basic cooperation from the stakeholders. If the STC or major retailors choose not to cooperate with an investigation on the safety of crumb rubber, partial, if not complete, data may be available elsewhere. For example, states that have given subsidies for the construction of synthetic turf fields and may have market data for their state. (A failure of the synthetic turf industry to cooperate with the study could be interpreted as a tacit admission that the industry believes that there are significant health risks associated with crumb rubber use. This could provide further justification for an immediate moratorium on the use of crumb rubber.)

A multivariate regression model with proxy variables and other basic explanatory variables such as age, gender, and position, as well as all necessary interaction terms could be created. Determination of the exact type of statistical model to be used should obviously be left up to biostatisticians / epidemiologists who regularly model cancer epidemiological data. A list of the types of cancer to investigate can be compiled from the list of cancer cases maintained by Coach Amy Griffin, and by consultation with toxicologists on the cancers expected from the carcinogens in crumb rubber. In addition, the Washington State Department of Health is validating the Washington State cancer cases on Amy's list and expects to publish some descriptive statistics concerning the list in the summer of 2016 (13). The DOH plans to determine if the cases represented on Amy's list represent an excessive rate of cancer cases among soccer players / goalkeepers in Washington (14). However, there is no plan to independently identify other cases of cancer in soccer players in Washington.

The main weakness of an epidemiologic study is that it has no ability to predict long-term effects. Crumb rubber has been widely used for around 15 years. The full effects of a carcinogen on human health typically take 30-50 years to appear. If the epidemiologic studies do not reveal any current cancer excesses, animal experimentation could help rule out any long-term risks. However animal experimentation is expensive, time-consuming, and should be avoided whenever possible for ethical reasons. If there is a current excess of cancer cases, then crumb rubber is unsafe and should not be used. Animal studies would not be necessary to determine whether or not to ban it.

Specific Comments on Exposure Study Design

Bioavailability

Any bioavailability studies should mimic real world exposure scenarios, including using realistic particle sizes and exposure periods as much as possible. Thus, gastric studies should include crumb rubber dust as well as crumbs. While some children engage in pica, and soccer goalies get crumbs in their mouths when diving for balls, much of the oral exposure of children is via hand to mouth behavior. Thus, children are ingesting dust, not tire shreds or crumbs. Toxins on particles 10 to 250 micrometers in diameter are likely to be much more bioavailable than toxins encased in shreds half an inch in length. The Kim study examined the effects of particle size on the bioavailability of lead in EPDM based on acid extraction and simulated digestive fluid extraction (15). The study found that lead was more than five times more bioavailable in particles less than 250 microns in diameter than it was in larger particles.

The bioavailability of toxins in 1-2 mm diameter crumbs in simulated lung fluid is not biologically relevant because humans are breathing in airborne particles, not large crumbs (4). Further, the smaller particles, those just a few microns in diameter, can pass through the lung tissue, into the bloodstream, and from there into various organs and tissues. At that point, the bioavailability of the toxicants in blood or tissue becomes relevant. Similarly, the estimated bioavailability of PAHs on PM 2.5 that are estimated to stay in the lungs for 3 months is very different than the estimated bioavailability of PAHs on a 1 mm crumb that is estimated to stay in the lungs for 24 hours.

Collection Procedures

Samples of crumb rubber should not be washed as washing removes the smaller dust particles.

Samples of new crumb rubber should be taken from the top, middle and the bottom of the bag because of granular convection, also known as the 'Brazil-nut effect." Different sized crumbs will have different surface areas relative to their mass. Hence the toxicants contained in them will have different levels of bioaccessibility. Different sizes of crumb rubber particles may also be chemically different. A tire is not composed of a uniform piece of rubber. Different portions of the tire have different formulations, some of which may be more likely to crumble than others. Different tire parts have been exposed to different microenvironments containing different contaminants. This affects how the rubber ages and breaks down. The outer layer of the tread that was most exposed to roadway contaminants could be the most brittle and likely to crumble into dust. Conversely, inner layers of rubber that were more protected from the elements and contaminants may remain as larger crumbs. Washing the dust off of the crumbs could mean washing away relevant contaminants from the sample.

Similarly, when collecting crumb rubber samples from fields and playgrounds, care must be taken to collect the dust and respirable particulate matter as well. Care must be taken not to re-suspend particulate matter that has settled from the air. Sweeping samples into a collector risks loss of dust and settled particulates. Vacuuming up the crumb may be the best way of capturing all of the crumb rubber in a given area. It is important to know all of what is actually on the fields, not just what is in the large crumbs on the fields.

Legislation or administrative action compelling institutions that receive federal funding, such as most public schools, to participate upon request should be considered. In 2011, Dr. Stuart Shalat noted that only 5 of the 50 schools and towns he contacted gave him permission to test their fields due to liability concerns (16). That was before Coach Amy Griffin's list of athletes who have developed cancer started raising public concern. Field owners might be much less cooperative today. Given previous difficulties in obtaining permissions to test fields, collecting 40 samples from fields, stratified by field type, age and census region may mean contacting hundreds of towns or schools. Alternatively, it might help to publicize the school districts and cities that refuse to allow their fields to be tested. At the same time, a policy of not releasing any individual results, unless hazardous levels of a toxicant are identified (such as lead > 400 ppm in crumbs), could shield participants from unintended negative consequences. Thus, those who refuse to help look like they have something to hide or like they aren't concerned about the health of their field users, while those that participate get to look like they are taking steps to protect public health.

All air monitoring should include personal air monitoring of VOCs, SVOCs, PM 2.5, and carbon black. Proper off-field, up wind controls should be taken concurrently. On-field sampling should be done during actual games, scrimmages or practices. Referees may wear the monitoring equipment if it is not feasible to have players wear monitors. Stationary monitors on the side of the field do little to reveal what players on the field are exposed to due to atmospheric mixing and the settling of dusts. Players actively churn the crumb re-suspending dust and PM 2.5, and opening up pockets of trapped gasses (16).

Measurements of PM 2.5 and carbon black from personal air monitors would be new information. Personal air monitors have been used for VOCs and SVOCs but not PM 2.5 (17). Even though carbon

black constitutes roughly 30% of crumb rubber, no measurements of ambient carbon black levels at synthetic turf fields in the U.S. using any type of monitor were located. The estimates of airborne carbon black from crumb rubber typically come from a study of indoor turf fields conducted in Norway (18).

Estimating exposures goal keepers receive, especially during practice diving drills may be difficult. It may not be safe for either the player or the equipment for goal keepers to dive into the turf while wearing the monitors. It may be more practical to have engineers study films of goalies diving after balls, and then design ways to mimic the spray of crumbs and dust particles they receive each time they dive into the turf.

It is encouraging that the CDC, CPSC and EPA are examining the toxic exposures that children and athletes receive when using playgrounds and athletic fields that use artificial turf. However, given the number of citizens that are exposed to crumb rubber on a daily basis, and the evidence that crumb rubber is already responsible for excess cancer cases in the country's youth, a more aggressive research program, including a large epidemiological study, is needed.

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PUBLIC SUBMISSION

As of: 5/3/16 6:43 PM
Received: May 02, 2016
Status: Posted
Posted: May 03, 2016
Tracking No. 1k0-8per-o6x7
Comments Due: May 02, 2016
Submission Type: Web

Docket: ATSDR-2016-0002
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ

Comment On: ATSDR-2016-0002-0003
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill ATSDR-2016-0002

Document: ATSDR-2016-0002-0079
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ Comment on FR Doc # 2016-03305

Submitter Information

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General Comment

Dear Federal Agencies:

I am a concerned parent with a background in environmental law and a lacrosse player and coach. Because of my education, I understand and appreciate the dangers inherent with repeated exposure to toxins. Since I am a coach and player, I have also spent many hours on tire crumb fields. I have witnessed how children are exposed to the fine particulate. After reading all the available literature, my wife and I concluded the risks far outweigh any benefits of using fields with tire crumb. Regardless of your final conclusions, it is clear that tire crumb is beyond our capacity to thoroughly investigate - as I will discuss below. So we will never let our three young children play on tire crumb. A generation of young Americans relies on you for similar protection.

Later this year, when the federal government issue its preliminary statement regarding the safety of tire crumb on synthetic turf fields, the most important messages to communicate to concerned parents are: 1) Tire Crumb is a "Moving Target" - tire manufacturers frequently change tire ingredients. So any formal study conclusion only speaks to existing fields. Any field installed after a study, or any field not studies, may contain chemicals that were not examined in past studies - including any federal study. So for all the millions of dollars of resources the federal government is about to spend on this study, any conclusions can only speak to actual

fields that were studied. A study can only be backwards looking by its very nature since there can be zero confidence that manufacturers will not change tire ingredients. This must be clearly communicated. 2) Compound based risk assessment can only be done on chemicals and compounds that have regulatory risk frameworks. Tire crumb contains numerous chemicals and compounds with no regulatory risk frameworks. Therefore, any formal study will necessarily contain significant data gaps. 3) Given that tire crumb contains multiple chemicals and compounds with no risk frameworks, epidemiological studies and animal studies are the only available methods of study to overcome this intrinsic problem. If there are no significant epidemiological studies undertaken or planned, this must be communicated. If there are no animal studies planned, this must be communicated.

If the three points of focus above were communicated clearly and prominently, it would help educated field users to truly understand that sometimes, a problem is beyond our ability and present capacity to accurately make predictions or draw conclusions regarding safely. If the federal government was realistic in this endeavor, it would recognize this from the very start. And given what we know about the multiple carcinogens, mutagens and reprotoxins in this material, the government should conclude from the start that tire crumb is simply too risky to use in such close proximity to children.

Sweden Concluded that Tires should Not be Used

Such a position would not be novel or unprecedented. The Swedish agency tasked with reviewing tire crumb on synthetic fields recommended that tires should not be used as material on synthetic turf fields for exactly these reasons. Sweden wisely concluded that given the complexity and the inherent unknowns regarding tire crumb use on turf fields, they simply should not be used.

"Tyres contain substances of very high concern

Tyres contain several substances that are substances of very high concern. These substances maypersist in the environment, they may be bioaccumulative, carcinogenic, reprotoxic, or mutagenic. This is true of, for example, polycyclic aromatic hydrocarbons (PAHs), phthalates and certain metals. These substances should not be released into the environment and thus waste tyres should not be used for synthetic turf surfaces.

KemI's Recommendations:

Do not select synthetic turf that contains substances of very high concern when laying new surfaces
Material that contains substances of very high concern should not be used, as specified by the environmental objectives of the Swedish parliament. This means that granulate formed from recycled rubber should not be used when laying new surfaces of synthetic turf. The Norwegian authorities have issued a similar recommendation."

http://www.wellesleyma.gov/pages/WellesleyMA_SpragueResources/Swedish%20Study.doc

In addition to Sweden and Norway, whole countries that have recommended that tires not be used on turf fields, municipalities like as New York City have has banned tire crumb since 2009 for their schools and parks.

Similarly in 2009, the L.A. Unified School district has banned tire crumb. The list grows larger by the week. In early 2015, Montgomery County, Maryland's most populous, banned tire crumb by a unanimous vote of the council.

Please honor the precautionary principal and recommend a complete ban on the use of tire crumb on turf fields and playgrounds. See attached for full comments.

Regards,

Jonathan Damm

Attachments

Comments on ASTDR 2016-0002 by Jonathan Damm

Comments on ASTDR 2016-0002-0003

Federal Research Action Plan on

Recycled Tire Crumbs Used on Playing Fields and Playgrounds

Submitted to Federal Register May 2, 2016

By Jonathan R. Damm

Dear Federal Agencies:

I am a concerned parent with a background in environmental law and a lacrosse player and coach. Because of my education, I understand and appreciate the dangers inherent with repeated exposure to toxins. Since I am a coach and player, I have also spent many hours on tire crumb fields. I have witnessed how children are exposed to the fine particulate. After reading all the available literature, my wife and I concluded the risks far outweigh any benefits of using fields with tire crumb. Regardless of your final conclusions, it is clear that tire crumb is beyond our capacity to thoroughly investigate – as I will discuss below. So we will never let our three young children play on tire crumb. **A generation of young Americans relies on you for similar protection.**

Later this year, when the federal government issue its preliminary statement regarding the safety of tire crumb on synthetic turf fields, the most important messages to communicate to concerned parents are: 1) Tire Crumb is a "**Moving Target**" – tire manufacturers frequently change tire ingredients. So any formal study conclusion only speaks to existing fields. Any field installed after a study, or any field not studies, may contain chemicals that were not examined in past studies – including any federal study. So for all the millions of dollars of resources the federal government is about to spend on this study, any conclusions can only speak to actual fields that were studied. A study can only be backwards looking by its very nature since there can be zero confidence that manufacturers will not change tire ingredients. This must be clearly communicated. 2) **Compound based risk assessment can only be done on chemicals and compounds that have regulatory risk frameworks. Tire crumb contains numerous chemicals and compounds with no regulatory risk frameworks.** Therefore, any formal study will necessarily contain significant data gaps. 3) Given that tire crumb contains multiple chemicals and compounds with no risk frameworks, epidemiological studies and animal studies are the only available methods of study to overcome this intrinsic problem**. If there are no significant epidemiological studies undertaken or planned, this must be communicated. If there are no animal studies planned, this must be communicated.**

If the three points of focus above were communicated clearly and prominently, it would help educated field users to truly understand that sometimes, a problem is beyond our ability and present capacity to accurately make predictions or draw conclusions regarding safely. If the federal government was realistic in this endeavor, it would recognize this from the very start. And given what we know about the multiple carcinogens, mutagens and reprotoxins in this material, the government should

conclude from the start that tire crumb is simply too risky to use in such close proximity to children. The following links provide examples of chemicals of concern in tire crumb.
http://www.albany.edu/ihe/Synthetic_Turf_Chemicals.php
http://www.ncbi.nlm.nih.gov/m/pubmed/22352997/
http://www.ehhi.org/turf/new_study_jun2015.shtml http://southlakesturf.org/wp-content/uploads/2015/02/Pg-31.jpg
http://southlakesturf.org/wp-content/uploads/2015/02/Attachment-1-Crumb-Rubber-Chemicals.pdf

Sweden Concluded that Tires should Not be Used

Such a position would not be novel or unprecedented. The Swedish agency tasked with reviewing tire crumb on synthetic fields recommended that tires should not be used as material on synthetic turf fields for exactly these reasons. Sweden wisely concluded that given the complexity and the inherent unknowns regarding tire crumb use on turf fields, they simply should not be used.

> ***Tyres contain substances of very high concern***
> Tyres contain several substances that are substances of very high concern. These substances maypersist in the environment, they may be **bioaccumulative, carcinogenic, reprotoxic, or mutagenic.** This is true of, for example, polycyclic aromatic hydrocarbons (PAHs), phthalates and certain metals. These substances should not be released into the environment and thus waste tyres should not be used for synthetic turf surfaces.
>
> ***Keml's Recommendations:***
> ***Do not select synthetic turf that contains substances of very high concern when laying new surfaces***
> Material that contains substances of very high concern should not be used, as specified by the environmental objectives of the Swedish parliament. This means that granulate formed from recycled rubber should not be used when laying new surfaces of synthetic turf. **The Norwegian authorities have issued a similar recommendation.**
> **http://www.wellesleyma.gov/pages/WellesleyMA_SpragueResources/Swedish%20Study.doc**

In addition to Sweden and Norway, whole countries that have recommended that tires not be used on turf fields, municipalities like as New York City have has banned tire crumb since 2009 for their schools and parks. http://www.nydailynews.com/new-york/city-yields-ground-crumb-rubber-turf-wars-article-1.389543
Similarly in 2009, the L.A. Unified School district has banned tire crumb.
http://usatoday30.usatoday.com/sports/2009-06-10-artificial-turf_N.htm
The list grows larger by the week. In early 2015, Montgomery County, Maryland's most populous, banned tire crumb by a unanimous vote of the council.
http://www.mymcmedia.org/councilmember-berliner-applauds-council-turning-the-page-

on-artificial-turf/ Recently, the city of Hartford, CT banned Tire Crumb as well. http://ctmirror.org/2016/02/12/a-shifting-ground-for-artificial-turf-in-connecticut/

There are many other communities taking similar action. A Google search will provide you with plenty of evidence. Industry lobbyists and representatives will likely tell you that these are just reactionary measures because of sensational headlines of anecdotal news about goalies with cancer. I will discuss the goalies with cancer below. First, Sweden and Norway took their precautionary measures in 2006, well before the news about goalies with cancer in 2014. It was enough for them to understand what is in tire crumb. They didn't need to conduct a generation long experiment to decide if it is safe. They erred on the side of caution, which is a reasonable measure given the multiple chemicals of concern, carcinogens, PAHs, VOCs, phthalates, heavy metals and endocrine disruptors. All these things are in tire crumb. There is no debate about that.

Over the last ten to twenty years, parents have been increasingly aware that they should take reasonable steps to protect their kids from having toxins bioaccumlate in their kids' bodies. So countries and municipalities that are avoiding tire crumb are not simply acting because they are scared, they are taking prudent and reasonable measures to minimize exposure to dangerous toxins. BPA and phthalates are good examples. These chemicals are not banned by EPA and really not heavily regulated as far as I understand.

Exposure

But the science is pretty clear at this point that we should protect children from unnecessary exposure to endocrine disruptors. When developing kids are on a tire crumb field, they often ingest tire crumb. They either ingest actual particles or they ingest micro particles that get mixed into their sweat as it runs over their skin and into their mouth. The attached document from the safe healthy playing fields coalition illustrates how small particles actually are. The picture below is from the attachment. But look at how small the dust is. The larger black spot is a highly magnified piece of tire crumb. The specs are microscopic dust. The picture of the woman illustrates how easily the dust can be transferred from a field to a sweaty person and into their mouth.

They inhale fine tire crumb dust. They inhale VOCs. They absorb chemicals and oils from tire plasticizers either directly through their skin or in open wounds. It gets in their noses. It gets in their eyes. There are multiple exposure routes.

Bioavailability

Based on limited study, industry representatives like to assert that the chemicals in tire crumb are somehow not bioavailable. But there are studies that contradict that. For example, there is a study from South Korea that concludes that lead in EPDM rubber particulate is indeed bioavailable. It should not be any different for metals in particulate and dust like tire crumb. **"Conclusions - Results of this study confirm that the exposure of lead ingestion and risk level increases as the particle size of crumb rubber gets smaller."** http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3278598/

So it is reasonable for parents to take precautions in their daily lives to protect their children from toxins. People wash fruit, they off-gas products, they avoid flame retardants, and they avoid endocrine disruptors and PAHs in their children's products. The list goes on. So when municipalities ban tire crumb, they are simply acting in the same reasonable and cautious way that their populations act every day. **Why would parents want to take reasonable steps to protect their children from harmful toxins in their daily lives, then turn around and expose their kids to all the same chemicals of concern and even worse? It does not make sense to take one step forward and two steps back.**

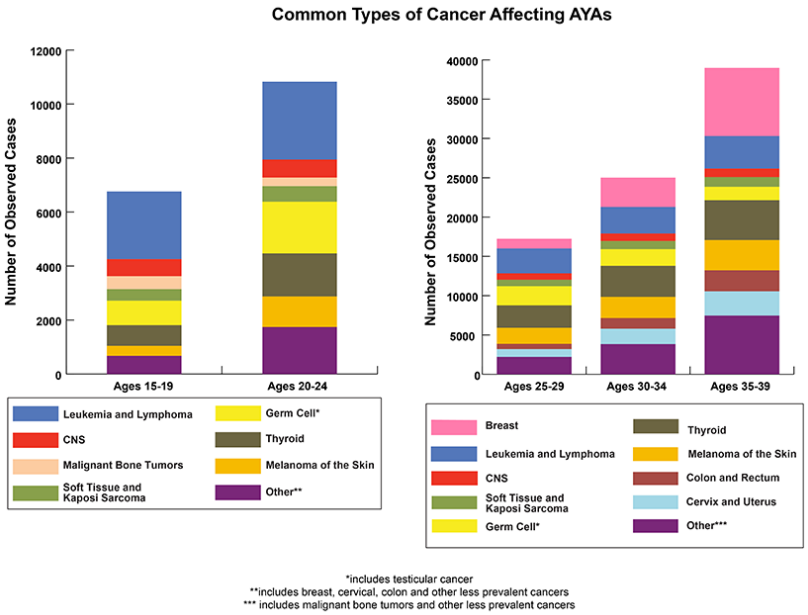
Avoiding tire crumb is not a reactionary measure to sensational news; it is wisdom and common sense. Using tire crumb where kids play is reckless and out of step with a growing population of educated American's approach to toxins around children. It is truly mind boggling that there are individuals in the federal government that consider this even remotely as a good idea.

Every day, we learn how toxins bioacumulate in the body. Folks take careful steps to protect their families. By even pretending that somehow a field full of all the same chemicals of concern could be tolerable under any circumstance is just plainly behind the times. The only reason there has not already been a mass revolt is that there has not been an opportunity to educate the millions of people that need the education. But if the same people who avoid BPA and phthalates in their childrens' products actually learned in detail just how full of toxins their kids' fields are, they would put it all together.

So please don't pretend that somehow different rules apply just because kids are running around an exercising. It is illogical to think that exercising somehow mitigates the harms and risks. If anything, it makes it worse.

Goalies with Cancer – Only 5000 blood Cancers a Year

What about those soccer goalies with cancer? Anything short of a serious statistical analysis would be too bad. It appears that there are only around 5000 blood cancers a year under the age of 24. There are now over 100 goalies on Amy Griffin's list. Most have blood cancers. Given so few kids with blood cancers in a given year, it seems very unlikely that one person would be able to put together a list of so many people with two things in common 1) plays one particular position (goalie), and 2) plays mostly on one particular kind of field (tire crumb). And there are still not that many tire crumb fields nationally – around 12,000. So Amy Griffins list should be taken very seriously.



http://www.cancer.gov/research/progress/snapshots/adolescent-young-adult

Carbon Black

Any investigation must also look closely at carbon black. Carbon black makes up about 1/3 of a tire. That means about 1/3 of a tire crumb field is also carbon black. Carbon black is a known animal carcinogen and a possible human carcinogen. Nanoparticles in carbon black have been theorized to present asbestos like concerns. http://www.turfandrec.com/index.php?option=com_content&task=view&id=2986 If this is not looked at very closely, it would be a monumental oversight. Will the study look closely at carbon black exposure?

Carbon Nanotubes

"**Inhaling carbon nanotubes could be as harmful as breathing in asbestos**, and its use should be regulated lest it lead to the same cancer and breathing problems that prompted a ban on the use of asbestos as insulation in buildings, according a new study

posted online . . . by *Nature Nanotechnology*."
http://www.scientificamerican.com/article/carbon-nanotube-danger/

"[Ti]res enhanced with CNT (carbon nanotubes) appear to have improved mechanical properties, such as tensile strength, tear strength and hardness of the composites, by almost 600%, 250% and 70% respectively, comparing with those of the pure SBR composites (styrene-butadiene rubber)." http://www.iosrjournals.org/iosr-jmce/papers/vol11-issue4/Version-1/B011410711.pdf

This concern with carbon nanotubes goes back to the "Moving Target" concern I discussed in the first page of this document. Tires are waste products that are not designed for use, ingestion, inhalation and absorption by children. Any slew of potentially carcinogenic material could make their way into the next generation of tires, and probably will. This should be unacceptable from the start.

Past studies have been negligent in how they collect data. They underestimate exposure. The 2008 EPA study set up a particle collector and had kids run by periodically. The particle collector was surrounded by a small 3 foot fence. That is not realistic exposure replication. In order to replicate a goalies exposure, you would literally have to kick the tire crumb fly-out into the collector again and again for hours and hours.

Past studies also use simulated body fluids that do not accurately extract all the chemicals in tire crumb. The Yale study found 12 carcinogens. http://www.ehhi.org/turf/findings0815.shtml Industry critics claim that Yale used to harsh an extraction method. But there is no debate that the carcinogens were present. One can make an argument that prior extraction methods based on simulated body fluids were not stringent enough.

I am attaching the written testimony of Dr. Wright from the Mount Sinai Children's Environmental Health Center.

https://dl.dropboxusercontent.com/u/101177270/CEHC%20RB%205139%20Testimony%20Feb%2016%202016.pdf

It says it all. In short:

1. "Given the hazards associated with recycled tire rubber, it is our recommendation that these products never be used as surfaces where children play."
2. "[W]e found significant gaps in the evidence supporting the safety of recycled rubber turf products."
3. "Children are uniquely vulnerable to harmful exposures from recycled rubber surfaces."
4. "In the absence of convincing evidence of safety, we recommend that children not play on recycled rubber surfaces that contain known carcinogens and neurotoxins and support a ban on the use of these products."

I hope the federal government takes the same reasonable position. Even if you do not, a large portion of the population will continue to act prudently and will avoid using fields with tire crumb. You might as well act responsibly and protect those that do not have the fortune to be as educated on the dangers of bioaccumulated toxic exposure.

Heat - 120 degrees

A few comments on heat - I read that the fields would be tested at two temperatures. One would be at room temperature or average outdoor temp. The other would be at a higher temperature to mimic a hot day. I hope you paid attention to the temperatures at the women's soccer world cup. The temperatures of the turf were not just hot, they were astonishingly hot. It was measured at 120 degrees! So please measure it at that temperature. Anything else would be a sham.
https://www.washingtonpost.com/news/early-lead/wp/2015/06/06/the-artificial-turf-at-the-womens-world-cup-was-reportedly-120-degrees-at-kick-off/

Industry MSDS

The Synthetic Turf Council has a MSDS that makes clear there are certain precautions that their installer should take. They include washing frequently, wearing a respirator, and wearing eye protection to name a few (see next page). But importantly, this is the industries own material. How can they be asserting on the one hand that children are safe to play on tire crumb and then at the same time, warning their installers to take very deliberate and thorough measures to protect themselves from tire crumb as they install it?

It is very puzzling to try to understand how this material is safe for players who get the same if not more exposure than installers. Kids who roll in tire crumb, eat tire crumb, drink tire crumb in sweat, inhale tire crumb, absorb tire crumb, and grow up on tire crumb are getting absolutely no warnings like the installers. It is a terrible injustice and wildly hypocritical.

Standard Format MSDS *(continued)*

PRECAUTIONS FOR SAFE HANDLING AND USE	
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED	Sweep up or vacuum into disposal containers
WASTE DISPOSAL METHOD	Product not defined as hazardous waste. Dispose of in accordance with federal, state, and local regulation.
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE	Do not store near flame or ignition source. Do not store hot material in tubs or containers where spontaneous ignition could occur.
OTHER PRECAUTIONS	If material burns, an oily residue will result. This residue must be disposed of in accordance with federal, state and local regulations.
RESPIRATORY PROTECTION (Specify Type)	Use any dust and mist respirator noted for up to 10 mg/m^3.

CONTROL MEASURES	
VENTILATION: Yes	LOCAL EXHAUST: Yes, if dusty conditions occur.
SPECIAL: None	MECHANICAL (General): Dust collector and
PROTECTIVE GLOVES: Recommended	EYE PROTECTION: Use safety goggles to prevent dust entry.
OTHER PROTECTIVE CLOTHING OR EQUIPMENT	Enough fresh air should flow past the user to prevent exposure to airborne fibers and particles.
WORK/HYGENE PRACTICES	Good personal hygiene; frequent washing with soap and water of exposed areas; remove and clean solid clothing.

The information contained in this MSDS is consistent with the U.S. Department of Labor OSHA Form OMB 1218-0072. Consult OSHA Hazard Communication Standard 29 CFR 1910.1200 for additional information. To fully understand the use of any material, the user should avail themselves of reference material and expert consultation in the fields of fire prevention, ventilation and toxicology.

https://www.dropbox.com/s/yvszy6bgtsis39a/STC%20MSDS.pdf?dl=0

Why should kids not receive the same warnings when they get even more exposure than installers? When parents are educated on this seeming hypocrisy, they see right through industry assertions that the material is safe. If you conclude that tire crumb is safe as well, you will have to explain why installers receive special warnings about wearing respirators and washing.

There should be signs on every field that provide the same warnings to parents and players.

These are just some thoughts that hopefully provide some insight as to why you should categorically conclude that tire crumb is too risky to use where children play. Please do the right thing and recommend that there be a moratorium on the use of tire crumb on synthetic turf fields and playgrounds.

Please consider attachments 1 and 2 as a fully incorporated part of this document and part of my formal comments as well.

Regards,

Jonathan R. Damm
Reston, VA 20191
jondamm@yahoo.com
Vermont Law School, JD, MSEL ‘99

Attachment 1

Icahn School of Medicine at Mount Sinai

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Department of Preventive Medicine
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Written Testimony before the Connecticut General Assembly Committee on Children
February 16, 2016

Testimony in Support of:
Raised Bill 5139, An Act Concerning the Use of Recycled Tire Rubber at Municipal and Public School Playgrounds.

To Senator Bartolomeo, Representative Urban, and honorable members of the Committee on Children:

We, the Children's Environmental Health Center of the Icahn School of Medicine at Mount Sinai, strongly support *Raised Bill 5139, An Act Concerning the Use of Recycled Tire Rubber at Municipal and Public School Playgrounds.* **Given the hazards associated with recycled tire rubber, it is our recommendation that these products never be used as surfaces where children play.**

As pediatricians, epidemiologists, and laboratory scientists at the Children's Environmental Health Center of the Icahn School of Medicine at Mount Sinai, which hosts one of 10 nationally funded Pediatric Environmental Health Specialty Units, we have received numerous phone calls from concerned parents and physicians regarding the wide scale use of recycled rubber 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 recycled rubber turf products**. Our findings are summarized below and discussed in detail in the attached documents: "Artificial Turf: A Health-Based Consumer Guide" and "Position Statement on the use of Recycled Tires in Artificial Turf Surfaces".

Children are uniquely vulnerable to harmful exposures from recycled rubber surfaces. Public playgrounds are typically utilized by children age 6 months to 12 years, a population exquisitely vulnerable to the health effects of toxic environmental exposures. This vulnerability is due to a number of factors including, but not limited to, their unique physiology and behaviors, rapidly developing organ systems, and immature detoxification mechanisms[1]. Additionally, because of their young age, children have more future years of life and therefore more time to develop chronic diseases.

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

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We have identified several potential dangers that playing on recycled rubber playing surfaces pose to children. These include:

1. **Extreme heat.** On hot summer days, temperatures of over 160 degrees Fahrenheit have been recorded on recycled rubber play surfaces[2]. 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[3]. In addition, children 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 injury[4].

2. **Inhalation and ingestion of toxic and carcinogenic chemicals.** Children are particularly vulnerable to chemical exposures from playground surfaces due to their developmentally appropriate hand to mouth behaviors. In addition, their close proximity to the ground and higher respiratory rates compared with adults increase the likelihood of inhalational exposures. Thus, there is a potential for toxins to be inhaled, absorbed through the skin and even swallowed by children who play on recycled rubber surfaces.

   The major chemical components of recycled rubber are styrene and butadiene, the principal ingredients of the synthetic rubber used for tires in the United States[5]. Styrene is neurotoxic and reasonably anticipated to be a human carcinogen[6]. Butadiene is a proven human carcinogen that has been shown to

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[2] Devitt, D.A., M.H. Young, M. Baghzouz, and B.M. Bird. 2007. Surface temperature, heat loading and spectral reflectance of artificial turfgrass. Journal of Turfgrass and Sports Surface Science 83:68-82

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

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

[5] Denly *et al* A Review of the Potential Health and Safety Risks from Synthetic Turf Fields Containing Crumb Rubber Infill. May 2008. http://www.nyc.gov/html/doh/downloads/pdf/eode/turf_report_05-08.pdf

[6] ATSDR Toxicological Profile for Styrene, November 2010. http://www.atsdr.cdc.gov/toxprofiles/tp53.pdf.

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cause leukemia and lymphoma[7]. Shredded and crumb rubber also contain lead, cadmium, and other metals known to damage the developing nervous system[8,9]. Some of these metals are included in tires during manufacture, and others picked up by tires as they roll down the nation's streets and highways. Children may also inhale potentially harmful chemicals that have been detected in the air above rubber turf such as benzathiazole and polycyclic aromatic hydrocarbons (PAHs), both of which are linked to cancer[10].

It is important to note that risk of harm due to exposures from recycled rubber turf has been assessed only for single chemicals, yet children are exposed to numerous harmful chemicals in aggregate during play on these surfaces. It is widely recognized that carcinogens and other environmental toxins act in an additive or multiplicative fashion, making risk assessment of the chemical mixtures present in recycled rubber critical for a comprehensive safety assessement[11]. Because tire rubber composition varies by manufacturer, it is impossible to know the full contents of chemicals contained within a recycled rubber playing surface. For a more comprehensive description of the harmful chemicals contained within recycled rubber products, please see the attached Consumer Guide.

4. **Transportation home of rubber pellets.** Recycled rubber materials used in play surfaces break down into smaller pieces over time that may be picked up on children's shoes, clothing and skin. The rubber is then tracked into children's homes and cars, and carried into the places where children live, play, eat and sleep. Thus exposure can continue for many hours beyond the time that a child spends in the play area.

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[7] International Agency for Research on Cancer, 2008. http://monographs.iarc.fr/ENG/Monographs/vol100F/mono100F-26.pdf

[8] Timothy Ciesielski *et al.* Cadmium Exposure and Neurodevelopmental Outcomes in U.S. Children. *Environ Health Perspect*. 2012 May; 120(5): 758–763. 27. doi: 10.1289/ehp.1104152

[9] CDC (2012) Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention. http://www.cdc.gov/nceh/lead/acclpp/final_document_010412.pdf

[10] Connecticut Department of Public Health (2010) Human Health Risk Assessment of Artificial Turf Fields Based Upon Results from Five Fields in Connecticut. http://www.ct.gov/deep/lib/deep/artificialturf/dph_artificial_turf_report.pdf

[11] Goodson WH *et al* 2015. Assessing the carcinogenic potential of low-dose exposures to chemical mixtures in the environment: the challenge ahead. Carcinogenesis 36(Suppl 1):S254–S296.

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5. **Escape of chemical hazards from rubber surfaces to the environment.** A number of the toxic and chemical components of the recycled rubber that is installed on playgrounds 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[12]. In addition, chemicals in turf can be released into the air and inhaled, particularly on hot days.

Disposal of recycled rubber surfaces. A further unresolved issue is what to do with the toxic components of recycled rubber play surfaces 10 years from now when they reach the end of their usable life-span and need to be dismantled. The costly process of separating, reclaiming, reusing, recycling, or disposing of the various components of a turf field are often overlooked at the time of installation. What will disposal cost? Who will pay? Often, these questions have not been factored into the overall cost.

Safe alternatives to recycled rubber playground surfaces exist. Daily outdoor play and physical activity are essential components of a healthy childhood. Thus safe play areas are critical to any school environment. While it is important to minimize playground injuries, the Consumer Product Safety Commission Public Playground Safety Handbook[13] contains several additional safe and affordable alternatives such as wood mulch, which does not carry the same risks of chemical and heat exposure outlined above.

The potential long-term consequences of exposures to synthetic rubber play surfaces have not been carefully assessed by independent third parties prior to their installation throughout the country. For this reason, Senator Richard Blumenthal called upon the federal government to conduct comprehensive studies to verify the safety of recycled rubber for use in areas where children play – including playgrounds[14]. Subsequently, on February 12, 2016, the United States Environmental Protection Agency 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

[12] 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

[13] US Consumer Product Safety Commision. *Public Playground Safety Handbook*. #365, November 2010. https://www.cpsc.gov//PageFiles/122149/325.pdf

[14] http://www.nhregister.com/article/NH/20151106/NEWS/151109637

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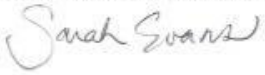
Commission, stating "existing studies do not comprehensively evaluate the concerns about health risks from exposure to tire crumb"[15]. **In the absence of convincing evidence of safety, we recommend that children not play on recycled rubber surfaces that contain known carcinogens and neurotoxins and support a ban on the use of these products.**

We urge your support of HB 5139 in order to protect the health of the children of Connecticut. Thank you for the opportunity to provide you with our professional opinion. We would be more than happy to answer any questions that you might have.

Kind Regards,

Robert Wright, MD, MPH
Director, Mount Sinai Children's Environmental Health Center



Sarah Evans, PhD, MPH
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[15] http://www.epa.gov/sites/production/files/2016-02/documents/us_federal_research_action_plan_tirecrumb_final_0.pdf

Attachment 2

Comments on ASTDR 2016-0002-0003

Federal Research Action Plan on

Recycled Tire Crumbs Used on Playing Fields and Playgrounds

Submitted to Federal Register May 2, 2016

SAFE AND HEALTHY PLAYING FIELDS COALITION www.safehealthyplayingfields.org

A grass roots coalition working for healthier alternatives for children and communities

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INTRODUCTION

On behalf of the millions of children, parents and athletes who play field sports in the US at schools, parks, athletic facilities and playgrounds, thank you for agreeing to study the potential harm caused by playing on or being near athletic fields with surfaces made waste tires. There are more than 12,000 of these playfields in place (15,000 according to the website of a large company that installs them), and they are being installed at a rate we estimate to be about 3000 a year. By our calculations, 12,000 fields currently present 2,380,000 tons or 4,760,000,000 pounds of loose, unencapsulated tire crumb on their field surface. (See our Table of Runoff and Material Volumes attached.) Tens of thousands of students and young athletes play on those fields, many more thousands have direct or indirect contact with the material. It is a public health issue of substantial importance.

The following lists our comments on the proposed study. We argue that the fields present known carcinogenic, pathogenic, and mutagenic material in a high surface area, pulverized form that is more toxic than whole tires, and should never have been allowed near children, or adults, because of risk of ingestion and inhalation exposure to all the ingredients in tires. On warm, sunny days the surface temperature routinely reaches over 150F, which presents direct, well-known heat injury risks to children. The heat increases off-gassing of the tire components, increasing the likelihood of pulmonary

exposures, and creates a complex dynamic in the children's exposure zone immediately above a field that has not been correctly modeled or studied yet. The material lacks uniformity, or any regulatory or exposure controls. We assert that it is impossible to assure even a single tire crumb field is free of inhalation and ingestion risk of dangerous particulate and gases inherent in tires, tire crumb, and add-in composites; and that dangerous and unwanted exposures from lead, benzothiazoles, 12 carcinogens, phthalates, carbon black and other materials, can happen with every use. The data gaps are enormous, and we hope CDC/CPSC/EPA will recognize there is no way the tire crumb industry can protect any player, on any field, from the potential for dangerous exposures with normal use. We argue that not enough scrutiny was placed on this material.

NOTE: The Safe and Healthy Playing Fields Coalition is a grass roots group of scientists, public health professionals, toxicologists, neurobiologist, educators, plastics engineers, medical doctors, waste management and remediation professionals, coaches, researchers, and parents who donate their own time and skills towards helping communities and individuals assess risks to their communities from tire crumb field use. We do not have a lobbying firm, law firm, hired laboratory, consultant, or revenue-generating source (such as tire crumb), and rely solely on the skill of researchers who donate time to compile our comments. That said, we have found compelling data that refutes almost all claims of safety, and when we asked for additional time to compile the information, we were given two weeks, but denied additional time. Hence, we are working at a disadvantage, and hope that during this study year, we will have time and opportunity to substantiate our concerns, and share our research with the study officials. One of our comments below explains our requests for a conference or virtual meeting that allows more disclosure and discussion.

Our comments are listed in numerically and organized into: 1. General Comments, 2. Characterization and methodology comments; 3.Summary List of requests, and a number of supporting documents are also submitted as part of our comments.

PART I: GENERAL COMMENTS:

1. CPSC/CDC/EPA should use their existing authority to immediately reclassify tire crumb athletic fields as a children's product, since thousands of fields have been installed in schools that serve hundreds of thousands of children.

2. We have grave concerns about their safety to human health and the environment, since **known carcinogenic and pathogenic components in the field material yield into both air and water pathways, and provide ample opportunity for both chronic low dose exposures with every use of the field to lead, chromium, mercury, zinc, PAH, VOC, carbon black, styrenes, benzothiazoles, and plastics; and more intermittent, but dangerous high dose exposures from "HOTSPOTS" of component material.** (See comments on Characterization). Each of the fields has material that is known to cause cancer, illnesses, and injury in humans; and leachate from runoff causes several negative impacts on the aquatic ecosystems. We believe that the potential for human illness (including several cancers) from both low dose and high dose exposures to the ingredients in tires is staggering. Basic logic favors our position. Based on the known potential for exposures to children, and the finding of a group of 200 soccer players with cancer (the group represents the reach of a single charismatic soccer coach), an immediate moratorium on new construction of the fields should be put in place with the existing authority of CDC/CPSC/EPA, until the tire crumb fields can be shown to be safe to inhale and ingest.

3. **The tire crumb recycling industry, which appears "green" in its efforts to sell millions of used tires in "repurposed" shredded form, in fact enables a direct transfer of the contamination burden of waste tires from landfills/collection sites (in the US and abroad) to the play surfaces of 12,000 schools and sports centers, where tens of thousands of children and adults have direct contact with the toxins in tire crumb materials on the field surface, and *these exposures could happen with every single contac*t.**

4. For the most part, the **schools and sports centers do not have resources to conduct toxicity due diligence;** meaning, they do not have access to a toxicologist who reads the industry studies with their health as the only priority. Purchasers rely on the tire crumb recycling industry statements, industry studies, and industry funded websites that claim toxicology assessment and public health guidance. The sales material can be striking, and the studies appear convincing on the surface, but our study groups have found significantly misleading information about the safety and actual risk of harm from the tire

crumb fields to all users, particularly children. They are likely unaware that claims that the fields are "SAFE TO INSTALL; SAFE TO PLAY" have been repealed.

5. **PEER Filings**. Public Employees for Environmental Responsibility have filed a number of complaints and documents that argue for a repeal of endorsements of tire crumb safety from EPA/CPSC, and those statements were in fact repealed; but most schools and potential purchasers are unaware of the removal of endorsements and claims of safety. The PEER filings are an excellent source for telling the toxicity story and regulatory story of this product. We respectfully request that the entire file of complaints and responses to the complaints, and other supporting material be entered into the record for ASTDR 2016-0002-0003.

The full list of documents for the ASTDR 2016-002-0003 collection and record can be found here: http://www.peer.org/campaigns/public-health/artificial-turf/news-releases.html. Please include all in that list, and all supporting materials.

6. Formal legal requests have been made to classify the tire crumb fields as a children's product since children use them, and sales and marketing material are very clear about tire crumb fields are for children. **CDC/CPSC/EPA should use their existing authority to explicitly label the fields as children's products.** (Please refer to PEER filings for details and supporting arguments: **http://www.peer.org/campaigns/public-health/artificial-turf/news-releases.html)**

7. CLASSIC CANCER CLUSTER APPEARANCE: SOCCER PLAYERS

Parents and schools may have trusted the "Safe to Play" statements, **but the parents of the 200 young women and men, who played intense soccer and were stricken with cancer do not trust those claims anymore.**

The case of over 200 young soccer players who used tire crumb fields and contracted cancer, strongly indicates a classic cancer cluster, though the cases have not undergone the formal validation process, not yet. That is because a process for the collection of this information, does not exist yet for either cancer victims, or for other illnesses, head injuries, and heat injuries/illness from the fields.

8. We respectfully request that an official study of the soccer player cancer cluster be initiated by CDC immediately.

Through our activist network, we learned about these cases, which were reported to the NBC news link, or directly to a single, trusted concerned soccer coach. EHHI reported as follows:

_____

"New Cancer Numbers Among Soccer Players on Synthetic Turf,

April 2016

It is important to remember that the only people counted in the numbers below are those who have known to call Amy Griffin. There is still no government agency tracking the cancers among the athletes who have played on synthetic turf. We know the actual numbers of athletes who have played on synthetic turf and contracted cancer have to be much greater than those who have known to report their illness to Amy Griffin.

In January of 2016, there were 159 cancers reported among soccer players; now (April 2016) there are 166. Ninety-seven of those in January were goalkeepers; now there are 102. Sixty-one percent of the soccer players with cancer are goalkeepers. As of this writing, 220 athletes of various sports who have played on synthetic turf have cancer; 166 soccer players who have played on synthetic turf also have cancer.

166 Soccer Players who have played on synthetic turf and have cancer

- 102 are goalkeepers (61% are goalkeepers)
- 64 soccer players with lymphomas, 39 are goalkeepers (61%—over half are goalkeepers)
- 10 soccer players with Non-Hodgkin lymphoma, 7 are goalkeepers (70%—over half)

- 54 soccer players with Hodgkin lymphoma, 32 are goalkeepers (60%—over half)
- 41 total leukemias, 24 are goalkeepers (59%—over half)
- 16 total sarcomas, 7 are goalkeepers (44%)
- 12 thyroid, 9 are goalkeepers (75%—over half)
- 11 brain—5 are goalkeepers (45%)
- 9 testicular—6 are goalkeepers (67%—over half)
- 4 lung—3 are goalkeepers (almost all are goalkeepers)

Remaining are OTHER rare cancers."

Source: Various; Victim parent volunteers, EHHI primary collection; 4/2016 (ongoing)

All the victims were frequent users of turf fields, spending multiple hours a week in close contact with the material in the fields. All were in their mid-twenties or younger.

9. The self-reporting to a trusted coach, is also an indication that the actual illness rates are not yet being properly assessed or managed by any hospital, medical system, or group; there is no "home" for this information, yet. The 200+ cancer victim count is likely the reach of a single coach with the help of a link in broadcast media, and a fraction of the actual count of victims of cancer or other serious illnesses. Better investigation and creating a "safe" place to report serious and intermittent illness will uncover many more victims, and provide needed perspective on the accuracy of risk assessment for this product.

10. The CDC and appropriate agencies should issue a directive asking for adequate screening for injury and disease. That US hospital and medical systems are not yet set up to collect this data is a contributing factor; and concurrently, screening for synthetic field use should be part of a responsible screening protocol. To our utter dismay, we learned from pediatric oncologists in our group that at least some oncologist are prohibited from screening victims/patients for tire crumb field use; the screening must be part of the approved protocol, and tire crumb product is not yet included..

11. In fact, the number of **all injuries from tire crumb fields should be collected and analyzed to include, but not be limited to: head injury and concussion; joint injuries (multiple); heat injury; blood cancer; lymphomas; testicular cancer; pulmonary illness; neurological impairment; kidney disease; diabetes; brain disease and cancers. These findings need to be documented, and the children who suffer from them should be screened for tire crumb field use and proximity.** No doctor or oncologist should be prevented from asking questions, screening for, or questioning the safety of this product or contact with this product. We believe there are many more heat related illnesses, head injuries, and endocrine system disruptions directly resulting from exposure to the fields than what is being reported.

12. REQUEST MORE INVESTIGATION INTO EXISTING AND POTENTIAL CANCER CLUSTER: We ask that the multiagency group takes steps to expedite the process of collecting epidemiological data and verification of the current soccer player cluster, and other potential clusters, to include field maintenance workers who rake the fields, field installers who pour the millions of pounds of material onto field surfaces, school custodians, high contact users of any kind, and school children in buildings adjacent to the fields. Residences near the fields should be considered in the scope of the study or subsequent studies. **In our own informal assessment, and using SEER database and known levels of cancer victims, we found the potential for 7-11 cancer clusters.** We respectfully ask the CDC experts to look into this possibility and take the necessary steps to prevent additional injury and cancers.

13. NEED FOR EXPLICIT PROTECTION FROM RETRIBUTION: Sadly, the families, coaches, and school leaders who have reported illnesses do so with concern for **retribution from the tire crumb industry, school boards, university administrations, and even sports league administrators, and may need explicit protection and remedy against retribution.** Researchers who study the potential for harm tell us that they do not have protection from retribution from tire crumb field industry proponents. Even in our own group, public health and medical professionals must make statements of concern anonymously to protect themselves from retribution—professionally and personally from industry proponents. Adequate protections need to be established to protect the professionals and parents who speak out.

14. **PROTECTION FOR CHILDREN IS NOT A COST-BENEFIT ANALYSIS.** Children have a unique vulnerability to toxic exposures—both intermittent high exposures—and to low dose exposures, and if we are aware of a carcinogenic presence, then we are responsible for using a precautionary principle, and removing that exposure risk. With due respect, this is not a cost-benefit analysis that will show a

percentage of children will get sick (cost) vs. tournaments played or jobs created (benefit). It is a decision made by a civil society that upholds protection for children's health above all other industry priorities, and a recognition that tens of thousands of children, if not hundreds of thousands, are already being exposed to material with known carcinogenic, and harmful materials on school turf fields.

15. The CDC/CPSC/EPA should recognize that the fields serve children, acknowledge that there are zero safety controls on the material and the potential exposures, and immediately acknowledge tire crumb fields as children's products, and use your existing authority to regulate them as children's products. **Therefore, we emphatically REQUEST THAT THE CPSC/EPA/CDC USE EXISTING AUTHORITY TO IMMEDIATELY CLASSIFY ARTIFICIAL TURF AS A CHILDREN'S PRODUCT, SINCE THOUSANDS OF CHILDREN ALREADY USE THE FIELDS, IN THOUSANDS OF SCHOOLS.**

Since children and adults are already being exposed on tire crumb fields to the materials in tires, we ask for an **immediate moratorium on further construction of tire crumb based or recycled rubber based artificial turf fields** until adequate assurances that tire crumb particulate, off-gassing, and combinations are safe for children to inhale and safe for children to ingest.

Your three agencies do not need to conduct a study to know with absolute certainty that tires were not designed to be inhaled by children, and we should protect children, at any length, from chronic or lose dose carcinogenic exposures.

Even if we cannot model or know (or will we ever know) the exposures to each child, each day (and we will never know), we do know with certainty that:

1. Carcinogens are in tires.
2. Shredded, pulverized tire crumb contains everything in tires, and more ingredients, including: carbon black, phthalates, VOCs, PAHs, benzothiazoles, lead, chromium, zinc, nanoparticle additives, proprietary additives, 12 known carcinogens, 90 materials known to be harmful to human and environmental health, (EHHI)
3. The material can be inhaled when playing and ingested with contact, or intermittent adjacent contact.

4. Every single direct or indirect use has the potential for exposure to hotspots and low dose chronic exposures to multiple scenarios of these materials.
5. The exposures could impact children, school buildings, and surrounding areas; contamination travels to cars, homes, and even children's bedrooms.
6. It is both within the authority and the responsibility of your three agencies to take immediate action to protect the public, especially children, from known carcinogenic, pathogenic exposures.

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Only a complete moratorium on their use will protect the millions of children, athletes and bystanders from inhalation and ingestion of the materials that yield from tire crumb synthetic turf fields.

16. It is also evident that tire crumb will never be safe unless ALL tire ingredients, all "recipes", the manufacturing of tires, and then preparation of materials for fields are controlled from a toxicity perspective. This level of voluntary cooperation from the tire manufacturing industry will, of course, never happen.

17. ONLY UNIFORM MATERIAL SAFE TO INHALE AND INGEST IS APPROPRIATE FOR SCHOOL FIELDS ; UNTIL THEN, A MORATORIUM. When the play surface material is uniform, consistent, and controlled, when it is tested by an adequate study with pediatric toxicology assessments to be safe for ingestion and inhalation, and results are peer reviewed following IRB standards, then we may consider a synthetic turf field might be safe. Until then, tire crumb should be rejected from any casual or unnecessary contact with children or adults.

18. RECONSIDERATION: A reconsideration of the moratorium could occur when the industry can demonstrate a uniform, non-carcinogenic, non-inhalable, non-ingestible alternative that does not present PAH, VOCs, phthalates, lead, chromium, mercury, 1,3-benzothiazoles, butadiene, styrenes, carbon black (in particulate, gaseous form, or any form to children); and the product undergoes strict, peer-reviewed study by independent qualified toxicologists who have a mandate to protect children's health and the health of the environment above the interests of industry. The hypothetical product should be subject to regular reviews and quality control determinations to ensure safety over the life of the synthetic field. Safety Data Sheets should be provided and accessible for every user. If waste tires

are used, the controls requested above will never be possible, since the tire material, by definition, is a composite of many toxins in unknown quantities and with unknown impacts.

PART TWO: CHARACTERIZATION OF TIRE CRUMB COMMENTS

1. SCALE AND SCOPE: Tire crumb potential to individuals, buildings, surrounding areas and stormwater for contamination is enormous.

2. PUBLIC HEALTH ISSUE: SCALE AND SCOPE CONCEPTS

The potential for contamination from tire crumb is a growing public health issue, in terms of the relative size of the product and its mass; the total number of potential fields; and their basic contact with students, athletes, school personnel, buildings, communities, and streams/storm water.

To give an idea of the existing volumes of material, the field runoff and children affected or who may be affected, we have developed reference tables, and the summary is attached to this filing These tables indicate the scope and scale, and demonstrate that these are not isolated fields, nor tiny exposure potentials. The quantities of material are enormous. The source and reasoning is explained, but the tables are designed for your model development and quick reference.

3. ENORMOUS QUANTITIES ON EACH FIELD SURFACE .

To give an idea of the scale, a modest soccer field uses 30,000 waste tires. According to a randomly selected company selling packaged tire crumb infill for original or replacement treatments, 30,000 tires makes about 396,667 pounds of lbs of material. According to our calculations, the volume for 2" thick field is about 525 cubic yards, However, a large football field, three times the size of a small soccer field, could use 1,000,000 pounds of tire crumb material.

4. The tires are shredded, pulverized into crumb of various sizes, and the shredded material is poured on top of a plastic "grass" carpet. Importantly, the material is loose, unencapsulated and can loft into the air when struck by a ball or foot, or body. We estimate that, depending on the school, each field has

regular, daily contact with at least 1000 athletes and students. At sports events, busy tournaments, or with active use, a field can have contact with many, many more.

5. No fields we found have mandated capture of the leachate or particulate at the field.

6. TOTAL FIELD VOLUMES POTENTIAL:. The universe of potential tire crumb playfields is approximately 200,000 - 220,000 schools and athletic facilities in the US, based on number of schools. The potential reach of exposure from use of these fields is in the millions of children, millions of adults, hundreds of thousands of exposed buildings and adjacent soils, and hundreds of thousands of public easements and storm water access points (we estimate 1:1 ratio for field to point source drainage).

7. TABLE RUNOFF AND VOLUMES: SUMMARY OF KEY METRICS

For reference, we analysed fields by sport type, by Metropolitan Service Area, and calculated the volumes for rainfall (by city), and for amount of tire crumb material on a field surface.

Key metrics are the following:

- Estimated tire crumb per 85,000 sq feet field and 2" deep tire crumb infill is 525 cubic yards, 396,667 pounds, or 198 tons per field.

- **The total amount of tire crumb material on surface of 12,000 fields is estimated to be 6,296,296 cubic yards, or 4,760,000,000 pounds or 2,380,000 tons** that are currently in sports centers and schools in April 2016..

- **Runoff is calculated by city and field size, but the total runoff for fields in the top 50 MSAs is 15,006,99,787 gallons.**

- **Total Runoff for** 12,000 fields based on number of fields per MSA, accounting for rainfall in that MSA, and added together for 2016 is: **23,370,639,827 gallons**… for a single year.

The calculations were made to illustrate the scale and scope of this product, and to characterize the reach of exposures from the field surface into the airway, and into the water pathway.

8. INGREDIENTS IN TIRE CRUMB: Lack Of Uniformity, High Variation, Multiple Toxins

Tire crumb appears to be a composite material, heterogenous with multiple known carcinogens, pathogens, and mutagens. The material is not uniform, comes from multiple sources and lots, and can be mixed with plastics and materials of unknown origin. The material can have anticlumping agents, flame retardant additives, paint, and strengthening or characteristic enhancing additives. Shredding of tires can cause small pieces of steel or metals to be included in the material from steel belted tires. Some tire crumb is from newer depositories from recalled tires, some from landfills, and some have been subjected to a variety of weather and conditions. Leachate and off gassing could be variable, with the expectation that newly installed/poured material off-gassing is higher than from an older field, but we expect those rates would vary with the age of the tires from which the tire crumb was made.

9. HETEROGENEOUS, MULTIPLE TOXINS, UNKNOWN ORIGIN: To say that tire crumb infill comes from multiple sources, is an understatement: dispensaries, landfills in the US, landfills abroad, collection centers, factory waste from China, factory waste from the US and abroad. Some of the newer marketed blends included multi colored sport shoe waste, shoe factory waste, and many unidentified synthetic materials. Just as tire companies may add anything to their "recipe" for a tire, an infill provider may offer materials that could have anything added into the blend. Tire plugs, tire polishes, tire coatings, and materials picked up on the roads should be considered. And even if it is known that there are only tires in the blend, there is a broad variation in the ingredients based on the use of the tire, and the manufacturer. Those tires may look the same, but from a toxicity standpoint their variation and the unknowns in the "recipe" create a margin of uncertainty that makes any claim of known safety for inhalation or ingestion impossible. If a vendor says he or she knows what is in a lot of tire crumb, and that is known to be safe, then they ignored the materials in the product. Since we never know what is

in any field for sure, and if we know that they have tire crumb, they cannot be demonstrated safe for children to inhale, ingest, nor play upon.

10. What Is In Tires? SOME GROUPS WENT LOOKING

Since it was difficult from MSDS or any other source to identify the components in tires or tire crumb, some groups studied them directly.

11. Environment and Human Health Inc, and Yale University Study

EHHI, Inc. in cooperation with Yale University studied samples of rubber mulch, and new tire crumb with the intent of characterizing their ingredients.

The summary text of their characterization study is found here:

http://www.ehhi.org/turf/metal_analysis2016.shtml

http://www.ehhi.org/turf/findings0815.shtml

The EHHI/Yale Study list of components found is explained this way:

The shredded rubber tire playground mulch samples tested were provided by the manufacturer and were purchased in new bags of rubber mulch for use in gardens and playgrounds. The rubber tire infill for synthetic turf fields was obtained as new infill material from installers of synthetic turf fields. There were 5 samples of infill from 5 different installers of fields and 9 different samples of rubber mulch taken from 9 different unopened bags of playground mulch.

RESULTS There were 96 chemicals found in 14 samples analyzed. Half of those chemicals had no government testing on them - so we have no idea whether they are safe or harmful to health. Of

those chemicals found that have had some government testing done on them these are the findings with their health effects.

TWELVE (12) KNOWN CARCINOGENS

2-Mercaptobenzothiazole/ **Carcinogen**, toxic to aquatic life

9,10-Dimethylanthracene/ **Carcinogen**, respiratory irritant and can cause asthma

Bis(2-ethylhexyl) phthalate/ **Carcinogen**, may cause damage to fetuses

Fluoranthene / **Carcinogen**, Fluoranthene is one of the US EPA's 16 priority pollutant, A PAH.

Heptadecane/ **Carcinogen**

2-mercaptobenzothiazole / **Carcinogen**

Phenol, 4-(1,1,3,3-tetramethylbutyl)/**Carcinogen**

Phenanthrene/ **Carcinogen** - A PAH

Phthalimide/ **Carcinogen**, skin, eye and lung irritan. A Fungicide

Pyrene, 1-methyl- /**Carcinogen**

Tetratriacontane /**Carcinogen**, eye and skin irritant. Can cause systemic damage to central nervous system.

Pyrene/ **Carcinogen,** toxic to liver and Kidneys, a PAH

Carbon Black/ **Carcinogen**

Carbon Black makes up to 20% to 30 % of every tire. It is used as a

reinforcing filler. Carbon Black is listed as a carcinogen by the International Agency for Research on Cancer (IARC).

Carbon Black, as such, was not analyzed by the Yale Study because Carbon Black is made up of a

number of chemicals – some of which were found in the Yale study.

Carbon Black is not one chemical -- it is made up of many chemicals - often of petroleum products. Furthermore, carbon black has no fixed composition, even of the many compounds it contains. Carbon black from different sources will have

differing compositions. In our method, carbon black will register as

a series of substances extracted from it. There is no carbon black

molecule, it is a mixture.

TWENTY (20) KNOWN IRRITANTS

1,4-Benzenediamine, N-(1,3-dimethylbutyl)-N'-phenyl-

Irritant - causes skin and eye irritation, toxic to aquatic life

1,4-Benzenediamine, N-(1-methylethyl)-N'-phenyl-

Irritant - causes skin and eye irritation, toxic to aquatic life

2(3H)-Benzothiazolone

Irritant - causes skin and lung irritantation

2-Dodecen-1-yl(-)succinic anhydride

Irritant - causes eyes, skin and lungs irritation

3,5-di-tert-Butyl-4-hydroxybenzaldehyde

Irritant - causes irritation to eyes, skin and lungs.

Anthracene

Irritant - causes skin, eye and respiratory irritation. Breathing it can irritate the nose, throat and lungs causing coughing and wheezing.

Benzenamine, 4-octyl-N-(4-octylphenyl)-

Irritant - causes eye and skin irritation

Benzenesulfonanilide

Considered hazardous, very little testing has been done on it.

Benzothiazole, 2-(methylthio)-

Irritant - causes Skin and eye irritation.

Dehydroabietic acid

Toxic to aquatic organisms

Docosane

Irritant - causes Skin irritation

Hexadecanoic acid, butyl ester

Irritant - causes eye, skin and lung irritant. Can cause reproductive effects.

Methyl stearate

Irritant - causes eye, skin and lung irritation.

Octadecane

Irritant - causes kin, eye and respiratory irritation

Octadecanoic acid also known as Stearic acid

Irritant - causes skin, eye and respiratory irritation

Oleic Acid

Irritant - causes skin and eye irritation

Phenol, 2,2'-methylenebis[6-(1,1-dimethylethyl)-4-ethyl-

Irritant - causes skin, eye and respiratory irritation

Tetradecanoic acid

Toxic to aquatic organisms. Skin and eye irritant.

Anthracene, 2-methyl-

Acute aquatic toxicity, Not much data available - what there is shows it to be an eye, skin and lung irritant

Anthracene, 9-methyl-

Acute aquatic toxicity, serious eye irritant

13. Carbon Black

Carbon black plays an extraordinary role in tires, and in their toxicity and potential for harm from exposures. Well known from decades of air pollution studies, urban epidemiological studies, carbon black causes lung cancer, brain cancer, kidney cancer, heart disease, neurological disorders, and cognitive degenerative disease.

A known carcinogen (WHO), we have found variations in percentages of the amount of carbon black in a tire, from 30%-68%. (EHHI/Yale Study; NY STUDY, .pdf, pp19-20.) Carbon black breaks down into many sized particles, including PM10/PM2.5. That size particle was shown to cause several types of cancer, including brain cancer, kidney cancer, kidney disease, bladder cancer, and neurological disease and cognitive impairment disorders. (CITE; Harvard Mexico Studies and Urban Cohort Studies) We know for sure that carbon black is in tires, in part from simple observation of color.

14. THE NY STUDY CHARACTERIZES TIRE CRUMB THIS WAY:

"The components of Firestone's and Dow Chemical Company's rubber are summarized in technical specification documents. Although they are only two of many different rubber manufacturers, a similarity between the two vendors is readily apparent, even between three different types of rubber, solution-SBR, cold polymerized emulsion SBR, and high cis2-4 polybutadiene rubber. In general, the following similarities were observed between the two manufacturers for the compounds used to produce the rubber:

• The polymer used to produce solution-SBR contained approximately 18-40% bound styrene.

• The oil content in the polymer ranged from 27.3-32.5% in solution-SBR and cold polymerized emulsion SBR. Oils used include aromatic oil, high viscosity naphthenic oil, and treated distillate aromatic extract oil.

• Besides the polymer used, the other components of the rubber were similar between manufacturers and the relative proportions (parts by weight) of these other components ranged as follows:

o Carbon black: 50.00 – 68.75

o Zinc oxide: 3.00

o Stearic acid: 1.00 – 2.00

o Sulfur: 1.5 – 1.75

o N-tert-butyl benzothiazole sulfonamide (TBBS): 0.9 – 1.50

o Naphthenic or aromatic oil: 5.00 – 15.0

The components summarized above are the principal components of the major type of rubber (SBR) used for the manufacturing of crumb rubber and therefore have the potential to have a significant presence in crumb rubber. As discussed in subsequent sections of this report, some of these components have been found to be prevalent in crumb rubber, including **zinc (from the zinc oxide), benzothiazole compounds** (from TBBS), and **PAHs** (possibly from the oils used). These compounds may be attributed to the SBR used in the manufacturing of crumb rubber."

15. Phthalates are a regulated toxin, and PEER filings covered some of the toxicity and regulatory discussion. Please refer to http://www.peer.org/campaigns/public-health/artificial-turf/news-releases.html

16. ZINC

Coastal Marine Resource Center Study, found fatal levels of zinc in leachate from tire crumb fields. This amount would cause fatal impacts to aquatic ecosystem within 48 hours. This is a notable amount, and though was assessed in terms of environmental health, indicates presence.

Menichini and Abate Study: "Zn concentrations (1 to 19 g/kg) and BaP concentrations (0.02 to 11 mg/kg) in granulates largely exceeded the pertinent standards, up to two orders of magnitude". "Zinc and BaP concentrations are high in rubber largely exceeding the Italian soil standards".

17. METALS: MERCURY, CHROMIUM, ARSENIC

The highest median values were found for Zn (10,229 mg/kg), Al (755 mg/kg), Mg (456 mg/kg), Fe (305 mg/kg), followed by Pb, Ba, Co, Cu and Sr. The other elements were present at few units of mg/kg. The highest leaching was observed for Zn (2300 µg/l) and Mg (2500 µg/l), followed by Fe, Sr, Al, Mn and

Ba. Little As, Cd, Co, Cr, Cu, Li, Mo, Ni, Pb, Rb, Sb and V leached, and Be, Hg, Se, Sn, Tl and W were below quantification limits. Data obtained were compared with the maximum tolerable amounts reported for similar materials, and only the concentration of Zn (total and leached) exceeded the expected values.

18. LEAD, POLITICS and CHILDREN

The problem is synthetic turf is NOT REGULATED as a children's product by the CPSC thwarting the ability to apply lead regulations that CPSC could enforce.

Lead was identified in synthetic turf fields as early as 2008 but was not addressed in any systemic way due to lack of standards or required testing (although the CPSC could have required the testing mandated for children's products since 2008). The CPSC has chosen not to mandate this children's product testing for synturf and in fact advised the industry about not having it designated as a children's product < http://parentscoalitionmc.blogspot.com/2009/03/artificial-turf-tale-of-lead-levels.html> .

This has led to a "buyer beware" situation especially after the CPSC tested synthetic turf carpets, found lead at varying levels depending on sample age, and astoundingly concluded the whole synthetic turf system was, always and everywhere, safe not just for adults but for children. The assumptions were based on inappropriate modelling for blood lead levels from a meager sampling and the troubling finding presupposes that there is, a safe level of blood lead, which most pediatricians and lead experts agree there is not safe level.

To this day the synthetic turf industry cites the still CPSC-posted "OK to Install, OK to Play on" press release which should never have been posted to begin with, has been disavowed, in front of US Congress, by CPSC commissioner Kaye and is an embarrassment to government science, policy and public health <http://www.cpsc.gov/en/Newsroom/News-Releases/2008/CPSC-Staff-Finds-Synthetic-Turf-Fields-OK-to-Install-OK-to-Play-On/ >

19. By contrast, The Centers for Disease Control (CDC) in contrast warned and continues to warn the " there is no safe level of lead" to expose children.

http://www.cdc.gov/nceh/lead/>

http://www.cdc.gov/nceh/information/healthy_homes_lead.htm.

"**No safe blood lead level in children has been identified.** Lead exposure can affect nearly every system in the body. Because lead exposure often occurs with no obvious symptoms, it frequently goes unrecognized"

In 2010 Van Ulirsch et al (Environ Health Perspect. 2010 Oct;118(10):1345-9 <http://www.ncbi.nlm.nih.gov/pubmed/20884393

20. Evaluating and regulating lead in synthetic turf.

Division of Health Assessment and Consultation, Agency for Toxic Substances and Disease Registry gulirsch@cdc.gov) concluded that: "Synthetic turf can deteriorate to form dust containing lead at levels that may pose a risk to children. Given elevated lead levels in turf and dust on recreational fields and in child care settings, it **is *imperative that a consistent, nationwide approach for sampling, assessment, and action be developed*.** In the absence of a standardized approach, we offer an interim approach to assess potential lead hazards when evaluating synthetic turf."

21. *But no such approach has ever been instituted. Indeed as reported in USA today this year: "The CDC in 2008 said communities should test recreational areas with turf fibers made from nylon, and they should bar children younger than 6 from the areas if the lead level exceeded the federal limit for lead in soil in children's play areas. But some communities have refused to test their fields, fearing that a high

lead level would generate lawsuits or force them to replace and remove a field, which costs about $1million, according to a 2011 New Jersey state report . Forty-five of 50 New Jersey schools and towns contacted in 2009 by epidemiologist Stuart Shalat would not let him test their turf-and-rubber fields, Shalat's report states. The EPA also found, in 2009, that "it was difficult to obtain access and permission to sample at playgrounds and synthetic turf fields."<http://www.usatoday.com/story/news/2015/03/15/artificial-turf-health-safety-studies/24727111/ >

22. And for the past 2 years the company FieldTurf has, with impunity, noted its synturf fields contain lead during testimony on various bills in the Maryland State House.

The latest admission documented on video: <http://wtop.com/montgomery-county/2016/03/md-lawmakers-seem-information-artificial-turf-schools/>

> "....asked point-blank by one delegate, “Is there lead in your products? The executive answered, “There’s lead in a lot of things in this world.”.... “**Yes, there’s lead in our products**." In spite of this admission and the fact that the legislation in question was meant to post the CDC prescribed warnings about minimizing lead and other toxin exposures from the synturf and tire waste products, and in spite of the fact that the legislation had strong and broad input and support, the legislation was not even allowed to come up for a vote in committee by the committee chair.

23. Public Employees for Environmental Responsibility compiled the literature as of early 2012 on lead

see: <http://www.peer.org/campaigns/public-health/artificial-turf/news-releases.html > and specifically: 2012-07-12 lead-limits-needed-on-tire-crumb-playgrounds (*NOTE if you go to PEER.ORG news releases: click on public health and "artificial turf" to find the actual filings with many links}*

Unfortunately for the children, fields with high lead remain. But those responsible for protecting children are kept in the dark. NO ONE IS MONITORING OR REGULATING ARTIFICIAL TURF FOR LEAD OR OTHER TOXINS in either old or new fields, including the Consumer Product Safety Commission (CPSC) (see <http://www.peer.org/news/news-releases/cpsc-drops-artificial-turf-playground-safety-review.html Even though the Chairman of the CPSC, recently admitted to congress that its soothing conclusions of safety after finding lead in synthetic turf were NOT correct.

Tested fields keep showing up with lead in them both old AND NEW. Some tested fields have little or no lead , some high levels and some have both within the same field. There is no way of knowing if any of the components of a field contain lead, and how much without stringent and thorough testing of each field.

This problem highlights the need for application of the designation as a children's product for testing and regulation : 1) stringent testing of all the colors and of the backing of the carpet for total lead content (chromium and cadmium should also be tested for) AND 2) Testing many samples of the infill which is an ever-changing â€˜witches brewâ€™ of chemicals- so undetectable, low and very high levels can all be found in the same field. In addition to having testimony both last year and this year in the MD state chambers from Field Turf that their product DOES indeed contain lead (as you heard in the recent committee testimony on MD house Bill 883 , and in addition to those referenced in the PEER review, other studies on lead also exist.

24. For a comprehensive media article on Lead in artificial turf which cites scientists and studies that the synturf industry avoids please go to: <http://www.usatoday.com/story/news/2015/03/15/artificial-turf-health-safety-studies/24727111/

>

For example as reported in that article:

Dr. Shalat's New Jersey State Study (2012) on artificial turf found lead in the field dust in the respirable

air space of a robot and real player- highly variable but sometimes very high (note most facilities would NOT LET THEM TEST).

<http://www.nj.gov/dep/dsr/publications/artificial-turf-report.pdf

25. PEER writes: The concerns about lead exposure have taken on a new urgency following the release in June of 2012 of a study done for the New Jersey Department of Environmental Protection which found artificial fields made of tire crumb can contain highly elevated levels of lead much greater than the allowed levels for children:

a)· It reports "concerns with regard to potential hazards that may exist for individuals and in particular children who engage in sports activities on artificial fields"; and

b) *"In**halable lead present in artificial turf fields can be resuspended by even minimal activity on the playing surface**."*

26. Dr. Lioy of Rutgers who is quoted in the USA Today article recently participated as the senior author in a study which found lead and other toxins in the BOTH the plastic rug (supplied to them by the industry) and tire crumb infill. LEAD was also was found in simulated body fluids meaning there is little or no protection of any kind against the lead getting out of the material into the body .

27. Pavilonis Study found lead.

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4038666/pdf/nihms565643.pdf > 2014

" **Bio-accessibility and Risk of Exposure to Metals and SVOCs in Artificial Turf Field Fill Materials and Fibers**" , Brian T. Pavilonis1,Clifford P. Weisel1, Brian Buckley1, and Paul J. Lioy1

QUOTE from Pavilonis et al:**."Since it is possible that children may be exposed to potentially high concentrations of lead while using artificial turf fields we recommend, at a minimum, all infill and**

fibers should be certified for low or no lead content prior to purchase and installation."

*<u>The main out-comes of concern from Pavilonis et al</u>**<u>:</u>**

a) the finding of **lead, and chromium** in **both** the **tire crumb** and **the plastic rug** and simulated **body fluids** at sometimes extremely high levels ***EVEN IN NEW FIELD CARPETS**.*

b) **Benzothiazole** derivatives and **4-(tert-octyl) phenol** were also found in in the simulated body fluids. Both are probable carcinogens (the subject of another fact sheet).

QUOTE: "**Lead was detected in almost all field samples** for digestive, sweat, and total extraction fluids with digestive fluid extract of one field sample as high as 260 mg/kg. Metal concentrations were not markedly different across the three different sample types (new infill, new turf fiber, tire crumb field sample). However, one of the ***new*** turf fiber samples contained relatively large concentrations of **chromium (820 mg/kg) and lead (4400 mg/kg)** compared to the other samples tested…the variability of lead contained in the infill material is large and can span more than two orders of magnitude* . One field [tire crumb] sample did contain a high lead level (260 mg/kg) which was on the s**ame order of magnitude as the NJ DEP cleanup value** (400 mg/kg)."

In summary: Lead-free is the only acceptable level for child products (and indeed for people in general). T**here is NO safe level of lead for children.** And yet many of our children are playing often, if not daily, on fields that may contain lead and certainly do contain many other toxic substances. Finding ANY lead in any play area for children of any age is unacceptable. As the CDC notes: Every effort should be made to eliminate ALL unnecessary sources of lead in the environment, especially a child's environment. ***Lead in artificial turf is not only totally unnecessary but dangerous to health AT ANY LEVEL*.**

28. Other sources of information on Lead in tire crumb fields:

www.ehhi.org/turf/<http://www.ehhi.org/turf/>

www.safehealthyplayingfields.org<http://www.safehealthyplayingfields.org>

www.synturf.org<http://www.synturf.org>

[FOOTNOTE SYN TURF]Where on the Synturf page on lead you can find:

No. 36] Mayo Clinics tips to protect children from lead in artificial turf. April 2015.

No. 35] Durham, New Hampshire: Lead scare at UNH, s Memorial Field. November 2012.

No. 34] Beware of lead content in exotic color artificial turf fields! September 2012.

No. 33] Odessa, Texas: Eager fans will not be given pieces of the artificial turf field. September 2012.

No. 32] U.S. Federal panel increases child protection against lead. February 2012.

No. 31] UNLV researcher spreads word about the need to test artificial turf fields. December 2010.

No. 30] Environmental Health Sciences study (2010): Deteriorating synthetic turf dust containing lead may pose a risk to children. October 2010.

No. 29] Concord, Mass.: Town replaces fake grass fields, officials insist nothing is wrong with the lead levels! July 2012

28. TWELVE (12) CARCINOGENS found and HOW DO THEY INTERACT:

The Yale Study identified the presence of so many carcinogenic materials in a single material that it raises many more questions about interaction of PAHs with metals, and combination impacts. The

interaction of the PAHs and benzothiazoles with other materials in the fields needs to be characterized and addressed

29. Strengthening Additives: Nanoparticles

We would also ask for information and clarity about tire strengthening additives of any kind that were built into the material anytime in the past 30 years, these would have been added to tires. [http://nice.asu.edu/nano/carbon-black-and-amorphous-silica-tires]

Similarly, we request that the tire manufacturing industry explain their use of nanoparticle products, of any kind, including the type and size, source company and source country, and ask for an explanation about how:

a. they can be quantified in the product, and
b. how can they be cleaned up if they are released when the tire crumb and or plastic “grass” carpet degrades?
c. We would also like to understand what material characterization of their behavior in tires performance,
d. And or their behavior once they are released into the environment.
e. We ask for any epidemiological due diligence that was conducted by any tire company on nanoparticle use prior to using them in a commercial product.
f. Plans for continued use and safety precautions tire companies will impose upon themselves
g. Epidemiological studies conducted on these particles in tires

30. Plastics, Microplastic Fibers, Microbeads, and Small Particulate Plastics

Assessment of microfiber particulate and small particulate plastics needs to be assessed in characterization studies.

31. Flame Retardants

Flame retardants can be added to a tire in production, or applied post production in a shipping setting or possibly as tire crumb. Since flame retardants are known carcinogens with health issues of concern, and will be on the surface of the waste tire crumb, tire infill providers need to know if they are present, and purchasers need to know that the material contains flame retardants prior to purchase.

32. Tires and Tire Crumb Additives

Myriad products exist to clean, protect, condition, and color tires. We wonder if they are components of tire crumb?

33. Road Waste Picked Up By Tires

Tires spend their lives on roadways, of course, and can pick up many materials in their travels. Debris, hydrocarbons, ….

34 CARINOGENIC, PATHOGENIC, and MUTAGENIC ingredients in tires cannot be removed by shredding tires into tire crumb and must be assumed to be accessible.

35. Tire crumb and repurposed rubber appear to be the same thing, with interchangeable use… but are they the same? We would like clarification.

We would like clarification about the distinction between the tire crumb, repurposed crumb rubber, and crumb rubber. Specifically if using the term “repurposed rubber crumb” implies uniformity of ingredients? Does that term imply tires are not used? If so, what are the ingredients in repurposed rubber crumb and how do they differ from tire crumb?

36. **We would also like access to all MSDS/SDS of tire crumb manufacturers and tire companies,** and the ability to ask questions about how and where they were made, variations on lots, source and composite addendums. It is difficult to locate them.

37. EXEMPTION ON LISTING HAZARDOUS MATERIALS: We would like to understand why tire companies have an exemption on their need to list ingredients under Section 2: Hazardous Materials of an MSDS/SDS. We were unable to find the source of that exemption, if it has a deadline, and whether your study group thinks it is an obstacle to understanding and characterizing risk of exposure from tires and tire crumb.

38. Of those MSDS that we located, several, like this Michelin North America Material Safety Data Sheet for Michelin, Uniroyal, BF Goodrich, says in **"Section 2 HAZARDOUS INGREDIENTS: Note: Tires meet the definition of article as defined by the OSHA Hazard Communication Standard (29 CFR 1910.1200) and are exempt from MSDS requirements."**

There was clearly no mention of 1,3 butadiene, carbon black, POHs, VOCs, benzothiazoles, or any plasticizers, nor metals, styrene, sulphur, known irritants, or well… anything. Since that section also outlines corrosive, combustible and waste treatment, it is important for more than this issue. We explicitly ask CDC/CPSC/EPA if they can use their existing authority to require tire crumb companies and tire companies to provide ingredient information.

39. SOURCE MATERIAL UNKNOWN: MSDS/SDS CANNOT REPRESENT WHOLE FIELD. Tire crumb comes from many tires, and many sources. Since not a single tire crumb field can accurately list or track which tires were source materials, or what other mixed in components, and there is no accountability from tire crumb recycling industry for the shredded product, then MSDS/SDS cannot be accurate for a whole field due to variability. Therefore, the burden of "proof" of risk lays squarely on the ability of the purchaser (schools, sports directors, booster clubs) to assess risk… of a very very complex product. So,

if the exemption stays in place, we will know for sure that we cannot know what is in a tire crumb based field.

40. TREATMENT TO SHOW NO PARTICULATE OR BREAKDOWN: SHOW US.

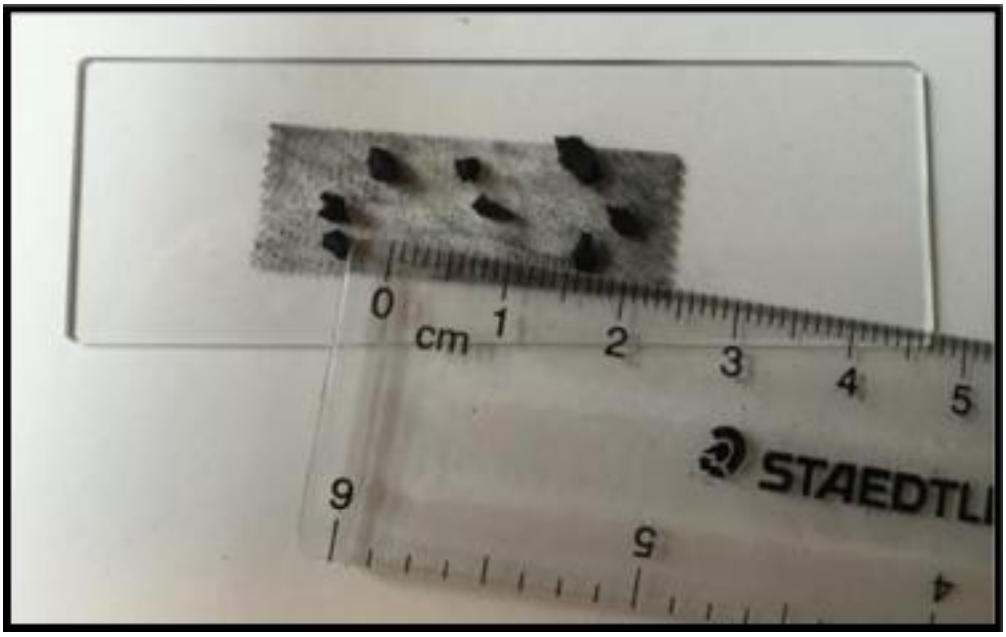
As for studies that claim that their product has been treated (such as cryogenic treatment) to not break down into dangerous particulate, we are deeply skeptical, and would ask for proof. We also ask for assay testing over a period of at least several summer weeks. We ask for the researchers to simulate the pounding over 10 years and assess the particulate characteristics and particle size. That testing in fact is being done right now… in thousands of children across the country. Simple observation on a player body, on the sideline benches, or under a microscope shows consistent breakdown into particulate.

41. SHREDDED, PULVERIZED, HIGH SURFACE AREA FORM OF TIRES and ADD INS is LIKELY MORE TOXIC THAN WHOLE TIRES.

Unfortunately, because it is shredded, pulverized, and in loose and unencapsulated form, tire crumb has exponentially more surface area than whole tires (Thomas, Gupta study;) and we are concerned the material is very likely more toxic—possibly many times more toxic—in the school field form than whole tire form, since the increased surface area provides more opportunity for molecules to escape. We know for sure that the increased amount of surface area in tire crumb makes the material in tire crumb more available to the breathing and exposure zones, and to runoff.

42. CRUMB IS SURROUNDED BY DUST PARTICULATE:

Accurate characterization technique must include a study of the particulate that surrounds tire crumbs, and steps must be taken to make sure that the sampling process does not inadvertently remove that dust and particles. We found several examples of the samples being washed, some in unbuffered water, prior to their analyses being done. Of course, that removes the particulate that concerns us the most. Distribution of the particulate size and type is important. Those particulate can become aerosolized by numerous gases and we ask that attempts are made to properly model this dynamic under high heat conditions, primarily.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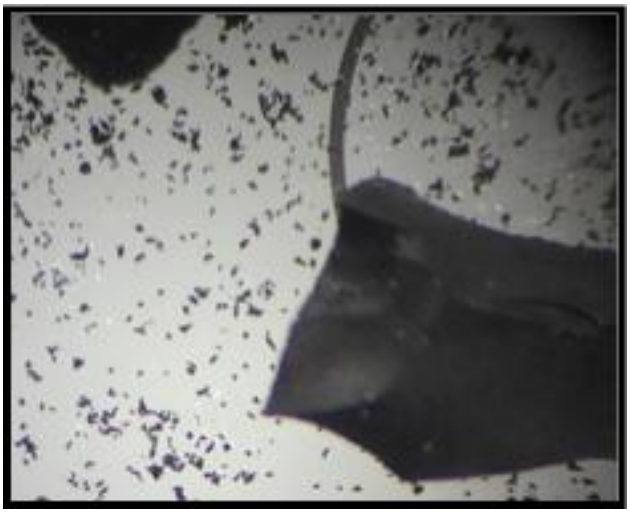

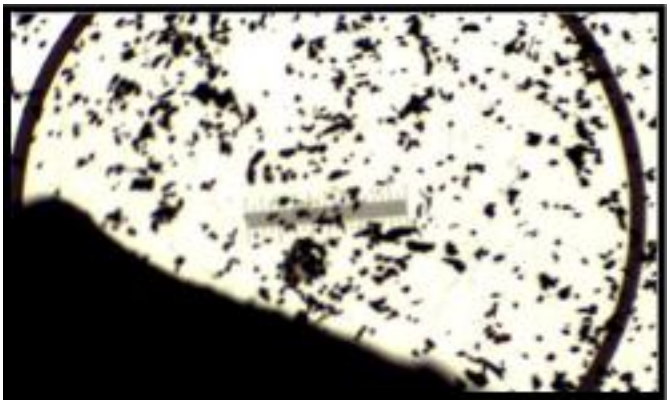

43. VERY COMPLEX PICTURE From TOXICOLOGY PERSPECTIVE: Tire crumb material is complex from a toxicology perspective, largely due to the chemical complexity presented by multiple known toxic components and variation. It has been described as a "toxic soup" of ingredients for which we have no consistent data on proportions or levels. Characterization of ingredients' margin of error is unknown.. Testing must be done at the field levels using accepted sampling plans that have been statistically shown to be valid. Not fields have been tested in sufficient detail to determine or rule out any exposures or risks. A look at testing protocols for lead in urban soil sites illustrate the level of attention required and show the degree that current testing has fallen short of that needed for decision making for children's health.

44. CONTACT PATTERNS, FIELD USE and ADJACENT BUILDING CONTAMINATION

Exposure is likely determined by ingredients in surface, activity, and number of children or users on field. Each school or community field has high use and high contact patterns, such as hosting contact sports, like football, lacrosse, soccer, and baseball, athletic camps, workshops and practices. In those sports, children dive into the field materials. As a child runs or skids or slide tackles, a column of material rises up, as does the dust and particulate that surround the tire crumbs themselves.

Testing for exposure need to list weather conditions including humidity, wind speed, and precipitation, temperature on field surface and ambient air temperature. Number of children on field, and activity level of that play needs to be recorded, video would be most interesting.

Children of all ages use the fields for multiple sports, recreation and school events. Artificial turf tire crumb fields abound in elementary schools and at indoor and outdoor sports centers where children of all ages and all stages of development play soccer, lacrosse, football, track, cheerleading, band, and use the field for general recreational school activities. In the fields with which we are familiar, families with members of all ages use the fields; and the community holds events, picnics, special fairs, and activities. Some fields are immediately adjacent to a school building.). That there are many uses, and probably many levels of contact and exposure is an important part of characterizing exposures, but both low dose exposures AND high contact exposure scenarios and use need to be examined, with appropriate epidemiological process.

45.. SCHOOL BUILDINGS AND SURROUNDING AREAS ARE CONTAMINATED with a great deal of tire crumbs. The fields appear to lose from 1-30 tons of material over their 8-10 year life, and some of it goes directly into buildings, cars, and then homes. This impact needs to be studied as an inadvertent consequence.

46. CANNOT ARGUE NO INHALATION OR INGESTION RISK or SAFETY FOR EVEN A SINGLE FIELD. We argue that given the unique characteristic of nonuniformity, known carcinogenic materials, breakdown into particulate/dust, no known source of origin, and no accurate studies on complex interactivity of those components in the children's exposure zone, in the tire crumb as it is installed today in 12, 000 fields, not a single field installer, nor material provider can demonstrate that the material is safe from inhalation and ingestion during normal use, active use, and on hot days.

47. EVERY USE COULD POSE A TOXIC EXPOSURE and it would be irrational to argue otherwise. We argue that due to the high variability of toxins in the tire crumb substrate (from tires, unknown additives, and factory waste add-ins), and lack of any control of the material, well-known sampling techniques will NOT accurately predict risks to human health.

48. CHILDREN CANNOT AVOID THE EXPOSURES: Since school children cannot self-advocate and take responsibility for staying off a field if directed to be there by coaches or school officials or parents, we must assume that children cannot avoid the exposures when they play on those fields.

49. CANNOT CLAIM THAT EXPOSURES WILL NOT OCCUR. Absolutely no way to responsibly claim that ingestion and inhalation of particulate from the material will NOT occur to those children.

50. HOTSPOTS of intermittent dangerous exposures are possible, and should be expected and searched for in every field.

We must assume that tires have different "recipes" based on their type of use. Therefore, knowing the type of tire used in tire crumb, and each tire "recipe" would be helpful in assessing characterization of

ingredients. However, there is no way to ever know what tires, or what material is in any field, and therefore, an MSDS/SDS cannot be representative of any field, or even any meaningful part of a field. Alarmingly, the high variability in the ingredients presents worrisome "hotspots" potential, where the hotspots might be missed in sampling but even a single exposure could have very serious impacts for a child who has the unfortunate luck to dive into that hotspot. PAH's may be more prevalent, and present dangerous levels for installation period of the field, and for some unknown period of time afterwards, and considered a "hotspot", then the consistent release of PAHs in the subsequent years could mean low dose, chronic exposures. Both need to be examined.

51. Lead, chromium, mercury and arsenic could be hotspot sources, based on which tires were used, and how they were treated prior to being placed in the field.

52. For example, when we asked about the source of lead in tire crumb fields, an infill vendor explained to us that a) lead could be in any field as an ingredient of the tires, of the treatment of tires, and b) once, they were aware of a shipment of tires that was treated with an anticlumping material that contained lead and the whole lot had lead, and c) that some lots had flame retardants added as well. They would never really know, but "most purchasers never ask", according to the infill material vendor. If an MSDS was required, an additional charge was to be imposed, since MSDS were not available from the materials they acquired from China or other countries. We have collected many more examples of the worrisome unknown ingredients in our fields and can share with the study teams, if requested. While this information is anecdotal, that is the point: we have no idea what is in any field, for sure.

53. Another example, but this is not anecdotal: in a primary study field exposures in CT, a researcher found that the children's monitors showed benzene. Since there is no safe level of exposure for benzene, and in fact, tires are not expected to have benzene, the field was sampled more closely, until that "hotspot" was located. The original source of that benzene was not determined, but it was next to a busy parking lot where cars' exhaust may have been a source as they turned the corner, or possibly the tire crumb material had been previously stored in an area with benzene in surrounding environment, or perhaps it was picked up from contact on roads. We will never know. That finding suggests that the carbon black in the tires can adsorb additional toxins present near tires or tire crumb, and could release that material as the fields are pounded with running feet, or possibly on a hot day.

The proper characterization of this material needs to account for adsorption characteristics of carbon black, and other interactions

54. The point is, that it is impossible to locate hotspots for all toxins in every field, and incorrect to extrapolate the risk for a whole field from a single sample or even multiple samples, since every sample is unique. So, while hotspots can easily be missed in a field, the unfortunate child that dives into that particular part of a field has an exposure that can actually be life threatening, but missed in its entirety in the sampling based risk assessment.

55. In fact, since the tire crumb creates multi sized "dust" particles, and off gases, it is impossible to prove that even a single field is safe from inhalation or ingestion exposures from tire dust particulate, off-gassing components, multiple toxins and combinations of toxins, and heat.

56. Importance of the Heat Factor: Source of direct injury and chemical catalyst

HOT HOT HOT HOT EXTREMELY HOT FIELDS

Grass playfields remain close to the temperature of ambient air, and are often much cooler. Asphalt playgrounds used to have a use limit of 141F and many schools remove children from playgrounds when temperatures get hot. With tire crumb based turf fields, surface temperatures can soar on even mild sunny days.

Tire crumb fields "superheat" to levels that are routinely over 150F on a sunny spring day, and in a recent study conducted on a sunny day Utah, found to be close to boiling point, 190F, according to the Penn State Field Turf Heat Study. The study found that tire crumb field surfaces are hotter than ambient air, and increase in heat in a non-linear function with each additional degree Kelvin of heat, hence the designation "superheating". To draw an example, on a Labor Day Weekend in DC area, with ambient temps of 82F, the field surface temperature hit 164F by noon on several fields used in a busy, tournament for about 1000 children, both boys and girls, ages 8-15. Those levels are known to melt plastic cleats, require tubs of water on the sidelines to cool down shoes, and create heat-related injury

including heat stroke, nausea, heat exhaustion, and dehydration in children and all users. It is not unusual for children players to vomit, faint, and suffer dehydration from hot conditions on the fields.

57. Marketing and sales for these fields tout their usability in all conditions as a benefit (more practice and play hours), but in fact, the heat build up on fields makes them very uncomfortable during many days and conditions. In DC, there are over 100 days of sunshine each year, and most are during the spring, summer and fall, making the fields uncomfortably hot and possibly dangerously hot for a third of a year. A calculus should be made on the percentage of safe days to play based on field yield risk, and heat.

58. Tire crumb fields do not have any protection from heat, and so they are irrigated to be cooled down, but the effect is temporary.

59. To our knowledge, there has been no well known place for doctors nor parents to report heat injury, though they are commonplace. (This author specifically remembers a hot, poor air quality day in August in 2014 in Washington DC when during a single practice, 4 soccer players vomited, another child was taken to the hospital after passing out, and another sidelined himself against the coach's wishes, due to extreme dizziness and nausea.)

60. **Reluctance to Report?** Yet, it is curiously uncommon for school teachers, coaches and parents to remove the children from the fields, due to temperature. We cannot explain that in rational terms.

We have also noted another curious effect: as football, soccer and lacrosse increase in popularity and competition in the US, competition for spots on high performance teams is fierce. There is a perception from strong sales and marketing of the fields, that the turf fields present a competitive edge for a school, a club or even a teenager trying to get into college, and are worth the high price paid. As psychologist Dr. Wendy Miller, explains, " it is a culture where high performance parents, players and schools might be willing to overlook these injuries, thinking that to complain would jeopardize their child's access to a competitive team. This thinking could easily lead to the silencing of reporting of injuries."

Heat injury reporting needs to be included in the survey questionnaires, and victims of heat injury and illnesses need to have a place to report, with impunity.

61. HEAT MAKES THE CHEMICAL DYNAMICS ABOVE A FIELD VERY COMPLEX

In addition to the serious issue of direct injury from hot playfields to young children, or anyone, the super hot fields present a very challenging chemical situation.

Dr. David Brown, ShD, toxicologist, professor and former Deputy Director of Public Health Practice Group at ATSDR/ CDC explains that, "the unintended, and largely unstudied chemical consequences of what comes off such an enormous quantity of high surface area material, in amounts and sequence that is scientifically accurate is very difficult to predict and model. Since the chemicals in the area above the field could change instantaneously, the conditions are critically important (number of players, temperature, time from last rainfall, etc.), as is the sampling methodology. But no one has been able to come close to modeling the actual yield, we only know the materials by characterization with samples, and that variation in samples is so broad as to almost be meaningless, since it could be easy to miss harmful exposures."

62. Analyzing the field yield on a hot day is very complex, and challenging to even trained toxicologists. The superheating of the fields makes gases yield at faster rates as temperatures on the tire crumb surface increases. So, as a day heats up, it is very likely that the yield increases directly with temperature increase; a hot day creates more gases. Based on well understood scientific laws, we presume that the gas yield from the field at surface temperature of 50F (a cloudy day in January in DC) would be considerably less than a field surface temperature of 158F measured last week. If more gases are escaping the surface, then there are more "opportunities" for particulate to adsorb onto the surface of the gases, creating very dynamic series of compounds, none of which would be recommended to inhale.. The changes in the chemical composition over the fields as their temperatures rise is very difficult to test and model. These changes happen in an instant… as a threshold is reached… and the exposures can increase sharply. It is a very sophisticated and difficult challenge to model. But what is the most important is not only that the 24 gases that escape tire crumb (Norway Study) create dangerous mixtures but those gas/particulate mixtures, (and air) create a vector for deep lung exposures of all the

materials in the tire crumb field. So, on poor air quality days, when there are many children on the field and a lot of stirring up of the material, the fields could present enormous risk.

63. We are concerned about the range of yield levels, but, we are most concerned about the intermittent risk to children during those hot periods (a hot, poor air quality summer day during children's soccer camp week in Washington DC, for example) when the fields are likely yielding more gas, and therefore particulate has more "carriage" into lungs, respiration rates are higher, skin is exposed, and perspiration is highest. All these are likely factors in exposure. It is during those days when exposures are probably highest, and high enough overwhelm a developing immune system.

64. Exposure Study Needs To Focus On Worst Case Conditions

We acknowledge that the level of yield from the fields might vary widely with material variation, and will also vary with outdoor weather (temperature, wind, humidity and sun) conditions. Taking averages from fields across the country will be meaningless, and will only help the industry to expand its message of "found no harm". An analogy might be to determine the health of a forest taking 4 samples from 40 locations, evenly spaced, but the sampling might easily miss a blazing forest fire. That one day might destroy living material exponentially, but it could easily be missed. Dangerous exposures can be unpredictable in this material due to the scope and scale, the toxic character, and the superheating characteristic.

65. A better approach is to carefully detect high yield days, and look THAT DAY for exposures in a child's body during those periods. Since the exposures might attenuate, the work would have to be done expeditiously. The harmful exposures may or may not be detectable a day or a month later in a child. Monitor both genders, for patterns that might lead to that awful air quality soccer camp in the city on a tire crumb field, on days when vomiting and melting shoes are commonplace. A focus on the impacts from the high end of those yields we believe will present exposures that are clearly, and unequivocally harmful from both heat injury perspective and toxicity exposure potential. We do not know for sure if the carcinogenic exposures from low dose regular exposures or from high dose "events" are more dangerous, but both need to be studied as separate situations, not as an average.

66. We urge your team to focus the study resources on primary measurements made in high use scenarios on hot days, and refrain from the approach used in earlier studies that look at chemical compositions during winter or rain conditions on limited number of fields.

67. The only reliable way to assess the risk to children from a particular field, or groups of fields, is to look at their direct exposures, and importantly look at bloodlevels of the known substances. Cooperation from both high use athletes and those exposed to chronic levels of materials will be important.

68. The Study Needs To Focus Also On Low Dose Exposure Risks

Trained immunotoxicologists look at the impacts of chronic low dose exposures to metals, PAHs, VOCs and many other materials in tire crumb. Their input is crucial to understanding risk of exposure in a developing child.

69. Characterization Mistakes

Studies look convincing, but miss the forest for the trees.

Tire recycling and tire crumb industry reports are quick to point out that when they find harmful materials in their samples, they are under the known safety limits. There are two interesting fallacies in that reasoning.

First, since the samples in several studies are few and not uniform, they fail to acknowledge the statistical significance of finding known regulated toxic material in 2 million pounds of powdered tires… if one finds the needle, is it luck, or is it because needles are more prevalent than expected?

Proof of presence is meaningful! For example, in the NY Study, PAHs were found, as were metals, benzothiazoles, and many substances. Their presence indicates a risk.

In a child's product, since many materials are not known how they affect children, just knowing they are there is enough to use a precautionary principle and prevent the exposure. Arguing that the materials

appear under a limit (especially if that quantity is an average of multiple samples), or there is no established limit (because it has not been studied), are not as meaningful as the proof of their presence.

Second, though the conclusions of the industry reports may be of no harm found/safety, a close look at the data itself on PAHs, lead, cobalt, chromium, etc. is useful, since a) it proves presence, and b) at levels that suggest risk for **chronic exposure**. Chronic exposure risk is the subject of a great deal of new cancer research, and we care about all the materials, including those which are potentially toxic.

70. ARGUMENT FOR MORATORIUM BASED ON KNOWN CHARACTERIZATION FOR TIRE CRUMB

Because of the:

a. known loss of 1-30 tons of material from the fields during the 8-10 year "life of the field" into air and water
b. ingredients list: over 50% of its components are known carcinogens and pathogens, [cite Yale Study]
c. massive scope and scale of this product, (the amount of material and surface area of these fields is enormous; scale/millions of pounds in each installation),
d. inability to control the levels of toxic exposure to children, or even properly characterize them due to immense variation and chemical complexity of what happens on a hot day over a field, and around children. We cannot suggest mitigation strategies for the danger, because the material is inconsistent,
e. Even if we did know for sure what was in each field, and suggest mitigation techniques and protections…. All the tire company has to do is change their recipe, or many recipes, as they do continually, and the study is worthless. Children are still being exposed to whatever is in the tire, the lot or that particular field..

71. Moving Target Analogy

Even if the study were completely successful, and the tire crumb material categorized properly, the trouble is, tire manufacturers could change the “recipe” for tires… and in fact they do this regularly… and the study results will be useless, or at best, diminish in usefulness.

Any attempt to study tire crumb safety on turf fields is analogous to trying to hit a moving target. Tire crumb is a waste product. Tires are not designed or intended to be used as infill for turf fields.

Ingestion, inhalation and absorption of fine particulate by children is not a consideration of tire manufacturers as they choose chemicals and compounds for their tires. Nor are they bound to maintain any safety considerations for such use by children.

So any study of present day tire crumb is a futile endeavor, because such study tells us nothing about a field that gets installed immediately after the study. Tire manufacturers often change the chemical composition of tires and will likely do so again.

Even if a field passed safely concerns in a present day study, a new field could easily fail a hypothetical study conducted the day after the present study. So unless every field was tested using the exact same methodology after every installation, there is absolutely no way to assure the user that their new field is safe. Those new fields could easily have an entirely different chemical composition simply because tire manufacturers changed their tire ingredients.

So the present Federal Study is only a backwards looking study, not forward looking. Any conclusion must be transparent and clear on that issue - upfront and center. Otherwise the public is being misled into a false sense of security.

72. **Sampling: Not Appropriate For Tire Crumb**

The core pediatric toxicology problem in industry based safety studies, is that there appears to be an assumption that tire crumb is a uniform material, and behaves uniformly. It does not. There also appears to be an assumption that sampling will be an accurate method for studying tire crumb risk to children, and it is not. **Sampling will not be accurate to assess a nonuniform, heterogeneous material with multiple known toxic ingredients, high direct contact (dermal, hand to mouth, breathing zone) for pediatric use**. **Sampling cannot produce a single sample that is representative of the whole field, or even a part of the field, other than the sample itself.**

73. Methodology needs to study PERFECT STORM exposure conditions, and be able to calculate exposures during those relatively dangerous days.

Nor can sampling in the way it is proposed (samples from 40 fields across the US), illustrate impacts from a perfect storm of exposure conditions on a particular field, say, during an intense soccer camp in in summer in Washington, DC with high ambient and field surface temperatures (ie 160F), bad air quality, no wind, when working athletes are breathing in particulate with high VOC, PAH, benzothiazoles, and carbon black… and many more compounds, on a particularly high yield day. Averages cannot be relied upon in sampling for this type of product, since they will further obscure the risk from exposures to hot spots of high risk material that are on fields. Averaging the results from a national distribution in various weather conditions simply obscures the acute risks further; it is useless for risk analysis. In layman's terms, it is like studying a forest using "x" number samples, but missing the forest fire that is blazing away at a nearby area of the park. For a child, it means that she plays on a field that was called "SAFE TO PLAY", after sampling, but in fact she might easily have been covered with multiple materials known to cause cancer, and in fact, that might be a regular event. The uncertainty of exposure frequency makes the risk higher, not less.

74. The core of the methodology used in the 50 studies asserted by the tire recycling industry were based on simple characterization of a single sample, but not on realistic, combined, nor worst case (the most important) use scenarios.

75. Multiple carcinogen and multiple pathogen combined effects need to be measured. Single material measurements could be only a fraction of the exposures, since the material exposures are likely to be from combinations of materials.

76. BIOMONITORING FRONT AND CENTER

Because sampling presents inconclusive results, a methodology that relies on biomontioring will be more meaningful. We suggest that more sophisticated approach be considered. Personal sampling monitors attached to children, dermal, urine, breathing analyses, and particularly, blood and tissue samples from frequent users, players on "Perfect Storm Days" and those expected to have chronic low dose exposures. We understand that biomonitoring raises more issues, but absent a good model, empirical data is the most reliable way to accumulate actual evidence of exposures and to be able to establish a reliable causal link to the cancers and diseases we predict from exposures.

77. IMMUNOTOXICOLOGY SUPPORT: RECRUIT THE BEST PEDIATRIC IMMUNOTOXICOLOGISTS AND RESEARCHERS. Some researchers and epidemiological professionals are already on the trail of better ways to identify actual exposures, and can create biomarker groups as indicators of presence of illness or exposures. These researchers have background in immunological toxicology, and can track subtle changes in an immune system that might be precursors to serious disease, like cancer, kidney disease, brain changes, and lung disease. It is possible to create biomarker group to prove tire crumb exposures in users and we believe that the preliminary proof of concept step could be accomplished in less than 6 months with cooperative athletes, and study volunteers, and modest budget. While we will not list them here, for protection of their privacy and frankly, for fear of industry retribution, we will nonetheless let you know that we have found multiple professionals who are capable and willing to work on this task, provided a protective forum and IRB standards are in place.

78. Immunotoxicology support: look carefully at the ages those immune system markers in all children who are using these fields, understanding that some metabolic types, and ages may be more

vulnerable than others. In fact, there are early indications that certain age groups, such as prepubescent females (age 8-11), may be more vulnerable to exposures to benzothiazoles, plastics, phthalates, and endocrine disruptors in general, and therefore might be at higher risk to contract cancer or disease from low dose particulate exposures from tirecrumb, and the plastic "grass" carpet particulate. We need to establish the datum from players to study this. We still do not know, but some indications exist. For that reason, we respectfully request that the study team include toxicologists and epidemiologists that are trained to keep these concepts front and center.

79. LOW DOSE EXPOSURE CONCEPTS and CONCERNS

Based on what we know now about low dose exposures to VOCs, PAHs, benzothaizoles, styrenes, carbon black, plastics, plasticizers, and metals, even at low, sub acute exposures, the fields could be very dangerous. That possibility was not considered in the CPSC study, EPA study, nor in mulitiple industry studies. These need to be assessed:

- Chronic exposure to metals, plastics and plasticizers
- Chronic exposure to carbon black mimics air pollution exposures
- Immune system reactions
- Endocrine disruption exposures from plasticizers and phthalates,
- Exposures from multiple low doses and chronic exposures

80. The study should calculate yield of material that leaves the fields, and how it leaves the fields. How much in the air , water pathways, and with users (in shoes, cars, etc.) Interviews with schools and vendors need to establish the replacement quantities of these fields, and how often new material is put into place, since it would affect exposures, and give an indication of gross yields. We estimate that the fields lose from 1-30 tons (estimated) of material, so exposures and impacts need to be measured in adjacent buildings, soils, and stormwater systems. With 12,000 existing facilities, this may need to be the subject of additional studies conducted to also assess if the fields shall be regulated as point source contamination under Clean Water Act and Clean Air Act. It is a very important metric, and a perfect opportunity to include it, with little incremental cost, in your study.

81. INTEGRITY STANDARDS. To track the history of the emergence of this product is to track effective lobbying for regulation changes that favored the tire industry, and the tire recycling industry. This industry took advantage of an enormous quantity of recalled and used tire stockpiles, and heavily sold and marketed the materials to schools, and sports centers where millions of children play. Central to the steps that catapulted this industry forward was the removal of the designation of artificial turf fields as children's products, based on the rationale that adults played on them, too. Yet the fields continue to be sold to elementary schools and to sports centers brimming with elementary, middle and high school players. The sales oriented industry was willing to submit children, schools and communities to the materials in tires in enormous amounts, and call them safe. As this claim is deeply questioned now, we also urge you to NOT allow the sampling or data collection to be conducted by an interested party, including schools, sports centers, athletic group personnel or administrators, field installers or laboratories or consultants hired by those groups, and establish peer reviewed standards for testing.

82. Any group or individual who does participate in the study, including regulatory staff, needs to sign an affidavit certifying that she or he, and her/his group has not received compensation or benefits in any form, including but not limited to sales commissions, direct payment, compensation, bonuses, grass to artificial turf grant, field financing, water savings rebates (State of California and possibly others), or physical benefits including but not limited to uniforms, facility enhancements (restrooms, concession stands, parking lots, storage facilities, etc.), stadium components, or field equipment of any sort, from the field installers or tire crumb field industry and its assigns, and has no financial conflict of interest. The document should be filed with an appropriate agency and made public.

83. We ask for full transparency on all parts of the study process for parents, interested parties, and schools.

OUR REQUESTS TO ASTDR/CDC/CPSC/EPA	
Request	Background
1. Regulate tire crumb and rubber mulch as children's product	PEER filed formal request; 12,000 fields x 30,000 tires is the amount of existing material in children's use; see table A for details on volumes and surface area sizes, children/schools. Known carcinogenic material and known

	contact.
2. Remove "safe to play, safe to install" or any other references that imply safety from all EPA, CPSC and CDC websites and public information sources	PEER Formal Request; agencies must remove all endorsements of safety.
3. Place all PEER artificial turf filings in Federal Record	**http://www.peer.org/campaigns/public-health/artificial-turf/news-releases.html**
4. Issue a directive to public health agencies to disseminate warnings regarding unknown risks from lead exposure from AT fields, as well as exposures to carbon black, known carcinogens, PAH, VOCs into air and water pathways; direct hospital systems and medical systems to screen for tire crumb field use, and report results	For parents, schools, athletic groups, and communities; conduct parent outreach webinars
5. Use only independent lab or consultants unassociated with tirecrumb industry, adhering to high ethics guidelines; transparent process for review; affidavit of no conflict of interest	
6. Commission a primary study, conducted by independent, peer reviewed group such as CDC to examine existing cancers AND illness in tire crumb field users and maintenance workers of tire crumb fields	
7. Mandate Cal Recycle Study corrections to methodology; mandate methodology peer review; and mandate to impose Prop 65 rule based on OEHHA's own findings on carcinogenic exposure	
8. Convene a conference for presentation of risks and concerns from parent groups, cancer survivors to Federal Research Team	Needs participation from CDC/CPSC/EPA staff so parents and public can have direct contact
9. Convene series of webinars and open comment opportunities	
10. Allow public health and environmental advocacy groups in Federal Research Team with complete transparency	
11. Establish a collection point for recording experience of victims and those who may have suffered injury from use of the fields, including heat injury, concussion or head trauma, cognitive disorder, illness, and cancer for study and documentation; victim hotline; for both child and adult contact with fields	
12. Funding to identify potential biomarkers of exposure; conclusive marker study in users	
13. Conduct blood monitoring and studies on existing cancer survivors.	
14. Conduct cancer cluster study on soccer player cluster, and identify additional clusters such as maintenance workers and installers	
15. Provide full transparency with all interested parties	
16. Conduct full epidemiological study of tire crumb on playfields existing and predictive	
17. Study forms and questionnaires should include data collection on what is released from fields into air, adjacent areas, water pathways, and quantified. Replacement quantities for tire crumb fields should be quantified and examined as a metric that indicates yield.	
18. Based on release/yield figures, and other inputs, tire crumb fields should be evaluated for compliance with Clean Water Act and Clean Air Act, and regulated accordingly.	
19. We request that OEHHA study methodology be peer reviewed by your agencies before it begins, taking into account the comments received in this proceeding.	
20. OEHHA Study Process and Methodology Concerns: How will those be considered?	
21. Consider explicit protection from retribution steps be put in place to protect researchers, players, and concerned parents from retribution	

PUBLIC SUBMISSION

As of: 5/3/16 6:44 PM
Received: May 02, 2016
Status: Posted
Posted: May 03, 2016
Tracking No. 1k0-8per-4adj
Comments Due: May 02, 2016
Submission Type: Web

Docket: ATSDR-2016-0002
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ

Comment On: ATSDR-2016-0002-0003
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill ATSDR-2016-0002

Document: ATSDR-2016-0002-0080
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ Comment on FR Doc # 2016-03305

Submitter Information

Name: Amy Stephan
Organization: Safe and Healthy Playing Fields Coalition

General Comment

Thank you for the opportunity to comment on this important proceeding on behalf of the Safe and Healthy Playing Fields Coalition we respectfully submit our comment and supporting material in the attached document. We hope to have the opportunity to provide additional comments and participate directly in this important study.

Attachments

SHPFC FINAL ASTDR 2016-0002-0003Comments

Comments on ASTDR 2016-0002-0003
Federal Research Action Plan on
Recycled Tire Crumbs Used on Playing Fields and Playgrounds
Submitted to Federal Register May 2, 2016

SAFE AND HEALTHY PLAYING FIELDS COALITION
www.safehealthyplayingfields.org
A grass roots coalition working for healthier alternatives for children and communities

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INTRODUCTION

On behalf of the millions of children, parents and athletes who play field sports in the US at schools, parks, athletic facilities and playgrounds, thank you for agreeing to study the potential harm caused by playing on or being near athletic fields with surfaces made waste tires. There are more than 12,000 of these playfields in place (15,000 according to the website of a large company that installs them), and they are being installed at a rate we estimate to be about 3000 a year. By our calculations, 12,000 fields currently present 2,380,000 tons or 4,760,000,000 pounds of loose, unencapsulated tire crumb on their field surface. (See our Table of Runoff and Material Volumes attached.) Tens of thousands of students and young athletes play on those fields, many more thousands have direct or indirect contact with the material. It is a public health issue of substantial importance.

The following lists our comments on the proposed study. We argue that the fields present known carcinogenic, neurotoxic, and endocrine disrupting material in a high surface area, pulverized form that is more toxic than whole tires, and should never have been allowed near children, or adults,

because of risk of ingestion and inhalation exposure to all the ingredients in tires. On warm, sunny days the surface temperature routinely reaches over 150 F, which presents direct, well-known heat injury risks to children. The heat increases off-gassing of the tire components, increasing the likelihood of pulmonary exposures, and creates a complex dynamic in the children's exposure zone immediately above a field that has not been correctly modeled or studied yet. The material lacks uniformity, or any regulatory or exposure controls. We assert that it is impossible to assure even a single tire crumb field is free of inhalation and ingestion risk of dangerous particulate and gases inherent in tires, tire crumb, and add-in composites; and that dangerous and unwanted exposures from lead, benzothiazoles, carcinogens, phthalates, carbon black and other harmful substances, can happen with every use. The data gaps are enormous, and we hope CDC/CPSC/EPA will recognize there is no way the tire crumb industry can protect any player, on any field, from the potential for dangerous exposures with normal use. We argue that not enough scrutiny was placed on this material.

NOTE: The Safe and Healthy Playing Fields Coalition is a grass roots group of parents, coaches, scientists, public health professionals, toxicologists, neurobiologists, educators, researchers, plastics engineers, medical doctors, waste management and remediation professionals who donate their own time and skills towards helping communities and individuals assess risks to their communities from tire crumb field use. We do not have a lobbying firm, law firm, hired laboratory, consultant, or revenue-generating source (such as tire crumb), and rely solely on the skill of researchers who donate time to compile our comments. That said, we have found compelling data that refutes almost all claims of safety, and when we asked for additional time to compile the information, we were given two weeks, but denied additional time. Hence, we are working at a

disadvantage, and hope that during this study year, we will have time and opportunity to substantiate our concerns, and share our research with the study officials. One of our comments below explains our requests for a conference or virtual meeting that allows more disclosure and discussion.

Our comments are listed numerically and organized into: 1. General Comments, 2. Characterization and methodology comments; 3.Summary List of requests. A number of supporting documents are also submitted as part of our comments.

PART I: GENERAL COMMENTS:

1. CPSC/CDC/EPA should use their existing authority to immediately enforce regulations on tire crumb playgrounds and athletic fields as a children's product, since thousands of fields have been installed in child-care facilities and schools that serve hundreds of thousands of children.

2. We have grave concerns about their safety to human health and the environment, since **known harmful components in the field material are released into both air and water pathways, and provide ample opportunity for both acute and chronic low to high dose exposures with every use of the field to known toxics such as lead, chromium, mercury, zinc, PAH, VOC, carbon black, styrene, benzothiazoles, and plasticizers. Intermittent 'Hotspots' of high levels of toxins such as lead are of particular concern for exposure.** (See comments on Characterization). Every tire crumb playground and synthetic turf field has material that is known to cause cancer, illnesses, and injury in humans; and leachate from runoff causes several negative impacts on the aquatic ecosystems. We believe that the potential for human illness (including

several cancers) from both low dose and high dose exposures to the ingredients in tires is staggering. Based on the known potential for exposures to children, and the finding of a group of now over 200 soccer players with cancer (the group represents the reach of a single soccer coach, implying that this group may be the 'tip of an iceberg' of affected individuals), an immediate moratorium on new construction of the fields should be put in place with the existing authority of CDC/CPSC/EPA, until the tire crumb fields can be shown to be safe to inhale and ingest.

3. **The tire crumb recycling industry, which appears "green" in its efforts to sell millions of used tires in "repurposed" shredded form, in fact enables a direct transfer of the contamination burden of waste tires from landfills/collection sites (in the US and abroad) to the play surfaces of 12,000 schools and sports centers, where tens of thousands of children and adults have direct contact with the toxins in tire crumb materials on the field surface, and *these exposures could happen with every single contac*t.**

4. For the most part, the **schools and sports centers do not have resources to conduct toxicity due diligence;** meaning, they do not have access to a toxicologist who reads the industry studies with their health as the only priority. Purchasers rely on the tire crumb recycling industry statements, industry studies, and industry funded websites that claim toxicology assessment and public health guidance. The sales material can be striking, and the studies appear convincing on the surface, but our study groups have found significantly misleading information about the safety and actual risk of harm from the tire crumb fields to all users, particularly children. They are likely unaware that the previous CPSC claims that the fields are "SAFE TO INSTALL; SAFE TO PLAY ON" have been repealed.

5. **PEER Filings**. Public Employees for Environmental Responsibility have filed a number of complaints and documents that argue for a repeal of endorsements of tire crumb safety from EPA/CPSC, and those statements were in fact repealed; but most schools and potential purchasers are unaware of the removal of endorsements and claims of safety. The PEER filings are an excellent source for telling the toxicity story and regulatory story of this product. We respectfully request that the entire file of complaints and responses to the complaints, and other supporting material be entered into the record for ASTDR 2016-0002-0003.

The full list of documents for the ASTDR 2016-002-0003 collection and record can be found here: http://www.peer.org/campaigns/public-health/artificial-turf/news-releases.html. Please include all in that list, and all supporting materials.

6. Formal legal requests have been made to classify the tire crumb fields as a children's product since children use them, and sales and marketing material are very clear about tire crumb fields are for children. **CDC/CPSC/EPA should use their existing authority to explicitly label the fields as children's products.** (Please refer to PEER filings for details and supporting arguments: **http://www.peer.org/campaigns/public-health/artificial-turf/news-releases.html)**

7. CLASSIC CANCER CLUSTER APPEARANCE: SOCCER PLAYERS

Parents and schools may have trusted the "Safe to Play" statements, **but the parents of the 200 young women and men, who played intense soccer and were stricken with cancer do not trust those claims anymore.**

The case of over 200 young soccer players who used tire crumb fields and contracted cancer, strongly indicates a classic cancer cluster, though the cases have not undergone the formal validation process yet. That is because a process for the collection of this information, does not exist yet for either cancer victims, or for other illnesses, head injuries, and heat injuries/illness from the fields.

8. We respectfully request that an official study of the soccer player cancer cluster be initiated by CDC immediately.

Through our activist network, we learned about these cases, which were reported to the NBC news link, or directly to a single, trusted concerned soccer coach. EHHI reported as follows:

_____

"New Cancer Numbers Among Soccer Players on Synthetic Turf,
April 2016

It is important to remember that the only people counted in the numbers below are those who have known to call Amy Griffin. There is still no government agency tracking the cancers among the athletes who have played on synthetic turf. We know the actual numbers of athletes who have played on synthetic turf and contracted cancer have to be much greater than those who have known to report their illness to Amy Griffin.

In January of 2016, there were 159 cancers reported among soccer players; now (April 2016) there are 166. Ninety-seven of those in January were goalkeepers; now there are 102. Sixty-one percent of the soccer players with cancer are goalkeepers. As of this writing, 220 athletes of various sports who have played on synthetic turf have cancer; 166 soccer

players who have played on synthetic turf also have cancer.

166 Soccer Players who have played on synthetic turf and have cancer

- 102 are goalkeepers (61% are goalkeepers)
- 64 soccer players with lymphomas, 39 are goalkeepers (61%––over half are goalkeepers)
- 10 soccer players with Non-Hodgkin lymphoma, 7 are goalkeepers (70%––over half)
- 54 soccer players with Hodgkin lymphoma, 32 are goalkeepers (60%––over half)
- 41 total leukemias, 24 are goalkeepers (59%––over half)
- 16 total sarcomas, 7 are goalkeepers (44%)
- 12 thyroid, 9 are goalkeepers (75%––over half)
- 11 brain––5 are goalkeepers (45%)
- 9 testicular––6 are goalkeepers (67%––over half)
- 4 lung––3 are goalkeepers (almost all are goalkeepers)

Remaining are OTHER rare cancers."

Source: Various; Victim parent volunteers, EHHI primary collection; 4/2016 (ongoing) _____

All the victims were frequent users of turf fields, spending multiple hours a week in close contact with the material in the fields. All were in their mid-twenties or younger.

9. The self-reporting to a trusted coach, is also an indication that the actual illness rates are not yet being properly assessed or managed by any hospital, medical system, or group; there is no "home" for this information, yet. The 200+ cancer victim count is likely the reach of a single coach with the help of a link in broadcast media, and a fraction of the

actual count of victims of cancer or other serious illnesses. Better investigation and creating a "safe" place to report serious and intermittent illness will uncover many more victims, and provide needed perspective on the accuracy of risk assessment for this product.

10. The CDC and appropriate agencies should issue a directive asking for adequate screening for injury and disease. That US hospital and medical systems are not yet set up to collect this data is a contributing factor; and concurrently, screening for synthetic field use should be part of a responsible screening protocol. To our utter dismay, we learned from pediatric oncologists in our group that at least some oncologist are prohibited from screening victims/patients for tire crumb field use; the screening must be part of the approved protocol, and tire crumb product is not yet included..

11. In fact, the number of **all injuries from tire crumb fields should be collected and analyzed to include, but not be limited to: head injury and concussion; joint injuries (multiple); heat injury; blood cancer; lymphomas; testicular cancer; pulmonary illness; neurological impairment; kidney disease; diabetes; brain disease and cancers. These findings need to be documented, and the children who suffer from them should be screened for tire crumb field use and proximity.** No doctor or oncologist should be prevented from asking questions, screening for, or questioning the safety of this product or contact with this product. We believe there are many more heat related illnesses, head injuries, and endocrine system disruptions directly resulting from exposure to the fields than what is being reported.

12. REQUEST MORE INVESTIGATION INTO EXISTING AND POTENTIAL CANCER CLUSTER: We ask that the multiagency group takes steps to

expedite the process of collecting epidemiological data and verification of the current soccer player cluster, and other potential clusters, to include field maintenance workers who rake the fields, field installers who pour the millions of pounds of material onto field surfaces, school custodians, high contact users of any kind, and school children in buildings adjacent to the fields. Residences near the fields should be considered in the scope of the study or subsequent studies. **In our own informal assessment, and using the SEER database and known levels of cancer victims, we found the potential for 7-11 cancer clusters.** We respectfully ask the CDC experts to look into this possibility and take the necessary steps to prevent additional injury and cancers.

13. NEED FOR EXPLICIT PROTECTION FROM RETRIBUTION: Sadly, the families, coaches, and school leaders who have reported illnesses do so with concern for **retribution from the tire crumb industry, school boards, university administrations, and even sports league administrators, and may need explicit protection and remedy against retribution.** Researchers who study the potential for harm tell us that they do not have protection from retribution from tire crumb field industry proponents. Public health and medical professionals sometimes make statements of concern anonymously to protect themselves from retribution––professionally and personally from industry proponents. Adequate protections need to be established to protect the professionals and parents who speak out.

14. PROTECTION FOR CHILDREN IS NOT A COST-BENEFIT ANALYSIS. Children have a unique vulnerability to toxic exposures––both intermittent high exposures––and to low dose exposures, and if we are aware of a carcinogenic presence, then we are responsible for using a precautionary principle, and removing that exposure risk. With due respect, this is not a

cost-benefit analysis that will show a percentage of children will get sick (cost) vs. tournaments played or jobs created (benefit). It is a decision made by a civil society that upholds protection for children's health above all other industry priorities, and a recognition that tens of thousands of children, if not hundreds of thousands, are already being exposed to material with known carcinogenic, and harmful materials on school turf fields.

15. The CDC/CPSC/EPA should recognize that the fields serve children, acknowledge that there are zero safety controls on the material and the potential exposures, and immediately acknowledge tire crumb fields as children's products, and use your existing authority to regulate them as children's products. **Therefore, we emphatically REQUEST THAT THE CPSC/EPA/CDC USE EXISTING AUTHORITY TO IMMEDIATELY CLASSIFY ARTIFICIAL TURF AS A CHILDREN'S PRODUCT, SINCE THOUSANDS OF CHILDREN ALREADY USE THE FIELDS, IN THOUSANDS OF SCHOOLS.**

Since children and adults are already being exposed on tire crumb fields to the materials in tires, we ask for an **immediate moratorium on further construction of tire crumb based or recycled rubber based artificial turf fields** until adequate assurances that tire crumb particulate, off-gassing, and combinations are safe for children to inhale and safe for children to ingest.

Your three agencies do not need to conduct a study to know with absolute certainty that tires were not designed to be inhaled by children, and we should protect children, at any length, from chronic or lose dose carcinogenic exposures.

Even if we cannot model or know (or will we ever know) the exposures to each child, each day (and we will never know), we do know with certainty that:

1. Carcinogens are in tires.
2. Shredded, pulverized tire crumb contains everything in tires, and more ingredients, including: carbon black, phthalates, VOCs, PAHs, benzothiazoles, lead, chromium, zinc, nanoparticle additives, proprietary additives, 12 known carcinogens, 90 materials known to be harmful to human and environmental health, (EHHI)
3. The material can be inhaled when playing and ingested with contact, or intermittent adjacent contact.
4. Every single direct or indirect use has the potential for exposure to hotspots and low dose chronic exposures to multiple scenarios of these materials.
5. The exposures could impact children, school buildings, and surrounding areas; contamination travels to cars, homes, and even children's bedrooms.
6. It is both within the authority and the responsibility of your three agencies to take immediate action to protect the public, especially children, from known carcinogenic, pathogenic exposures.

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Only a complete moratorium on their use will protect the millions of children, athletes and bystanders from inhalation and ingestion of the materials that yield from tire crumb synthetic turf fields.

16. It is also evident that tire crumb will never be safe unless ALL tire ingredients, all "recipes", the manufacturing of tires, and then preparation of materials for fields are controlled from a toxicity perspective. This level of voluntary cooperation from the tire manufacturing industry will, of course, never happen.

17. ONLY UNIFORM MATERIAL SAFE TO INHALE AND INGEST IS APPROPRIATE FOR SCHOOL FIELDS ; UNTIL THEN, A MORATORIUM. When the play surface material is uniform, consistent, and controlled, when it is tested by an adequate study with pediatric toxicology assessments to be safe for ingestion and inhalation, and results are peer reviewed following IRB standards, then we may consider a synthetic turf field might be safe. Until then, tire crumb should be rejected from any casual or unnecessary contact with children or adults.

18. RECONSIDERATION: A reconsideration of the moratorium could occur when the industry can demonstrate a uniform, non-carcinogenic, non-inhalable, non-ingestible alternative that does not present PAH, VOCs, phthalates, lead, chromium, mercury, 1,3-benzothiazoles, butadiene, styrenes, carbon black (in particulate, gaseous form, or any form to children); and the product undergoes strict, peer-reviewed study by independent qualified toxicologists who have a mandate to protect children's health and the health of the environment above the interests of industry. The hypothetical product should be subject to regular reviews and quality control determinations to ensure safety over the life of the synthetic field. Safety Data Sheets should be provided and accessible for every user. If waste tires are used, the controls requested above will never be possible, since the tire material, by definition, is a composite of many toxins in unknown quantities and with unknown impacts.

PART TWO: CHARACTERIZATION OF TIRE CRUMB COMMENTS

1. SCALE AND SCOPE: Tire crumb potential to individuals, buildings, surrounding areas and stormwater for contamination is enormous.

2. PUBLIC HEALTH ISSUE: SCALE AND SCOPE CONCEPTS

The potential for contamination from tire crumb is a growing public health issue, in terms of the relative size of the product and its mass; the total number of potential fields; and their basic contact with students, athletes, school personnel, buildings, communities, and streams/storm water.

To give an idea of the existing volumes of material, the field runoff and children affected or who may be affected, we have developed reference tables, and the summary is attached to this filing These tables indicate the scope and scale, and demonstrate that these are not isolated fields, nor tiny exposure potentials. The quantities of material are enormous. The source and reasoning is explained, but the tables are designed for your model development and quick reference.

3. ENORMOUS QUANTITIES ON EACH FIELD SURFACE .

To give an idea of the scale, a modest soccer field uses 30,000 waste tires. According to a randomly selected company selling packaged tire crumb infill for original or replacement treatments, 30,000 tires makes about 396,667 pounds of lbs of material. According to our calculations, the volume for 2" thick field is about 525 cubic yards, However, a large football field, three times the size of a small soccer field, could use 1,000,000 pounds of tire crumb material.

4. The tires are shredded, pulverized into crumb of various sizes, and the shredded material is poured on top of a plastic "grass" carpet. Importantly, the material is loose, unencapsulated and can loft into the air when struck by a ball or foot, or body. We estimate that, depending on the school, each field has regular, daily contact with at least 1000 athletes and students. At

sports events, busy tournaments, or with active use, a field can have contact with many, many more.

5. No fields we found have mandated capture of the leachate or particulate at the field.

6. TOTAL FIELD VOLUMES POTENTIAL:. The universe of potential tire crumb playfields is approximately 200,000 - 220,000 schools and athletic facilities in the US, based on number of schools. The potential reach of exposure from use of these fields is in the millions of children, millions of adults, hundreds of thousands of exposed buildings and adjacent soils, and hundreds of thousands of public easements and storm water access points (we estimate 1:1 ratio for field to point source drainage).

7. TABLE RUNOFF AND VOLUMES: SUMMARY OF KEY METRICS

For reference, we analysed fields by sport type, by Metropolitan Service Area, and calculated the volumes for rainfall (by city), and for amount of tire crumb material on a field surface.

Key metrics are the following:

- Estimated tire crumb per 85,000 sq feet field and 2" deep tire crumb infill is 525 cubic yards, 396,667 pounds, or 198 tons per field.

- **The total amount of tire crumb material on surface of 12,000 fields is estimated to be 6,296,296 cubic yards, or 4,760,000,000 pounds or 2,380,000 tons** that are currently in sports centers and schools in April 2016..

- **Runoff is calculated by city and field size, but the total runoff for fields in the top 50 MSAs is 15,006,99,787 gallons.**

- **Total Runoff for** 12,000 fields based on number of fields per MSA, accounting for rainfall in that MSA, and added together for 2016 is: **23,370,639,827 gallons**… for a single year.

The calculations were made to illustrate the scale and scope of this product, and to characterize the reach of exposures from the field surface into the airway, and into the water pathway.

8. INGREDIENTS IN TIRE CRUMB: Lack Of Uniformity, High Variation, Multiple Toxins

Tire crumb appears to be a composite material, heterogenous with multiple known carcinogens, pathogens, and mutagens. The material is not uniform, comes from multiple sources and lots, and can be mixed with plastics and materials of unknown origin. The material can have anticlumping agents, flame retardant additives, paint, and strengthening or characteristic enhancing additives. Shredding of tires can cause small pieces of steel or metals to be included in the material from steel belted tires. Some tire crumb is from newer depositories from recalled tires, some from landfills, and some have been subjected to a variety of weather and conditions. Leachate and off gassing could be variable, with the expectation that newly installed/poured material off-gassing is higher than from an older field, but we expect those rates would vary with the age of the tires from which the tire crumb was made.

9. HETEROGENEOUS, MULTIPLE TOXINS, UNKNOWN ORIGIN: To say that tire crumb infill comes from multiple sources, is an understatement: dispensaries, landfills in the US, landfills abroad, collection centers, factory waste from China, factory waste from the US and abroad. Some of the newer marketed blends included multi colored sport shoe waste, shoe factory waste, and many unidentified synthetic materials. Just as tire companies may add anything to their "recipe" for a tire, an infill provider may offer materials that could have anything added into the blend. Tire plugs, tire polishes, tire coatings, and materials picked up on the roads should be considered. And even if it is known that there are only tires in the blend, there is a broad variation in the ingredients based on the use of the tire, and the manufacturer. Those tires may look the same, but from a toxicity standpoint their variation and the unknowns in the "recipe" create a margin of uncertainty that makes any claim of known safety for inhalation or ingestion impossible. If a vendor says he or she knows what is in a lot of tire crumb, and that is known to be safe, then they ignored the materials in the product. Since we never know what is in any field for sure, and if we know that they have tire crumb, they cannot be demonstrated safe for children to inhale, ingest, nor play upon.

10. What Is In Tires? SOME GROUPS WENT LOOKING

Since it was difficult from MSDS or any other source to identify the components in tires or tire crumb, some groups studied them directly.

11. Environment and Human Health Inc, and Yale University Study

EHHI, Inc. in cooperation with Yale University studied samples of rubber mulch, and new tire crumb with the intent of characterizing their ingredients.

The summary text of their characterization study is found here:

http://www.ehhi.org/turf/metal_analysis2016.shtml
http://www.ehhi.org/turf/findings0815.shtml

The EHHI/Yale Study list of components found is explained this way:

The shredded rubber tire playground mulch samples tested were provided by the manufacturer and were purchased in new bags of rubber mulch for use in gardens and playgrounds. The rubber tire infill for synthetic turf fields was obtained as new infill material from installers of synthetic turf fields. There were 5 samples of infill from 5 different installers of fields and 9 different samples of rubber mulch taken from 9 different unopened bags of playground mulch.

RESULTS There were 96 chemicals found in 14 samples analyzed. Half of those chemicals had no government testing on them - so we have no idea whether they are safe or harmful to health. Of those chemicals found that have had some government testing done on them these are the findings with their health effects.

TWELVE (12) KNOWN CARCINOGENS

2-Mercaptobenzothiazole/ **Carcinogen**, toxic to aquatic life

9,10-Dimethylanthracene/ **Carcinogen**, respiratory irritant and can cause asthma

Bis(2-ethylhexyl) phthalate/ **Carcinogen**, may cause damage to fetuses

Fluoranthene / **Carcinogen**, Fluoranthene is one of the US EPA's 16 priority pollutant, A PAH.

Heptadecane/ **Carcinogen**

2-mercaptobenzothiazole / **Carcinogen**

Phenol, 4-(1,1,3,3-tetramethylbutyl)/**Carcinogen**

Phenanthrene/ **Carcinogen** - A PAH

Phthalimide/ **Carcinogen**, skin, eye and lung irritan. A Fungicide

Pyrene, 1-methyl- /**Carcinogen**

Tetratriacontane /**Carcinogen**, eye and skin irritant. Can cause systemic damage to central nervous system.

Pyrene/ **Carcinogen,** toxic to liver and Kidneys, a PAH

Carbon Black/ **Carcinogen**

Carbon Black makes up to 20% to 30 % of every tire. It is used as a reinforcing filler. Carbon Black is listed as a carcinogen by the International Agency for Research on Cancer (IARC).

Carbon Black, as such, was not analyzed by the Yale Study because Carbon Black is made up of a number of chemicals – some of which were found in the Yale study.
Carbon Black is not one chemical -- it is made up of many chemicals - often of petroleum products. Furthermore, carbon black has no fixed composition, even of the many compounds it contains. Carbon black from different sources will have
differing compositions. In our method, carbon black will register as a series of substances extracted from it. There is no carbon black molecule, it is a mixture.

TWENTY (20) KNOWN IRRITANTS

1,4-Benzenediamine, N-(1,3-dimethylbutyl)-N'-phenyl-

Irritant - causes skin and eye irritation, toxic to aquatic life

1,4-Benzenediamine, N-(1-methylethyl)-N'-phenyl-

Irritant - causes skin and eye irritation, toxic to aquatic life

2(3H)-Benzothiazolone

Irritant - causes skin and lung irritantation

2-Dodecen-1-yl(-)succinic anhydride

Irritant - causes eyes, skin and lungs irritation

3,5-di-tert-Butyl-4-hydroxybenzaldehyde

Irritant - causes irritation to eyes, skin and lungs.

Anthracene

Irritant - causes skin, eye and respiratory irritation. Breathing it can irritate the nose, throat and lungs causing coughing and wheezing.

Benzenamine, 4-octyl-N-(4-octylphenyl)-

Irritant - causes eye and skin irritation

Benzenesulfonanilide

Considered hazardous, very little testing has been done on it.

Benzothiazole, 2-(methylthio)-

Irritant - causes Skin and eye irritation.

Dehydroabietic acid

Toxic to aquatic organisms

Docosane

Irritant - causes Skin irritation

Hexadecanoic acid, butyl ester

Irritant - causes eye, skin and lung irritant. Can cause reproductive effects.

Methyl stearate

Irritant - causes eye, skin and lung irritation.

Octadecane

Irritant - causes kin, eye and respiratory irritation

Octadecanoic acid also known as Stearic acid

Irritant - causes skin, eye and respiratory irritation

Oleic Acid

Irritant - causes skin and eye irritation

Phenol, 2,2'-methylenebis[6-(1,1-dimethylethyl)-4-ethyl-

Irritant - causes skin, eye and respiratory irritation

Tetradecanoic acid

Toxic to aquatic organisms. Skin and eye irritant.

Anthracene, 2-methyl-

Acute aquatic toxicity, Not much data available - what there is shows it to be an eye, skin and lung irritant

Anthracene, 9-methyl-
Acute aquatic toxicity, serious eye irritant

13. Carbon Black

Carbon black plays an extraordinary role in tires, and in their toxicity and potential for harm from exposures. Well known from decades of air pollution studies, urban epidemiological studies, airborne carbon black causes lung cancer, brain cancer, kidney cancer, heart disease, neurological disorders, and cognitive degenerative disease.

A known carcinogen (WHO), we have found variations in percentages of the amount of carbon black in a tire, from 30%-68%. (EHHI/Yale Study; NY STUDY, .pdf, pp19-20.) Carbon black breaks down into many sized particles, including PM10/PM2.5 and potentially smaller. That size particle was shown to cause several types of cancer, including brain cancer, kidney cancer, kidney disease, bladder cancer, and neurological disease and cognitive impairment disorders. (CITE; Harvard Mexico Studies and Urban Cohort Studies).

14. THE NY STUDY CHARACTERIZES TIRE CRUMB THIS WAY:

"The components of Firestone's and Dow Chemical Company's rubber are summarized in technical specification documents. Although they are only two of many different rubber manufacturers, a similarity between the two vendors is readily apparent, even between three different types of rubber, solution-SBR, cold polymerized emulsion SBR, and high cis2-4 polybutadiene rubber. In general, the following similarities were observed between the two manufacturers for the compounds used to produce the rubber:

• The polymer used to produce solution-SBR contained approximately 18-40% bound styrene.

• The oil content in the polymer ranged from 27.3-32.5% in solution-SBR and cold polymerized emulsion SBR. Oils used include aromatic oil, high viscosity naphthenic oil, and treated distillate aromatic extract oil.

• Besides the polymer used, the other components of the rubber were similar between manufacturers and the relative proportions (parts by weight) of these other components ranged as follows:

o Carbon black: 50.00 – 68.75
o Zinc oxide: 3.00
o Stearic acid: 1.00 – 2.00
o Sulfur: 1.5 – 1.75
o N-tert-butyl benzothiazole sulfonamide (TBBS): 0.9 – 1.50
o Naphthenic or aromatic oil: 5.00 – 15.0

The components summarized above are the principal components of the major type of rubber (SBR) used for the manufacturing of crumb rubber and therefore have the potential to have a significant presence in crumb rubber. As discussed in subsequent sections of this report, some of these components have been found to be prevalent in crumb rubber, including **zinc (from the zinc oxide), benzothiazole compounds** (from TBBS), and **PAHs** (possibly from the oils used). These compounds may be attributed to the SBR used in the manufacturing of crumb rubber."

15. Phthalates are a regulated toxin, and PEER filings covered some of the toxicity and regulatory discussion. Please refer to http://www.peer.org/campaigns/public-health/artificial-turf/news-releases.html

16. ZINC

Coastal Marine Resource Center Study, found levels of zinc in leachate from tire crumb fields with fatal impacts to an aquatic ecosystem within 48 hours.

Menichini and Abate Study: “Zn concentrations (1 to 19 g/kg) and BaP concentrations (0.02 to 11 mg/kg) in granulates largely exceeded the pertinent standards, up to two orders of magnitude”. “Zinc and BaP concentrations are high in rubber largely exceeding the Italian soil standards”.

17. METALS: MERCURY, CHROMIUM, ARSENIC

The highest median values were found for Zn (10,229 mg/kg), Al (755 mg/kg), Mg (456 mg/kg), Fe (305 mg/kg), followed by Pb, Ba, Co, Cu and Sr. The other elements were present at few units of mg/kg. The highest leaching was observed for Zn (2300 µg/l) and Mg (2500 µg/l), followed by Fe, Sr, Al, Mn and Ba. Little As, Cd, Co, Cr, Cu, Li, Mo, Ni, Pb, Rb, Sb and V leached, and Be, Hg, Se, Sn, Tl and W were below quantification limits. Data obtained were compared with the maximum tolerable amounts reported for similar materials, and only the concentration of Zn (total and leached) exceeded the expected values.

18. LEAD, POLITICS and CHILDREN

The problem is synthetic turf is NOT REGULATED as a children's product by the CPSC thwarting the ability to apply lead regulations that CPSC could enforce.

Lead was identified in synthetic turf fields as early as 2008 but was not

addressed in any systemic way due to lack of standards or required testing (although the CPSC could have required the testing mandated for children's products since 2008). The CPSC has chosen not to mandate this children's product testing for synturf and in fact advised the industry about not having it designated as a children's product < http://parentscoalitionmc.blogspot.com/2009/03/artificial-turf-tale-of-lead-levels.html> .

This has led to a "buyer beware" situation especially after the CPSC tested synthetic turf carpets, found lead at varying levels depending on sample age, and astoundingly concluded the whole synthetic turf system was, always and everywhere, safe not just for adults but for children. The assumptions were based on inappropriate modelling for blood lead levels from a meager sampling and the troubling finding presupposes that there is, a safe level of blood lead, which most pediatricians and lead experts agree there is not safe level.

To this day the synthetic turf industry cites the still CPSC-posted "OK to Install, OK to Play on" press release which should never have been posted to begin with, has been disavowed, in front of US Congress, by CPSC commissioner Kaye and is an embarrassment to government science, policy and public health <http://www.cpsc.gov/en/Newsroom/News-Releases/2008/CPSC-Staff-Finds-Synthetic-Turf-Fields-OK-to-Install-OK-to-Play-On/ >

19. The Centers for Disease Control (CDC) in contrast warned and continues to warn that" there is no safe level of lead" to expose children to.

http://www.cdc.gov/nceh/lead/>

http://www.cdc.gov/nceh/information/healthy_homes_lead.htm.

"**No safe blood lead level in children has been identified.** Lead exposure can affect nearly every system in the body. Because lead exposure often occurs with no obvious symptoms, it frequently goes unrecognized"

In 2010 Van Ulirsch et al (Environ Health Perspect. 2010 Oct;118(10):1345-9 <http://www.ncbi.nlm.nih.gov/pubmed/20884393

20. Evaluating and regulating lead in synthetic turf.

Division of Health Assessment and Consultation, Agency for Toxic Substances and Disease Registry gulirsch@cdc.gov) concluded that: "Synthetic turf can deteriorate to form dust containing lead at levels that may pose a risk to children. Given elevated lead levels in turf and dust on recreational fields and in child care settings, it **is *imperative that a consistent, nationwide approach for sampling, assessment, and action be developed*.** In the absence of a standardized approach, we offer an interim approach to assess potential lead hazards when evaluating synthetic turf."

21. *But no such approach has ever been instituted. Indeed as reported in USA today this year: "The CDC in 2008 said communities should test recreational areas with turf fibers made from nylon, and they should bar children younger than 6 from the areas if the lead level exceeded the federal limit for lead in soil in children's play areas. But some communities have refused to test their fields, fearing that a high lead level would generate lawsuits or force them to replace and remove a field, which costs about $1million, according to a 2011 New Jersey state report . Forty-five of 50 New Jersey schools and towns contacted in 2009 by epidemiologist Stuart Shalat would not let him test their turf-and-rubber

fields, Shalat's report states. The EPA also found, in 2009, that "it was difficult to obtain access and permission to sample at playgrounds and synthetic turf fields."<http://www.usatoday.com/story/news/2015/03/15/artificial-turf-health-safety-studies/24727111/ >

22. And for the past 2 years the company FieldTurf has, with impunity, noted its synturf fields contain lead during testimony on various bills in the Maryland State House.

The latest admission documented on video: <http://wtop.com/montgomery-county/2016/03/md-lawmakers-seem-information-artificial-turf-schools/>

> "....asked point-blank by one delegate, “Is there lead in your products? The executive answered, “There’s lead in a lot of things in this world.”.... “**Yes, there’s lead in our products**." In spite of this admission and the fact that the legislation in question was meant to post the CDC prescribed warnings about minimizing lead and other toxin exposures from the synturf and tire waste products, and in spite of the fact that the legislation had strong and broad input and support, the legislation was not even allowed to come up for a vote in committee by the committee chair.

23. Public Employees for Environmental Responsibility compiled the literature as of early 2012 on lead

see: <http://www.peer.org/campaigns/public-health/artificial-turf/news-releases.html > and specifically: 2012-07-12 lead-limits-needed-on-tire-crumb-playgrounds (*NOTE if you go to PEER.ORG news releases: click on public health and "artificial turf" to find the actual filings with many links}*

Unfortunately for the children, fields with high lead remain. But those responsible for protecting children are kept in the dark. NO ONE IS MONITORING OR REGULATING ARTIFICIAL TURF FOR LEAD OR OTHER TOXINS in either old or new fields, including the Consumer Product Safety Commission (CPSC) (see <http://www.peer.org/news/news-releases/cpsc-drops-artificial-turf-playground-safety-review.html Even though the Chairman of the CPSC, recently admitted to congress that its soothing conclusions of safety after finding lead in synthetic turf were NOT correct.

Tested fields keep showing up with lead in them both old AND NEW. Some tested fields have little or no lead , some high levels and some have both within the same field. There is no way of knowing if any of the components of a field contain lead, and how much without stringent and thorough testing of each field.

This problem highlights the need for application of the designation as a children's product for testing and regulation : 1) stringent testing of all the colors and of the backing of the carpet for total lead content (chromium and cadmium should also be tested for) AND 2) Testing many samples of the infill which is an ever-changing witch's brew of chemicals- so undetectable, low and very high levels can all be found in the same field. In addition to having testimony both last year and this year in the MD state chambers from Field Turf that their product DOES indeed contain lead (as heard in the recent committee testimony on MD house Bill 883) , and in addition to those referenced in the PEER review, other studies on lead also exist.

24. For a helpful media article on Lead in artificial turf which cites scientists and studies that the synturf industry avoids please go to:

<http://www.usatoday.com/story/news/2015/03/15/artificial-turf-health-safety-studies/24727111/

>

For example as reported in that article:

Dr. Shalat's New Jersey State Study (2012) on artificial turf found lead in the field dust in the respirable air space of a robot and real player- highly variable but sometimes very high (note most facilities would NOT LET THEM TEST).

<http://www.nj.gov/dep/dsr/publications/artificial-turf-report.pdf

25. PEER writes: The concerns about lead exposure have taken on a new urgency following the release in June of 2012 of a study done for the New Jersey Department of Environmental Protection which found artificial fields made of tire crumb can contain highly elevated levels of lead much greater than the allowed levels for children:

a)· It reports "concerns with regard to potential hazards that may exist for individuals and in particular children who engage in sports activities on artificial fields"; and

b) *"In**halable lead present in artificial turf fields can be resuspended by even minimal activity on the playing surface**."*

26. Dr. Lioy of Rutgers who is quoted in the USA Today article recently participated as the senior author in a study which found lead and other toxins in the BOTH the plastic rug (supplied to them by the industry) and tire crumb infill. LEAD was also was found in simulated body fluids meaning there is little or no protection of any kind against the lead getting

out of the material into the body .

27. Pavilonis Study found lead.

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4038666/pdf/nihms565643.pdf > 2014

" **Bio-accessibility and Risk of Exposure to Metals and SVOCs in Artificial Turf Field Fill Materials and Fibers**" , Brian T. Pavilonis1,Clifford P. Weisel1, Brian Buckley1, and Paul J. Lioy1

QUOTE from Pavilonis et al:**."Since it is possible that children may be exposed to potentially high concentrations of lead while using artificial turf fields we recommend, at a minimum, all infill and fibers should be certified for low or no lead content prior to purchase and installation."**

*The main out-comes of concern from Pavilonis et al**:**

a) the finding of **lead, and chromium** in **both** the **tire crumb** and **the plastic rug** and simulated **body fluids** at sometimes extremely high levels ***EVEN IN NEW FIELD CARPETS**.*

b) **Benzothiazole** derivatives and **4-(tert-octyl) phenol** were also found in in the simulated body fluids. Both are probable carcinogens (the subject of another fact sheet).

QUOTE: "**Lead was detected in almost all field samples** for digestive, sweat, and total extraction fluids with digestive fluid extract of one field sample as high as 260 mg/kg. Metal concentrations were not markedly different across the three different sample types (new infill, new turf fiber, tire crumb field sample). However, one of the ***new*** turf fiber samples contained

relatively large concentrations of **chromium (820 mg/kg) and lead (4400 mg/kg)** compared to the other samples tested…the variability of lead contained in the infill material is large and can span more than two orders of magnitude* . One field [tire crumb] sample did contain a high lead level (260 mg/kg) which was on the s**ame order of magnitude as the NJ DEP cleanup value** (400 mg/kg)."

In summary: Lead-free is the only acceptable level for child products (and indeed for people in general). T**here is NO safe level of lead for children.** And yet many of our children are playing often, if not daily, on fields that may contain lead and certainly do contain many other toxic substances. Finding ANY lead in any play area for children of any age is unacceptable. As the CDC notes: Every effort should be made to eliminate ALL unnecessary sources of lead in the environment, especially a child's environment. ***Lead in artificial turf is not only totally unnecessary but dangerous to health AT ANY LEVEL*.**

28. Other sources of information on Lead in tire crumb fields:

www.ehhi.org/turf/<http://www.ehhi.org/turf/>
www.safehealthyplayingfields.org<http://www.safehealthyplayingfields.org>
www.synturf.org<http://www.synturf.org>

At www.synturf.org , a sampling of findings of lead on fields is available on the page on lead:

No. 36] Mayo Clinics tips to protect children from lead in artificial turf. April 2015.

No. 35] Durham, New Hampshire: Lead scare at UNH, s Memorial Field.

November 2012.

No. 34] Beware of lead content in exotic color artificial turf fields! September 2012.

No. 33] Odessa, Texas: Eager fans will not be given pieces of the artificial turf field. September 2012.

No. 32] U.S. Federal panel increases child protection against lead. February 2012.

No. 31] UNLV researcher spreads word about the need to test artificial turf fields. December 2010.

No. 30] Environmental Health Sciences study (2010): Deteriorating synthetic turf dust containing lead may pose a risk to children. October 2010.

No. 29] Concord, Mass.: Town replaces fake grass fields, officials insist nothing is wrong with the lead levels! July 2012

28. TWELVE (12) CARCINOGENS found and HOW DO THEY INTERACT:

The Yale Study identified the presence of so many carcinogenic materials in a single material that it raises many more questions about interaction of PAHs with metals, and combination impacts. The interaction of the PAHs and benzothiazoles with other materials in the fields needs to be characterized and addressed

29. Strengthening Additives: Nanoparticles

We would also ask for information and clarity about tire strengthening additives of any kind that were built into the material anytime in the past 30 years, these would have been added to tires.

[http://nice.asu.edu/nano/carbon-black-and-amorphous-silica-tires]

Similarly, we request that the tire manufacturing industry explain their use of nanoparticle products, of any kind, including the type and size, source company and source country, and ask for an explanation about how:

a. they can be quantified in the product, and
b. how can they be cleaned up if they are released when the tire crumb and or plastic "grass" carpet degrades?
c. We would also like to understand what material characterization of their behavior in tires performance,
d. And or their behavior once they are released into the environment.
e. We ask for any epidemiological due diligence that was conducted by any tire company on nanoparticle use prior to using them in a commercial product.
f. Plans for continued use and safety precautions tire companies will impose upon themselves
g. Epidemiological studies conducted on these particles in tires

30. Plastics, Microplastic Fibers, Microbeads, and Small Particulate Plastics

Assessment of microfiber particulate and small particulate plastics needs to be assessed in characterization studies.

31. Flame Retardants

Flame retardants can be added to a tire in production, or applied post production in a shipping setting or possibly as tire crumb. Since flame retardants are known carcinogens with health issues of concern, and will be on the surface of the waste tire crumb, tire infill providers need to know

if they are present, and purchasers need to know that the material contains flame retardants prior to purchase.

32. Tires and Tire Crumb Additives

Myriad products exist to clean, protect, condition, and color tires. We wonder if they are components of tire crumb?

33. Road Waste Picked Up By Tires

Tires spend their lives on roadways, of course, and can pick up many materials in their travels. Debris, hydrocarbons, ….

34 CARCINOGENIC, PATHOGENIC, Endocrine disrupting and other harmful ingredients in tires cannot be removed by shredding tires into tire crumb and must be assumed to be accessible.

35. Tire crumb and repurposed rubber appear to be the same thing, with interchangeable use… but are they the same? We would like clarification.

We would like clarification about the distinction between the tire crumb, repurposed crumb rubber, and crumb rubber. Specifically if using the term "repurposed rubber crumb" implies uniformity of ingredients? Does that term imply tires are not used? If so, what are the ingredients in repurposed rubber crumb and how do they differ from tire crumb?

36. **We would also like access to all MSDS/SDS of tire crumb manufacturers and tire companies,** and the ability to ask questions about how and where they were made, variations on lots, source and composite addendums. It is difficult to locate them.

37. EXEMPTION ON LISTING HAZARDOUS MATERIALS: We would like to understand why tire companies have an exemption on their need to list ingredients under Section 2: Hazardous Materials of an MSDS/SDS. We were unable to find the source of that exemption, if it has a deadline, and whether your study group thinks it is an obstacle to understanding and characterizing risk of exposure from tires and tire crumb.

38. Of those MSDS that we located, several, like this Michelin North America Material Safety Data Sheet for Michelin, Uniroyal, BF Goodrich, says in **"Section 2 HAZARDOUS INGREDIENTS: Note: Tires meet the definition of article as defined by the OSHA Hazard Communication Standard (29 CFR 1910.1200) and are exempt from MSDS requirements."**

There was clearly no mention of 1,3 butadiene, carbon black, POHs, VOCs, benzothiazoles, or any plasticizers, nor metals, styrene, sulphur, known irritants, or well… anything. Since that section also outlines corrosive, combustible and waste treatment, it is important for more than this issue. We explicitly ask CDC/CPSC/EPA if they can use their existing authority to require tire crumb companies and tire companies to provide ingredient information.

39. SOURCE MATERIAL UNKNOWN: MSDS/SDS CANNOT REPRESENT WHOLE FIELD. Tire crumb comes from many tires, and many sources. Since not a single tire crumb field can accurately list or track which tires were source materials, or what other mixed in components, and there is no accountability from tire crumb recycling industry for the shredded product, then MSDS/SDS cannot be accurate for a whole field due to variability. Therefore, the burden of "proof" of risk lays squarely on the ability of the purchaser (schools, sports directors, booster clubs) to assess risk… of a

very very complex product. So, if the exemption stays in place, we will know for sure that we cannot know what is in a tire crumb based field.

40. TREATMENT TO SHOW NO PARTICULATE OR BREAKDOWN: SHOW US.

As for studies that claim that their product has been treated (such as cryogenic treatment) to not break down into dangerous particulate, we are deeply skeptical, and would ask for proof. We also ask for assay testing over a period of at least several summer weeks. We ask for the researchers to simulate the pounding over 10 years and assess the particulate characteristics and particle size. That testing in fact is being done right now… in thousands of children across the country. Simple observation on a player body, on the sideline benches, or under a microscope shows consistent breakdown into particulate.

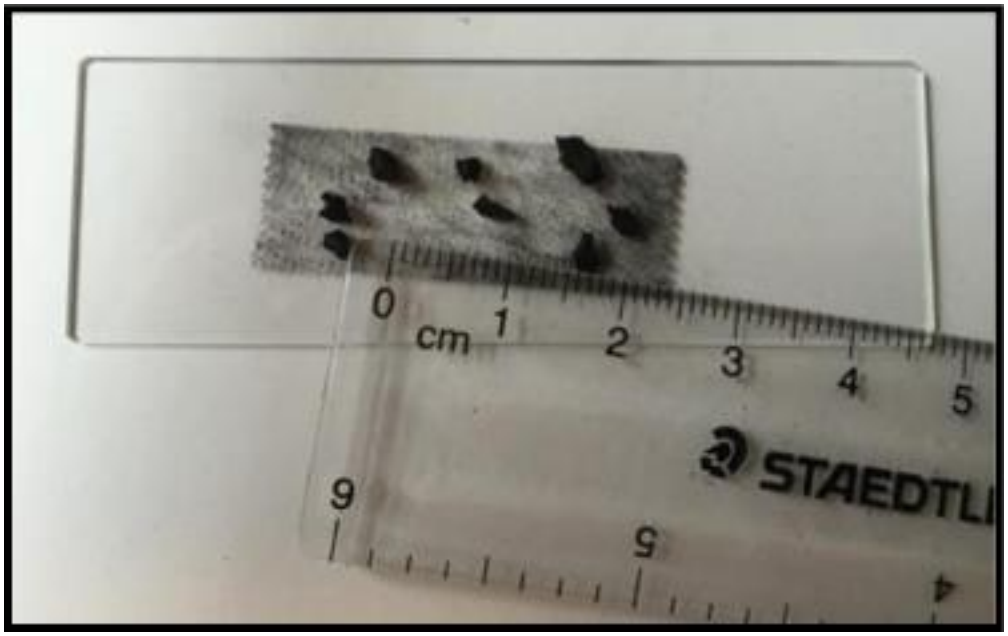
41. SHREDDED, PULVERIZED, HIGH SURFACE AREA FORM OF TIRES and ADD INS is LIKELY MORE TOXIC THAN WHOLE TIRES.

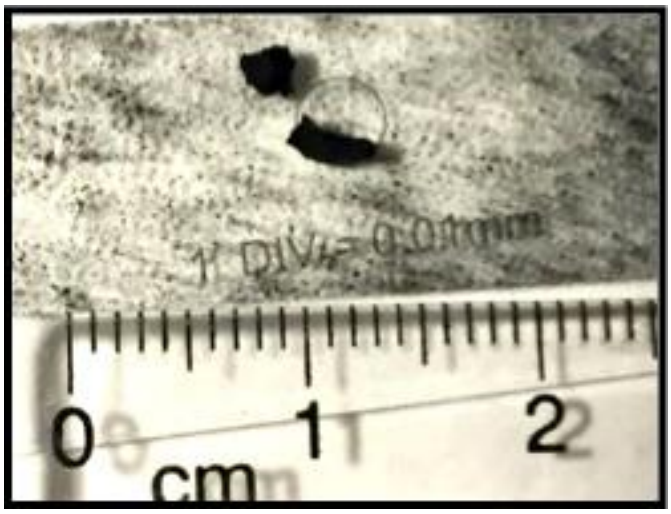
Unfortunately, because it is shredded, pulverized, and in loose and unencapsulated form, tire crumb has exponentially more surface area than whole tires (Thomas, Gupta study;) and we are concerned the material is very likely more toxic––possibly many times more toxic––in the school field form than whole tire form, since the increased surface area provides more opportunity for molecules to escape. We know for sure that the increased amount of surface area in tire crumb makes the material in tire crumb more available to the breathing and exposure zones, and to runoff.

42. CRUMB IS SURROUNDED BY DUST PARTICULATE:

Accurate characterization technique must include a study of the particulate that surrounds tire crumbs, and steps must be taken to make sure that the

sampling process does not inadvertently remove that dust and particles. We found several examples of the samples being washed, some in unbuffered water, prior to their analyses being done. Of course, that removes the particulate that concerns us the most. Distribution of the particulate size and type is important. Those particulate can become aerosolized by numerous gases and we ask that attempts are made to properly model this dynamic under high heat conditions, primarily.

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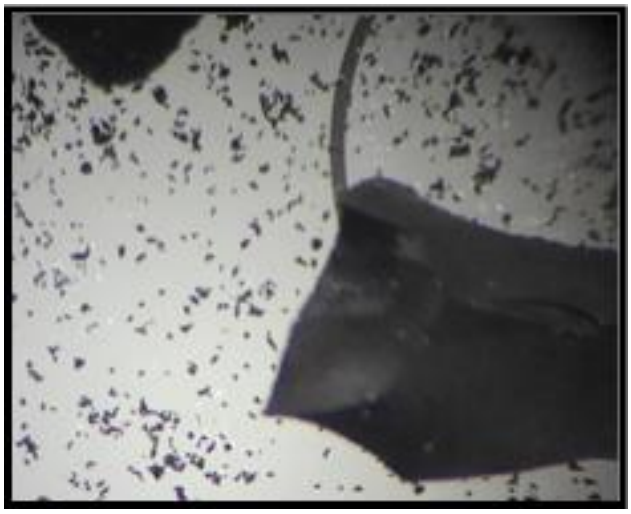

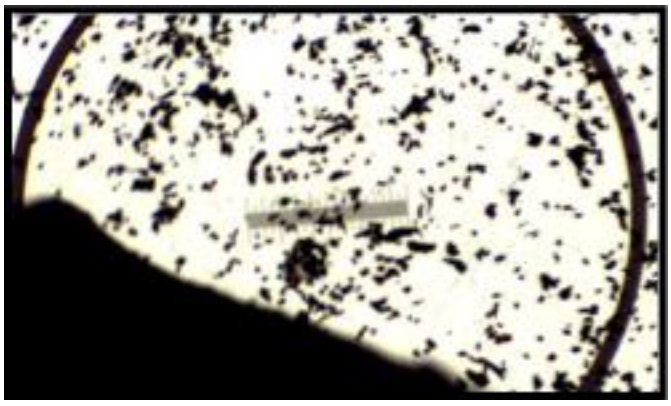

43. VERY COMPLEX PICTURE From TOXICOLOGY PERSPECTIVE: Tire crumb material is complex from a toxicology perspective, largely due to the chemical complexity presented by multiple known toxic components and variation. It has been described as a "toxic soup" of ingredients for which we have no consistent data on proportions or levels. Characterization of ingredients' margin of error is unknown..

Testing must be done at the field levels using accepted sampling plans that have been statistically shown to be valid. Not fields have been tested in sufficient detail to determine or rule out any exposures or risks. A look at testing protocols for lead in urban soil sites illustrate the level of attention required and show the degree that current testing has fallen short of that needed for decision making for children's health.

44. CONTACT PATTERNS, FIELD USE and ADJACENT BUILDING CONTAMINATION

Exposure is likely determined by ingredients in surface, activity, and number of children or users on field. Each school or community field has high use and high contact patterns, such as hosting contact sports, like football, lacrosse, soccer, and baseball, athletic camps, workshops and practices. In those sports, children dive into the field materials. As a child runs or skids or slide tackles, a column of material rises up, as does the dust and particulate that surround the tire crumbs themselves.

Testing for exposure need to list weather conditions including humidity, wind speed, and precipitation, temperature on field surface and ambient air temperature. Number of children on field, and activity level of that play needs to be recorded, video would be most interesting.

Children of all ages use the fields for multiple sports, recreation and school events. Artificial turf tire crumb fields abound in elementary schools and at

indoor and outdoor sports centers where children of all ages and all stages of development play soccer, lacrosse, football, track, cheerleading, band, and use the field for general recreational school activities. In the fields with which we are familiar, families with members of all ages use the fields; and the community holds events, picnics, special fairs, and activities. Some fields are immediately adjacent to a school building.). That there are many uses, and probably many levels of contact and exposure is an important part of characterizing exposures, but both low dose exposures AND high contact exposure scenarios and use need to be examined, with appropriate epidemiological process.

45.. SCHOOL BUILDINGS AND SURROUNDING AREAS ARE CONTAMINATED with a great deal of tire crumbs. The fields appear to lose from 1-30 tons of material over their 8-10 year life, and some of it goes directly into buildings, cars, and then homes. This impact needs to be studied as an inadvertent consequence.

46. CANNOT ARGUE NO INHALATION OR INGESTION RISK or SAFETY FOR EVEN A SINGLE FIELD. We argue that given the unique characteristic of nonuniformity, known carcinogenic materials, breakdown into particulate/dust, no known source of origin, and no accurate studies on complex interactivity of those components in the children's exposure zone, in the tire crumb as it is installed today in 12, 000 fields, not a single field installer, nor material provider can demonstrate that the material is safe from inhalation and ingestion during normal use, active use, and on hot days.

47. EVERY USE COULD POSE A TOXIC EXPOSURE and it would be irrational to argue otherwise. We argue that due to the high variability of toxins in the tire crumb substrate (from tires, unknown additives, and

factory waste add-ins), and lack of any control of the material, well-known sampling techniques will NOT accurately predict risks to human health.

48. CHILDREN CANNOT AVOID THE EXPOSURES: Since school children cannot self-advocate and take responsibility for staying off a field if directed to be there by coaches or school officials or parents, we must assume that children cannot avoid the exposures when they play on those fields.

49. CANNOT CLAIM THAT EXPOSURES WILL NOT OCCUR. Absolutely no way to responsibly claim that ingestion and inhalation of particulate from the material will NOT occur to those children.

50. HOTSPOTS of intermittent dangerous exposures are possible, and should be expected and searched for in every field.

We must assume that tires have different "recipes" based on their type of use. Therefore, knowing the type of tire used in tire crumb, and each tire "recipe" would be helpful in assessing characterization of ingredients. However, there is no way to ever know what tires, or what material is in any field, and therefore, an MSDS/SDS cannot be representative of any field, or even any meaningful part of a field. Alarmingly, the high variability in the ingredients presents worrisome "hotspots" potential, where the hotspots might be missed in sampling but even a single exposure could have very serious impacts for a child who has the unfortunate luck to dive into that hotspot. PAH's may be more prevalent, and present dangerous levels for installation period of the field, and for some unknown period of time afterwards, and considered a "hotspot", then the consistent release of PAHs in the subsequent years could mean low dose, chronic exposures. Both need to be examined.

51. Lead, chromium, mercury and arsenic could be present in hotspots, based on which tires were used, and how they were treated prior to being placed in the field.

52. For example, when we asked about the source of lead in tire crumb fields, an infill vendor explained to us that a) lead could be in any field as an ingredient of the tires, of the treatment of tires, and b) once, they were aware of a shipment of tires that was treated with an anticlumping material that contained lead and the whole lot had lead, and c) that some lots had flame retardants added as well. They would never really know, but "most purchasers never ask", according to the infill material vendor. If an MSDS was required, an additional charge was to be imposed, since MSDS were not available from the materials they acquired from China or other countries. We have collected many more examples of the worrisome unknown ingredients in our fields and can share with the study teams, if requested. While this information is anecdotal, that is the point: we have no idea what is in any field, for sure.

53. Another example, but this is not anecdotal: in a primary study field exposures in CT, a researcher found that the children's monitors showed benzene. Since there is no safe level of exposure for benzene, and in fact, tires are not expected to have benzene, the field was sampled more closely, until that "hotspot" was located. The original source of that benzene was not determined, but it was next to a busy parking lot where cars' exhaust may have been a source as they turned the corner, or possibly the tire crumb material had been previously stored in an area with benzene in surrounding environment, or perhaps it was picked up from contact on roads. We will never know. That finding suggests that the carbon black in the tires can adsorb additional toxins present near tires or tire crumb, and

could release that material as the fields are pounded with running feet, or possibly on a hot day. The proper characterization of this material needs to account for adsorption characteristics of carbon black, and other interactions

54. The point is, that it is impossible to locate hotspots for all toxins in every field, and incorrect to extrapolate the risk for a whole field from a single sample or even multiple samples, since every sample is unique. So, while hotspots can easily be missed in a field, the unfortunate child that dives into that particular part of a field has an exposure that can actually be life threatening, but missed in its entirety in the sampling based risk assessment.

55. In fact, since the tire crumb creates multi sized "dust" particles, and off gases, it is impossible to prove that even a single field is safe from inhalation or ingestion exposures from tire dust particulate, off-gassing components, multiple toxins and combinations of toxins, and heat.

56. Importance of the Heat Factor: Source of direct injury and chemical catalyst

HOT HOT HOT HOT EXTREMELY HOT FIELDS

Grass playfields remain close to the temperature of ambient air, and are often much cooler. Asphalt playgrounds used to have a use limit of 141F and many schools remove children from playgrounds when temperatures get hot. With tire crumb based turf fields, surface temperatures can soar on even mild sunny days.

Tire crumb fields "superheat" to levels that are routinely over 150F on a sunny spring day, and in a recent study conducted on a sunny day Utah, found to be close to boiling point, 190F, according to the Penn State Field Turf Heat Study. The study found that tire crumb field surfaces are hotter than ambient air, and increase in heat in a non-linear function with each additional degree Kelvin of heat, hence the designation "superheating". To draw an example, on a Labor Day Weekend in DC area, with ambient temps of 82F, the field surface temperature hit 164F by noon on several fields used in a busy, tournament for about 1000 children, both boys and girls, ages 8-15. Those levels are known to melt plastic cleats, require tubs of water on the sidelines to cool down shoes, and create heat-related injury including heat stroke, nausea, heat exhaustion, and dehydration in children and all users. It is not unusual for children players to vomit, faint, and suffer dehydration from hot conditions on the fields.

57. Marketing and sales for these fields tout their usability in all conditions as a benefit (more practice and play hours), but in fact, the heat build up on fields makes them very uncomfortable during many days and conditions. In DC, there are over 100 days of sunshine each year, and most are during the spring, summer and fall, making the fields uncomfortably hot and possibly dangerously hot for a third of a year. A calculus should be made on the percentage of safe days to play based on field yield risk, and heat.

58. Tire crumb fields do not have any protection from heat, and so they are irrigated to be cooled down, but the effect is temporary.

59. To our knowledge, there has been no well known place for doctors nor parents to report heat injury, though they are commonplace. (This author

specifically remembers a hot, poor air quality day in August in 2014 in Washington DC when during a single practice, 4 soccer players vomited, another child was taken to the hospital after passing out, and another sidelined himself against the coach's wishes, due to extreme dizziness and nausea.)

60. **Reluctance to Report?** Yet, it is curiously uncommon for school teachers, coaches and parents to remove the children from the fields, due to temperature. We cannot explain that in rational terms.

We have also noted another curious effect: as football, soccer and lacrosse increase in popularity and competition in the US, competition for spots on high performance teams is fierce. There is a perception from strong sales and marketing of the fields, that the turf fields present a competitive edge for a school, a club or even a teenager trying to get into college, and are worth the high price paid. As psychologist Dr. Wendy Miller, explains, " it is a culture where high performance parents, players and schools might be willing to overlook these injuries, thinking that to complain would jeopardize their child's access to a competitive team. This thinking could easily lead to the silencing of reporting of injuries."

Heat injury reporting needs to be included in the survey questionnaires, and victims of heat injury and illnesses need to have a place to report, with impunity.

61. HEAT MAKES THE CHEMICAL DYNAMICS ABOVE A FIELD VERY COMPLEX

In addition to the serious issue of direct injury from hot playfields to young children, or anyone, the super hot fields present a very challenging chemical situation.

Dr. David Brown, ShD, toxicologist, professor and former Deputy Director of Public Health Practice Group at ATSDR/ CDC explains that, "the unintended, and largely unstudied chemical consequences of what comes off such an enormous quantity of high surface area material, in amounts and sequence that is scientifically accurate is very difficult to predict and model. Since the chemicals in the area above the field could change instantaneously, the conditions are critically important (number of players, temperature, time from last rainfall, etc.), as is the sampling methodology. But no one has been able to come close to modeling the actual yield, we only know the materials by characterization with samples, and that variation in samples is so broad as to almost be meaningless, since it could be easy to miss harmful exposures."

62. Analyzing the field yield on a hot day is very complex, and challenging to even trained toxicologists. The superheating of the fields makes gases yield at faster rates as temperatures on the tire crumb surface increases. So, as a day heats up, it is very likely that the yield increases directly with temperature increase; a hot day creates more gases. Based on well understood scientific laws, we presume that the gas yield from the field at surface temperature of 50F (a cloudy day in January in DC) would be considerably less than a field surface temperature of 158F measured last week. If more gases are escaping the surface, then there are more "opportunities" for particulate to adsorb onto the surface of the gases, creating very dynamic series of compounds, none of which would be recommended to inhale.. The changes in the chemical composition over the fields as their temperatures rise is very difficult to test and model. These changes happen in an instant… as a threshold is reached… and the

exposures can increase sharply. It is a very sophisticated and difficult challenge to model. But what is the most important is not only that the 24 gases that escape tire crumb (Norway Study) create dangerous mixtures but those gas/particulate mixtures, (and air) create a vector for deep lung exposures of all the materials in the tire crumb field. So, on poor air quality days, when there are many children on the field and a lot of stirring up of the material, the fields could present enormous risk.

63. We are concerned about the range of yield levels, but, we are most concerned about the intermittent risk to children during those hot periods (a hot, poor air quality summer day during children's soccer camp week in Washington DC, for example) when the fields are likely yielding more gas, and therefore particulate has more "carriage" into lungs, respiration rates are higher, skin is exposed, and perspiration is highest. All these are likely factors in exposure. It is during those days when exposures are probably highest, and high enough overwhelm a developing immune system.

64. Exposure Study Needs To Focus On Worst Case Conditions

We acknowledge that the level of yield from the fields might vary widely with material variation, and will also vary with outdoor weather (temperature, wind, humidity and sun) conditions. Taking averages from fields across the country will be meaningless, and will only help the industry to expand its message of "found no harm". An analogy might be to determine the health of a forest taking 4 samples from 40 locations, evenly spaced, but the sampling might easily miss a blazing forest fire. That one day might destroy living material exponentially, but it could easily be missed. Dangerous exposures can be unpredictable in this material due to the scope and scale, the toxic character, and the superheating characteristic.

65. A better approach is to carefully detect high yield days, and look THAT DAY for exposures in a child's body during those periods. Since the exposures might attenuate, the work would have to be done expeditiously. The harmful exposures may or may not be detectable a day or a month later in a child. Monitor both genders, for patterns that might lead to that awful air quality soccer camp in the city on a tire crumb field, on days when vomiting and melting shoes are commonplace. A focus on the impacts from the high end of those yields we believe will present exposures that are clearly, and unequivocally harmful from both heat injury perspective and toxicity exposure potential. We do not know for sure if the carcinogenic exposures from low dose regular exposures or from high dose "events" are more dangerous, but both need to be studied as separate situations, not as an average.

66. We urge your team to focus the study resources on primary measurements made in high use scenarios on hot days, and refrain from the approach used in earlier studies that look at chemical compositions during winter or rain conditions on limited number of fields.

67. The only reliable way to assess the risk to children from a particular field, or groups of fields, is to look at their direct exposures, and importantly look at bloodlevels of the known substances. Cooperation from both high use athletes and those exposed to chronic levels of materials will be important.

68. The Study Needs To Focus Also On Low Dose Exposure Risks

Trained immunotoxicologists look at the impacts of chronic low dose exposures to metals, PAHs, VOCs and many other materials in tire

crumb. Their input is crucial to understanding risk of exposure in a developing child.

69. Characterization Mistakes

Studies look convincing, but miss the forest for the trees.
Tire recycling and tire crumb industry reports are quick to point out that when they find harmful materials in their samples, they are under the known safety limits. There are two interesting fallacies in that reasoning.

First, since the samples in several studies are few and not uniform, they fail to acknowledge the statistical significance of finding known regulated toxic material in 2 million pounds of powdered tires… if one finds the needle, is it luck, or is it because needles are more prevalent than expected?

Proof of presence is meaningful! For example, in the NY Study, PAHs were found, as were metals, benzothiazoles, and many substances. Their presence indicates a risk.

In a child's product, since many materials are not known how they affect children, just knowing they are there is enough to use a precautionary principle and prevent the exposure. Arguing that the materials appear under a limit (especially if that quantity is an average of multiple samples), or there is no established limit (because it has not been studied), are not as meaningful as the proof of their presence.

Second, though the conclusions of the industry reports may be of no harm found/safety, a close look at the data itself on PAHs, lead, cobalt, chromium, etc. is useful, since a) it proves presence, and b) at levels that suggest risk for **chronic exposure**. Chronic exposure risk is the subject of

a great deal of new cancer research, and we care about all the materials, including those which are potentially toxic.

70. ARGUMENT FOR MORATORIUM BASED ON KNOWN CHARACTERIZATION FOR TIRE CRUMB

Because of the:

a. known loss of 1-30 tons of material from the fields during the 8-10 year "life of the field" into air and water
b. ingredients list: over 50% of its components are known carcinogens and pathogens, [cite Yale Study]
c. massive scope and scale of this product, (the amount of material and surface area of these fields is enormous; scale/millions of pounds in each installation),
d. inability to control the levels of toxic exposure to children, or even properly characterize them due to immense variation and chemical complexity of what happens on a hot day over a field, and around children. We cannot suggest mitigation strategies for the danger, because the material is inconsistent,
e. Even if we did know for sure what was in each field, and suggest mitigation techniques and protections…. All the tire company has to do is change their recipe, or many recipes, as they do continually, and the study is worthless. Children are still being exposed to whatever is in the tire, the lot or that particular field..

71. Moving Target Analogy

Even if the study were completely successful, and the tire crumb material categorized properly, the trouble is, tire manufacturers could change the "recipe" for tires… and in fact they do this regularly… and the study results will be useless, or at best, diminish in usefulness.

Any attempt to study tire crumb safety on turf fields is analogous to trying to hit a moving target. Tire crumb is a waste product. Tires are not designed or intended to be used as infill for turf fields.

Ingestion, inhalation and absorption of fine particulate by children is not a consideration of tire manufacturers as they choose chemicals and compounds for their tires. Nor are they bound to maintain any safety considerations for such use by children.

So any study of present day tire crumb is a futile endeavor, because such study tells us nothing about a field that gets installed immediately after the study. Tire manufacturers often change the chemical composition of tires and will likely do so again.

Even if a field passed safely concerns in a present day study, a new field could easily fail a hypothetical study conducted the day after the present study. So unless every field was tested using the exact same methodology after every installation, there is absolutely no way to assure the user that their new field is safe. Those new fields could easily have an entirely different chemical composition simply because tire manufacturers changed their tire ingredients.

So the present Federal Study is only a backwards looking study, not forward looking. Any conclusion must be transparent and clear on that issue - upfront and center. Otherwise the public is being misled into a false sense of security.

72. **Sampling: Not Appropriate For Tire Crumb**

The core pediatric toxicology problem in industry based safety studies, is that there appears to be an assumption that tire crumb is a uniform material, and behaves uniformly. It does not. There also appears to be an assumption that sampling will be an accurate method for studying tire crumb risk to children, and it is not. **Sampling will not be accurate to assess a non-uniform, heterogeneous material with multiple known toxic ingredients, high direct contact (dermal, hand to mouth, breathing zone) for pediatric use**. **Sampling cannot produce a single sample that is representative of the whole field, or even a part of the field, other than the sample itself.**

73. Methodology needs to study PERFECT STORM exposure conditions, and be able to calculate exposures during those relatively dangerous days.

Nor can sampling in the way it is proposed (samples from 40 fields across the US), illustrate impacts from a perfect storm of exposure conditions on a particular field, say, during an intense soccer camp in in summer in Washington, DC with high ambient and field surface temperatures (ie 160F), bad air quality, no wind, when working athletes are breathing in particulate with high VOC, PAH, benzothiazoles, and carbon black… and many more compounds, on a particularly high yield day. Averages cannot be relied upon in sampling for this type of product, since they will further obscure the risk from exposures to hot spots of high risk material that are on fields. Averaging the results from a national distribution in various weather conditions simply obscures the acute risks further; it is useless for risk analysis. In layman's terms, it is like studying a forest using "x" number samples, but missing the forest fire that is blazing away at a nearby area of the park. For a child, it means that she plays on a field that was called "SAFE TO PLAY", after sampling, but in fact she might easily have

been covered with multiple materials known to cause cancer, and in fact, that might be a regular event. The uncertainty of exposure frequency makes the risk higher, not less.

74. The core of the methodology used in the 50 studies asserted by the tire recycling industry were based on simple characterization of a single sample, but not on realistic, combined, nor worst case (the most important) use scenarios.

75. Multiple carcinogen and multiple pathogen combined effects need to be measured. Single material measurements could be only a fraction of the exposures, since the material exposures are likely to be from combinations of materials.

76. BIOMONITORING FRONT AND CENTER

Because sampling presents inconclusive results, a methodology that relies on biomonitoring will be more meaningful. We suggest that more sophisticated approach be considered. Personal sampling monitors attached to children, dermal, urine, breathing analyses, and particularly, blood and tissue samples from frequent users, players on "Perfect Storm Days" and those expected to have chronic low dose exposures. We understand that biomonitoring raises more issues, but absent a good model, empirical data is the most reliable way to accumulate actual evidence of exposures and to be able to establish a reliable causal link to the cancers and diseases we predict from exposures.

77. IMMUNOTOXICOLOGY SUPPORT: RECRUIT THE BEST PEDIATRIC IMMUNOTOXICOLOGISTS AND RESEARCHERS. Some researchers and epidemiological professionals are already on the trail of better ways to

identify actual exposures, and can create biomarker groups as indicators of presence of illness or exposures. These researchers have background in immunological toxicology, and can track subtle changes in an immune system that might be precursors to serious disease, like cancer, kidney disease, brain changes, and lung disease. It is possible to create biomarker group to prove tire crumb exposures in users and we believe that the preliminary proof of concept step could be accomplished in less than 6 months with cooperative athletes, and study volunteers, and modest budget. While we will not list them here, for protection of their privacy and frankly, for fear of industry retribution, we will nonetheless let you know that we have found multiple professionals who are capable and willing to work on this task, provided a protective forum and IRB standards are in place.

78. Immunotoxicology support: look carefully at the ages those immune system markers in all children who are using these fields, understanding that some metabolic types, and ages may be more vulnerable than others. In fact, there are early indications that certain age groups, such as prepubescent females (age 8-11), may be more vulnerable to exposures to benzothiazoles, plastics, phthalates, and endocrine disruptors in general, and therefore might be at higher risk to contract cancer or disease from low dose particulate exposures from tirecrumb, and the plastic "grass" carpet particulate. We need to establish the datum from players to study this. We still do not know, but some indications exist. For that reason, we respectfully request that the study team include toxicologists and epidemiologists that are trained to keep these concepts front and center.

79. LOW DOSE EXPOSURE CONCEPTS and CONCERNS

Based on what we know now about low dose exposures to VOCs, PAHs, benzothaizoles, styrenes, carbon black, plastics, plasticizers, and metals, even at low, sub-acute exposures, the fields could be very dangerous. That possibility was not considered in the CPSC study, EPA study, nor in mulitiple industry studies. These need to be assessed:

- Chronic exposure to metals, plastics and plasticizers
- Chronic exposure to carbon black mimics air pollution exposures
- Immune system reactions
- Endocrine disruption exposures from plasticizers and phthalates,
- Exposures from multiple low doses and chronic exposures

80. The study should calculate yield of material that leaves the fields, and how it leaves the fields. How much in the air , water pathways, and with users (in shoes, cars, etc.) Interviews with schools and vendors need to establish the replacement quantities of these fields, and how often new material is put into place, since it would affect exposures, and give an indication of gross yields. We estimate that the fields lose from 1-30 tons (estimated) of material, so exposures and impacts need to be measured in adjacent buildings, soils, and stormwater systems. With 12,000 existing facilities, this may need to be the subject of additional studies conducted to also assess if the fields shall be regulated as point source contamination under Clean Water Act and Clean Air Act. It is a very important metric, and a perfect opportunity to include it, with little incremental cost, in your study.

81. INTEGRITY STANDARDS. To track the history of the emergence of this product is to track effective lobbying for regulation changes that favored the tire industry, and the tire recycling industry. This industry took

advantage of an enormous quantity of recalled and used tire stockpiles, and heavily sold and marketed the materials to schools, and sports centers where millions of children play. Central to the steps that catapulted this industry forward was the removal of the designation of artificial turf fields as children's products, based on the rationale that adults played on them, too. Yet the fields continue to be sold to elementary schools and to sports centers brimming with elementary, middle and high school players. The sales oriented industry was willing to submit children, schools and communities to the materials in tires in enormous amounts, and call them safe. As this claim is deeply questioned now, we also urge you to NOT allow the sampling or data collection to be conducted by an interested party, including schools, sports centers, athletic group personnel or administrators, field installers or laboratories or consultants hired by those groups, and establish peer reviewed standards for testing.

82. Any group or individual who does participate in the study, including regulatory staff, needs to sign an affidavit certifying that she or he, and her/his group has not received compensation or benefits in any form, including but not limited to sales commissions, direct payment, compensation, bonuses, grass to artificial turf grant, field financing, water savings rebates (State of California and possibly others), or physical benefits including but not limited to uniforms, facility enhancements (restrooms, concession stands, parking lots, storage facilities, etc.), stadium components, or field equipment of any sort, from the field installers or tire crumb field industry and its assigns, and has no financial conflict of interest. The document should be filed with an appropriate agency and made public.

83. We ask for full transparency on all parts of the study process for parents, interested parties, and schools.

OUR REQUESTS TO ASTDR/CDC/CPSC/EPA	
Request	Background
1. Regulate tire crumb and rubber mulch as children's product	PEER filed formal request; 12,000 fields x 30,000 tires is the amount of existing material in children's use; see table A for details on volumes and surface area sizes, children/schools. Known

	carcinogenic material and known contact.
2. Remove "safe to play, safe to install" or any other references that imply safety from all EPA, CPSC and CDC websites and public information sources	PEER Formal Request; agencies must remove all endorsements of safety.
3. Place all PEER artificial turf filings in Federal Record	**http://www.peer.org/campaigns/public-health/artificial-turf/news-releases.html**
4. Issue a directive to public health agencies to disseminate warnings regarding unknown risks from lead exposure from AT fields, as well as exposures to carbon black, known carcinogens, PAH, VOCs into air and water pathways; direct hospital systems and medical systems to screen for tire crumb field use, and report results	For parents, schools, athletic groups and communities; conduct parent outreach webinars
5. Use only independent lab or consultants unassociated with tirecrumb industry, adhering to high ethics guidelines; transparent process for review; affidavit of no conflict of interest	
6. Commission a primary study, conducted by independent, peer reviewed group such as CDC to examine existing cancers AND illness in tire crumb field users and maintenance workers of tire crumb fields	
7. Mandate Cal Recycle Study corrections to methodology; mandate methodology peer review; and mandate to impose Prop 65 rule based on OEHHA's own findings on carcinogenic exposure	
8. Convene a conference for presentation of risks and concerns from parent groups, cancer survivors to Federal Research Team	Needs participation from CDC/CPSC/EPA staff so parents and public can have direct contact
9. Convene series of webinars and open comment opportunities	
10. Allow public health and environmental advocacy groups in Federal Research Team with complete transparency	
11. Establish a collection point for recording experience of victims and those who may have suffered injury from use of the fields, including heat injury, concussion or head trauma, cognitive disorder, illness, and cancer for study and documentation; victim hotline; for both child and adult contact with fields	
12. Funding to identify potential biomarkers of exposure; conclusive marker study in users	
13. Conduct blood monitoring and studies on existing cancer survivors.	
14. Conduct cancer cluster study on soccer player cluster, and identify additional clusters such as maintenance workers and installers	
15. Provide full transparency with all interested parties	
16. Conduct full epidemiological study of tire crumb on playfields existing and predictive	
17. Study forms and questionnaires should include data collection on what is released from fields into air, adjacent areas, water pathways, and quantified. Replacement quantities for tire crumb fields should be quantified and examined as a metric that indicates yield.	
18. Based on release/yield figures, and other inputs, tire crumb fields should be evaluated for compliance with Clean Water Act and Clean Air Act, and regulated accordingly.	
19. We request that OEHHA study methodology be peer reviewed by your agencies before it begins, taking into account the comments received in this proceeding.	
20. OEHHA Study Process and Methodology Concerns: How will those be considered?	
21. Consider explicit protection from retribution steps be put in place to protect researchers, players, and concerned parents from retribution	

PUBLIC SUBMISSION

As of: 5/3/16 6:45 PM
Received: May 02, 2016
Status: Posted
Posted: May 03, 2016
Tracking No. 1k0-8per-wqbb
Comments Due: May 02, 2016
Submission Type: Web

Docket: ATSDR-2016-0002
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ

Comment On: ATSDR-2016-0002-0003
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill ATSDR-2016-0002

Document: ATSDR-2016-0002-0081
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ Comment on FR Doc # 2016-03305

Submitter Information

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General Comment

Health professionals, including experts on children's environmental exposures from Mt. Sinai Hospital, are voicing extreme concern over exposure, particularly in children, to the known carcinogens, endocrine distributors, neuro-toxins, and toxic heavy metals, contained within the finely ground tire mixture. This concern is partly fueled by the growing number of cancer cases in children and young adults who were frequently exposed to the recycled rubber surfaces.

Previously, the EPA endorsed the use of crumb rubber as a viable way to dispose of millions of used tires, as well as a way to reduce injury, but some of its own scientists have pointed to research suggesting potential hazards from exposure to crumb rubber. This research includes the 2012 study: Hazardous Organic Chemicals in Rubber Recycled Tire Playgrounds and Pavers- which concluded that the "presence of a high number of harmful compounds, frequently at high or extremely high levels, in these recycled rubber materials. Therefore. They should be carefully controlled and their final use should be restricted or even prohibited in some cases", and a very recent 2015 study: Release of Polycyclic Aromatic Hydrocarbons (PAH's) and Heavy Metals from Rubber Crumb in Synthetic Fields- which concluded that "the recent study demonstrate that PAH's are continuously released from rubber through evaporation. Athletes frequenting grounds with synthetic turf are therefore exposed to chronic toxicity from PAH's."

I am among a growing group of parents who have opted to take the precautionary measure of

keeping our children off of these fields all together, and advocate for safer alternatives, while waiting for an answer to the question so many are asking "Are these fields safe?" Before I knew about the toxicity and carcinogenic chemicals contained in crumb rubber, my children did play on the fields. I remember that even on mildly warm days the smell of tires was significant, and on days over 80 degrees the combination of heat and smell was enough to drive many parents from the field, to sit on a nearby grass median. I remember watching babies crawling on the sidelines squishing the grass blades with their hands some attempting to eat the crumbs, many with bottles in hand. I saw preschoolers sitting and making piles of crumb rubber with one hand and a snack in the other hand. These children were just inches above the turf surface. We have created a situation where our youngest children are exposed to a toxic substance from birth and continuing through crucial developmental years. This type of use and exposure has, admittedly, not been adequately studied, and in essence we are carrying out a large scale experiment on our nation's children! Parents like me, have assumed that the fields are safe. We would never imagine that a substance, which can be inhaled and ingested, and is clearly marketed for children to play on, was not thoroughly tested for safety.

We need real answers- from epidemiological studies- and in the meantime the public should be provided with information on protective measures to take on current fields. Additionally, there should be a moratorium in place on construction of new crumb rubber fields. The potential is great and the risk is simply not acceptable.

PUBLIC SUBMISSION

As of: 5/3/16 6:46 PM
Received: May 02, 2016
Status: Posted
Posted: May 03, 2016
Tracking No. 1k0-8per-6zzd
Comments Due: May 02, 2016
Submission Type: Web

Docket: ATSDR-2016-0002
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Comment On: ATSDR-2016-0002-0003
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill ATSDR-2016-0002

Document: ATSDR-2016-0002-0083
Collections Related to Synthetic Turf Fields with Crumb Rubber Infill 0923-16PJ Comment on FR Doc # 2016-03305

Submitter Information

Name: SHPFC Fairfax Chapter
Organization: Safe Healthy Playing Fields - Fairfax County Chapter

General Comment

These Comments were also submitted by the Safe and Healthy Playing Fields Coalition. The Fairfax Chapter is submitting them as well in order to document our support for the comments.

INTRODUCTION

On behalf of the millions of children, parents and athletes who play field sports in the US at schools, parks, athletic facilities and playgrounds, thank you for agreeing to study the potential harm caused by playing on or being near athletic fields with surfaces made waste tires. There are more than 12,000 of these playfields in place (15,000 according to the website of a large company that installs them), and they are being installed at a rate we estimate to be about 3000 a year. By our calculations, 12,000 fields currently present 2,380,000 tons or 4,760,000,000 pounds of loose, unencapsulated tire crumb on their field surface. (See our Table of Runoff and Material Volumes attached.) Tens of thousands of students and young athletes play on those fields, many more thousands have direct or indirect contact with the material. It is a public health issue of substantial importance.

The following lists our comments on the proposed study. We argue that the fields present known carcinogenic, pathogenic, and mutagenic material in a high surface area, pulverized form that is more toxic than whole tires, and should never have been allowed near children, or adults, because of risk of ingestion and inhalation exposure to all the ingredients in tires. On

warm, sunny days the surface temperature routinely reaches over 150F, which presents direct, well-known heat injury risks to children. The heat increases off-gassing of the tire components, increasing the likelihood of pulmonary exposures, and creates a complex dynamic in the children's exposure zone immediately above a field that has not been correctly modeled or studied yet. The material lacks uniformity, or any regulatory or exposure controls. We assert that it is impossible to assure even a single tire crumb field is free of inhalation and ingestion risk of dangerous particulate and gases inherent in tires, tire crumb, and add-in composites; and that dangerous and unwanted exposures from lead, benzothiazoles, 12 carcinogens, phthalates, carbon black and other materials, can happen with every use. The data gaps are enormous, and we hope CDC/CPSC/EPA will recognize there is no way the tire crumb industry can protect any player, on any field, from the potential for dangerous exposures with normal use. We argue that not enough scrutiny was placed on this material.

NOTE: The Safe and Healthy Playing Fields Coalition is a grass roots group of scientists, public health professionals, toxicologists, neurobiologist, educators, plastics engineers, medical doctors, waste management and remediation professionals, coaches, researchers, and parents who donate their own time and skills towards helping communities and individuals assess risks to their communities from tire crumb field use. We do not have a lobbying firm, law firm, hired laboratory, consultant, or revenue-generating source (such as tire crumb), and rely solely on the skill of researchers who donate time to compile our comments. That said, we have found compelling data that refutes almost all claims of safety, and when we asked for additional time to compile the information, we were given two weeks, but denied additional time. Hence, we are working at a disadvantage, and hope that during this study year, we will have time and opportunity to substantiate our concerns, and share our research with the study officials. One of our comments below explains our requests for a conference or virtual meeting that allows more disclosure and discussion.

Our comments are listed in numerically and organized into: 1. General Comments, 2. Characterization and methodology comments; 3.Summary List of requests, and a number of supporting documents are also submitted as part of our comments.

Attachments

SHPFC FINAL ASTDR 2016-0002

Comments on ASTDR 2016-0002-0003
Federal Research Action Plan on
Recycled Tire Crumbs Used on Playing Fields and Playgrounds
Submitted to Federal Register May 2, 2016

SAFE AND HEALTHY PLAYING FIELDS COALITION
www.safehealthyplayingfields.org
A grass roots coalition working for healthier alternatives for children and communities

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PART I: GENERAL COMMENTS:

1. CPSC/CDC/EPA should use their existing authority to immediately reclassify tire crumb athletic fields as a children's product, since thousands of fields have been installed in schools that serve hundreds of thousands of children.

2. We have grave concerns about their safety to human health and the environment, since **known carcinogenic and pathogenic components in the field material yield into both air and water pathways, and provide ample opportunity for both chronic low dose exposures with every use of the field to lead, chromium, mercury, zinc, PAH, VOC, carbon black, styrenes, benzothiazoles, and plastics; and more intermittent, but dangerous high dose exposures from "HOTSPOTS" of component material.** (See comments on Characterization). Each of the fields has material that is known to cause cancer, illnesses, and injury in humans; and leachate from runoff causes several negative impacts on the aquatic ecosystems. We believe that the potential for human illness (including several cancers) from both low dose and high dose exposures to the ingredients in tires is staggering. Basic logic favors our position. Based on

the known potential for exposures to children, and the finding of a group of 200 soccer players with cancer (the group represents the reach of a single charismatic soccer coach), an immediate moratorium on new construction of the fields should be put in place with the existing authority of CDC/CPSC/EPA, until the tire crumb fields can be shown to be safe to inhale and ingest.

3. **The tire crumb recycling industry, which appears "green" in its efforts to sell millions of used tires in "repurposed" shredded form, in fact enables a direct transfer of the contamination burden of waste tires from landfills/collection sites (in the US and abroad) to the play surfaces of 12,000 schools and sports centers, where tens of thousands of children and adults have direct contact with the toxins in tire crumb materials on the field surface, and *these exposures could happen with every single contac*t.**

4. For the most part, the **schools and sports centers do not have resources to conduct toxicity due diligence;** meaning, they do not have access to a toxicologist who reads the industry studies with their health as the only priority. Purchasers rely on the tire crumb recycling industry statements, industry studies, and industry funded websites that claim toxicology assessment and public health guidance. The sales material can be striking, and the studies appear convincing on the surface, but our study groups have found significantly misleading information about the safety and actual risk of harm from the tire crumb fields to all users, particularly children. They are likely unaware that claims that the fields are "SAFE TO INSTALL; SAFE TO PLAY" have been repealed.

5. **PEER Filings**. Public Employees for Environmental Responsibility have filed a number of complaints and documents that argue for a repeal of

endorsements of tire crumb safety from EPA/CPSC, and those statements were in fact repealed; but most schools and potential purchasers are unaware of the removal of endorsements and claims of safety. The PEER filings are an excellent source for telling the toxicity story and regulatory story of this product. We respectfully request that the entire file of complaints and responses to the complaints, and other supporting material be entered into the record for ASTDR 2016-0002-0003.

The full list of documents for the ASTDR 2016-002-0003 collection and record can be found here: http://www.peer.org/campaigns/public-health/artificial-turf/news-releases.html. Please include all in that list, and all supporting materials.

6. Formal legal requests have been made to classify the tire crumb fields as a children's product since children use them, and sales and marketing material are very clear about tire crumb fields are for children. **CDC/CPSC/EPA should use their existing authority to explicitly label the fields as children's products.** (Please refer to PEER filings for details and supporting arguments: **http://www.peer.org/campaigns/public-health/artificial-turf/news-releases.html)**

7. CLASSIC CANCER CLUSTER APPEARANCE: SOCCER PLAYERS

Parents and schools may have trusted the "Safe to Play" statements, **but the parents of the 200 young women and men, who played intense soccer and were stricken with cancer do not trust those claims anymore.**

The case of over 200 young soccer players who used tire crumb fields and contracted cancer, strongly indicates a classic cancer cluster, though the cases have not undergone the formal validation process, not yet. That is because a process for the collection of this information, does not exist yet for either cancer victims, or for other illnesses, head injuries, and heat injuries/illness from the fields.

8. We respectfully request that an official study of the soccer player cancer cluster be initiated by CDC immediately.

Through our activist network, we learned about these cases, which were reported to the NBC news link, or directly to a single, trusted concerned soccer coach. EHHI reported as follows:

"New Cancer Numbers Among Soccer Players on Synthetic Turf,
April 2016

It is important to remember that the only people counted in the numbers below are those who have known to call Amy Griffin. There is still no government agency tracking the cancers among the athletes who have played on synthetic turf. We know the actual numbers of athletes who have played on synthetic turf and contracted cancer have to be much greater than those who have known to report their illness to Amy Griffin.

In January of 2016, there were 159 cancers reported among soccer players; now (April 2016) there are 166. Ninety-seven of those in January were goalkeepers; now there are 102. Sixty-one percent of the soccer players with cancer are goalkeepers. As of this writing, 220 athletes of various sports who have played on synthetic turf have cancer; 166 soccer players who have played on synthetic turf also have cancer.

166 Soccer Players who have played on synthetic turf and have cancer

- 102 are goalkeepers (61% are goalkeepers)
- 64 soccer players with lymphomas, 39 are goalkeepers (61%––over half are goalkeepers)
- 10 soccer players with Non-Hodgkin lymphoma, 7 are goalkeepers (70%––over half)
- 54 soccer players with Hodgkin lymphoma, 32 are goalkeepers (60%––over half)
- 41 total leukemias, 24 are goalkeepers (59%––over half)
- 16 total sarcomas, 7 are goalkeepers (44%)
- 12 thyroid, 9 are goalkeepers (75%––over half)
- 11 brain––5 are goalkeepers (45%)
- 9 testicular––6 are goalkeepers (67%––over half)
- 4 lung––3 are goalkeepers (almost all are goalkeepers)

Remaining are OTHER rare cancers."

Source: Various; Victim parent volunteers, EHHI primary collection; 4/2016 (ongoing) _____

All the victims were frequent users of turf fields, spending multiple hours a week in close contact with the material in the fields. All were in their mid-twenties or younger.

9. The self-reporting to a trusted coach, is also an indication that the actual illness rates are not yet being properly assessed or managed by any hospital, medical system, or group; there is no "home" for this information, yet. The 200+ cancer victim count is likely the reach of a single coach with the help of a link in broadcast media, and a fraction of the actual count of victims of cancer or other serious illnesses. Better

investigation and creating a “safe” place to report serious and intermittent illness will uncover many more victims, and provide needed perspective on the accuracy of risk assessment for this product.

10. The CDC and appropriate agencies should issue a directive asking for adequate screening for injury and disease. That US hospital and medical systems are not yet set up to collect this data is a contributing factor; and concurrently, screening for synthetic field use should be part of a responsible screening protocol. To our utter dismay, we learned from pediatric oncologists in our group that at least some oncologist are prohibited from screening victims/patients for tire crumb field use; the screening must be part of the approved protocol, and tire crumb product is not yet included..

11. In fact, the number of **all injuries from tire crumb fields should be collected and analyzed to include, but not be limited to: head injury and concussion; joint injuries (multiple); heat injury; blood cancer; lymphomas; testicular cancer; pulmonary illness; neurological impairment; kidney disease; diabetes; brain disease and cancers. These findings need to be documented, and the children who suffer from them should be screened for tire crumb field use and proximity.** No doctor or oncologist should be prevented from asking questions, screening for, or questioning the safety of this product or contact with this product. We believe there are many more heat related illnesses, head injuries, and endocrine system disruptions directly resulting from exposure to the fields than what is being reported.

12. REQUEST MORE INVESTIGATION INTO EXISTING AND POTENTIAL CANCER CLUSTER: We ask that the multiagency group takes steps to expedite the process of collecting epidemiological data and verification of

the current soccer player cluster, and other potential clusters, to include field maintenance workers who rake the fields, field installers who pour the millions of pounds of material onto field surfaces, school custodians, high contact users of any kind, and school children in buildings adjacent to the fields. Residences near the fields should be considered in the scope of the study or subsequent studies. **In our own informal assessment, and using SEER database and known levels of cancer victims, we found the potential for 7-11 cancer clusters.** We respectfully ask the CDC experts to look into this possibility and take the necessary steps to prevent additional injury and cancers.

13. NEED FOR EXPLICIT PROTECTION FROM RETRIBUTION: Sadly, the families, coaches, and school leaders who have reported illnesses do so with concern for **retribution from the tire crumb industry, school boards, university administrations, and even sports league administrators, and may need explicit protection and remedy against retribution.** Researchers who study the potential for harm tell us that they do not have protection from retribution from tire crumb field industry proponents. Even in our own group, public health and medical professionals must make statements of concern anonymously to protect themselves from retribution––professionally and personally from industry proponents. Adequate protections need to be established to protect the professionals and parents who speak out.

14. PROTECTION FOR CHILDREN IS NOT A COST-BENEFIT ANALYSIS. Children have a unique vulnerability to toxic exposures––both intermittent high exposures––and to low dose exposures, and if we are aware of a carcinogenic presence, then we are responsible for using a precautionary principle, and removing that exposure risk. With due respect, this is not a cost-benefit analysis that will show a percentage of children will get sick

(cost) vs. tournaments played or jobs created (benefit). It is a decision made by a civil society that upholds protection for children's health above all other industry priorities, and a recognition that tens of thousands of children, if not hundreds of thousands, are already being exposed to material with known carcinogenic, and harmful materials on school turf fields.

15. The CDC/CPSC/EPA should recognize that the fields serve children, acknowledge that there are zero safety controls on the material and the potential exposures, and immediately acknowledge tire crumb fields as children's products, and use your existing authority to regulate them as children's products. **Therefore, we emphatically REQUEST THAT THE CPSC/EPA/CDC USE EXISTING AUTHORITY TO IMMEDIATELY CLASSIFY ARTIFICIAL TURF AS A CHILDREN'S PRODUCT, SINCE THOUSANDS OF CHILDREN ALREADY USE THE FIELDS, IN THOUSANDS OF SCHOOLS.**

Since children and adults are already being exposed on tire crumb fields to the materials in tires, we ask for an **immediate moratorium on further construction of tire crumb based or recycled rubber based artificial turf fields** until adequate assurances that tire crumb particulate, off-gassing, and combinations are safe for children to inhale and safe for children to ingest.

Your three agencies do not need to conduct a study to know with absolute certainty that tires were not designed to be inhaled by children, and we should protect children, at any length, from chronic or lose dose carcinogenic exposures.

Even if we cannot model or know (or will we ever know) the exposures to each child, each day (and we will never know), we do know with certainty that:

1. Carcinogens are in tires.
2. Shredded, pulverized tire crumb contains everything in tires, and more ingredients, including: carbon black, phthalates, VOCs, PAHs, benzothiazoles, lead, chromium, zinc, nanoparticle additives, proprietary additives, 12 known carcinogens, 90 materials known to be harmful to human and environmental health, (EHHI)
3. The material can be inhaled when playing and ingested with contact, or intermittent adjacent contact.
4. Every single direct or indirect use has the potential for exposure to hotspots and low dose chronic exposures to multiple scenarios of these materials.
5. The exposures could impact children, school buildings, and surrounding areas; contamination travels to cars, homes, and even children's bedrooms.
6. It is both within the authority and the responsibility of your three agencies to take immediate action to protect the public, especially children, from known carcinogenic, pathogenic exposures.

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Only a complete moratorium on their use will protect the millions of children, athletes and bystanders from inhalation and ingestion of the materials that yield from tire crumb synthetic turf fields.

16. It is also evident that tire crumb will never be safe unless ALL tire ingredients, all "recipes", the manufacturing of tires, and then preparation of materials for fields are controlled from a toxicity perspective. This level of voluntary cooperation from the tire manufacturing industry will, of course, never happen.

17. ONLY UNIFORM MATERIAL SAFE TO INHALE AND INGEST IS APPROPRIATE FOR SCHOOL FIELDS ; UNTIL THEN, A MORATORIUM. When the play surface material is uniform, consistent, and controlled, when it is tested by an adequate study with pediatric toxicology assessments to be safe for ingestion and inhalation, and results are peer reviewed following IRB standards, then we may consider a synthetic turf field might be safe. Until then, tire crumb should be rejected from any casual or unnecessary contact with children or adults.

18. RECONSIDERATION: A reconsideration of the moratorium could occur when the industry can demonstrate a uniform, non-carcinogenic, non-inhalable, non-ingestible alternative that does not present PAH, VOCs, phthalates, lead, chromium, mercury, 1,3-benzothiazoles, butadiene, styrenes, carbon black (in particulate, gaseous form, or any form to children); and the product undergoes strict, peer-reviewed study by independent qualified toxicologists who have a mandate to protect children's health and the health of the environment above the interests of industry. The hypothetical product should be subject to regular reviews and quality control determinations to ensure safety over the life of the synthetic field. Safety Data Sheets should be provided and accessible for every user. If waste tires are used, the controls requested above will never be possible, since the tire material, by definition, is a composite of many toxins in unknown quantities and with unknown impacts.

PART TWO: CHARACTERIZATION OF TIRE CRUMB COMMENTS

1. SCALE AND SCOPE: Tire crumb potential to individuals, buildings, surrounding areas and stormwater for contamination is enormous.

2. PUBLIC HEALTH ISSUE: SCALE AND SCOPE CONCEPTS

The potential for contamination from tire crumb is a growing public health issue, in terms of the relative size of the product and its mass; the total number of potential fields; and their basic contact with students, athletes, school personnel, buildings, communities, and streams/storm water.

To give an idea of the existing volumes of material, the field runoff and children affected or who may be affected, we have developed reference tables, and the summary is attached to this filing These tables indicate the scope and scale, and demonstrate that these are not isolated fields, nor tiny exposure potentials. The quantities of material are enormous. The source and reasoning is explained, but the tables are designed for your model development and quick reference.

3. ENORMOUS QUANTITIES ON EACH FIELD SURFACE .

To give an idea of the scale, a modest soccer field uses 30,000 waste tires. According to a randomly selected company selling packaged tire crumb infill for original or replacement treatments, 30,000 tires makes about 396,667 pounds of lbs of material. According to our calculations, the volume for 2" thick field is about 525 cubic yards, However, a large football field, three times the size of a small soccer field, could use 1,000,000 pounds of tire crumb material.

4. The tires are shredded, pulverized into crumb of various sizes, and the shredded material is poured on top of a plastic "grass" carpet. Importantly, the material is loose, unencapsulated and can loft into the air when struck by a ball or foot, or body. We estimate that, depending on the school, each field has regular, daily contact with at least 1000 athletes and students. At

sports events, busy tournaments, or with active use, a field can have contact with many, many more.

5. No fields we found have mandated capture of the leachate or particulate at the field.

6. TOTAL FIELD VOLUMES POTENTIAL:. The universe of potential tire crumb playfields is approximately 200,000 - 220,000 schools and athletic facilities in the US, based on number of schools. The potential reach of exposure from use of these fields is in the millions of children, millions of adults, hundreds of thousands of exposed buildings and adjacent soils, and hundreds of thousands of public easements and storm water access points (we estimate 1:1 ratio for field to point source drainage).

7. TABLE RUNOFF AND VOLUMES: SUMMARY OF KEY METRICS

For reference, we analysed fields by sport type, by Metropolitan Service Area, and calculated the volumes for rainfall (by city), and for amount of tire crumb material on a field surface.

Key metrics are the following:

- Estimated tire crumb per 85,000 sq feet field and 2" deep tire crumb infill is 525 cubic yards, 396,667 pounds, or 198 tons per field.

- **The total amount of tire crumb material on surface of 12,000 fields is estimated to be 6,296,296 cubic yards, or 4,760,000,000 pounds or 2,380,000 tons** that are currently in sports centers and schools in April 2016..

- **Runoff is calculated by city and field size, but the total runoff for fields in the top 50 MSAs is 15,006,99,787 gallons.**

- **Total Runoff for** 12,000 fields based on number of fields per MSA, accounting for rainfall in that MSA, and added together for 2016 is: **23,370,639,827 gallons**… for a single year.

The calculations were made to illustrate the scale and scope of this product, and to characterize the reach of exposures from the field surface into the airway, and into the water pathway.

8. INGREDIENTS IN TIRE CRUMB: Lack Of Uniformity, High Variation, Multiple Toxins

Tire crumb appears to be a composite material, heterogenous with multiple known carcinogens, pathogens, and mutagens. The material is not uniform, comes from multiple sources and lots, and can be mixed with plastics and materials of unknown origin. The material can have anticlumping agents, flame retardant additives, paint, and strengthening or characteristic enhancing additives. Shredding of tires can cause small pieces of steel or metals to be included in the material from steel belted tires. Some tire crumb is from newer depositories from recalled tires, some from landfills, and some have been subjected to a variety of weather and conditions. Leachate and off gassing could be variable, with the expectation that newly installed/poured material off-gassing is higher than from an older field, but we expect those rates would vary with the age of the tires from which the tire crumb was made.

9. HETEROGENEOUS, MULTIPLE TOXINS, UNKNOWN ORIGIN: To say that tire crumb infill comes from multiple sources, is an understatement: dispensaries, landfills in the US, landfills abroad, collection centers, factory waste from China, factory waste from the US and abroad. Some of the newer marketed blends included multi colored sport shoe waste, shoe factory waste, and many unidentified synthetic materials. Just as tire companies may add anything to their "recipe" for a tire, an infill provider may offer materials that could have anything added into the blend. Tire plugs, tire polishes, tire coatings, and materials picked up on the roads should be considered. And even if it is known that there are only tires in the blend, there is a broad variation in the ingredients based on the use of the tire, and the manufacturer. Those tires may look the same, but from a toxicity standpoint their variation and the unknowns in the "recipe" create a margin of uncertainty that makes any claim of known safety for inhalation or ingestion impossible. If a vendor says he or she knows what is in a lot of tire crumb, and that is known to be safe, then they ignored the materials in the product. Since we never know what is in any field for sure, and if we know that they have tire crumb, they cannot be demonstrated safe for children to inhale, ingest, nor play upon.

10. What Is In Tires? SOME GROUPS WENT LOOKING

Since it was difficult from MSDS or any other source to identify the components in tires or tire crumb, some groups studied them directly.

11. Environment and Human Health Inc, and Yale University Study

EHHI, Inc. in cooperation with Yale University studied samples of rubber mulch, and new tire crumb with the intent of characterizing their ingredients.

The summary text of their characterization study is found here:

http://www.ehhi.org/turf/metal_analysis2016.shtml
http://www.ehhi.org/turf/findings0815.shtml

The EHHI/Yale Study list of components found is explained this way:

The shredded rubber tire playground mulch samples tested were provided by the manufacturer and were purchased in new bags of rubber mulch for use in gardens and playgrounds. The rubber tire infill for synthetic turf fields was obtained as new infill material from installers of synthetic turf fields. There were 5 samples of infill from 5 different installers of fields and 9 different samples of rubber mulch taken from 9 different unopened bags of playground mulch.

RESULTS There were 96 chemicals found in 14 samples analyzed. Half of those chemicals had no government testing on them - so we have no idea whether they are safe or harmful to health. Of those chemicals found that have had some government testing done on them these are the findings with their health effects.

TWELVE (12) KNOWN CARCINOGENS

2-Mercaptobenzothiazole/ **Carcinogen**, toxic to aquatic life

9,10-Dimethylanthracene/ **Carcinogen**, respiratory irritant and can cause asthma

Bis(2-ethylhexyl) phthalate/ **Carcinogen**, may cause damage to fetuses

Fluoranthene / **Carcinogen**, Fluoranthene is one of the US EPA's 16 priority pollutant, A PAH.

Heptadecane/ **Carcinogen**

2-mercaptobenzothiazole / **Carcinogen**

Phenol, 4-(1,1,3,3-tetramethylbutyl)/**Carcinogen**

Phenanthrene/ **Carcinogen** - A PAH

Phthalimide/ **Carcinogen**, skin, eye and lung irritan. A Fungicide

Pyrene, 1-methyl- /**Carcinogen**

Tetratriacontane /**Carcinogen**, eye and skin irritant. Can cause systemic damage to central nervous system.

Pyrene/ **Carcinogen,** toxic to liver and Kidneys, a PAH

Carbon Black/ **Carcinogen**

Carbon Black makes up to 20% to 30 % of every tire. It is used as a reinforcing filler. Carbon Black is listed as a carcinogen by the International Agency for Research on Cancer (IARC).

Carbon Black, as such, was not analyzed by the Yale Study because Carbon Black is made up of a number of chemicals – some of which were found in the Yale study.
Carbon Black is not one chemical -- it is made up of many chemicals - often of petroleum products. Furthermore, carbon black has no fixed composition, even of the many compounds it contains. Carbon black from different sources will have
differing compositions. In our method, carbon black will register as a series of substances extracted from it. There is no carbon black molecule, it is a mixture.

TWENTY (20) KNOWN IRRITANTS

1,4-Benzenediamine, N-(1,3-dimethylbutyl)-N'-phenyl-

Irritant - causes skin and eye irritation, toxic to aquatic life

1,4-Benzenediamine, N-(1-methylethyl)-N'-phenyl-

Irritant - causes skin and eye irritation, toxic to aquatic life

2(3H)-Benzothiazolone

Irritant - causes skin and lung irritantation

2-Dodecen-1-yl(-)succinic anhydride

Irritant - causes eyes, skin and lungs irritation

3,5-di-tert-Butyl-4-hydroxybenzaldehyde

Irritant - causes irritation to eyes, skin and lungs.

Anthracene

Irritant - causes skin, eye and respiratory irritation. Breathing it can irritate the nose, throat and lungs causing coughing and wheezing.

Benzenamine, 4-octyl-N-(4-octylphenyl)-

Irritant - causes eye and skin irritation

Benzenesulfonanilide

Considered hazardous, very little testing has been done on it.

Benzothiazole, 2-(methylthio)-

Irritant - causes Skin and eye irritation.

Dehydroabietic acid

Toxic to aquatic organisms

Docosane

Irritant - causes Skin irritation

Hexadecanoic acid, butyl ester

Irritant - causes eye, skin and lung irritant. Can cause reproductive effects.

Methyl stearate

Irritant - causes eye, skin and lung irritation.

Octadecane

Irritant - causes kin, eye and respiratory irritation

Octadecanoic acid also known as Stearic acid

Irritant - causes skin, eye and respiratory irritation

Oleic Acid

Irritant - causes skin and eye irritation

Phenol, 2,2'-methylenebis[6-(1,1-dimethylethyl)-4-ethyl-

Irritant - causes skin, eye and respiratory irritation

Tetradecanoic acid

Toxic to aquatic organisms. Skin and eye irritant.

Anthracene, 2-methyl-

Acute aquatic toxicity, Not much data available - what there is shows it to be an eye, skin and lung irritant

Anthracene, 9-methyl-
Acute aquatic toxicity, serious eye irritant

13. Carbon Black

Carbon black plays an extraordinary role in tires, and in their toxicity and potential for harm from exposures. Well known from decades of air pollution studies, urban epidemiological studies, carbon black causes lung cancer, brain cancer, kidney cancer, heart disease, neurological disorders, and cognitive degenerative disease.

A known carcinogen (WHO), we have found variations in percentages of the amount of carbon black in a tire, from 30%-68%. (EHHI/Yale Study; NY STUDY, .pdf, pp19-20.) Carbon black breaks down into many sized particles, including PM10/PM2.5. That size particle was shown to cause several types of cancer, including brain cancer, kidney cancer, kidney disease, bladder cancer, and neurological disease and cognitive impairment disorders. (CITE; Harvard Mexico Studies and Urban Cohort Studies) We know for sure that carbon black is in tires, in part from simple observation of color.

14. THE NY STUDY CHARACTERIZES TIRE CRUMB THIS WAY:

"The components of Firestone's and Dow Chemical Company's rubber are summarized in technical specification documents. Although they are only two of many different rubber manufacturers, a similarity between the two vendors is readily apparent, even between three different types of rubber, solution-SBR, cold polymerized emulsion SBR, and high cis2-4 polybutadiene rubber. In general, the following similarities were observed between the two manufacturers for the compounds used to produce the rubber:

• The polymer used to produce solution-SBR contained approximately 18-40% bound styrene.

• The oil content in the polymer ranged from 27.3-32.5% in solution-SBR and cold polymerized emulsion SBR. Oils used include aromatic oil, high viscosity naphthenic oil, and treated distillate aromatic extract oil.

• Besides the polymer used, the other components of the rubber were similar between manufacturers and the relative proportions (parts by weight) of these other components ranged as follows:

o Carbon black: 50.00 – 68.75
o Zinc oxide: 3.00
o Stearic acid: 1.00 – 2.00
o Sulfur: 1.5 – 1.75
o N-tert-butyl benzothiazole sulfonamide (TBBS): 0.9 – 1.50
o Naphthenic or aromatic oil: 5.00 – 15.0

The components summarized above are the principal components of the major type of rubber (SBR) used for the manufacturing of crumb rubber and therefore have the potential to have a significant presence in crumb rubber. As discussed in subsequent sections of this report, some of these components have been found to be prevalent in crumb rubber, including **zinc (from the zinc oxide), benzothiazole compounds** (from TBBS), and **PAHs** (possibly from the oils used). These compounds may be attributed to the SBR used in the manufacturing of crumb rubber."

15. Phthalates are a regulated toxin, and PEER filings covered some of the toxicity and regulatory discussion. Please refer to http://www.peer.org/campaigns/public-health/artificial-turf/news-releases.html

16. ZINC

Coastal Marine Resource Center Study, found fatal levels of zinc in leachate from tire crumb fields. This amount would cause fatal impacts to aquatic ecosystem within 48 hours. This is a notable amount, and though was assessed in terms of environmental health, indicates presence.

Menichini and Abate Study: "Zn concentrations (1 to 19 g/kg) and BaP concentrations (0.02 to 11 mg/kg) in granulates largely exceeded the pertinent standards, up to two orders of magnitude". "Zinc and BaP concentrations are high in rubber largely exceeding the Italian soil standards".

17. METALS: MERCURY, CHROMIUM, ARSENIC

The highest median values were found for Zn (10,229 mg/kg), Al (755 mg/kg), Mg (456 mg/kg), Fe (305 mg/kg), followed by Pb, Ba, Co, Cu and Sr. The other elements were present at few units of mg/kg. The highest leaching was observed for Zn (2300 µg/l) and Mg (2500 µg/l), followed by Fe, Sr, Al, Mn and Ba. Little As, Cd, Co, Cr, Cu, Li, Mo, Ni, Pb, Rb, Sb and V leached, and Be, Hg, Se, Sn, Tl and W were below quantification limits. Data obtained were compared with the maximum tolerable amounts reported for similar materials, and only the concentration of Zn (total and leached) exceeded the expected values.

18. LEAD, POLITICS and CHILDREN

The problem is synthetic turf is NOT REGULATED as a children's product by the CPSC thwarting the ability to apply lead regulations that CPSC could enforce.

Lead was identified in synthetic turf fields as early as 2008 but was not addressed in any systemic way due to lack of standards or required testing (although the CPSC could have required the testing mandated for children's products since 2008). The CPSC has chosen not to mandate this children's product testing for synturf and in fact advised the industry about not having it designated as a children's product < http://parentscoalitionmc.blogspot.com/2009/03/artificial-turf-tale-of-lead-levels.html> .

This has led to a "buyer beware" situation especially after the CPSC tested synthetic turf carpets, found lead at varying levels depending on sample age, and astoundingly concluded the whole synthetic turf system was, always and everywhere, safe not just for adults but for children. The assumptions were based on inappropriate modelling for blood lead levels from a meager sampling and the troubling finding presupposes that there is, a safe level of blood lead, which most pediatricians and lead experts agree there is not safe level.

To this day the synthetic turf industry cites the still CPSC-posted "OK to Install, OK to Play on" press release which should never have been posted to begin with, has been disavowed, in front of US Congress, by CPSC commissioner Kaye and is an embarrassment to government science, policy and public health <http://www.cpsc.gov/en/Newsroom/News-Releases/2008/CPSC-Staff-Finds-Synthetic-Turf-Fields-OK-to-Install-OK-to-Play-On/ >

19. By contrast, The Centers for Disease Control (CDC) in contrast warned and continues to warn the " there is no safe level of lead" to expose children.

http://www.cdc.gov/nceh/lead/>

http://www.cdc.gov/nceh/information/healthy_homes_lead.htm.
"**No safe blood lead level in children has been identified.** Lead exposure can affect nearly every system in the body. Because lead exposure often occurs with no obvious symptoms, it frequently goes unrecognized"

In 2010 Van Ulirsch et al (Environ Health Perspect. 2010 Oct;118(10):1345-9 <http://www.ncbi.nlm.nih.gov/pubmed/20884393

20. Evaluating and regulating lead in synthetic turf.
Division of Health Assessment and Consultation, Agency for Toxic Substances and Disease Registry gulirsch@cdc.gov) concluded that: "Synthetic turf can deteriorate to form dust containing lead at levels that may pose a risk to children. Given elevated lead levels in turf and dust on recreational fields and in child care settings, it **is *imperative that a consistent, nationwide approach for sampling, assessment, and action be developed*.** In the absence of a standardized approach, we offer an interim approach to assess potential lead hazards when evaluating synthetic turf."

21. *But no such approach has ever been instituted. Indeed as reported in USA today this year: "The CDC in 2008 said communities should test recreational areas with turf fibers made from nylon, and they should bar children younger than 6 from the areas if the lead level exceeded the federal limit for lead in soil in children's play areas. But some communities have refused to test their fields, fearing that a high lead level would generate lawsuits or force them to replace and remove a field, which costs about $1million, according to a 2011 New Jersey state report . Forty-

five of 50 New Jersey schools and towns contacted in 2009 by epidemiologist Stuart Shalat would not let him test their turf-and-rubber fields, Shalat's report states. The EPA also found, in 2009, that "it was difficult to obtain access and permission to sample at playgrounds and synthetic turf fields."<http://www.usatoday.com/story/news/2015/03/15/artificial-turf-health-safety-studies/24727111/ >

22. And for the past 2 years the company FieldTurf has, with impunity, noted its synturf fields contain lead during testimony on various bills in the Maryland State House.

The latest admission documented on video: <http://wtop.com/montgomery-county/2016/03/md-lawmakers-seem-information-artificial-turf-schools/>

> "....asked point-blank by one delegate, “Is there lead in your products? The executive answered, “There’s lead in a lot of things in this world.”.... “**Yes, there’s lead in our products**." In spite of this admission and the fact that the legislation in question was meant to post the CDC prescribed warnings about minimizing lead and other toxin exposures from the synturf and tire waste products, and in spite of the fact that the legislation had strong and broad input and support, the legislation was not even allowed to come up for a vote in committee by the committee chair.

23. Public Employees for Environmental Responsibility compiled the literature as of early 2012 on lead

see: <http://www.peer.org/campaigns/public-health/artificial-turf/news-releases.html > and specifically: 2012-07-12 lead-limits-needed-on-tire-

crumb-playgrounds (*NOTE if you go to PEER.ORG news releases: click on public health and "artificial turf" to find the actual filings with many links}*

Unfortunately for the children, fields with high lead remain. But those responsible for protecting children are kept in the dark. NO ONE IS MONITORING OR REGULATING ARTIFICIAL TURF FOR LEAD OR OTHER TOXINS in either old or new fields, including the Consumer Product Safety Commission (CPSC) (see <http://www.peer.org/news/news-releases/cpsc-drops-artificial-turf-playground-safety-review.html Even though the Chairman of the CPSC, recently admitted to congress that its soothing conclusions of safety after finding lead in synthetic turf were NOT correct.

Tested fields keep showing up with lead in them both old AND NEW. Some tested fields have little or no lead , some high levels and some have both within the same field. There is no way of knowing if any of the components of a field contain lead, and how much without stringent and thorough testing of each field.

This problem highlights the need for application of the designation as a children's product for testing and regulation : 1) stringent testing of all the colors and of the backing of the carpet for total lead content (chromium and cadmium should also be tested for) AND 2) Testing many samples of the infill which is an ever-changing â€˜witches brewâ€™ of chemicals- so undetectable, low and very high levels can all be found in the same field. In addition to having testimony both last year and this year in the MD state chambers from Field Turf that their product DOES indeed contain lead (as you heard in the recent committee testimony on MD house Bill 883 , and in addition to those referenced in the PEER review, other studies on lead also exist.

24. For a comprehensive media article on Lead in artificial turf which cites scientists and studies that the synturf industry avoids please go to: <http://www.usatoday.com/story/news/2015/03/15/artificial-turf-health-safety-studies/24727111/

>

For example as reported in that article:

Dr. Shalat's New Jersey State Study (2012) on artificial turf found lead in the field dust in the respirable air space of a robot and real player- highly variable but sometimes very high (note most facilities would NOT LET THEM TEST).

<http://www.nj.gov/dep/dsr/publications/artificial-turf-report.pdf

25. PEER writes: The concerns about lead exposure have taken on a new urgency following the release in June of 2012 of a study done for the New Jersey Department of Environmental Protection which found artificial fields made of tire crumb can contain highly elevated levels of lead much greater than the allowed levels for children:

a)· It reports "concerns with regard to potential hazards that may exist for individuals and in particular children who engage in sports activities on artificial fields"; and

b) *"In**halable lead present in artificial turf fields can be resuspended by even minimal activity on the playing surface**."*

26. Dr. Lioy of Rutgers who is quoted in the USA Today article recently participated as the senior author in a study which found lead and other

toxins in the BOTH the plastic rug (supplied to them by the industry) and tire crumb infill. LEAD was also was found in simulated body fluids meaning there is little or no protection of any kind against the lead getting out of the material into the body .

27. Pavilonis Study found lead.

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4038666/pdf/nihms565643.pdf > 2014

" **Bio-accessibility and Risk of Exposure to Metals and SVOCs in Artificial Turf Field Fill Materials and Fibers**" , Brian T. Pavilonis1,Clifford P. Weisel1, Brian Buckley1, and Paul J. Lioy1

QUOTE from Pavilonis et al:**."Since it is possible that children may be exposed to potentially high concentrations of lead while using artificial turf fields we recommend, at a minimum, all infill and fibers should be certified for low or no lead content prior to purchase and installation."**

*The main out-comes of concern from Pavilonis et al**:**

a) the finding of **lead, and chromium** in **both** the **tire crumb** and **the plastic rug** and simulated **body fluids** at sometimes extremely high levels ***EVEN IN NEW FIELD CARPETS**.*

b) **Benzothiazole** derivatives and **4-(tert-octyl) phenol** were also found in in the simulated body fluids. Both are probable carcinogens (the subject of another fact sheet).

QUOTE: "**Lead was detected in almost all field samples** for digestive, sweat, and total extraction fluids with digestive fluid extract of one field sample as high as 260 mg/kg. Metal

concentrations were not markedly different across the three different sample types (new infill, new turf fiber, tire crumb field sample). However, one of the *__new__* turf fiber samples contained relatively large concentrations of **chromium (820 mg/kg) and lead (4400 mg/kg)** compared to the other samples tested…the variability of lead contained in the infill material is large and can span more than two orders of magnitude* . One field [tire crumb] sample did contain a high lead level (260 mg/kg) which was on the s**ame order of magnitude as the NJ DEP cleanup value** (400 mg/kg)."

In summary: Lead-free is the only acceptable level for child products (and indeed for people in general). T**here is NO safe level of lead for children.** And yet many of our children are playing often, if not daily, on fields that may contain lead and certainly do contain many other toxic substances. Finding ANY lead in any play area for children of any age is unacceptable. As the CDC notes: Every effort should be made to eliminate ALL unnecessary sources of lead in the environment, especially a child's environment. ***Lead in artificial turf is not only totally unnecessary but dangerous to health AT ANY LEVEL*.**

28. Other sources of information on Lead in tire crumb fields:

www.ehhi.org/turf/<http://www.ehhi.org/turf/>
www.safehealthyplayingfields.org<http://www.safehealthyplayingfields.org>
www.synturf.org<http://www.synturf.org>

[FOOTNOTE SYN TURF]Where on the Synturf page on lead you can find:
No. 36] Mayo Clinics tips to protect children from lead in artificial turf.

April 2015.

No. 35] Durham, New Hampshire: Lead scare at UNH, s Memorial Field. November 2012.

No. 34] Beware of lead content in exotic color artificial turf fields! September 2012.

No. 33] Odessa, Texas: Eager fans will not be given pieces of the artificial turf field. September 2012.

No. 32] U.S. Federal panel increases child protection against lead. February 2012.

No. 31] UNLV researcher spreads word about the need to test artificial turf fields. December 2010.

No. 30] Environmental Health Sciences study (2010): Deteriorating synthetic turf dust containing lead may pose a risk to children. October 2010.

No. 29] Concord, Mass.: Town replaces fake grass fields, officials insist nothing is wrong with the lead levels! July 2012

28. TWELVE (12) CARCINOGENS found and HOW DO THEY INTERACT:

The Yale Study identified the presence of so many carcinogenic materials in a single material that it raises many more questions about interaction of PAHs with metals, and combination impacts. The interaction of the PAHs and benzothiazoles with other materials in the fields needs to be characterized and addressed

29. Strengthening Additives: Nanoparticles

We would also ask for information and clarity about tire strengthening additives of any kind that were built into the material anytime in the past

30 years, these would have been added to tires.
[http://nice.asu.edu/nano/carbon-black-and-amorphous-silica-tires]

Similarly, we request that the tire manufacturing industry explain their use of nanoparticle products, of any kind, including the type and size, source company and source country, and ask for an explanation about how:

a. they can be quantified in the product, and
b. how can they be cleaned up if they are released when the tire crumb and or plastic "grass" carpet degrades?
c. We would also like to understand what material characterization of their behavior in tires performance,
d. And or their behavior once they are released into the environment.
e. We ask for any epidemiological due diligence that was conducted by any tire company on nanoparticle use prior to using them in a commercial product.
f. Plans for continued use and safety precautions tire companies will impose upon themselves
g. Epidemiological studies conducted on these particles in tires

30. Plastics, Microplastic Fibers, Microbeads, and Small Particulate Plastics

Assessment of microfiber particulate and small particulate plastics needs to be assessed in characterization studies.

31. Flame Retardants

Flame retardants can be added to a tire in production, or applied post production in a shipping setting or possibly as tire crumb. Since flame

retardants are known carcinogens with health issues of concern, and will be on the surface of the waste tire crumb, tire infill providers need to know if they are present, and purchasers need to know that the material contains flame retardants prior to purchase.

32. Tires and Tire Crumb Additives

Myriad products exist to clean, protect, condition, and color tires. We wonder if they are components of tire crumb?

33. Road Waste Picked Up By Tires

Tires spend their lives on roadways, of course, and can pick up many materials in their travels. Debris, hydrocarbons, ….

34 CARINOGENIC, PATHOGENIC, and MUTAGENIC ingredients in tires cannot be removed by shredding tires into tire crumb and must be assumed to be accessible.

35. Tire crumb and repurposed rubber appear to be the same thing, with interchangeable use… but are they the same? We would like clarification.

We would like clarification about the distinction between the tire crumb, repurposed crumb rubber, and crumb rubber. Specifically if using the term "repurposed rubber crumb" implies uniformity of ingredients? Does that term imply tires are not used? If so, what are the ingredients in repurposed rubber crumb and how do they differ from tire crumb?

36. **We would also like access to all MSDS/SDS of tire crumb manufacturers and tire companies,** and the ability to ask questions about

how and where they were made, variations on lots, source and composite addendums. It is difficult to locate them.

37. EXEMPTION ON LISTING HAZARDOUS MATERIALS: We would like to understand why tire companies have an exemption on their need to list ingredients under Section 2: Hazardous Materials of an MSDS/SDS. We were unable to find the source of that exemption, if it has a deadline, and whether your study group thinks it is an obstacle to understanding and characterizing risk of exposure from tires and tire crumb.

38. Of those MSDS that we located, several, like this Michelin North America Material Safety Data Sheet for Michelin, Uniroyal, BF Goodrich, says in **"Section 2 HAZARDOUS INGREDIENTS: Note: Tires meet the definition of article as defined by the OSHA Hazard Communication Standard (29 CFR 1910.1200) and are exempt from MSDS requirements."**

There was clearly no mention of 1,3 butadiene, carbon black, POHs, VOCs, benzothiazoles, or any plasticizers, nor metals, styrene, sulphur, known irritants, or well… anything. Since that section also outlines corrosive, combustible and waste treatment, it is important for more than this issue. We explicitly ask CDC/CPSC/EPA if they can use their existing authority to require tire crumb companies and tire companies to provide ingredient information.

39. SOURCE MATERIAL UNKNOWN: MSDS/SDS CANNOT REPRESENT WHOLE FIELD. Tire crumb comes from many tires, and many sources. Since not a single tire crumb field can accurately list or track which tires were source materials, or what other mixed in components, and there is no accountability from tire crumb recycling industry for the shredded product,

then MSDS/SDS cannot be accurate for a whole field due to variability. Therefore, the burden of "proof" of risk lays squarely on the ability of the purchaser (schools, sports directors, booster clubs) to assess risk… of a very very complex product. So, if the exemption stays in place, we will know for sure that we cannot know what is in a tire crumb based field.

40. TREATMENT TO SHOW NO PARTICULATE OR BREAKDOWN: SHOW US.

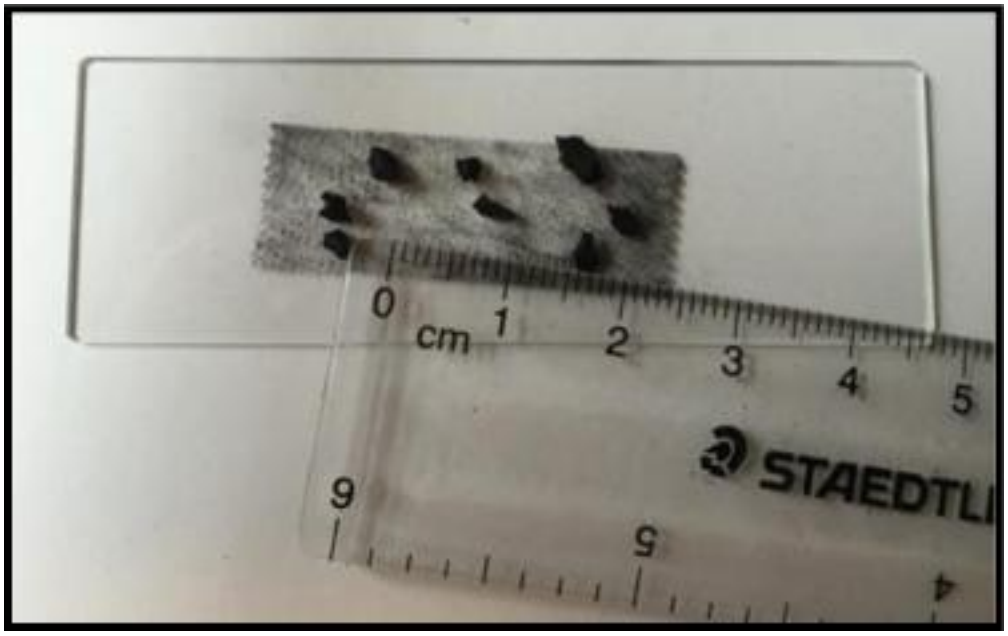
As for studies that claim that their product has been treated (such as cryogenic treatment) to not break down into dangerous particulate, we are deeply skeptical, and would ask for proof. We also ask for assay testing over a period of at least several summer weeks. We ask for the researchers to simulate the pounding over 10 years and assess the particulate characteristics and particle size. That testing in fact is being done right now… in thousands of children across the country. Simple observation on a player body, on the sideline benches, or under a microscope shows consistent breakdown into particulate.

41. SHREDDED, PULVERIZED, HIGH SURFACE AREA FORM OF TIRES and ADD INS is LIKELY MORE TOXIC THAN WHOLE TIRES.

Unfortunately, because it is shredded, pulverized, and in loose and unencapsulated form, tire crumb has exponentially more surface area than whole tires (Thomas, Gupta study;) and we are concerned the material is very likely more toxic––possibly many times more toxic––in the school field form than whole tire form, since the increased surface area provides more opportunity for molecules to escape. We know for sure that the increased amount of surface area in tire crumb makes the material in tire crumb more available to the breathing and exposure zones, and to runoff.

42. CRUMB IS SURROUNDED BY DUST PARTICULATE:

Accurate characterization technique must include a study of the particulate that surrounds tire crumbs, and steps must be taken to make sure that the sampling process does not inadvertently remove that dust and particles. We found several examples of the samples being washed, some in unbuffered water, prior to their analyses being done. Of course, that removes the particulate that concerns us the most. Distribution of the particulate size and type is important. Those particulate can become aerosolized by numerous gases and we ask that attempts are made to properly model this dynamic under high heat conditions, primarily.

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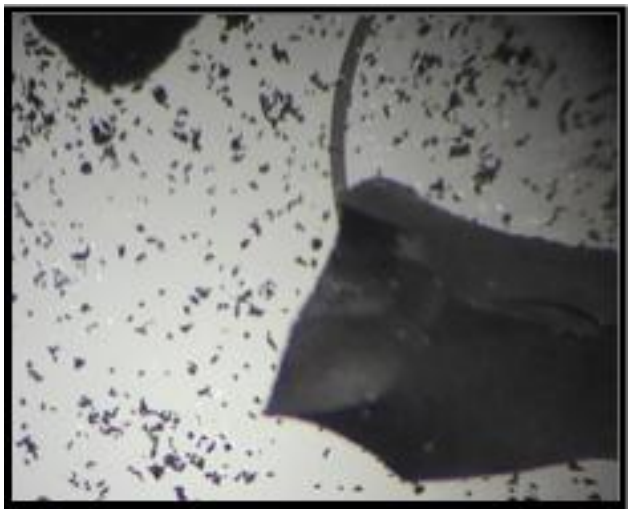

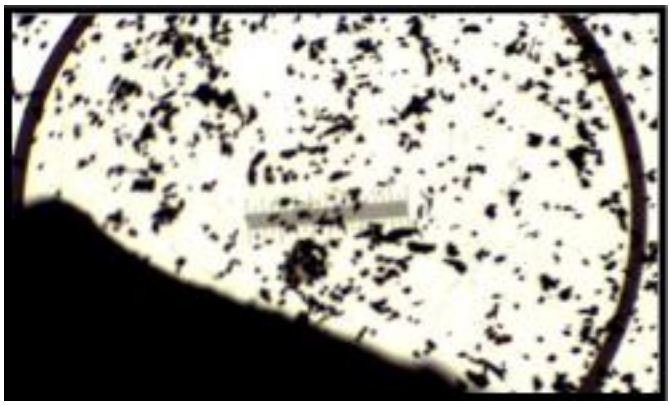

43. VERY COMPLEX PICTURE From TOXICOLOGY PERSPECTIVE: Tire crumb material is complex from a toxicology perspective, largely due to the chemical complexity presented by multiple known toxic components and variation. It has been described as a "toxic soup" of ingredients for which we have no consistent data on proportions or levels. Characterization of ingredients' margin of error is unknown..

Testing must be done at the field levels using accepted sampling plans that have been statistically shown to be valid. Not fields have been tested in sufficient detail to determine or rule out any exposures or risks. A look at testing protocols for lead in urban soil sites illustrate the level of attention required and show the degree that current testing has fallen short of that needed for decision making for children's health.

44. CONTACT PATTERNS, FIELD USE and ADJACENT BUILDING CONTAMINATION

Exposure is likely determined by ingredients in surface, activity, and number of children or users on field. Each school or community field has high use and high contact patterns, such as hosting contact sports, like football, lacrosse, soccer, and baseball, athletic camps, workshops and practices. In those sports, children dive into the field materials. As a child runs or skids or slide tackles, a column of material rises up, as does the dust and particulate that surround the tire crumbs themselves.

Testing for exposure need to list weather conditions including humidity, wind speed, and precipitation, temperature on field surface and ambient air temperature. Number of children on field, and activity level of that play needs to be recorded, video would be most interesting.

Children of all ages use the fields for multiple sports, recreation and school events. Artificial turf tire crumb fields abound in elementary schools and at

indoor and outdoor sports centers where children of all ages and all stages of development play soccer, lacrosse, football, track, cheerleading, band, and use the field for general recreational school activities. In the fields with which we are familiar, families with members of all ages use the fields; and the community holds events, picnics, special fairs, and activities. Some fields are immediately adjacent to a school building.). That there are many uses, and probably many levels of contact and exposure is an important part of characterizing exposures, but both low dose exposures AND high contact exposure scenarios and use need to be examined, with appropriate epidemiological process.

45.. SCHOOL BUILDINGS AND SURROUNDING AREAS ARE CONTAMINATED with a great deal of tire crumbs. The fields appear to lose from 1-30 tons of material over their 8-10 year life, and some of it goes directly into buildings, cars, and then homes. This impact needs to be studied as an inadvertent consequence.

46. CANNOT ARGUE NO INHALATION OR INGESTION RISK or SAFETY FOR EVEN A SINGLE FIELD. We argue that given the unique characteristic of nonuniformity, known carcinogenic materials, breakdown into particulate/dust, no known source of origin, and no accurate studies on complex interactivity of those components in the children's exposure zone, in the tire crumb as it is installed today in 12, 000 fields, not a single field installer, nor material provider can demonstrate that the material is safe from inhalation and ingestion during normal use, active use, and on hot days.

47. EVERY USE COULD POSE A TOXIC EXPOSURE and it would be irrational to argue otherwise. We argue that due to the high variability of toxins in the tire crumb substrate (from tires, unknown additives, and

factory waste add-ins), and lack of any control of the material, well-known sampling techniques will NOT accurately predict risks to human health.

48. CHILDREN CANNOT AVOID THE EXPOSURES: Since school children cannot self-advocate and take responsibility for staying off a field if directed to be there by coaches or school officials or parents, we must assume that children cannot avoid the exposures when they play on those fields.

49. CANNOT CLAIM THAT EXPOSURES WILL NOT OCCUR. Absolutely no way to responsibly claim that ingestion and inhalation of particulate from the material will NOT occur to those children.

50. HOTSPOTS of intermittent dangerous exposures are possible, and should be expected and searched for in every field.

We must assume that tires have different "recipes" based on their type of use. Therefore, knowing the type of tire used in tire crumb, and each tire "recipe" would be helpful in assessing characterization of ingredients. However, there is no way to ever know what tires, or what material is in any field, and therefore, an MSDS/SDS cannot be representative of any field, or even any meaningful part of a field. Alarmingly, the high variability in the ingredients presents worrisome "hotspots" potential, where the hotspots might be missed in sampling but even a single exposure could have very serious impacts for a child who has the unfortunate luck to dive into that hotspot. PAH's may be more prevalent, and present dangerous levels for installation period of the field, and for some unknown period of time afterwards, and considered a "hotspot", then the consistent release of PAHs in the subsequent years could mean low dose, chronic exposures. Both need to be examined.

51. Lead, chromium, mercury and arsenic could be hotspot sources, based on which tires were used, and how they were treated prior to being placed in the field.

52. For example, when we asked about the source of lead in tire crumb fields, an infill vendor explained to us that a) lead could be in any field as an ingredient of the tires, of the treatment of tires, and b) once, they were aware of a shipment of tires that was treated with an anticlumping material that contained lead and the whole lot had lead, and c) that some lots had flame retardants added as well. They would never really know, but "most purchasers never ask", according to the infill material vendor. If an MSDS was required, an additional charge was to be imposed, since MSDS were not available from the materials they acquired from China or other countries. We have collected many more examples of the worrisome unknown ingredients in our fields and can share with the study teams, if requested. While this information is anecdotal, that is the point: we have no idea what is in any field, for sure.

53. Another example, but this is not anecdotal: in a primary study field exposures in CT, a researcher found that the children's monitors showed benzene. Since there is no safe level of exposure for benzene, and in fact, tires are not expected to have benzene, the field was sampled more closely, until that "hotspot" was located. The original source of that benzene was not determined, but it was next to a busy parking lot where cars' exhaust may have been a source as they turned the corner, or possibly the tire crumb material had been previously stored in an area with benzene in surrounding environment, or perhaps it was picked up from contact on roads. We will never know. That finding suggests that the carbon black in the tires can adsorb additional toxins present near tires or tire crumb, and

could release that material as the fields are pounded with running feet, or possibly on a hot day. The proper characterization of this material needs to account for adsorption characteristics of carbon black, and other interactions

54. The point is, that it is impossible to locate hotspots for all toxins in every field, and incorrect to extrapolate the risk for a whole field from a single sample or even multiple samples, since every sample is unique. So, while hotspots can easily be missed in a field, the unfortunate child that dives into that particular part of a field has an exposure that can actually be life threatening, but missed in its entirety in the sampling based risk assessment.

55. In fact, since the tire crumb creates multi sized "dust" particles, and off gases, it is impossible to prove that even a single field is safe from inhalation or ingestion exposures from tire dust particulate, off-gassing components, multiple toxins and combinations of toxins, and heat.

56. Importance of the Heat Factor: Source of direct injury and chemical catalyst

HOT HOT HOT HOT EXTREMELY HOT FIELDS

Grass playfields remain close to the temperature of ambient air, and are often much cooler. Asphalt playgrounds used to have a use limit of 141F and many schools remove children from playgrounds when temperatures get hot. With tire crumb based turf fields, surface temperatures can soar on even mild sunny days.

Tire crumb fields "superheat" to levels that are routinely over 150F on a sunny spring day, and in a recent study conducted on a sunny day Utah, found to be close to boiling point, 190F, according to the Penn State Field Turf Heat Study. The study found that tire crumb field surfaces are hotter than ambient air, and increase in heat in a non-linear function with each additional degree Kelvin of heat, hence the designation "superheating". To draw an example, on a Labor Day Weekend in DC area, with ambient temps of 82F, the field surface temperature hit 164F by noon on several fields used in a busy, tournament for about 1000 children, both boys and girls, ages 8-15. Those levels are known to melt plastic cleats, require tubs of water on the sidelines to cool down shoes, and create heat-related injury including heat stroke, nausea, heat exhaustion, and dehydration in children and all users. It is not unusual for children players to vomit, faint, and suffer dehydration from hot conditions on the fields.

57. Marketing and sales for these fields tout their usability in all conditions as a benefit (more practice and play hours), but in fact, the heat build up on fields makes them very uncomfortable during many days and conditions. In DC, there are over 100 days of sunshine each year, and most are during the spring, summer and fall, making the fields uncomfortably hot and possibly dangerously hot for a third of a year. A calculus should be made on the percentage of safe days to play based on field yield risk, and heat.

58. Tire crumb fields do not have any protection from heat, and so they are irrigated to be cooled down, but the effect is temporary.

59. To our knowledge, there has been no well known place for doctors nor parents to report heat injury, though they are commonplace. (This author

specifically remembers a hot, poor air quality day in August in 2014 in Washington DC when during a single practice, 4 soccer players vomited, another child was taken to the hospital after passing out, and another sidelined himself against the coach's wishes, due to extreme dizziness and nausea.)

60. **Reluctance to Report?** Yet, it is curiously uncommon for school teachers, coaches and parents to remove the children from the fields, due to temperature. We cannot explain that in rational terms.

We have also noted another curious effect: as football, soccer and lacrosse increase in popularity and competition in the US, competition for spots on high performance teams is fierce. There is a perception from strong sales and marketing of the fields, that the turf fields present a competitive edge for a school, a club or even a teenager trying to get into college, and are worth the high price paid. As psychologist Dr. Wendy Miller, explains, " it is a culture where high performance parents, players and schools might be willing to overlook these injuries, thinking that to complain would jeopardize their child's access to a competitive team. This thinking could easily lead to the silencing of reporting of injuries."

Heat injury reporting needs to be included in the survey questionnaires, and victims of heat injury and illnesses need to have a place to report, with impunity.

61. HEAT MAKES THE CHEMICAL DYNAMICS ABOVE A FIELD VERY COMPLEX

In addition to the serious issue of direct injury from hot playfields to young children, or anyone, the super hot fields present a very challenging chemical situation.

Dr. David Brown, ShD, toxicologist, professor and former Deputy Director of Public Health Practice Group at ATSDR/ CDC explains that, "the unintended, and largely unstudied chemical consequences of what comes off such an enormous quantity of high surface area material, in amounts and sequence that is scientifically accurate is very difficult to predict and model. Since the chemicals in the area above the field could change instantaneously, the conditions are critically important (number of players, temperature, time from last rainfall, etc.), as is the sampling methodology. But no one has been able to come close to modeling the actual yield, we only know the materials by characterization with samples, and that variation in samples is so broad as to almost be meaningless, since it could be easy to miss harmful exposures."

62. Analyzing the field yield on a hot day is very complex, and challenging to even trained toxicologists. The superheating of the fields makes gases yield at faster rates as temperatures on the tire crumb surface increases. So, as a day heats up, it is very likely that the yield increases directly with temperature increase; a hot day creates more gases. Based on well understood scientific laws, we presume that the gas yield from the field at surface temperature of 50F (a cloudy day in January in DC) would be considerably less than a field surface temperature of 158F measured last week. If more gases are escaping the surface, then there are more "opportunities" for particulate to adsorb onto the surface of the gases, creating very dynamic series of compounds, none of which would be recommended to inhale.. The changes in the chemical composition over the fields as their temperatures rise is very difficult to test and model. These changes happen in an instant… as a threshold is reached… and the

exposures can increase sharply. It is a very sophisticated and difficult challenge to model. But what is the most important is not only that the 24 gases that escape tire crumb (Norway Study) create dangerous mixtures but those gas/particulate mixtures, (and air) create a vector for deep lung exposures of all the materials in the tire crumb field. So, on poor air quality days, when there are many children on the field and a lot of stirring up of the material, the fields could present enormous risk.

63. We are concerned about the range of yield levels, but, we are most concerned about the intermittent risk to children during those hot periods (a hot, poor air quality summer day during children's soccer camp week in Washington DC, for example) when the fields are likely yielding more gas, and therefore particulate has more "carriage" into lungs, respiration rates are higher, skin is exposed, and perspiration is highest. All these are likely factors in exposure. It is during those days when exposures are probably highest, and high enough overwhelm a developing immune system.

64. Exposure Study Needs To Focus On Worst Case Conditions

We acknowledge that the level of yield from the fields might vary widely with material variation, and will also vary with outdoor weather (temperature, wind, humidity and sun) conditions. Taking averages from fields across the country will be meaningless, and will only help the industry to expand its message of "found no harm". An analogy might be to determine the health of a forest taking 4 samples from 40 locations, evenly spaced, but the sampling might easily miss a blazing forest fire. That one day might destroy living material exponentially, but it could easily be missed. Dangerous exposures can be unpredictable in this material due to the scope and scale, the toxic character, and the superheating characteristic.

65. A better approach is to carefully detect high yield days, and look THAT DAY for exposures in a child's body during those periods. Since the exposures might attenuate, the work would have to be done expeditiously. The harmful exposures may or may not be detectable a day or a month later in a child. Monitor both genders, for patterns that might lead to that awful air quality soccer camp in the city on a tire crumb field, on days when vomiting and melting shoes are commonplace. A focus on the impacts from the high end of those yields we believe will present exposures that are clearly, and unequivocally harmful from both heat injury perspective and toxicity exposure potential. We do not know for sure if the carcinogenic exposures from low dose regular exposures or from high dose "events" are more dangerous, but both need to be studied as separate situations, not as an average.

66. We urge your team to focus the study resources on primary measurements made in high use scenarios on hot days, and refrain from the approach used in earlier studies that look at chemical compositions during winter or rain conditions on limited number of fields.

67. The only reliable way to assess the risk to children from a particular field, or groups of fields, is to look at their direct exposures, and importantly look at bloodlevels of the known substances. Cooperation from both high use athletes and those exposed to chronic levels of materials will be important.

68. The Study Needs To Focus Also On Low Dose Exposure Risks

Trained immunotoxicologists look at the impacts of chronic low dose exposures to metals, PAHs, VOCs and many other materials in tire

crumb. Their input is crucial to understanding risk of exposure in a developing child.

69. Characterization Mistakes

Studies look convincing, but miss the forest for the trees.
Tire recycling and tire crumb industry reports are quick to point out that when they find harmful materials in their samples, they are under the known safety limits. There are two interesting fallacies in that reasoning.

First, since the samples in several studies are few and not uniform, they fail to acknowledge the statistical significance of finding known regulated toxic material in 2 million pounds of powdered tires… if one finds the needle, is it luck, or is it because needles are more prevalent than expected?

Proof of presence is meaningful! For example, in the NY Study, PAHs were found, as were metals, benzothiazoles, and many substances. Their presence indicates a risk.

In a child's product, since many materials are not known how they affect children, just knowing they are there is enough to use a precautionary principle and prevent the exposure. Arguing that the materials appear under a limit (especially if that quantity is an average of multiple samples), or there is no established limit (because it has not been studied), are not as meaningful as the proof of their presence.

Second, though the conclusions of the industry reports may be of no harm found/safety, a close look at the data itself on PAHs, lead, cobalt, chromium, etc. is useful, since a) it proves presence, and b) at levels that suggest risk for **chronic exposure**. Chronic exposure risk is the subject of

a great deal of new cancer research, and we care about all the materials, including those which are potentially toxic.

70. ARGUMENT FOR MORATORIUM BASED ON KNOWN CHARACTERIZATION FOR TIRE CRUMB

Because of the:

a. known loss of 1-30 tons of material from the fields during the 8-10 year "life of the field" into air and water
b. ingredients list: over 50% of its components are known carcinogens and pathogens, [cite Yale Study]
c. massive scope and scale of this product, (the amount of material and surface area of these fields is enormous; scale/millions of pounds in each installation),
d. inability to control the levels of toxic exposure to children, or even properly characterize them due to immense variation and chemical complexity of what happens on a hot day over a field, and around children. We cannot suggest mitigation strategies for the danger, because the material is inconsistent,
e. Even if we did know for sure what was in each field, and suggest mitigation techniques and protections…. All the tire company has to do is change their recipe, or many recipes, as they do continually, and the study is worthless. Children are still being exposed to whatever is in the tire, the lot or that particular field..

71. Moving Target Analogy

Even if the study were completely successful, and the tire crumb material categorized properly, the trouble is, tire manufacturers could change the "recipe" for tires… and in fact they do this regularly… and the study results will be useless, or at best, diminish in usefulness.

Any attempt to study tire crumb safety on turf fields is analogous to trying to hit a moving target. Tire crumb is a waste product. Tires are not designed or intended to be used as infill for turf fields.

Ingestion, inhalation and absorption of fine particulate by children is not a consideration of tire manufacturers as they choose chemicals and compounds for their tires. Nor are they bound to maintain any safety considerations for such use by children.

So any study of present day tire crumb is a futile endeavor, because such study tells us nothing about a field that gets installed immediately after the study. Tire manufacturers often change the chemical composition of tires and will likely do so again.

Even if a field passed safely concerns in a present day study, a new field could easily fail a hypothetical study conducted the day after the present study. So unless every field was tested using the exact same methodology after every installation, there is absolutely no way to assure the user that their new field is safe. Those new fields could easily have an entirely different chemical composition simply because tire manufacturers changed their tire ingredients.

So the present Federal Study is only a backwards looking study, not forward looking. Any conclusion must be transparent and clear on that issue - upfront and center. Otherwise the public is being misled into a false sense of security.

72. **Sampling: Not Appropriate For Tire Crumb**

The core pediatric toxicology problem in industry based safety studies, is that there appears to be an assumption that tire crumb is a uniform material, and behaves uniformly. It does not. There also appears to be an assumption that sampling will be an accurate method for studying tire crumb risk to children, and it is not. **Sampling will not be accurate to assess a nonuniform, heterogeneous material with multiple known toxic ingredients, high direct contact (dermal, hand to mouth, breathing zone) for pediatric use**. **Sampling cannot produce a single sample that is representative of the whole field, or even a part of the field, other than the sample itself.**

73. Methodology needs to study PERFECT STORM exposure conditions, and be able to calculate exposures during those relatively dangerous days.

Nor can sampling in the way it is proposed (samples from 40 fields across the US), illustrate impacts from a perfect storm of exposure conditions on a particular field, say, during an intense soccer camp in in summer in Washington, DC with high ambient and field surface temperatures (ie 160F), bad air quality, no wind, when working athletes are breathing in particulate with high VOC, PAH, benzothiazoles, and carbon black… and many more compounds, on a particularly high yield day. Averages cannot be relied upon in sampling for this type of product, since they will further obscure the risk from exposures to hot spots of high risk material that are on fields. Averaging the results from a national distribution in various weather conditions simply obscures the acute risks further; it is useless for risk analysis. In layman's terms, it is like studying a forest using "x" number samples, but missing the forest fire that is blazing away at a nearby area of the park. For a child, it means that she plays on a field that was called "SAFE TO PLAY", after sampling, but in fact she might easily have

been covered with multiple materials known to cause cancer, and in fact, that might be a regular event. The uncertainty of exposure frequency makes the risk higher, not less.

74. The core of the methodology used in the 50 studies asserted by the tire recycling industry were based on simple characterization of a single sample, but not on realistic, combined, nor worst case (the most important) use scenarios.

75. Multiple carcinogen and multiple pathogen combined effects need to be measured. Single material measurements could be only a fraction of the exposures, since the material exposures are likely to be from combinations of materials.

76. BIOMONITORING FRONT AND CENTER

Because sampling presents inconclusive results, a methodology that relies on biomontioring will be more meaningful. We suggest that more sophisticated approach be considered. Personal sampling monitors attached to children, dermal, urine, breathing analyses, and particularly, blood and tissue samples from frequent users, players on "Perfect Storm Days" and those expected to have chronic low dose exposures. We understand that biomonitoring raises more issues, but absent a good model, empirical data is the most reliable way to accumulate actual evidence of exposures and to be able to establish a reliable causal link to the cancers and diseases we predict from exposures.

77. IMMUNOTOXICOLOGY SUPPORT: RECRUIT THE BEST PEDIATRIC IMMUNOTOXICOLOGISTS AND RESEARCHERS. Some researchers and epidemiological professionals are already on the trail of better ways to

identify actual exposures, and can create biomarker groups as indicators of presence of illness or exposures. These researchers have background in immunological toxicology, and can track subtle changes in an immune system that might be precursors to serious disease, like cancer, kidney disease, brain changes, and lung disease. It is possible to create biomarker group to prove tire crumb exposures in users and we believe that the preliminary proof of concept step could be accomplished in less than 6 months with cooperative athletes, and study volunteers, and modest budget. While we will not list them here, for protection of their privacy and frankly, for fear of industry retribution, we will nonetheless let you know that we have found multiple professionals who are capable and willing to work on this task, provided a protective forum and IRB standards are in place.

78. Immunotoxicology support: look carefully at the ages those immune system markers in all children who are using these fields, understanding that some metabolic types, and ages may be more vulnerable than others. In fact, there are early indications that certain age groups, such as prepubescent females (age 8-11), may be more vulnerable to exposures to benzothiazoles, plastics, phthalates, and endocrine disruptors in general, and therefore might be at higher risk to contract cancer or disease from low dose particulate exposures from tirecrumb, and the plastic "grass" carpet particulate. We need to establish the datum from players to study this. We still do not know, but some indications exist. For that reason, we respectfully request that the study team include toxicologists and epidemiologists that are trained to keep these concepts front and center.

79. LOW DOSE EXPOSURE CONCEPTS and CONCERNS

Based on what we know now about low dose exposures to VOCs, PAHs, benzothaizoles, styrenes, carbon black, plastics, plasticizers, and metals, even at low, sub acute exposures, the fields could be very dangerous. That possibility was not considered in the CPSC study, EPA study, nor in mulitiple industry studies. These need to be assessed:

- Chronic exposure to metals, plastics and plasticizers
- Chronic exposure to carbon black mimics air pollution exposures
- Immune system reactions
- Endocrine disruption exposures from plasticizers and phthalates,
- Exposures from multiple low doses and chronic exposures

80. The study should calculate yield of material that leaves the fields, and how it leaves the fields. How much in the air , water pathways, and with users (in shoes, cars, etc.) Interviews with schools and vendors need to establish the replacement quantities of these fields, and how often new material is put into place, since it would affect exposures, and give an indication of gross yields. We estimate that the fields lose from 1-30 tons (estimated) of material, so exposures and impacts need to be measured in adjacent buildings, soils, and stormwater systems. With 12,000 existing facilities, this may need to be the subject of additional studies conducted to also assess if the fields shall be regulated as point source contamination under Clean Water Act and Clean Air Act. It is a very important metric, and a perfect opportunity to include it, with little incremental cost, in your study.

81. INTEGRITY STANDARDS. To track the history of the emergence of this product is to track effective lobbying for regulation changes that favored the tire industry, and the tire recycling industry. This industry took

advantage of an enormous quantity of recalled and used tire stockpiles, and heavily sold and marketed the materials to schools, and sports centers where millions of children play. Central to the steps that catapulted this industry forward was the removal of the designation of artificial turf fields as children's products, based on the rationale that adults played on them, too. Yet the fields continue to be sold to elementary schools and to sports centers brimming with elementary, middle and high school players. The sales oriented industry was willing to submit children, schools and communities to the materials in tires in enormous amounts, and call them safe. As this claim is deeply questioned now, we also urge you to NOT allow the sampling or data collection to be conducted by an interested party, including schools, sports centers, athletic group personnel or administrators, field installers or laboratories or consultants hired by those groups, and establish peer reviewed standards for testing.

82. Any group or individual who does participate in the study, including regulatory staff, needs to sign an affidavit certifying that she or he, and her/his group has not received compensation or benefits in any form, including but not limited to sales commissions, direct payment, compensation, bonuses, grass to artificial turf grant, field financing, water savings rebates (State of California and possibly others), or physical benefits including but not limited to uniforms, facility enhancements (restrooms, concession stands, parking lots, storage facilities, etc.), stadium components, or field equipment of any sort, from the field installers or tire crumb field industry and its assigns, and has no financial conflict of interest. The document should be filed with an appropriate agency and made public.

83. We ask for full transparency on all parts of the study process for parents, interested parties, and schools.

OUR REQUESTS TO ASTDR/CDC/CPSC/EPA	
Request	Background
1. Regulate tire crumb and rubber mulch as children's product	PEER filed formal request; 12,000 fields x 30,000 tires is the amount of existing material in children's use; see table A for details on volumes and surface area sizes, children/schools. Known carcinogenic material and known

	contact.
2. Remove "safe to play, safe to install" or any other references that imply safety from all EPA, CPSC and CDC websites and public information sources	PEER Formal Request; agencies must remove all endorsements of safety.
3. Place all PEER artificial turf filings in Federal Record	**http://www.peer.org/campaigns/public-health/artificial-turf/news-releases.html**
4. Issue a directive to public health agencies to disseminate warnings regarding unknown risks from lead exposure from AT fields, as well as exposures to carbon black, known carcinogens, PAH, VOCs into air and water pathways; direct hospital systems and medical systems to screen for tire crumb field use, and report results	For parents, schools, athletic groups, and communities; conduct parent outreach webinars
5. Use only independent lab or consultants unassociated with tirecrumb industry, adhering to high ethics guidelines; transparent process for review; affidavit of no conflict of interest	
6. Commission a primary study, conducted by independent, peer reviewed group such as CDC to examine existing cancers AND illness in tire crumb field users and maintenance workers of tire crumb fields	
7. Mandate Cal Recycle Study corrections to methodology; mandate methodology peer review; and mandate to impose Prop 65 rule based on OEHHA's own findings on carcinogenic exposure	
8. Convene a conference for presentation of risks and concerns from parent groups, cancer survivors to Federal Research Team	Needs participation from CDC/CPSC/EPA staff so parents and public can have direct contact
9. Convene series of webinars and open comment opportunities	
10. Allow public health and environmental advocacy groups in Federal Research Team with complete transparency	
11. Establish a collection point for recording experience of victims and those who may have suffered injury from use of the fields, including heat injury, concussion or head trauma, cognitive disorder, illness, and cancer for study and documentation; victim hotline; for both child and adult contact with fields	
12. Funding to identify potential biomarkers of exposure; conclusive marker study in users	
13. Conduct blood monitoring and studies on existing cancer survivors.	
14. Conduct cancer cluster study on soccer player cluster, and identify additional clusters such as maintenance workers and installers	
15. Provide full transparency with all interested parties	
16. Conduct full epidemiological study of tire crumb on playfields existing and predictive	
17. Study forms and questionnaires should include data collection on what is released from fields into air, adjacent areas, water pathways, and quantified. Replacement quantities for tire crumb fields should be quantified and examined as a metric that indicates yield.	
18. Based on release/yield figures, and other inputs, tire crumb fields should be evaluated for compliance with Clean Water Act and Clean Air Act, and regulated accordingly.	
19. We request that OEHHA study methodology be peer reviewed by your agencies before it begins, taking into account the comments received in this proceeding.	
20. OEHHA Study Process and Methodology Concerns: How will those be considered?	
21. Consider explicit protection from retribution steps be put in place to protect researchers, players, and concerned parents from retribution	
