



# COMMONWEALTH of VIRGINIA

## Department of Health

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Dr. Gloria Addo-Ayensu,

Thank you for contacting the Virginia Department of Health (VDH) Division of Environmental Epidemiology with your request to review *the appropriateness and rigor of methodologies used in artificial turf field related research reports* your office submitted May 8, 2015. VDH has finished reviewing these documents and concludes that the methodologies were appropriate for assessing chemicals in crumb rubber and in the environment where crumb rubber is used. Should Fairfax County decide to pursue a study to evaluate crumb rubber turf fields located in your county, working with an environmental contractor and contracting laboratories familiar with the analytical methods cited in this letter would be valuable. VDH is available to provide technical assistance with reviewing proposed study designs and interpreting sampling results.

### BACKGROUND

On May 7, 2015, Fairfax County Health Department contacted the VDH Division of Environmental Epidemiology for assistance with evaluating reports on crumb rubber turf fields. Fairfax County Health Department drafted a literature review of health effects and crumb rubber fields in 2012. A second opinion was requested to evaluate the appropriateness of the methods used in several of the study reports given recent media and local concerns regarding the use of crumb rubber in artificial turf fields in Fairfax County.

The 11 reports that VDH reviewed were provided by Fairfax County Health Department. The methodology of each report is presented in part below with a discussion of the appropriateness and rigor of the methodology at the end of this letter. VDH does not discuss the risk assessments, meteorological analysis, or actual findings except as they pertain to the relevance of the methodology or usefulness to address potential risks to health. Also, biological sampling and analysis, and epidemiological studies are not discussed.

## Methods

### California (2010)<sup>1</sup>

#### *Study goals*

*Determine whether the new generation of artificial turf athletic field containing recycled crumb rubber infill is a public health hazard with regard to:*

- Inhalation: *Do these fields release significant amounts of volatile organic compounds (VOCs) or fine particulates of aerodynamic diameter less than 2.5 microns (PM<sub>2.5</sub> and associated metals) into the air? If so, are the levels harmful to the health of persons using these fields?*
- Skin infection: *Do these fields increase the risk of serious skin infections in athletes, either by harboring more bacteria or by causing more skin abrasions (also known as turf burns) than natural turf? (methodology not reviewed)*

#### *Methodology*

##### VOCs

Volatile organic compounds (VOCs) samples were collected at artificial fields during hot summer days and compared to VOC samples collected from nearby natural fields.

Stationary air samplers placed on the four artificial fields (aged less than a year to five years) and four natural fields when temperature was expected to exceed 90 °F. Samples were collected in six liter SUMMA canisters (duplicates) beginning at 8:00 AM and ending at 5:00 PM at 45 minute intervals (flow rate was 125 milliliters per minute). Analysis of VOCs in each canister was completed within 30 days using EPA method TO-15. In addition, VOC emissions from the field were concentrated by collecting samples inside an inverted galvanized steel garbage can. Samples were also collected from Fort Funston and were used as an additional check for possible false positives. Quality control tests run included method blanks, duplicate control samples, and laboratory control spikes.

##### PM<sub>2.5</sub>

Particulate matter measuring 2.5 microns (PM<sub>2.5</sub>) and bound metal samples were collected at artificial field during use and compared with samples collected upwind of each field. Air samples were collected during active field use from three artificial fields that ranged from three months to two years old. Monitors were placed one meter from the sideline of the field on the downwind side. No significant precipitation was noted on the day preceding sampling or the day of

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<sup>1</sup> California Department of Resources Recycling and Recovery. 2010. Safety Study of Artificial Turf Containing Crumb Rubber Infill Made From Recycled Tires: Measurements of Chemicals and Particulates in the Air, Bacteria in the Turf, and Skin Abrasions Caused by Contact with the Surface.

sampling. Air samples were also collected a few hundred meters upwind of the fields. This was repeated the following day. Air samples were collected four feet above the ground at a flow rate of five liters per minute over three hours. Flow check was measured with a calibrated manometer and sample blanks were included in the analysis. Samples were analyzed using both gravimetry and XRF analysis.

### *New York (2008)*<sup>2</sup>

This document is an intensive literature review focusing on the potential exposure and health effects related to synthetic turf fields. It also identifies gaps in what is known. While the report does make conclusions and recommendations on its findings, environmental sampling and analysis is not the intent of the paper and therefore was not reviewed for this letter.

### *New York City (2009)*<sup>3</sup>

An air quality survey consisting of semi-volatile organic compounds (SVOCs), VOCs, metals and PM<sub>2.5</sub> at two outdoor synthetic athletic fields and two natural athletic fields in New York City was conducted.

Stationary samplers were used to collect samples three feet above the ground. Samples were collected at fields (one less than a year old and one more than three years old) with simultaneous collection of sample upwind of the fields. Grass fields were sampled similarly to synthetic fields. Samples were collected under summer conditions in the late morning to afternoon on four separate days. Samples were collected under simulated playing conditions. VOCs sampling time was for 60 minutes using SUMMA canisters. Sampling time for the other substances was for 120 minutes. Meteorological data and age of field was recorded as well as traffic conditions near the fields. Field, trip, and laboratory blanks were also analyzed. Sampling method/analytical methodology were as follows:

- VOCs – EPA TO-15
- SVOCs/PAHs – NIOSH 5506
- Metals – OSHA ID 125
- SVOCs/Benzothiazole – NIOSH 2550
- PM<sub>2.5</sub> – Continuous sampling

Bulk crumb rubber analysis details were not provided.

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<sup>2</sup> New York City Department of Health and Mental Hygiene (DOHMH). 2008. A Review of Potential Health and Safety Risk from Synthetic Turf Fields Containing Crumb Rubber Infill. Prepared by TRC for DOHMH

<sup>3</sup> New York City Department of Health and Mental Hygiene (DOHMH). 2009. Air Quality survey of Synthetic Turf Fields Containing Crumb Rubber Infill. Prepared by TRC for DOHMH

New York State (2009)<sup>4</sup>

This study evaluated chemicals in crumb rubber under laboratory and field conditions. In the laboratory setting, crumb rubber from four scrap tire processing facilities in New York were:

- subjected to two sequential aggressive leach tests
- tested under simulated acid rain conditions
- tested for lead using acid digestion
- subjected to different temperatures and chemicals off-gassing analyzed

Field sampling comprised of surface water, groundwater, air quality, and temperature analysis. This was achieved by:

- collecting runoff samples from drainage pipes at synthetic fields during rainfall events
- collecting samples from down gradient wells at synthetic field
- monitoring organic and particulate matter concentrations above and upwind of synthetic fields
- measuring surface temperatures at synthetic fields and nearby grass and sand surfaces

The following table summarizes the methodology used in this report.

Test	Methodology	Additional Information
Laboratory Leaching Test	EPA SW-846 Method 1312	100 grams crumb rubber in 2 liters water (pH 4.2) mixed for 18 hours. Filtered and analyzed for SVOCs and metals.
Laboratory Off-gassing Test	TO-15 method modified	VOC and SVOCs analyzed over different temperatures (25°C, 47°C, and 70°C). Method proved difficult due to adsorptive property of crumb rubber. Quantitation limit raised due to dilution.
Laboratory Column Test	Column in house design. Eluent samples analyzed for zinc (SW-846 Method 6010), and selected SVOCs (SW-846 Method 8270C)	Crumb rubber packed (2.2 inches) in Chromaflex Glass Columns eluted with simulated rainfall (acetic acid/acetate buffer (0.0003 M) adjusted to pH 4.2 with 0.5 M HNO <sub>3</sub> /H <sub>2</sub> SO <sub>4</sub> using a computerized pump (2mL/min) that alternated on and off every 30 minutes until the equivalent of 12 inches of

<sup>4</sup> New York State Department of Environmental Conservation. 2009. An Assessment of Chemical Leaching Release to Air and Temperature at Crumb Rubber Infilled Synthetic Turf Fields

		rain passed through the column.
Water Quality Survey (Surface Water)	Methods 624, 625, and 200.7 ELAP certified Lab (H2M Labs. Inc.)	Surface runoff collected from one field installed in 2007. Analysis did not include chemicals related to crumb rubber.
Water Quality Survey (Groundwater)	SW-846 Method 9270C	VOCs including aniline and benzothiazole
Air Quality Survey (VOC)		VOCs collected Tenax cartridge and Tenax/Anasorb cartridge in series drawing 120 L of air over 2 hours. Inlet placed 1 mm above field surface
Air Quality Survey (SVOC)		SVOCs collected using PUF/XAD cartridges drawing 4 L/minute over 2 hours. Inlet placed 2 mm above field surface
Air Quality Survey (Wipe samples)	ASTM E1728 and HUD guidelines (1995), infrared thermometer (Extech 42510A) for field temperature	
Air Quality Survey (Microvacuum samples)	Collected according to ASTM D 5755-95 and HUD guidelines (1995)	Samples collected using 25 mm particulate filter cassettes with a 0.45 µm filter coupled to a Buck BioAire sampling pump.
Air Quality Survey (PM <sub>10</sub> and PM <sub>2.5</sub> )	Thermo DataRam 4000 aerosol monitor with PM <sub>10</sub> and PM <sub>2.5</sub> size collectors	

### Connecticut (2010)<sup>5</sup>

The purpose of the study was to determine concentrations of VOCs, SVOCs, PM<sub>10</sub> and rubber related compounds at select synthetic fields in Connecticut under active field use. Personal and area (field) sampling was conducted. In addition, bulk samples of crumb rubber were analyzed. A summary of methodologies is provided in the table below.

Test	Methodology	Additional Information
VOCs	EPA TO-15	1.4 L SUMMA (personal) 6.0 L SUMMA (area)
SVOCs	EPA T0-13A	PS-1 Sampler PUF and XAD-2
Targeted SVOCs	WOHL Method LC-100 (NIOSH 2550 based)	Personal Pump (personal) Gilair, SKC

<sup>5</sup> University of Connecticut Heath Center (UCHC) 2010. Artificial Turf Field Investigation in Connecticut (Final Report). Prepared By Nancy Simcox, Anne Bracker, and John Meyer

		Airlite XAD-2 37 mm, 2 µm PTFE pre-filter (area)
Nitrosamines	WOHL Method LC-96 (NIOSH 2522 based)	Personal Pump (personal) Gilair, SKC Airlite Thermosorb/N (area)
PM <sub>10</sub>	CFR Title 40 Part 50 (Appendix L) WP001-03 Gravimetric Analysis	MS&T Area Sampler 37 mm Teflon Filter 2µm pore size

Bulk samples were collected and analyzed for:

- VOCs using headspace gas chromatography coupled to a mass selective detector. This was done according to WOHL method WG086.2 (OHSA PV2120 based).
- targeted SVOCs using thermally extracted using a Supelco Adsorbent Tube Injector System and analyzed using high-performance liquid chromatography coupled to a triple quadrupole mass selective detector.
- lead using laboratory modified EPA SW-846 3050/ ICP, modified OSHA ID 125.

**Connecticut (2010)<sup>6</sup>**

The purpose of study was to identify substances off-gassing and leaching from synthetic fields, measure off-gassed compounds and particulate matter in childrens’ breathing zones, measure leached compounds in stormwater runoff, and establish level of variability at individual synthetic fields and between synthetic fields in Connecticut.

Specific stormwater sampling plan, criteria, and procedures are listed in more detail in the study report. The following laboratory methods used include:

- EPA Method 130.1, hardness
- EPA Method 150.2, pH
- EPA Method 200.7, metals
- EPA Method 624, VOCs
- EPA Method 625, SVOCs

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<sup>6</sup> Connecticut Department of Environmental Protection. 2010. Artificial Tuft Study; Leachate and stormwater characteristics

### Connecticut (2010)<sup>7</sup>

This report is a peer review done by the Connecticut Academy of Science and Engineering of the study titled “An Evaluation of the Health and Environmental Impacts Associated with Synthetic Turf Playing Fields.” It was reviewed by VDH to gain insight into other reports published by Connecticut state agencies.

### EPA (2009)<sup>8</sup>

The study was to collect and analyze air, wipe, and material samples at a playgrounds and synthetic fields using the following methodologies:

- VOCs – grab samples collected using 6 L SUMMA stainless steel canisters with inlet one meter above the surface and analyzed using EPA Method TO-15
- PM<sub>10</sub> – two integrated air PM<sub>10</sub> samples were collected at one meter above the surface (one for PM and metals, other for scanning electron microscopy (SEM)) and PM<sub>10</sub> determined gravimetrically, metal concentration by X-ray fluorescence; and particle size and morphology by SEM.
- Field Wipes – ASTM standard wet wipe E1728-03 method and EPA In Vitro Relative Biaccessibility Assessment Method 9200.1-86.

### EHHI (2007)<sup>9</sup>

The report was meant to put exposure to ground-up tires and mulch in a scientifically based qualitative and quantitative context. A laboratory analysis of crumb rubber is presented in the appendix and addresses the questions:

- Are compounds volatilizing from crumb-rubber?
- What are the identities of the volatile compounds?
- Can organic or elemental components be leached from the tire crumbs by water?

Methods were not descriptive enough for the methods included in the EHHI report to be reviewed for appropriateness. In short, tire crumbs were heated in a 2 mL capped sampling vial with a SPME needle at 60° C and analyzed for VOCs using a gas chromatograph coupled to a mass spectrometer. This method was used to answer the first two questions above. To answer if organic materials can be leached, 17 grams of crumb rubber were soaked in 50 mL of water for seven weeks, the leachate filtered, and analyzed using the SPME procedure described above. In a separate experiment, 2 grams of crumb rubber in 40 mL of water were agitated for 18 hours and

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<sup>7</sup> Committee Report: Peer Review of an Evaluation of the Health and Environmental Impacts Associated with Synthetic Turf Playing Fields. 2010. Prepared by The Connecticut Academy of Science and Engineering

<sup>8</sup> United States Environmental Protection Agency (US EPA). 2009. A Scoping Level Field Monitoring Study of Synthetic Turf Fields and Playgrounds

<sup>9</sup> EHHI (2007) “Artificial Turf Exposures to Ground-up Rubber Tires: Athletic Fields, Playgrounds, Gardening Mulch.” Environment & Human Health Inc., North Haven, CT.

the leachate analyzed using ICP. This was repeated using acidified water, pH 4.2. The procedure was based on EPA SW-846 Method 1312.

## **DISCUSSION**

Methods developed and approved by governmental agencies were used in the reports to measure chemicals in crumb rubber and in the environment where crumb rubber is used, particularly for athletic fields. These methods are the standards for environmental analysis in both laboratory and real world settings. Crumb rubber is composed of multiple classes of chemicals that include metals, VOCs, and SVOCs. There is no single method that can measure the concentration of all chemicals in all states of matter (gas, liquid, solid) found in crumb rubber. Therefore, multiple methodologies must be used. The sampling and analysis methodologies used in these studies are generally considered appropriate for identifying chemicals present in crumb rubber infill and evaluating potential exposure to chemicals in crumb rubber turf fields.

Reports that provide sampling methodology done exclusively in a controlled laboratory setting may not necessarily represent a “real world exposure” to chemicals in crumb rubber. However, laboratory analysis provides an alternative to identifying chemicals (by employing strong extraction techniques and concentrating chemicals to detectable concentration before analysis) in crumb rubber that might be present in low concentrations in the environment.

Some reports provided more detailed information about the methodology used. Collectively, the methodologies used in studies conducted by state agencies of California, New York, Connecticut, and by the EPA to detect chemicals found in crumb rubber and in environments where crumb rubber is used were appropriate, keeping in mind that employing rigorous controls are a must and field sampling design may vary from one field to the next.

## **CONCLUSION**

VDH concludes that the methodologies were appropriate for assessing chemicals in crumb rubber and in environments where crumb rubber is used.

I trust that the above information will be of help to you. Should you have any additional questions please contact me at (804)-864-8127 or by email: [dwight.flammia@vdh.virginia.gov](mailto:dwight.flammia@vdh.virginia.gov).

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