Town of Arlington
Department of Health and Human Services
Office of the Board of Health
27 Maple Street
Arlington, MA 02476

Tel: (781) 316-3170
Fax: (781) 316-3175

Artificial Turf Study Committee Agenda
03/12/24

Meeting Date: March 12, 2024
Meeting Time: 5PM-6:30PM
Location: Zoom

Objectives:

1) To discuss the narrative reports submitted by each working group.
2) To discuss potential recommendations/conclusions based on the narrative reports.

Agenda

I. Acceptance of Meeting Minutes: February 20, 2024 and February 27, 2024
II. Correspondence Received
III. Discussion: Draft Working Group Narrative Sections
   a. Health
   b. Safety
   c. Environmental
IV. Discussion: Recommendations/Conclusions
V. Discussion: Project Timeline, Deliverables, Draft Report
VI. New Business
VII. Adjourn

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ARTIFICIAL TURF COMMITTEE MEETING COMMENTS FROM THE CHAT

Date: February 27, 2024
Time: 5PM
Location: Remote Participation

Phil Lasker

25:57
PL

And tracks

Susan Chapnick

29:00
SC

Burlington does have heat limits / protocols for organized sports on artificial turf

Susan Chapnick

31:51
SC

Respectfully to Joe's comments - it is true that we have many chemical and heat stressors in our daily lives and the environment. It is prudent to human health and the health of the environment to consider reducing "cumulative" impacts - so, just because there are other daily exposures to chemicals and heat, doesn't mean we should "give up" and not look for ways to reduce these potential cumulative impacts.

Grant Cook

32:59
GC

I think if we shut down a soccer practice at the High School and then 300 yards away, the Boys Tennis Team is practicing on the Grove St. courts, it might seem a bit odd.

Susan Chapnick

37:27
SC

The 2 Artificial Turf fields that are in Arlington now have tire crumb rubber - if the health subcommittee is suggesting some education and mitigation for these type of fields - should we consider implementing it regardless of new fields?

Susan Chapnick

40:18
SC

Tire crumb rubber infill is specified for the new Arlington HS artificial turf field that has not yet been installed.

Grant Cook

48:09
GC

Delivery of this committee's report may be as late as Oct '24, if the Article before TM extends the timeline. APS Construction Phase 4, which begins Dec '24, involves the field work, so procurement activity could be already started.

Susan Chapnick

53:10
SC

They have not procured the artificial turf carpet yet. They only procured the sub-base.

Installation expected 2025 based on conversations with Jeff Thielman

Grant Cook

54:47
GC

Today is Feb '24. My point was procurement in Nov '24, 9 months from now.

Phil Lasker

55:03
PL

I submitted several documents related to PFAS and heavy metals to Natasha last night...technical specifications, actual 3rd party independent testing on turf components and alternative infills.

Phil Lasker

56:06
PL

I've often heard statements being made that we don't know what's in alternative infills. That is simply not true.

Phil Lasker

57:21
PL

The contract for the HS turf was already awarded Susan. Any pivot would require a change order.

Phil Lasker

01:07:07
PL

Regarding player safety keep in mind that AT fields are tested for many performance factors at installation and often throughout the life of the warranty whereas NT fields are not. I submitted this info to Natasha last night as well.

Phil Lasker

01:08:32
PL

Coated sand will most likely become a microplastic in the future.

Phil Lasker

01:09:36
PL

I also provided contacts for several maintenance companies in the area.

Susan Chapnick

01:10:34

SC

Totally agree with Leslie - we need to allocate $ for maintenance in Town especially for our fields.

Grant Cook

01:12:30

GC

We are of two minds - demand premier facilities/services and decry overrides, all the while being somewhat (well, more than somewhat) averse to new growth that brings additional funding on the tax roll.

Phil Lasker

01:12:33

PL

Maintenance requirements for AT are included in the contract specifications with training and often include follow up visits by the manufacturer.

Phil Lasker

01:15:03

PL

Great point Joe. Resting fields limits our kids from being active.

Natasha Waden

01:23:51

NW

Phil, whatever you submitted will be included in the next packet's meeting. In order to comply with OML I need to received documents typically by Thursday at 5pm prior to the meeting. The only exception is if we have a Monday holiday or meet on a different day.

Phil Lasker

01:25:21

PL

Understood, thanks!

Joe Connelly-Recreation

01:37:20

JC

Thanks everyone, I need to set up for the Park Commission meeting.

Claire Ricker, DPCD

01:38:19

CR

Thanks all - I've learned so much from you all and will loop David Morgan in on where we are when he's back next week

Susan Chapnick

01:40:19

SC

The NEWMOA presentation I sent to you shows some of the PFAS differences

Phil Lasker

01:40:34

PL

Our consultants for the turf forum spoke about that and it is included in some of the documents I sent.

Lauren Doneski

01:40:35

LD

https://playingforkeeps.info/pfas/?utm_source=Q1Media&utm_medium=FB&utm_campaign=PFAS%20&utm_content=B2&fbclid=IwAR3Z9pdPSfT1MeGBuBCzM4Qv0keH40r8oJwWphZSSOD0fnciSGRqh-7MyJc

Phil Lasker

01:41:40

PL

PVDF-HFP is not bio available

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Artificial Turf Study Committee Meeting Minutes

Meeting Date: February 20, 2024
Meeting Time: 5PM-6:30PM
Location: Zoom- Registration link:
https://town-arlington-ma-us.zoom.us/meeting/register/tZAvcuqoqTssHt1BnuSXOpbXEnysRzAC-LUe

Objectives:

1) To hear from subject matter experts on various topics concerning the Health, Safety, and Environmental concerns associated with natural grass and artificial turf fields.
2) To discuss the draft bullet reports submitted by each working group.

Committee Members present: James DiTullio, Chair; Natasha Waden, Clerk; Mike Gildesgame; Leslie Mayer; Joseph Barr; Jill Krajewski; Marvin Lewiton; Claire Ricker; Joseph Connelly

Agenda

I. Acceptance of Meeting Minutes

Motion to approve meeting minutes from 02/13/2024 was made by Marvin Lewiton.

2nd by Leslie Mayer.

Vote:
- Mike Gildesgame, Abstain
- Leslie Mayer, Yes
- Joseph Barr, Not present for vote
- Jill Krajewski, Absent
- Natasha Waden, Yes
- Marvin Lewiton, Yes
- James DiTullio, Yes

Approved (4-0 with 1 Absent, 1 Abstain, and 1 not present for the vote)

II. Correspondence Received

There was no correspondence received.

III. Guest Speaker (s)

a. Ian Lacy, Lead Project Advisor for Tom Irwin
https://tomirwin.com/about-us/

Ian presented the Committee with the following Power Point Presentation:

Mr. Lacy started the presentation by asking folks to try and remove any negative thoughts they may have about either artificial or natural grass turf fields. Mr. Lacy explained that you can't compare Natural turf to synthetic turf fields because they are completely different systems. Synthetic turf fields are designed and highly engineered systems, whereas the majority of natural grass fields are indigenous fields that have adapted over time into playing fields. Mr. Lacy discussed the benefits and limitations of both types of fields but asserted that there is no way you can get the same level of usage from a natural grass turf playing field as compared to a synthetic turf playing field.

Mr. Lacy presented approximate estimates for the cost associated with the construction and maintenance of both synthetic and natural turf fields. There was a lengthy discussion about the importance of maintaining the synthetic turf field and how improperly maintained synthetic turf fields can lead to the decreased life expectancy of the field carpet and/or potentially increase the costs if repairs are needed. As such, Mr. Lacy stressed that maintenance should be taken into consideration when/if the Town makes a decision about a particular playing surface. Mr. Lacy pointed out that although it is clear from the slides artificial turf field costs are significantly more than natural grass fields, it does not take into account the usage rate. In comparing the usage rate, Mr. Lacy estimated that it's possible to get 1/3 to ½ more usage from a synthetic turf field than that of a natural grass turf field. When factoring usage into the equation, artificial turf is still more expensive, but it becomes a bit more comparable to that of a natural grass turf field. Mr. Lacy reiterated that before a decision is made on the type of field to be installed, municipalities should look at the maintenance costs associated with both types of fields, because if it can't be properly maintained, you are not likely to get the most use out of the field.

Additionally, Mr. Lacy has begun receiving inquiries from other municipalities about converting an existing synthetic turf field back to a natural grass field; therefore he reviewed the estimated costs associated with this type of conversion.

At the end of his presentation, Mr. Lacy answered several questions asked by Committee Members which are summarized below:

A Member asked a question about the disposal of artificial turf carpet and infill materials and whether or not recycling actually occurs. Mr. Lacy responded that it differs among installation companies. In his experience, he stated that typically when a carpet is lifted, all of the infill is shaken out and collected into bags and kept separate from the carpet. He has heard of multiple kinds of recycling: in some cases, the carpet may end up at a facility that just collects that material, but is still at a landfill; in other cases, the carpet may physically be recycled by grinding and melting and then either disposing the material or being utilized again for a different purpose/industry. He has also heard of the synthetic carpet being used as a top surface at landfill sites, or utilizing the used carpet as pathways on golf courses. Mr. Lacy acknowledged that recycling of this material is still a bit of a grey area, but it is an important question that should be asked.

Another Member asked Mr. Lacy if he was familiar with Tencate's work and their efforts on recycling synthetic turf. Mr. Lacy acknowledged that Tencate is a large global organization with many arms including one that focuses on recycling. He explained that their recycling approach for turf consists of grinding up the carpet so that it can be reused as material that might be utilized by other industries. Mr. Lacy stated that this was good, but that more manufacturers need to take on the responsibility of recycling this material as well.

Another Member asked Mr. Lacy what the life expectancy is of an artificial turf field in New England. Mr. Lacy stated that this depends on the usage and maintenance. In some cases, he has observed fields starting to degrade (in high use areas) in 3-4 years, but that doesn't necessarily mean it's dangerous to use, just that it is degrading. Mr. Lacy mentioned that 95% of fields Tom Irwin Advisors have assessed in New England are not maintained to the level that they should or need to be. As a result, the typical life expectancy may be 7-8 years, but again, there are variables related to each field that could shorten or extend the life expectancy.

Another Member asked what percentage or measurement such as weight/volume of infill replacement is needed to maintain a synthetic turf field. Mr. Lacy provided an overview of the infill material stating that a new carpet typically weighs 8-9lbs per square foot. However, it is typically the weight of the actual carpet and sand that holds the carpet in place and contributes to the weight per square foot, while the weight of the rubber does not contribute much to the overall weight. As such, the infill is typically composed of 30% sand and 70 % rubber or other alternative infill material. In regards to what is needed for infill, Mr. Lacy stated that it is dependent on the maintenance and use. But, typically, 10- 20 tons of rubber infill would be needed to top off the central area of the field. Mr. Lacy noted that this is not necessarily an annual occurrence; the application of replacement infill largely depends on the usage and maintenance of the field.

Another Member asked for clarification as what the company's (Tom Irwin Advisors) role is in the industry. Mr. Lacy stated that Tom Irwin Advisors is a sales and distribution company in the sports and golf industry. The core business was to sell and distribute grass seed and fertilizer. However, 10 years ago, the focus shifted as clients were looking for advice on the best playing surfaces. As such, the company changed its focus to an advisory role, in which case they assist clients with identifying the best playing surface/field/green space based on the site specific issues and budgets. Tom Irwin does not sell or distribute natural grass (sod) or synthetic turf, but they do assist with evaluating existing site specific conditions, testing soils, and then making recommendations on the surface type and maintenance based on the findings. Often times, they will be hired by a company in either industry to conduct testing and make recommendations. A reference was made to Robbin's Farm Park whereas Tom Irwin Advisors were hired by Weston and Sampson to analyze the soil at this site and provide them with recommendations based on the analysis. Mr. Lacy stated he could not speak to what happened after the recommendations were given, as Tom Irwin Advisors were not involved in that aspect of the project.

Another Member inquired about a project that Tom Irwin Advisors worked on in Sharon, MA that involved a moratorium on the installation of Artificial Turf. Mr. Lacy briefly discussed the project as conducting an evaluation of two fields in Sharon, MA to determine if the fields could be maintained as natural turf and keep up with the usage demands. Unfortunately, due to a high school construction project, the scope of work changed as the 2 fields would be needed for additional demands. As such, to address drainage issues and get the best use out of the 2 fields in their existing state, Tom Irwin advised the Town to install a linear sand injection system on both fields. In doing so, they injected grooves 8-10 inches apart across the fields that were 6 inches deep and ¾ wide and packed them with sand. This system acted as the initial transport of moisture, taking water down about 6-7 inches into the soil profile. While the field may not be in great physical shape and they did not get to conduct the original study, the result is that both fields are at least structurally in better shape than they were prior to Tom Irwin's involvement.

Another Member asked a two part question: 1) whether or not Tom Irwin Advisors have ever encountered a municipality with a large enough budget or staffing capacity to meet the demands associated with the maintenance of either natural or synthetic turf surfaces; and 2) are they familiar with alternative infills. Mr. Lacy reported that it is very rarely that a municipality can afford the maintenance plan that he has discussed in his presentation, which is why his company takes this into account in their evaluation process. In response to alternative landfills, Mr. Lacy reported that Envirofill green sand is the safest infill product in terms of environmentally friendly, least toxic to children, and least abrasive; however, it requires the installation of a shock pad.

Another Committee Member inquired about the cost associated with the linear sand injection system. Mr. Lacy responded that for a full sized soccer field the cost would likely be between $15-20K.

The final question asked by the Committee was in regards to thoughts about other various infill materials such as cork and coconut husks. Mr. Lacy reported, in his opinion that the very best infill material was sand. Mr. Lacy stated that cork expands when exposed to moisture, crumb rubber is not healthy but synthesized rubber is slightly better. He also stated that in terms of heat, coating materials with lighter color helps to deflect heat slightly, but watering a field does not have a long lasting effect. Mr. Lacy stated that natural turf is much more consistent with temperatures; however, synthetic turf can cool down quickly when the sun is behind the clouds. Mr. Lacy also acknowledged that there have been advances in grass seed in which case some seed does not require as much watering as other seed.

IV. Discussion: Draft Working Group Reports

a. Environmental

This group is composed of Mike Gildesgame, Joseph Barr, and Claire Ricker.

The group briefly summarized their draft report and clarified questions asked by Committee members.

A Committee Member from the Safety group was glad to know that the environmental health group would be looking at the heat island effect that artificial turf fields might have on the environment, as the Health and Safety groups are looking closely at the effects heat might have on the individual users.

A Committee member from the Health group inquired about the types of mitigation measures, if any, that the group has identified within each of their topic areas. An example given was whether or not any mitigation measures used to decrease the heat island effect a parking lot may have on the environment could be applied to that of an artificial turf field. The group explained that they are still looking at mitigation measures for environmental concerns, but acknowledged that mitigation measures utilized for shade in a parking lot vs. on/near an artificial turf surface would likely be different. For example, shade trees may not be possible to install on or in close proximity to artificial turf. Additionally, the group acknowledged that the color of the infill may also be considered a mitigation measure, but perhaps will not address all of the heat/environmental concerns. The group also spoke about the use of water treatment facilities that utilize water filtration systems to filter out chemicals such as PFAS; however, there is still concern about how the used filters are disposed.

A Committee member from the Health group inquired about whether or not the environmental group was aware of any filtration devices or other mitigation measures to prevent microplastics or other runoff material from artificial turf from migrating onto adjacent wetlands or other areas. The group acknowledged that MIT utilizes a filtration system and would look into the specifics as well as other possible mitigation measures.

A Committee Member from the Safety group acknowledged the Environmental groups heavy focus on the wetland areas and inquired about whether or not fields that are not in close proximity to wetland areas should be treated or considered differently as it pertains to artificial vs. natural turf fields. The Environmental group acknowledged the differences and agreed to look more into that.

A Committee Member from the Safety group inquired about what information the Environmental group has found in regards to the impact/effects that artificial turf has on wildlife, aside from the water runoff and impacts on aquatic life. The Environmental group acknowledged this topic as an area in which they planned to look into further and report back to the Committee. The Committee member referenced a study about bacteria levels being lower on artificial turf as opposed to natural turf, and wondered if this had anything to do with the fact that wildlife are not migrating/defecating on the synthetic turf. The Environmental group acknowledged this point and agreed to look further into it.

A Committee Member from the Safety group inquired about whether or not the current Town Wetland Protection Bylaw and State Wetland Protection Laws are written and take into consideration environmental concerns/protections associated with artificial turf surfaces or if changes are necessary. The Committee Member recalled that the Conservation Commission may have been looking at Bylaw changes last year, but it was not clear, what, if any changes were made, and/or if those changes take into consideration environmental protections associated with artificial turf installation. The Environmental group acknowledged this inquiry and agreed to look into what/if any Bylaw Changes have been made or are being proposed. The group also acknowledged that the State is currently reviewing language to consider artificial turf as an impermeable surface.

b. Safety
   This report was not discussed at this meeting.

c. Health

This report was not discussed at this meeting.

V. Discussion: Reports, Deliverables, Project Timeline

Jim DiTullio reminded the Committee that we would continue to review the draft working group reports at next week's meeting and that the written narrative reports are due on Friday March 1st.

VI. New Business

There was no new business to discuss.

VII. Adjourn

Motion to adjourn was made by Mike Gildesgame.

2nd by Marvin Lewiton.

Vote:

Mike Gildesgame, Yes
Leslie Mayer, Yes
Joseph Barr, Yes
Jill Krajewski, Absent
Natasha Waden, Yes
Marvin Lewiton, Yes
James DiTullio, Yes

Approved (6-0, with 1 Absent)

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Artificial Turf Study Committee Meeting Minutes

Meeting Date: February 27, 2024
Meeting Time: 5PM-6:30PM
Location: Zoom- Registration link:
https://town-arlington-ma-us.zoom.us/meeting/register/tZAvcuqoqTssHt1BnuSXOpbXEnysRzAC-LUe

Objectives:

1) To hear from subject matter experts on various topics concerning the Health, Safety, and Environmental concerns associated with natural grass and artificial turf fields.
2) To discuss the draft bullet reports submitted by each working group.

Committee Members present: James DiTullio, Chair; Natasha Waden, Clerk; Mike Gildesgame; Leslie Mayer; Jill Krajewski; Marvin Lewiton; Claire Ricker; Joseph Connelly

Agenda

Jim DiTullio called the meeting to order and acknowledged that there would be no meeting minutes to approve, but that two sets of meeting minutes would be included at the next meeting. Natasha Waden informed the Committee that last week's recorded meeting and presentation had been uploaded to the Artificial Turf Study Committee website. DiTullio encouraged anyone who had not been present for the meeting to go back and watch the recording.

I. Correspondence Received

Natasha Waden reviewed the following correspondence received:

- One email from Robin Bergman which included one report: Tiny Particles of Plastic Now Pollute our Food, Water, and Even the Clouds;

- One email from Wynelle Evans with five links to reports:
  - 1) Acute Exposure to Microplastics Inducted Changes in Behavior and Inflammation in Young and Old Mice;
  - 2) The Minderoo-Monaco Commission on Plastics and Human Health;
  - 3) CDC Per-and Polyfluorinated Substances FACT SHEET;
  - 4) Our Community has been deceived: Turf Wars Mount over PFAS; and
  - 5) PFAS Free Synthetic Turf Standards

- One email from Beth Melofchick with two links to reports:

- 1) Personal injury firms look for people exposed to PFAS from Joint Base Cape Cod; and
- 2) Why parents and coaches of cancer-stricken athletes are worried about artificial turf.

Waden also explained that there was difficulty with the size of the packet, therefore, she was only able to include a few pages of one of the articles submitted by Melofchick, but the link with the full article was included in both the packet and email to Committee Members. Waden stated that if we continue to get large files, she will only be able to include the first few pages but will make note of that and provide the link so that Members and the Public have access to the full article.

There was no additional discussion.

II. Discussion: Draft Working Group Reports- continuation from 02/20/2024 Meeting

a. Environmental

This report had been discussed at the 02/20/2024 meeting. There was no additional discussion of this report.

b. Health

This group is composed of Marvin Lewiton, Jill Krajewski and Natasha Waden.

The group briefly provided a summary of their report and clarified questions/concerns raised by Committee Members.

A Committee Member from the safety group discussed the concerns about placing restrictions on one type of surface (artificial turf) vs. other types of surfaces (tennis courts, basketball courts, running tracks, playgrounds etc.) and the difficulties that may be associated with regulating their use during periods of time when heat/temperature may be excessive. The Member expressed caution to the Committee about the potential over regulation and an individual user's choice to utilize a recreational space during excessive heat events. An important point noted was that there are not permit requirements for activities such as playing at the playground, running on a track, or playing a game of pickup tennis/pickle ball. Additionally, it would be extremely difficult for the Town to close these open spaces during an excessive heat event. The Health working group members clarified that closure guidelines would be related to organized sports groups, not individual users, and focused on the Artificial Turf surfaces only, as studies have identified this surface temperature to get excessively hotter than other surfaces including tennis courts, playgrounds, and basketball fields. Additionally, the group clarified that their intention to propose shade structures as a mitigation measure is largely related to new construction or renovations to existing spaces. Whereas the number of excessively hot days will likely increase due to climate change, the Health group believes that implementing heat mitigation measures should be a consideration in various outdoor projects/spaces, regardless of playing surface. A final point made by a Committee Member was that any guidelines/mitigation measures that are adopted, in relation to the use of artificial turf fields during excessive heat, may likely be referred to as guidance for closure of other recreational spaces; therefore, it is important to ensure mitigation measures are attainable.

c. Safety
This group is composed of James DiTullio, Leslie Mayer, and Joseph Connelly.

The group briefly provided a summary of their report and clarified questions asked by the Committee Members

A Committee Member from the Environmental group agreed with the Safety group's discussion about the inability to determine whether or not artificial turf is better than natural grass in terms of injury rates because there are a variety of factors, other than surface type, that seem to relate to how or why an injury occurs.

A Committee Member from the Health group discussed the importance of maintenance regardless of field type and was wondering where or if this should be included in the overall Committee report. Many other Committee members were in agreement about the importance of maintenance not only of fields, but in relation to all of the town's outdoor public assets and that unfortunately it has not always been a spending priority. The discussion touched the costs and labor associated with maintaining these assets. A Member of the Safety group revealed that there are only 6 town employees that currently maintain the parks, playgrounds, fields, and common areas of recreational spaces. As such, simply increasing the budget to maintain these assets wouldn't be effective; additional staff is also needed to properly maintain these areas.

III. Discussion: Reports, Deliverables, Project Timeline

Jim DiTullio discussed the upcoming deadline for working group narratives which is Friday March 1st and the possibility of postponing next week's meeting to provide the opportunity to compile the individual group narratives into a single document. All Committee Members present were in agreement with this approach, but the official decision to postpone next week's meeting will be made by the end of the week.

A Member asked whether or not the Committee was done collecting data and hearing from speakers. Waden clarified that the Committee would continue to collect data and consider potential speakers, until the final completion of the Committee report.

DiTullio discussed a potential warrant article that has been submitted for the 2024 Town Meeting which would grant an extension for the Artificial Turf Study Committee until October 2024. He further stated that based on the progress the Committee has made; an extension may not be needed. DiTullio informed Members that the Committee's report is due to the Select Board within 30 days of the start of Town Meeting. As such, DiTullio expressed interest in drafting a letter to the Select Board requesting a 2-3 week extension for submitting the report. DiTullio explained that the purpose of this would be to ensure the Committee can submit a comprehensive report and allow time for public input, but also deliver the report to Town Meeting members before the start of Town Meeting. Committee Members seemed to be supportive of a 2-3 week extension.

IV. New Business

Waden also acknowledged that David Morgan will be returning to the Committee at the next meeting and thanked Claire Ricker for her assistance during his absence.

A brief discussion was had amongst Members in regards to the use of terminology in the final report: mitigation measures vs. best practices. The Committee determined that the term mitigation measures will be used in the final report.

Waden addressed a comment in the chat regarding materials that had been sent via email for the distribution to Committee Members. Waden clarified that any information that had not been included in this week's packet was likely because it was received after the packet deadline (Thursday at 5pm, before a Tuesday Meeting), but that it would be included in the next packet.

Waden shared that she had spoken with Select Board Member Sandman from the Town of Brookline regarding their Artificial Turf Committee findings. Waden stated that she would provide a written memo to the Committee at the next meeting outlining the conversations with both Brookline and Malden and provide any additional links to information. One point Waden referenced from the conversation with Brookline was that a chemist on their Committee seemed to have referred to different and less hazardous type of PFAS material (referred to as PVDF) being found in Artificial Turf. Waden inquired if any other Committee Members had knowledge of PVDF, but none referenced they had. Some members of the public provided various links in the Chat, which Waden stated she would follow up on.

V. Adjourn

Motion to adjourn was made by Natasha Waden.

2nd by Marvin Lewiton.

Vote:
Mike Gildesgame, Yes
Leslie Mayer, Yes
Joseph Barr, Absent
Jill Krajewski, Yes
Natasha Waden, Yes
Marvin Lewiton, Yes
James DiTullio, Yes

Approved (6-0, with 1 Absent)

Fw: Material shared for AT Study Committee consideration

James DiTullio <james_ditullio@hotmail.com>

Thu 2/22/2024 9:47 PM

To:Natasha Waden <nwaden@town.arlington.ma.us>

CAUTION: This email originated from outside your organization. Exercise caution when opening attachments or clicking links, especially from unknown senders.

From: Beth Melofchik <tankmadel@yahoo.com>
Sent: Thursday, February 22, 2024 5:25 AM
To: James Ditullio <james_ditullio@hotmail.com>
Subject: Material shared for AT Study Committee consideration

James di Tullio, Chair, Artificial Turf Study Committee, Arlington

Jim,

2 films I want to share with you and your team. They were broadcast on PBS stations.

They are worth watching for context. Plastic is not a benign material. At issue are both components and materials used during production. You may find additional sources of information in the films.

We're All Plastic People Now

South Florida PBS Presents | We're All Plastic People Now | PBS

South Florida PBS Presents | We're All Plastic People Now | PBS

Investigation into the hidden story of plastic and its effects on human health.

When you are ready to read some subtitles, about half the following documentary is in English, this is another powerful and informative film.

We the Guinea Pigs

Watch 'We The Guinea Pigs' by Louise Kjeldsen

Watch 'We The Guinea Pigs' by Louise Kjeldsen

Could it be that we are all involuntary participants in a huge experiment, threatening humankind? According to t...

Watch 'We The Guinea Pigs' by Louise Kjeldsen

Could it be that we are all involuntary participants in a huge experiment, threatening humankind? According to t...

At issue are the health, safety and welfare of our children, residents and the environment.

There was a time it was thought that asbestos was a miraculous versatile material, common in homes and school classrooms as ceiling tiles and consumer products and lab equipment.

I thank you for the work you do.

Beth Melofchik

NB: hyperlinks go wonky if forwarded. I had to cut and paste to share.

Re: Artificial turf

Phil Lasker <phil_lasker@yahoo.com>
Thu 3/7/2024 8:25 AM
To:Natasha Waden <nwaden@town.arlington.ma.us>

CAUTION: This email originated from outside your organization. Exercise caution when opening attachments or clicking links, especially from unknown senders.

I think if you could print the first 7 pages for them that would be critical. Then they can use the link for all the supporting documents. There's a lot of good information in there relevant to the discussions.

One other thing the Committee should be aware of. Marblehead is often mentioned by the anti-turf folks as a community that has had success using organically managed natural turf fields. It should be pointed out that they have a synthetic turf field at the High School. It is currently out to bid for replacement. The specs call for the infill (crumb rubber and sand) to be reused in the new field and the turf carpet to be recycled.

Also, Roosevelt Park in Malden is currently out to bid. I will be obtaining those bid documents soon and will report back with any relevant info.

On Wednesday, March 6, 2024 at 05:48:33 PM EST, Natasha Waden <nwaden@town.arlington.ma.us> wrote:

Thank you Phil,

I will try to put together a memo that goes along with your email and describes why I couldn't include the entire document or even the first few pages. I truly appreciate your quick response and contribution.

Best,

Natasha

Natasha Waden, MPA
Public Health Director

Email: nwaden@town.arlington.ma.us
Phone: 781-316-3170

Town of Arlington
www.arlingtonma.gov

From: Phil Lasker <phil_lasker@yahoo.com>
Sent: Wednesday, March 6, 2024 5:37 PM
To: Natasha Waden <nwaden@town.arlington.ma.us>
Subject: Re: Artificial turf

CAUTION: This email originated from outside your organization. Exercise caution when opening attachments or clicking links, especially from unknown senders.

Hi Natasha,
Unfortunately with the test reports they have language in them that says the entire document needs to be included if being reproduced. That's what made the file so large. The Committee would be able to use the link.

On Wednesday, March 6, 2024 at 05:32:37 PM EST, Natasha Waden <nwaden@town.arlington.ma.us> wrote:

Hi Phil,

Received. This is a large document, I will likely only be able to share hard copies of the first 5 pages, but will provide the Committee with the link you provided-- is this something that they would be able to open as well?

Many thanks for the clarification.

Best,

Natasha

Natasha Waden, MPA
Public Health Director

Email: nwaden@town.arlington.ma.us
Phone: 781-316-3170

Town of Arlington
www.arlingtonma.gov

From: Phil Lasker <phil_lasker@yahoo.com>
Sent: Monday, February 26, 2024 6:39 PM
To: Natasha Waden <nwaden@town.arlington.ma.us>
Subject: Artificial turf

Hi Natasha,
I would like to submit the attached document to the Artificial Turf Study Committee. This includes information related to all topics of discussion. Please confirm receipt.

https://www.dropbox.com/scl/fo/gs7a2a6s6auy1jq0wfvq6/h?rlkey=3frfyp2dpmaoqnxeg2ahfsybh&dl=0

Thanks,
Phil

INFORMATION FOR ARTIFICIAL TURF COMMITTEE

Prepared by: Phil Lasker, 1 Claremont Ct, Arlington MA

Date: February 26, 2024

EXCERPTS OF SPEC SECTIONS FOR PROJECTS **CURRENTLY OUT TO BID** RELATED TO PFAS AND HEAVY METALS REQUIREMENTS:

- MANSFIELD HS TRACK & FIELD, MANSFIELD MA

A certified letter and specifications sheet certifying that the products in this section meet or exceed specified requirements including certification from the turf manufacturer that lead or lead chromate, or the 6 PFAS regulated by MassDEP (PFHxS, PFHpA, PFOA, PFOS, PFNA, PFDA) are not used in the manufacturing of the specified system. Including test results from the time the material leaves the plant indicating such.

Turf Manufacturer shall submit certified copies of independent (third party) laboratory reports on the **actual turf** system and its components manufactured for this specific project as follows:

a. Lead Content – ASTM F2765-09
b. Drainage capability of 10" minimum / hour
c. EPA Method 533 Modified, EPA Method 537 Modified laboratory analysis with isotope dilution, DoD QSM 5.4 Table B-15, or Engineer approved equivalent showing non-detectable concentrations of all PFAS quantified by the analysis method utilized.

Upon delivery of the turf material to the project site, the Turf Manufacturer shall deliver to the Engineer three (3) copies of notarized letter addressed to the Owner certifying that all products provided by them for incorporation into the system do not contain PFAS quantified by EPA Method 533 Modified, EPA Method 537 Modified with isotope dilution, DoD QSM 5.4 Table B-15 or Engineer approved equivalent and do not contain any other hazardous materials exceeding current EPA and CPSC requirements. The PFAS testing method utilized must report at least 29 PFAS compounds including the 6 PFAS regulated by the MassDEP, and on the most current European Union REACH and California Proposition 65 compound lists:

Compound	CAS #	Reference
PFBS	375-73-5	REACH
PFHxS	355-46-4	REACH, MassDEP

PFOA	335-67-1	REACH, Prop 65, MassDEP
PFHpA and Salts	375-85-9	REACH, MassDEP
PFOS	1763-23-1	Prop 65, MassDEP
PFOS precursors	various	Prop 65
PFNA	375-95-1	REACH, Prop 65, MassDEP
PFDA	335-76-2	REACH, MassDEP
PFUnDA	2058-94-8	REACH
PFTrDA	72629-94-8	REACH
PFTDA	376-06-7	REACH

As of 3/17/23

The synthetic athletic turf system shall be considered "PFAS/PFOS free" according to REACH and PROP 65. Turf system shall be non-detect (ND) for 30 PFAS compounds tested via EPA Method 537Modified and have a statement from the vendor that the turf does not contain and is not manufactured with PFAS/PFOA. Refer to the requirements listed in Part-1 of this section.

- LINCOLN FIELDS, LEXINGTON MA

There are at least seven definitions currently used to define per and polyfluoroalkyl substances (PFAS). By defining and testing for only the six PFAS that are currently regulated in Massachusetts, or even a few others, the remaining thousands of PFAS are not accounted for. All PFAS contain organofluorine(s). By using a screening method that identifies the group of chemicals that contain organofluorine, a more complete assessment of the PFAS present in turf materials is obtained. The presence of PFAS in a product or product component as measured using the total organic fluorine method, as described in the linked pdf, shall be documented.

https://cdnmedia.eurofins.com/apac/media/601777/environote-1080-tof.pdf

Testing shall be conducted after the manufacturing process.

HEAVY METALS: The Infilled Synthetic Turf Vendor shall submit a signed letter, on company letterhead, stating the company's specific manufacturing and procurement practices that address health and safety concerns. The letter shall certify, through the independent testing of all Infilled Synthetic Turf System components installed as part of the Project, that their system's lead and other heavy metal content complies with the United States Consumer Product Safety Commission's (CPSC) most stringent requirement for lead content in children's toys (below 100 ppm), is safe for the environment and for use by people of all ages. Copies of the testing reports shall also be provided in conjunction with the certification. Installation of the field shall not commence until the written certification is received. Adjustments to the project schedule to accommodate testing laboratory schedules will not be granted.

EXCERPTS OF SPEC SECTIONS FROM **RECENTLY COMPLETED** PROJECTS RELATED TO PFAS AND HEAVY METALS:

- MANCHESTER ESSEX REGIONAL SCHOOL DISTRICT, MANCHESTER BY THE SEA MA

In accordance with the Town of Manchester-by-the-Sea Conservation Commission RDA approval (copy attached), the General Contractor/Turf Supplier is required to commission an independent qualified lab to test the turf, infill, and shockpad for PFOA, PFOS and other selected perfluoroalkyls and polyfluoroalkyls (PFAs) according to current best-practice testing protocols. The results of these tests must be provided to the Commission before work is begun, which will be permitted only if the results show no measurable PFAs in the turf, infill, and shock pad which will be used on this project.

The contractor/turf supplier to provide a signed copy of the Illicit Disclosure statement prior to the start of work. (copy provided with RDA approval).

The General Contractor/Turf Supplier is required to commission an independent qualified lab to test the turf, infill and shock pad for PFOA, PFOS and other selected perfluoroalkyls and polyfluoroalkyls (PFAs) according to current best-practice testing protocols. The results of these tests must be provided to the Commission before work is begun, which will be permitted only if the results show no measurable PFAs in the turf, infill and shock pad which will be used on this project.

- ALGONQUIN REGIONAL HS, NORTHBOROUGH MA

Prior to delivery of the turf material to the project site, the Contractor shall deliver to the Town Engineer three copies of a notarized letter addressed to the Owner certifying that all products provided by them for incorporation into the system do not contain PFAS as quantified by EPA Method 533 Modified, EPA Method 537 Modified laboratory analysis with isotope dilution, DoD QSM 5.4 Table B-15 or Engineer approved equivalent showing non-detectable concentrations of all PFAS quantified by the analysis method. The PFAS testing method utilized must report at least 29 PFAS compounds including the 6 PFAS regulated by the MassDEP, and on the most current European Union REACH and California Proposition 65 compound lists.

A signed letter on turf manufacturer company letterhead holding the Owner, Designer and all other project consultants harmless for any violation of patent rights or infringements and claims related to hazardous materials (e.g. lead, zinc, PFAS) or other environmental impacts.

- PHR RECREATION COMPLEX, BILLERICA MA

Items to be submitted after manufacturing but prior to installation:

1. Post manufacturing/pre-shipment test results from an independent lab for carpet identification shall include tuft bind, pile height, pile weight, carpet mass, tuft count, Dtex values, lead content in parts per million and EPA Method 537 Modified test results showing non-detect (ND) for 30 PFAS compounds.

Specifications of the turf system components' physical properties and assembled system performance characteristics meeting requirements specified herein and industry standards including certification from the turf manufacturer that lead or lead chromate, and PFAS/PFOS are not used in the manufacturing of the specified system. Submit manufacturer's specifications and installation instructions for all products in the synthetic turf

Lead Test to meet 2015 CPSC requirements. Not to exceed 50 P.P.M. Refer to section 1.07 as specified herein.

EXCERPTS OF SPEC SECTIONS FROM **ARLINGTON HIGH SCHOOL** PROJECT RELATED TO PFAS AND HEAVY METALS:

- ARLINGTON HIGH SCHOOL, ARLINGTON MA

A. Environmental Health and Safety: Fiber and Infill materials shall be tested for compliance with the following:

1. Provide Independent Compliance Testing for compliance with ASTM F2765-14 Standard Specification for Total Lead Content in Synthetic Turf Fibers
2. Provide Independent Compliance Testing for compliance with ASTM F3188-17 Standard Specification for Extractable Hazardous Metals in Synthetic Turf Infill Materials.
3. Provide Independent Compliance Testing by an accredited and or approved laboratory for compliance with State Regulations for Per and Polyfluoroalkyl Substances (PFAS) in solids using EPA 537.1 Modified with Isotope Dilution techniques by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS) by a laboratory accredited and or approved for these tests. Reporting limits shall not exceed 0.5 µg/kg (NYDEC part 375), and the reporting criteria shall be less than of equal to 1.0 µg/k kg (NYDEC part 375). Turf fibers and backing materials shall be sampled using State Approved Protocol for soil sampling and results shall be compliant with the state approved thresholds. The testing shall include the following PFAS.

Test Method	Compound	Abbreviation	CASRN	PubChem NIH Safety Class
EPA 537.1	Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6b	Corrosive-Irritant
EPA 537.1	N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6	ENV Contaminant
EPA 537.1	N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9	ENV Contaminant
EPA 537.1	Perfluorobutanesulfonic acid	PFBS	375-73-5	Corrosive-Irritant
EPA 537.1	Perfluorodecanoic acid	PFDA	335-76-2	Corrosive-Acute Toxicity-Irritant
EPA 537.1	Perfluorododecanoic acid	PFDoA	307-55-1	Corrosive-Irritant
EPA 537.1	Perfluoroheptanoic acid	PFHpA	375-85-9	Corrosive-Irritant
EPA 537.1	Perfluorohexanesulfonic acid	PFHxS	355-46-4	Corrosive-Irritant
EPA 537.1	Perfluorohexanoic acid	PFHxA	307-24-4	Corrosive
EPA 537.1	Perfluorononanoic acid	PFNA	375-95-1	Corrosive-Irritant
EPA 537.1	Perfluorooctanesulfonic acid	PFOS	1763-23-1	Corrosive-Health Hazard-Irritant-ENV Hazard
EPA 537.1	Perfluorooctanoic acid	PFOA	335-67-1	Corrosive-Health Hazard-Irritant
EPA 537.1	Perfluorotetradecanoic acid	PFTA	376-06-7	Corrosive
EPA 537.1	Perfluorotridecanoic acid	PFTrDA	72629-94-8	Unavailable at PubChem NIH
EPA 537.1	Perfluoroundecanoic acid	PFUnA	2058-94-8	Irritant
EPA 537.1	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9c	Unavailable at PubChem NIH
EPA 537.1	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	9Cl-PF3ONS	756426-58-1d	Corrosive-Irritant
EPA 537.1	4,8-dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4e	Corrosive-Irritant
EPA 533	Perfluorobutanoic acid	PFBA	375-22-4	Corrosive-Irritant
EPA 533	Perfluoropentanoic acid	PFPeA	2706-90-3	Corrosive
Note: Includes compounds regulated in northeast states tested under both EPA 537.1 and EPA 533				

INDEPENDENT TEST RESULTS/CERTIFICATIONS FOR PFAS FROM RECENTLY COMPLETED PROJECTS (See Attached):

- PHR RECREATIONAL COMPLEX, BILLERICA MA
- MANCHESTER ESSEX REGIONAL SCHOOL DISTRICT, MANCHESTER BY THE SEA MA
- ALGONQUIN REGIONAL HIGH SCHOOL, NORTHBOROUGH MA

INFORMATION RELATED TO PFAS FROM OTHER COMMUNITIES (See attached):

- PORTSMOUTH NH- TRC TECHNICAL MEMO
- NEWTON MA- WESTON & SAMPSON PFAS PRIMER PRESENTATION
- NEWTON MA- WESTON & SAMPSON SUMMARY MEMO
- LEXINGTON MA- EUROFINS PFAS GUIDELINES (INCLUDED IN CURRENT SPECS FOR LINCOLN FIELDS)

INFORMATION RELATED TO ORGANIC INFILLS (See attached):

- BROCK USA- BROCKFILL MILLENIUM TESTING
- BROCK USA- BROCKFILL SAFETY DATA SHEET
- BROCK USA- BROCKFILL EUROFINS TESTING

STUDIES FROM OTHER COMMUNITIES (See attached):

- BELMONT MA
- LEXINGTON MA
- NANTUCKET MA (NATURAL VS ARTIFICIAL COST ANALYSIS)

PERFORMANCE TESTING REQUIREMENTS:

- ONE TURF CONCEPT (See attached)
- ARLINGTON HS SPECIFICATIONS

3.08 FIELD PERFORMANCE TESTING

A. The Manufacturer is responsible for delivering a project the meets all required testing and for providing all test results to the ARCHITECT for review and approval.

B. G-max Testing: Shall be performed at construction completion and during each year of the life of the Warranty. Initial g-max testing for shock attenuation on completed field shall be range between 80-100 g-max.

1. Testing shall be performed at the locations required by ASTM F1936, and in addition testing shall be performed at the center field, at the goal locations for all sports, and at ten yards inside the corners, **resulting in a total of 19 test locations**.
2. Testing shall consist of shock attenuation per ASTM F1936. G-max shall not change more than 10% at any one location per year over the life of the Warranty, however, at no time during the life of the warranty shall the g-max be less than 165. In cases where the results of the g-max testing exceeds the specified values, the condition shall be corrected by the manufacturer. The manufacturer shall provide adequate information to confirm that the mitigation measures were effective. At no time in the life of the Warranty shall the g-max be165 or greater at any one point on the field. Results of this testing shall be provided to the OWNER, ARCHITECT and Commissioning Agent each year after testing.
3. If non-compliant areas are located as part of the yearly assessment, the extent of these areas shall be determined by performing the g-max test towards each end zone and each sideline until tests meeting requirements are obtained. The point at which the results meet the requirements of this specification shall represent the limit of non-compliant turf and shall be remedied to be in-compliance with the requirements.

C. Surface Ball and Surface Player Performance Testing: During the first year of installation the field will be tested to the Surface Ball and Surface Player Performance Testing FIFA standards indicated on Article 1.04, "System Description", paragraph "Performance Requirements". Testing shall be performed at the same ten designated test points for the ASTM F1936 tests. Where deviation from these values exists, the field shall be brought into compliance. This is not intended to require FIFA Certification. Testing shall be completed after infill settlements which may impact performance of the system.

D. Infill Depth Measurements for Uniformity and Consistency: Prior to acceptance of the field by the OWNER the infill depth will be field measured by an independent testing's agency and recorded. The measurements shall be made at five yard intervals along the length of the field with five measurement points even spaced across the field. Measurements shall be made by depth gauge method and be to an accuracy of +/- 1 mm. The test point data shall be summarized in a report listing average depth and range. In cases where the average depth is outside of the indicated range the field shall be brought into compliance by the manufacturer.

- LINCOLN FIELDS, LEXINGTON MA SPECIFICATIONS

PERFORMANCE TESTING ON FINAL SURFACE

A. Performance Testing by an Independent Testing Company as specified within will be completed and the results verified as acceptable prior to substantial completion.

1. GMAX: The Infilled Synthetic Turf System Vendor shall have G-Max testing performed by an approved and certified Independent Testing Company prior to requesting Substantial Completion. Testing shall consist of shock attenuation per ASTM F-355-A and F-1936 current edition and shall include the depth of infill as the test location as well as the temperature on the day of testing. The Owner and Landscape Architect/Civil Engineer shall be provided with copies of all testing.

    a. Testing locations shall be performed in accordance with ASTM Test Method F-1936 current edition. Tests shall also be taken at four (4) random spots. Locations to be selected by the Landscape Architect/Civil Engineer or Owner.
    b. At no time shall the G-Max be less than 85 nor exceed 150 at any one point of the field.
    c. In cases where the result of a test falls outside the specified values, additional tests shall be taken in 10-foot increments in four (4) opposite directions (north, south, east and west) from the failing test point and each subsequent failing test point until all tests fall within the specified values. The failing area shall be marked off, repaired and retested by the Infilled Synthetic Turf System Vendor until all tests fall within the specified values.
    d. G-Max testing during the remainder of the warranty period will be performed by and at the discretion of the Owner. Results of these tests will be provided to the Base Contractor and Infilled Synthetic Turf Vendor, if specifically requested.
    e. If any tests fall within 5% of the maximum specified value, the Owner, at their discretion may require one additional set of tests at any time during the calendar year to be paid for by the Infilled Synthetic Turf Vendor.

2. HIC Testing: Testing shall be in accordance with EN-1177 and critical fall height shall not be less than 1.4-meters.

3. Artificial Athlete: Testing shall be in accordance with EN-14808/14809 and shall be completed in 6 locations over each field area. Vertical deformation shall be 4-11 mm, shock absorption shall be 55-70%, and energy restitution 25-50%.

4. Infill Depth: Infill depth testing by means of an infill depth gauge capable of measuring 0-2 inches per ASTM WK51663 using a Constant Ground Pressure 3-Prong Gauge. A minimum of 40 test locations shall be taken at random and documented in the test results provided to the Landscape Architect / Civil Engineer and Owner.

    a. If the results of the depth gauge show the infill height to be on average lower than the depth specified, additional infill will be added to meet the specification and the field will be re-tested to show compliance.

MAINTENANCE OF FIELDS CONTACTS:

- REPLAY MAINTENANCE USA https://replaymaintenanceusa.com/
- APW ENTERPRISES https://apwturf.com/
- SHREWSBURY LANDSCAPE (NATURAL & SYNTHETIC) http://www.shrewsburylandscapes.com/

RECYCLING/REPURPOSING TURF:

- TENCATE TURF RECYCLING SOLUTIONS https://turfrecycling.us/
- SHAW SPORTS TURF https://www.shawsportsturf.com/reclamation/
- APW ENTERPRISES https://apwturf.com/
- TURF RECLAMATION SOLUTIONS https://turfreclamationsolutions.com/
- SMG TURF MUNCHER 5000D (SEE ATTACHED PRODUCT INFO)

Microplastics in Every Human Placenta, New UNM Health Sciences Research Discovers

Robin Bergman <robinorig@gmail.com>

Tue 2/27/2024 2:13 PM

To:Jim DiTullio <james_ditullio@hotmail.com>;Natasha Waden <nwaden@town.arlington.ma.us>

https://hsc.unm.edu/news/2024/02/hsc-newsroom-post-microplastics.html

Hi Jim & Natasha,
Please add this article and the new study mentioned to the documented correspondence for the artificial turf study committee and please share this information with the committee.
Thanks again, for your work on this important subject.

Best,
Robin Bergman
Town Meeting Member, precinct 12

HSC Newsroom › 2024

› **Microplastics in Every Human Placenta, New UNM Health Sciences Research Discovers**

By Michael Haederle | February 20, 2024

Microplastics in Every Human Placenta, New UNM Health Sciences Research Discovers

A flurry of recent studies has found that microplastics are present in virtually everything we consume, from bottled water to meat and plant-based food. Now, University of New Mexico Health Sciences researchers have used a new analytical tool to measure the microplastics present in human placentas.

In a study published February 17 in the journal *Toxicological Sciences*, a team led by Matthew Campen, PhD, Regents' Professor in the UNM Department of Pharmaceutical Sciences, reported finding microplastics in all 62 of the placenta samples tested, with concentrations ranging from 6.5 to 790 micrograms per gram of tissue.

Although those numbers may seem small (a microgram is a millionth of a gram), Campen is worried about the health effects of a steadily rising volume of microplastics in the environment.

If we're seeing effects on placentas, then all mammalian life on this planet could be impacted. That's not good.

— **Matthew Campen, PhD**, *Regents' Professor in the UNM Department of Pharmaceutical Sciences*

For toxicologists, "dose makes the poison," he said. "If the dose keeps going up, we start to worry. If we're seeing effects on placentas, then all mammalian life on this planet could be impacted. That's not good."

In the study, Campen and his team, partnering with colleagues at the Baylor College of Medicine and Oklahoma State University, analyzed donated placenta tissue. In a process called saponification, they chemically treated the samples to "digest" the fat and proteins into a kind of soap.

Then, they spun each sample in an ultracentrifuge, which left a small nugget of plastic at the bottom of a tube. Next, using a technique called pyrolysis, they put the plastic pellet in a metal cup and heated it to 600 degrees Celsius, then captured gas emissions as different types of plastic combusted at specific temperatures.

"The gas emission goes into a mass spectrometer and gives you a specific fingerprint," Campen said. "It's really cool."

The researchers found the most prevalent polymer in placental tissue was polyethylene, which is used to make plastic bags and bottles. It accounted for 54% of the total plastics. Polyvinyl chloride (better known as PVC) and nylon each represented about 10% of the total, with the remainder consisting of nine other polymers.

Marcus Garcia, PharmD, a postdoctoral fellow in Campen's lab who performed many of the experiments, said that until now, it has been difficult to quantify how much microplastic was present in human tissue. Typically, researchers would simply count the number of particles visible under a microscope, even though some particles are too small to be seen.

With the new analytical method, he said, "We can take it to that next step to be able to adequately quantify it and say, 'This is how many micrograms or milligrams,' depending on the plastics that we have."

Plastic use worldwide has grown exponentially since the early 1950s, producing a metric ton of plastic waste for every person on the planet. About a third of the plastic that has been produced is still in use, but most of the rest has been discarded or sent to landfills, where it starts to break down from exposure to ultraviolet radiation present in sunlight.

“That ends up in groundwater, and sometimes it aerosolizes and ends up in our environment,” Garcia said. “We’re not only getting it from ingestion but also through inhalation as well. It not only affects us as humans, but all off our animals – chickens, livestock – and all of our plants. We’re seeing it in everything.”

Campen points out that many plastics have a long half-life – the amount of time needed for half of a sample to degrade. “So, the half-life of some things is 300 years and the half-life of others is 50 years, but between now and 300 years some of that plastic gets degraded,” he said. “Those microplastics that we’re seeing in the environment are probably 40 or 50 years old.”

While microplastics are already present in our bodies, it is unclear what health effects they might have, if any. Traditionally, plastics have been assumed to be biologically inert, but some microplastics so small they are measured in nanometers – a billionth of a meter – and are capable of crossing cell membranes, he said.

Campen said the growing concentration of microplastics in human tissue might explain puzzling increases in some types of health problems, such as inflammatory bowel disease and colon cancer in people under 50, as well as declining sperm counts.

The concentration of microplastics in placentas is particularly troubling, he said, because the tissue has only been growing for eight months (it starts to form about a month into a pregnancy). “Other organs of your body are accumulating over much longer periods of time.”

Campen and his colleagues are planning further research to answer some of these questions, but in the meantime he is deeply concerned by the growing production of plastics worldwide.

“It’s only getting worse, and the trajectory is it will double every 10 to 15 years,” he said. “So, even if we were to stop it today, in 2050 there will be three times as much plastic in the background as there is now. And we’re not going to stop it today.”

Categories: College of Pharmacy, Research, Top Stories

New PFAs info

Mike Gildesgame <mikeg125@gmail.com>

Tue 2/27/2024 6:55 PM

To:Natasha Waden <nwaden@town.arlington.ma.us>

CAUTION: This email originated from outside your organization. Exercise caution when opening attachments or clicking links, especially from unknown senders.

From EPA....

https://www.epa.gov/newsreleases/epa-requires-toxics-release-inventory-reporting-seven-additional-pfas

EPA Requires Toxics Release Inventory Reporting for Seven Additional PFAS

January 9, 2024

Contact Information
EPA Press Office (press@epa.gov)

WASHINGTON – Today, the U.S. Environmental Protection Agency (EPA) announced the automatic addition of seven per- and polyfluoroalkyl substances (PFAS) to the list of chemicals covered by the Toxics Release Inventory (TRI).

TRI data is reported to EPA annually by facilities in designated industry sectors and federal facilities that manufacture, process, or otherwise use TRI-listed chemicals above set quantities. The data include quantities of such chemicals that were released into the environment or otherwise managed as waste. Information collected through TRI allows communities to learn how facilities in their area are managing listed chemicals. The data collected is available online <https://epa.gov/toxics-release-inventory-tri-program/find-understand-and-use-tri> and helps to support informed decision-making by companies, government agencies, non-governmental organizations and the public, and advances the Biden-Harris commitments to ensuring environmental justice through improved accountability and transparency for families, workers, and communities across the country.

The addition of these seven PFAS helps to further the Biden-Harris Administration's commitment <https://www.whitehouse.gov/briefing-room/statements-releases/2021/10/18/fact-sheet-biden-harris-administration-launches-plan-to-combat-pfas-pollution/> to address the impacts of these forever chemicals, and advances EPA's PFAS Strategic Roadmap <https://epa.gov/pfas/pfas-strategic-roadmap-epas-commitments-action-2021-2024> to confront the human health and environmental risks of PFAS.

"With these additions to the Toxics Release Inventory, we'll be collecting data on the release and management of almost 200 PFAS in communities across the country, furthering our efforts to better understand and protect people from these chemicals," said **Assistant Administrator for the Office of**

Chemical Safety and Pollution Prevention Michal Freedhoff. "We'll also share this information with the public, empowering communities to engage with the facilities using these chemicals to prevent or reduce pollution."

These seven PFAS were added to the TRI list pursuant to the Fiscal Year 2020 National Defense Authorization Act (NDAA), which provides the framework for the automatic addition of PFAS to TRI each year in response to specified EPA activities involving such PFAS. For TRI Reporting Year 2024 (reporting forms due by July 1, 2025), reporting is required for these seven additional PFAS, bringing the total PFAS subject to TRI reporting to 196.

Addition of PFAS with final toxicity values

The 2020 NDAA includes a provision that automatically adds PFAS to the TRI list upon the Agency's finalization of a toxicity value. Six PFAS were automatically added for Reporting Year 2024 due to EPA having finalized a toxicity value during 2023. Only these particular salt forms of the acids are added to the list.

- Ammonium perfluorohexanoate; Chemical Abstract Service Registration Number (CASRN) 21615-47-4
- Lithium bis[(trifluoromethyl)sulfonyl] azanide; CASRN 90076-65-6
- Perfluorohexanoic acid (PFHxA); CASRN 307-24-4
- Perfluoropropanoic acid (PFPrA); CASRN 422-64-0
- Sodium perfluorohexanoate; CASRN 2923-26-4
- 1,1,1-Trifluoro-N-[(trifluoromethyl)sulfonyl] methanesulfonamide; CASRN 82113-65-3

Addition of PFAS no longer claimed as confidential business information

Under NDAA section 7321(e), EPA must review confidential business information (CBI) claims before adding a PFAS to the TRI list if the chemical identity is subject to a claim of protection from disclosure under 5 U.S.C. 552(a). EPA previously identified one PFAS for addition to the TRI list based on the NDAA's provision to include specific PFAS upon the NDAA's enactment. However, due to CBI claims related to its identity, this PFAS was not added to the TRI list at that time. The identity of this chemical was subsequently declassified in an update to the Toxic Substances Control Act Inventory <https://epa.gov/tsca-inventory> in February 2023. Because its identity is no longer confidential, the following chemical was added to the TRI list:

- Betaines, dimethyl(.gamma.-.omega.-perfluoro-.gamma.-hydro-C8-18-alkyl); CASRN 2816091-53-7

As of January 1, 2024, facilities that are subject to reporting requirements for these chemicals should begin tracking their activities involving these PFAS as required by Section 313 of the Emergency Planning and Community Right-to-Know Act. Reporting forms will be due by July 1, 2025.

These seven newly added PFAS, along with the previous 189 TRI-listed PFAS, are also subject to EPA's action in October 2023 to classify all PFAS subject to TRI reporting as chemicals of special concern <https://epa.gov/newsreleases/epa-finalizes-rule-require-enhanced-pfas-reporting-toxics-release-inventory>. Among other impacts, this removes the use of a reporting exemption that allowed facilities to avoid reporting information on PFAS when those chemicals were used in small concentrations.

Learn more about the addition of these PFAS to the Toxics Release Inventory <https://epa.gov/toxics-release-inventory-tri-program/addition-certain-pfas-tri-national-defense-authorization-act>.

Contact Us <https://epa.gov/newsreleases/forms/contact-us> to ask a question, provide feedback, or report a problem.

LAST UPDATED ON JANUARY 9, 2024

Organic Maintenance of Athletic Fields

Susan D. Chapnick <s.chapnick@comcast.net>

Wed 2/28/2024 11:59 AM

To:BOH <BOH@town.arlington.ma.us>
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1 attachments (382 KB)

TURI_Building an Organic Maintenance Program for Athletic Fields_2021.pdf;

Natasha,
Please accept this communication to the Artificial Turf Study Committee in reference to discussions from the 2/27/24 meeting where the issue of maintenance of athletic fields was raised.
The attached report is from TURI, 2021, entitled "Building an Organic Maintenance Program for Athletic Fields: Guidance from Experts and Experienced Communities". Here is the link, as well:
https://www.turi.org/var/plain_site/storage/original/application/982fb1bc7bb561b4ce07072c5d26ab11.pdf

Best regards,
Susan

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Building an Organic Maintenance Program for Athletic Fields: Guidance from Experts and Experienced Communities

Introduction

Natural grass fields can provide a protective, high-performance surface for athletic activities. Organic field maintenance practices can improve the health of soil and grass without the need for synthetic pesticides or fertilizers. These practices include frequent aeration, frequent mowing, soil testing, and use of organic fertilizers and soil amendments. Communities and schools can accommodate a wide range of recreational activities on their athletic fields by building healthy, balanced soil and a strong root system. Organically managed natural grass fields serve as an affordable, practical and safer alternative to artificial turf.

Many schools and communities have questions on how to implement organic practices. This fact sheet provides information gathered from athletic field landscaping professionals, as well as lessons learned by individual communities that are successfully maintaining their athletic fields with organic practices. This fact sheet draws primarily upon three case studies created by the Toxics Use Reduction Institute (TURI) highlighting organically managed grass fields in Springfield, Marblehead, and Martha's Vineyard, Massachusetts. It also draws on the experience of several sustainably managed grass athletic fields in southwest Pennsylvania and Ohio.

The information presented here represents key messages from our case studies and interviews with experts. This information is not a substitute for more detailed, site-specific advice that can be provided by natural grass and athletic field experts. Some sources for additional guidance are provided at the end of this document.

The techniques described here are useful even if your community is not committed to full organic management. These techniques can improve the sustainability of any grass field. By building healthy soil and root systems, over time these approaches also help to reduce maintenance costs.

Getting Started

There are several steps to take before creating an action plan for maintaining a healthy grass playing field using organic methods. These steps include diagnosing existing problems on the field, finding guidance, and determining whether rehabilitation or a rebuild of the field is right for your community.

A good first step is assessing the field conditions and diagnosing existing issues. For example, a field may be hard (compacted) or visibly worn, or there may be areas with puddling. It is essential to understand why these deficiencies are occurring before creating a plan of action.

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There are many options and technologies available to help understand why a grass field is underperforming. Problems with grass growth are most often linked to soil health. Soil testing can identify imbalances in soil health. Results from these tests can help facilities managers or grass consultants better understand how to adjust maintenance practices to improve soil health, leading to heathier and more resilient grass coverage. Some schools or communities may choose to employ a consultant or landscaper specialized in grass athletic fields for guidance.

Soil testing

Soil testing is a critical first step to understanding the baseline physical, chemical, and biological characteristics of soil on an athletic field. Identifying imbalances within the nutrient and mineral composition pinpoints steps needed to improve grass growth in the soil. Results serve as a stepping-off point to creating a customized maintenance program for individual fields.

Soil sample taken in Chilmark, Martha's Vineyard.

Soil testing can measure physiochemical characteristics, such as texture, moisture, pH, and organic content; nutrient levels important for plant growth, including phosphorus, potassium, nitrate, and calcium; and microorganisms, such as bacteria, fungi, and other beneficial soil organisms. These results reveal any imbalances in the soil, allowing for the maintenance program builder to choose specific blends and amounts of fertilizers, soil amendments (such as lime) to adjust pH, and types of soil to be added to the field to create an ideal habitat for grass growth. Using this tailored approach helps avoid overapplication of fertilizers and soil amendments, which saves money and helps protect the surrounding environment from pollution through excess nutrient runoff.

For example, the City of Springfield used soil tests to identify imbalances in the soil before building an action plan. The variables tested are listed in Table 1. Springfield repeats these tests every two to three years in order to determine how much fertilizer and soil amendment is needed throughout the year.

Table 1. Examples of variables measured during soil testing

Physiochemical (understanding permeability, water holding capacity and other physical capabilities)	**Nutrients** (essential for grass growth)	**Biological** (helpful vs harmful microorganisms)
Texture	Phosphorus	Total organic biomass
Moisture	Potassium	Active bacterial biomass
pH	Nitrate	Active fungal biomass
Organic content	Calcium	Nematodes

Source: Osborne, Chip. 2015. *Organic Land Care Project: Springfield, MA: Technical Review.* Report provided to Patrick Sullivan, Director, Springfield Parks Department.

In another example, Heidelberg Park in the Borough of Heidelberg, Pennsylvania, was initially constructed on poor-quality soil. An initial step in improving the field was to test soil quality. The soil test, in turn, made it possible to create an appropriate plan for fertilizer use and improvement of soil health.

Finding a consultant or advisor

A consultant specialized in athletic field maintenance practices can be a valuable resource when deciding how to rehabilitate or rebuild a natural grass field. These professionals offer services including field assessments, soil testing and analysis, creation of customized rehabilitation or long-term maintenance plans, organization of maintenance logistics, and training for landscaping staff. A consultant can also provide more detailed diagnostic information, including mapping of moisture and compaction as well as assessing weed populations. Local landscapers who are educated in organic practices can also assist and provide knowledge on organic maintenance practices, and carry out the maintenance work.

When the City of Springfield decided to make the transition to organic management on their grass athletic fields and other city properties, they hired a natural grass athletic field consulting group, Osborne Organics, to help them diagnose problems and build correction plans using basic organic management techniques. Springfield also works with PJC Organics for semiannual soil testing and ordering of customized shipments of organic products each year.

The Field Fund, an athletic field management group on the island of Martha's Vineyard, hired consultants at Natural Grass Advisory Group (NGAG) to analyze and map problem areas on playing fields. NGAG uses specialized tools, such as soil probes and drone photography, to understand drainage, compaction, and other issues in specific areas of the field. Pinpointing and focusing on areas of the field that need attention instead of maintaining an entire athletic field the same way can help save on maintenance costs. Martha's Vineyard also used outside consulting services to completely rebuild a playing field complex at Oak Bluffs School.

Rehabilitation vs. rebuilding

Many communities simply wish to rehabilitate an existing field. The quality and resiliency of an existing grass playing field can be improved by adopting basic organic management practices. Other communities are in a position to rebuild a field. This choice may depend on available resources.

Rehabilitation focuses on correcting problems, such as water pooling, weeds, hard surface, or uneven grass cover, by improving the quality of the existing soil and grass. This involves understanding imbalances in soil nutrient and organic matter, and adjusting maintenance practices and/or soil amendment applications to correct these imbalances. This method may also involve changing the type of a grass seed used to something better matched for the climate or type of play. Rehabilitation is less invasive and less expensive. By simply improving the quality of the soil and grass, many may find their playing fields need no other interventions.

For example, Bethlehem Center School District in East Bethlehem Township, Pennsylvania, aimed to diagnose and rehabilitate a practice soccer field on a low budget. The field had uneven soil and patchy grass coverage. Simple steps to begin rehabilitating the field included soil testing, aerating, and fertilizing, as well as rolling to smooth out the surface of the field.

Rebuilding a playing field offers the advantage of designing a well-functioning field from the soil up. This may include using new soil with the correct amount of organic matter, engineered drainage, and an irrigation system. This method can be considerably more expensive, but may be an option for communities with the budget for new field construction.

This option is more intensive, but is possible to complete in an efficient amount of time. The Field Fund worked closely with the Oak Bluffs community in Martha's Vineyard to rebuild a 2.75-acre field. Planning for the Oak Bluffs school fields began June 27, 2018. Both fields were open for the start of the school year on September 4, 2018. The fields were playable three weeks after seeding.

Building a playing field with organic management in mind may also be easier to maintain over time. Springfield saved time and money by using organic management as soon as the playing field at Camp Wilder was constructed. The City was able to avoid restructuring the soil in the future.

Taking action

The next steps to building an organic maintenance plan depend on soil testing results and unique conditions of the field. The goal is to create a healthy environment for grass growth. Reaching this goal will create a resilient, protective athletic field with grass that can withstand play and outcompete weeds and pests. The details of the plan will depend on the starting conditions and the level of use that is anticipated for the field.

In many cases, a community may not need to take costly or time-consuming steps. Simple changes such as regular mowing and aeration, along with adjustments to fertilizer use, may be all that is necessary to reach the quality needed by the community. A spectrum of maintenance practices can be adopted depending on the community's budget and goals.

Core organic maintenance elements include:

Fertilizer and soil amendments: Add types and amounts needed, depending on soil testing.

Seeds: Choose seeds appropriate for climate and type of field use.

Aeration: Aerate soil frequently to alleviate compaction. Aerate more often in high use areas.

Mowing: Frequently mow to an appropriate height.

Fertilizer and soil amendments

Soil nutrient levels critical for grass growth, such as nitrogen, phosphorus, potassium, and calcium, can be modified using organic fertilizers. Natural grass specialists recommend testing soil periodically as the needs of the field change with use over time. Organic fertilizer is generally made with a combination of natural ingredients. For example, PJC Organics fertilizer is composed of soybean meal, feather meal, and potassium sulfate. Use of organic practices to increase organic matter in the soil will also reduce fertilizer needs over time.

At Heidelberg Park, fertilizers and soil amendments were added to the field in order to build soil health and foster the development of a robust root system. Products were chosen to replenish basic nutrients as well as supporting the growth of beneficial fungi.

In some cases, fertilizers cannot be used on an athletic field. On Martha's Vineyard, a field in Chilmark cannot be fertilized due to its close proximity to a wellhead. Instead, The Field Fund plans to use organic liquid worm casting as a nutrient source.

Use of soil amendments also depends on soil testing, and may include addition of soil conditioner, compost, or lime. Each of these amendments serves to improve a part of the soil's composition. The soil conditioner used by PJC Organic is made of charcoal, kelp, soybean, and molasses, and is used in the spring to help jump-start microbial activity in the soil. Compost adds organic matter, provides macro- and micronutrients, and increases soil moisture retention and porosity. Adding compost can also increase diversity of microbes, including fungi and nematodes, which can improve disease resistance. Lime is generally made from ground limestone rock, which contains magnesium carbonate and calcium carbonate. Addition of lime helps correct soil pH, allowing grass roots to take up nutrients and minerals.

Tip!

Weed growth and issues with grass growth can tell you about specific problems with the soil. Here are a few examples:

- Dandelion growth can indicate low pH in the soil, which may be alleviated with the addition of calcium.
- Dollar spot can indicate low nitrogen, drought stress, and excess thatch, which may be alleviated by adjusting fertilizer, applying compost, and irrigating.
- Patches of dead grass may be due to grubs, which may be alleviated by adding beneficial nematodes.

Source: Grassroots Environmental Education. Grassroots healthy lawn program: six steps for organic lawn care. https://www.grassrootsinfo.org/pdf/six_steps.pdf

Seed selection

Selecting the appropriate type of grass seed is critical to maintaining the long-term health of athletic playing fields. Individual grass species offer different protective capabilities, such as heat or cold tolerance, drought resistance, deep root systems, and weed resistance. A combination of grass species can be used to create a resilient play surface to match the climate. For example, The Field Fund on Martha's Vineyard uses a combination of high-quality perennial ryegrass and Kentucky bluegrass. This seed combination creates heat-tolerant, durable fields that are able to support heavy use nearly year round.

At Denison University in Granville, Ohio, the varsity soccer field is planted with bermudagrass and ryegrass. Bermudagrass goes dormant in winter, whereas ryegrass goes dormant during hot weather. In combination, the two grass types provide a durable play surface usable in multiple seasons.

Tip!

Bare spots are signs that the soil is compacted or soil chemistry is out of balance. Fill in bare spots by adding top soil and grass seeds at any point during the year.

There are several methods used to add seeds. Slit seeding uses a slice aerator to create holes to drop the seeds under the soil surface and typically performed twice per year. Overseeding uses a spreader to scatter seeds on the soil surface. Finding the best time of year to overseed will depend on the grass seeds being used. For example, the best time to plant perennial rye grass in colder climates is in the fall.

Aeration

Aeration is arguably the most important step for maintaining healthy grass. Aeration relieves compacted soil and dethatches grass to allow air, water, and added nutrients to penetrate the soil. Relieving compaction can improve drainage, decrease the need for irrigation, and create a softer, more protective playing surface. Aeration is accomplished by pulling up plugs of soil and grass or by slicing into the soil using a riding or push machine. Consultants typically recommend aerating several times per year. Springfield sees best results when fields are aerated four times per year. However, high traffic areas will benefit from more aeration. The Field Fund in Martha's Vineyard aerates the entire fields two to three times per year, and high traffic areas an additional one or two times per year.

Aerating a field in Springfield, Mass.

Mowing

A mowing program works best when adjusted to accommodate changing growth rates and summer heat. Consultants suggest mowing regularly to avoid cutting more than one third of the grass blade at one time. Some experts recommend grass be mowed high (3 to 3.5 inches) to encourage deep roots and to shade the soil. Others focus on benefits from cutting grass more frequently to a shorter length. Fields often require mowing twice per week during the peak grass growing months, and once per week at other times. Sharpening mower blades is important to prevent tearing or damage of grass blades, as damaged grass blades lose moisture and are more susceptible to disease. Local golf courses are sometimes willing to sharpen mower blades for community maintenance programs. It is also important to avoid mowing wet grass.

Tip!

Ensuring the mower blades are sharp will greatly improve grass health and help it grow evenly. Sharpening services may be available at lawn equipment stores or local golf courses.

Irrigation

Depending on climate and annual rainfall, irrigation may be needed to supply adequate moisture to soil and grass. It is essential to ensure irrigation systems are adjusted properly to evenly water a field. Controllers can be used to help conserve and direct water to certain areas of fields. The Field Fund uses a "smart" irrigation controller called a HydroPoint, which aids in irrigation and the conservation of water.

> **Tip!**
>
> Each sport creates different areas of high impact on fields, leading to compaction of grass and soil in certain areas. Move goals, nets, and other equipment periodically to avoid concentrating heavy use in certain areas of the field.

An irrigation system may not be necessary. Focusing on increasing organic matter content in soil, decompacting soil, and choosing drought tolerant grass may allow for rainfall to provide enough moisture throughout the growing season.

Special technologies

The team at The Field Fund in Martha's Vineyard uses some specialized technologies to help pinpoint problem areas on the field. Directing resources to targeted problem areas rather than the entire field can help reduce cost. One of these technologies is a wireless sensor tool called POGO that measures soil water content, soil salinity, field surface temperature, and GPS location. These data are used to create a map to identify specific areas on the field in need of extra maintenance. Low soil moisture is an indicator of compaction or low organic matter content. The Field Fund also uses drones to identify wear patterns in the fields as well as helping to monitor irrigation function.

Long-term maintenance

The key to sustaining healthy soil and grass is to keep up with regular maintenance. Several resources mentioned at the end of this document offer month-to-month calendars of recommended organic maintenance schedules. These resources are geared primarily towards lawn care, but many of the points they include can be useful for athletic field maintenance as well. The PJC Organics website provides educational resources including a month-to-month calendar for guidance on organic grass with cultural practices and product recommendations, and a list of "10 Steps to an Organic Lawn." The Grassroots Environmental Education website provides a PDF guide that gives steps accompanying a month-by-month schedule.

Whether rehabilitating or rebuilding a field, it is crucial to educate groundskeepers and staff about new organic maintenance practices including equipment and schedules for soil testing, mowing, aeration, and fertilization to maintain the long-term health of fields. It is also important to coordinate maintenance responsibilities with school and town representatives to ensure that maintenance activities do not disrupt regular field use.

Resources

Below are a few natural-grass consulting and educational organizations that focus on the use of organic management techniques. Note that TURI does not endorse any specific provider.

- The Phipps Conservatory provides a Sustainable Landcare Accreditation course. This is an intensive training course for landscape and lawn care professionals, focusing on organic landcare techniques.
- Northeast Organic Farming Association (NOFA) supports organic practices in New England through education on organic land care topics including fertilizers and soil amendments, pest management, disease control, and others. NOFA also offers soil technical assistance services such as soil testing. They also offers a search tool to find local organic landscaping services and money-saving bulk order programs for products. NOFA also hosts an accreditation course in organic land care for land care professionals.
- Grassroots Environmental Education is a New York-based non-profit organization with a mission to educate the public about the links between common environmental exposures and human health, including use of pesticides and synthetic turf. They have created an organic lawn and landscaping program to educate and train professionals in organic grass care. They also offer a number of educational resources on their website including a healthy lawn care document describing "six steps for organic lawn care."
- IPM Institute of America provides a range of services to help reduce pesticide use, support pollinator health, support sustainable agriculture, and support integrated pest management for schools, among other activities. Midwest Grows Green, an initiative of the IPM Institute of America, provides information on techniques for reducing pesticide and fertilizer use, drawing upon on a range of community-based projects. Midwest Grows Green has created guidance for athletic fields, and provides informational templates for a small fee.
- PJC Organics is a small organic grass consulting company and organic fertilizer and soil amendment manufacturer located in Massachusetts. The company offers diagnostic services including site visits, soil testing guidance, and maintenance program development. PJC Organics analyzes soil test results in order to recommend products, application amounts per acre, and application schedules for individual fields. PJC Organic's website also provides resources including a month by month breakdown of organic field care and resources to help connect with local landscapers for field needs.
- Osborne Organics is a consulting group that specializes in helping municipalities and institutions improve the quality of their playing fields by transitioning to organic grass management. Osborne Organics builds custom rehabilitation and long-term maintenance plans base on comprehensive assessments of fields, soil testing, and understanding current and past cultural and product management practices. They also provide training for landscape professionals and property managers on best practices in organic grass management. TURI interviewed Chip Osborne of Osborne Organics to help communities better understand how organic management of grass can improve the quality of grass without use of pesticides or synthetic surfacing materials.

- Natural Grass Advisory Group (NGAG) is a consulting group that combines core principles of natural grass maintenance with data collection and newer technologies to strengthen grass on athletic fields, allowing for more play time and better resilience. NGAG provide basic services such as soil testing, but also use sensors to measure both environmental and performance variables on field surfaces. They build maintenance plans focused on alleviating compacted areas, increasing organic matter, and balancing soil chemistry. NGAG also provides workshops, on-site training, and seminars about different aspects of maintenance and budgeting for organic maintenance.
- EarthWorks manufactures carbon-based fertilizers and other soil additives for grass and landscaping. Their staff includes agronomists that can share advice on products and growing healthy grass using sustainable methods.
- The Town of Wellesley Natural Resources Commission created a guide for reducing pesticide use through organic land care.

Acknowledgments

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The Toxics Use Reduction Institute is a multi-disciplinary research, education, and policy center established by the Massachusetts Toxics Use Reduction Act of 1989. The Institute sponsors and conducts research, organizes education and training programs, and provides technical support to help Massachusetts companies and communities reduce the use of toxic chemicals.

Toxics Use Reduction Institute, University of Massachusetts Lowell • The Offices at Boott Mills West • 126 John Street, Suite 14 Lowell, MA 01852-1152 • (978) 934-3275 • www.turi.org

April 2021

Engineered Green Infrastructure to reduce 6PPD-quinone in stormwater runoff

Susan D. Chapnick <s.chapnick@comcast.net>

Tue 3/5/2024 9:42 AM

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1 attachments (3 MB)

Rodgers-et-al-2023-Bioretention-cells_reduction-in-6ppd-quinone_EnvironSciTechnol_2023.pdf;

Natasha,
Please accept this communication to the Artificial Turf Study Committee of the peer-reviewed science that assesses the efficacy of stormwater green infrastructure in reducing 6PPD-quinone loadings to receiving waters. As has previously been communicated from peer reviewed literature, 6PPD-quinone is a chemical that is oxidized from tires and found in runoff from roadways and from tire crumb rubber infill - and this chemical is lethally toxic to salmon and some fresh water fish.
Rodgers, Timothy, et al. 2023. "Bioretention Cells Provide a 10-Fold Reduction in 6PPD-Quinone Mass Loadings to Receiving Waters: Evidence from a Field Experiment and Modeling,"
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Respectfully submitted,
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Letter

Bioretention Cells Provide a 10-Fold Reduction in 6PPD-Quinone Mass Loadings to Receiving Waters: Evidence from a Field Experiment and Modeling

Timothy F. M. Rodgers,[†] Yanru Wang,[†] Cassandra Humes, Matthew Jeronimo, Cassandra Johannessen, Sylvie Spraakman, Amanda Giang, and Rachel C. Scholes*

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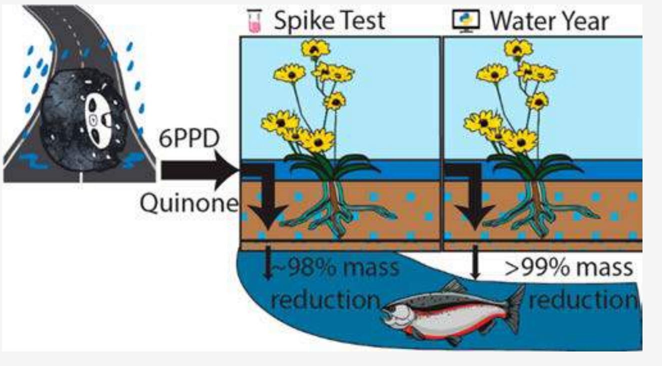
ABSTRACT: Road runoff to streams and rivers exposes aquatic organisms to complex mixtures of chemical contaminants. In particular, the tire-derived chemical 6PPD-quinone (*N*-(1,3-dimethylbutyl)-*N*′-phenyl-*p*-phenylenediamine-quinone) is acutely toxic to several species of salmonids, which are critical to fisheries, ecosystems, and Indigenous cultures. We therefore urgently require interventions that can reduce loadings of 6PPD-quinone to salmonid habitats. Herein, we conducted a spike and recovery experiment on a full-scale, mature bioretention cell to assess the efficacy of stormwater green infrastructure technologies in reducing 6PPD-quinone loadings to receiving waters. We then interpreted and extended the results of our experiment using an improved version of the "Bioretention Blues" contaminant transport and fate model. Overall, our results showed that stormwater bioretention systems can effectively mitigate >∼90% of 6PPD-quinone loadings to streams under most "typical" storm conditions (i.e., < 2-year return period). We therefore recommend that stormwater managers and other environmental stewards redirect stormwater away from receiving waters and into engineered green infrastructure systems such as bioretention cells.



KEYWORDS: *bioretention, stormwater, 6PPD-quinone, trace organic contaminants, fate models, green infrastructure, salmonids*

■ INTRODUCTION

Road runoff to creeks, streams, and rivers exposes aquatic organisms to complex mixtures of chemical contaminants. Salmonids are anadromous or freshwater fish species that are frequently found in waters that receive road runoff. Wild or farmed salmonids are found in temperate waters around the globe and make up ∼18% of global fisheries and aquaculture trade.[1] Salmonids are particularly important along the Pacific coast of North America, where they are keystone species of critical importance to many ecosystems[2] and Indigenous cultures.[3,4]

This cultural, ecological, and economic importance means that in many areas managing threats to salmonid populations is important to maintaining socio-ecologically healthy aquatic environments. In streams in the U.S. Pacific Northwest, exposure to road runoff has been linked to the prespawn mortality of 40−90% of returning coho salmon (*Oncorhynchus kisutch*).[5] For coho salmon, the primary toxicant in road runoff was recently discovered to be the compound 6PPD-quinone (*N*-(1,3-dimethylbutyl)-*N*′-phenyl-*p*-phenylenediamine-quinone), which is produced as a transformation product when atmospheric ozone reacts with 6PPD, an antiozonant tire additive.[6] 6PPD-quinone has been found at toxicologically relevant levels in many urban streams across North America,[7−9] and in road dust in Japan,[10] and further research has shown that a number of other salmonid species are impacted at environmentally relevant concentrations of 6PPD-quinone.[11−13] 6PPD-quinone toxicity is an area of evolving research, with results indicating that juvenile salmon are also very sensitive to 6PPD-quinone exposure,[14] that toxicity is not consistent among aquatic organisms, and that the modes of toxicity are not fully understood.[15]

We therefore urgently require interventions that can reduce loadings of 6PPD-quinone to salmonid habitats, particularly in urban areas along the Pacific coast of North America where sensitive populations and high loadings coincide. Regulators are currently assessing alternatives to 6PPD in car tires, but the

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development and adoption of alternatives, including the replacement of the current in-use stock of tires, will likely take many years.[16] For instance, the California (USA) Department of Toxic Substances Control has proposed listing motor vehicle tires containing 6PPD as a "priority product", which would require labeling and alternatives assessments by manufacturers, but would not ban its use. The Washington State (USA) Department of Ecology investigated alternatives to 6PPD, but concluded that it was difficult to determine if any alternative would be safer than 6PPD.[17]

Previous research suggests that bioretention systems or "rain gardens",[18,19] a type of "green infrastructure", or "low impact development"[20,21] technology, could be effective at reducing 6PPD-quinone loadings to urban streams. First, the physicochemical properties of 6PPD-quinone indicate that it could be partially captured by soil sorption.[22] Further, in studies conducted before 6PPD-quinone was discovered as the primary causal toxicant in stormwater runoff, McIntyre et al.[23] and Spromberg et al.[24] found that stormwater filtered through laboratory-scale bioretention columns protected coho salmon from the acutely lethal effects of stormwater runoff. However, in a field-scale bioretention system preferential flow paths, differing loading patterns, and other factors can substantially impact bioretention system performance.[25,26]

Herein, we conducted a 6PPD-quinone spike and recovery test on a full-scale bioretention cell in Vancouver, Canada. We interpreted and extended our analysis using the Bioretention Blues model of organic contaminant fate in bioretention systems.[22] The goals of our study were to (A) Experimentally assess the effectiveness of mature bioretention systems for reducing the discharge of 6PPD-quinone, (B) model the performance of bioretention systems for removing 6PPD-quinone under different hydrological conditions, and (C) model dominant processes in 6PPD-quinone fate in bioretention systems and determine gaps in our understanding of those processes.

■ METHODS

Study Site. The studied bioretention system is located on the northeast corner of Pine and eighth Streets in Vancouver, Canada. It was constructed in summer 2021 and planted in fall 2021. The system area is 22 m^2, the contributing drainage area is 694 m^2, ponding depth is 15 cm, media depth is 45 cm with a layer of mulch on the surface, and the unlined bottom contains an underdrain wrapped in clear crush gravel and geotextile. Figures S1 and S2 show engineering drawings of the system, and SI section S1.1 gives additional site details.

Experimental Protocol. Our spike and recovery experiment was designed to represent the largest rainfall event that did not cause the system to overflow. We followed the experimental framework of Gu et al.[27] with some modifications. First, we conducted a "spike" test where chemicals (including 6PPD-quinone, bromide and rhodamine-WT) were added to the system while water was pumped from a water truck on July 28th, 2022. To assess whether 6PPD-quinone would be remobilized by rain events with small antecedent dry periods, we conducted a "flushing" test, where ∼13m^3 of water but no chemicals were added (Figure 1C) on August third, 2022. We took effluent samples from the system's underdrain at a frequency of ∼5−20 min for a total of 28 effluent and triplicate spike mixture samples during the spike test and 17 effluent samples during the flushing test. Further details are available in SI S1.2. Measured concentrations for 6PPD-quinone, rhodamine-WT, and bromide, measured flow rates and other water quality parameters (temperature, pH, and conductivity), the version of the Bioretention Blues model used here, and all input model parametrization files (including an EPA-SWMM model of the catchment) can be found in our data repository[28] and from the cofirst author's GitHub page.[29]

Sample Extraction and Analysis. We quantified 6PPD-quinone by extracting the water samples using off-line solid-phase extraction (SPE), and analyzed 1 mL of well-mixed extract using an Agilent 1200 series high-performance liquid chromatography (HPLC) system and a 6410 triple quadrupole mass spectrometer (Agilent Technologies, CA, USA). Full details on the sample extraction and analysis are discussed in the SI (Section S1.3 and Table S1). We measured the concentrations of the bromide and rhodamine-WT tracers using ion chromatography (Dionex Aquion, Thermo Scientific, Ontario, Canada) and UV/vis spectroscopy (Unicam UV 300, Thermo Spectronic, USA), respectively.

Quality Assurance and Quality Control. We collected six field blanks, four background samples from the water truck, and two field duplicate samples. We created three additional duplicates by subsampling the volumes collected in the field. When analyzing our results, we replaced values below the MDL with half the MDL. We defined the method detection limit (MDL) as the mean field blank level plus either the 99 or the 98% confidence interval from the field blanks (Table S2).

Model Development, Parametrization, and Calibration. We developed an updated version of the Bioretention Blues[22] model (Figure 1C) to help interpret the spike and recovery experiment and to extend our results to conditions and design configurations beyond those observed during the experiment (see SI S1.4 for full details).

We parametrized the updated Bioretention Blues model to represent the bioretention system at Pine and eighth St. in Vancouver, Canada. We calibrated the model hydrology using the Kling-Gupta efficiency (KGE)[30] between the measured and modeled outflows, and contaminant behavior using the conservative bromide and the sorptive rhodamine-WT tracers (full details in SI S1.4). We did not calibrate any parameters for 6PPD-quinone. We estimated the partition coefficients for 6PPD-quinone using BIOVIA COSMOtherm (version 21.0),[31−34] the estimated values for log K_{OC} of 3.14 and the octanol−water partition coefficient (log K_{OW}) of 4.12 are both close to experimental values of 3.2−3.5, for log K_{OC} in road dust,[10] and 4.3 for log K_{OW}.[35] We linearly interpolated the concentrations and flow rates between observations to generate a higher temporal resolution data set to use as inputs to the model (see additional parametrization details in SI S1.4).

Model Application. First, we modeled the spike and recovery experiment, using the fit between the measured and modeled values to evaluate the model, and the model outputs to help interpret the experimental results. Then, we used the model to extend our analysis and evaluate how a "typical" bioretention cell,[18] represented by our system, would perform in reducing loadings of 6PPD-quinone to receiving bodies. We simulated single event time-series for 28 design storms across the intensity-duration-frequency (IDF) curves used by the City of Vancouver, and for a continuous simulation across a synthetic "average" water year used by the City of Vancouver that contains less intense events (see SI Section S1.5 for full details, Table S3 shows the rainfall intensities for the IDF

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Environ. Sci. Technol. Lett. 2023, 10, 582−588

events and our data repository[28] contains the complete time-series used as inputs to the model).

We defined the "performance" of the system as its ability to reduce mass loadings and effluent concentrations of 6PPD-quinone. We assessed the "direct effluent" as the proportion of the influent mass that was released to the sewer network, through the underdrain or by overflowing. We defined the flow-weighted mean effluent concentration (MEC, ng L^{-1}) as the direct effluent mass of 6PPD-quinone divided by the total water volume entering the sewer network. We also calculated the acute risk quotient (RQ)[36] using the LC_{50} for adult coho salmon of 95 ng L^{-1}.[9] We note that an LC_{50} of 41 ng L^{-1} was recently reported by Lo et al.[14] for juvenile Coho salmon, using this value would increase all of the reported RQs by 2.3 times. We used the RQ to calculate an average (RQ_{av}) based on the MEC. An $RQ_{av} > 0.5$ indicates a "high" risk, $0.1 \leq RQ_{av} \leq 0.5$ the potential for acute risk, and $0.05 \leq RQ_{av} \leq 0.1$ the potential for acute risk to endangered species.[36]

■ RESULTS AND DISCUSSION

Our results indicate that bioretention systems can effectively reduce 6PPD-quinone loadings in urban runoff. Despite the short hydraulic residence time (peak effluent concentrations were observed ~3−11 min after injection), our experimental results showed substantial mass and concentration reductions to the effluent for 6PPD-quinone. The observed flow rates (Figure 1a) indicated that water infiltrated rapidly into the studied system and then exfiltrated to the surrounding soil.

The bromide tracer (Figure 1b, orange) peaked within ~5 min and was flushed from the system in under an hour, exhibiting a right-skewed distribution. By contrast, the sorptive rhodamine-WT tracer peaked after ~3 min (Figure 1b, blue), but then had a long tail of continued detectable concentrations. This indicates that rhodamine-WT sorbed to the soil during the initial spike and then desorbed back into the flowing water. For 6PPD-quinone (Figure 1c), the experimental results indicated a mass reduction of ~95% to the underdrain. The peak effluent concentration of ~150 ng L^{-1} was substantially lower than the influent spike mixture concentration of ~4300 ng L^{-1}, partially because the spike mixture was immediately diluted with injection water. Notably, there was a 7 min period where the concentration of 6PPD-quinone was above the LC_{50} of coho salmon (95 ng/L), but the concentration fell below the MDL (14−16 ng L^{-1}) within half an hour after spiking.

Model Evaluation and Results. The fit between measured and modeled data indicated that the Bioretention Blues model reproduced the processes involved in contaminant transport and fate in the bioretention cell during the spike and recovery experiment (Figure 1, see SI Section S2.1). The model showed adequate performance (defined as KGE values ≥0.5, 1 indicates an ideal fit)[22,37] for the calibrated flows (Figure 1a) and for the tracer compounds bromide and rhodamine-WT (Figure 1b). For 6PPD-quinone, the KGE modified to ignore bias in variances was 0.64 (Figure 1c, see SI Section S2.2).

Encouragingly, our results indicated that once captured 6PPD-quinone is unlikely to leach out of the bioretention system, at least over short interevent time scales. First, during our initial experiment we only saw detectable levels of 6PPD-quinone immediately following the spike injection. By contrast, concentrations of rhodamine-WT remained elevated throughout the experiment. This difference in fate was captured by our model, which predicted substantial remobilization of rhodamine-WT with the influx of clean water but predicted that 6PPD-quinone would mostly remain sorbed to the soil. Supporting this contention, during the flushing experiment, where we introduced ~13m^3 of clean water approximately 1 week after the initial spike experiment, we did not observe detectable effluent concentrations of 6PPD-quinone. For this event, the model predicted that ~2% of the influent mass would be remobilized to either the underdrain or to the surrounding soil. Although this lack of detection could have been caused by transformation or plant uptake of the 6PPD-quinone (given the uncertainty in the model parameters for those processes), it still showed that remobilization and leaching of 6PPD-quinone from fresh influent was not a substantial mass transport process, even given a very short interval (of <1 week) between large events. Overall, across the modeled period the model estimated that ~75% of the influent 6PPD-quinone was retained by the soil, with <5% released through the underdrain and ~20% exfiltrated to the surrounding soil (Figure 1d), with 2.5% predicted trans-

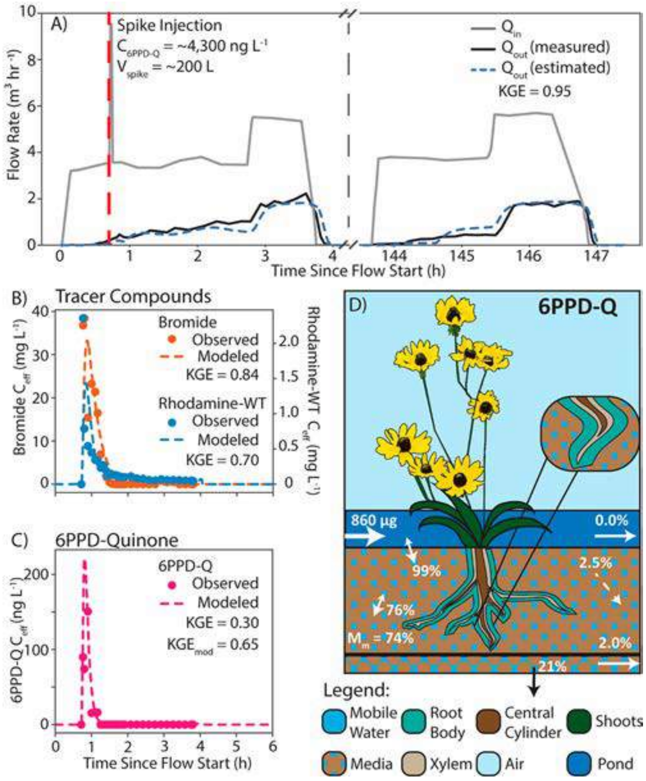

Figure 1. Overview of the results from the 6PPD-quinone (6PPD-Q) spike test. (A) Hydrology of the spike and recovery and flushing experiment, showing the measured influent and effluent flow rates, the modeled effluent flow rate (dashed line), and the timing of the spike injection. (B, C) Modeled (dashed lines) and measured (dots) effluent underdrain concentrations of the (B) calibrated tracer compounds and (C) uncalibrated 6PPD-quinone for the initial spike and recovery test period. (D) Modeled fate of 6PPD-quinone across the entire spike and flush test time period. Solid arrows represent mass transfers between compartments or into and out of the system, as a percentage of the influent mass (shown entering the ponding zone with units in μg); double-headed arrows indicate two-way processes with the larger arrowhead showing the dominant direction of exchange (e.g., 76% transfer from mobile water to media). Dashed lines represent primary transformation. M_m shows the percentage of influent mass retained by the soil.

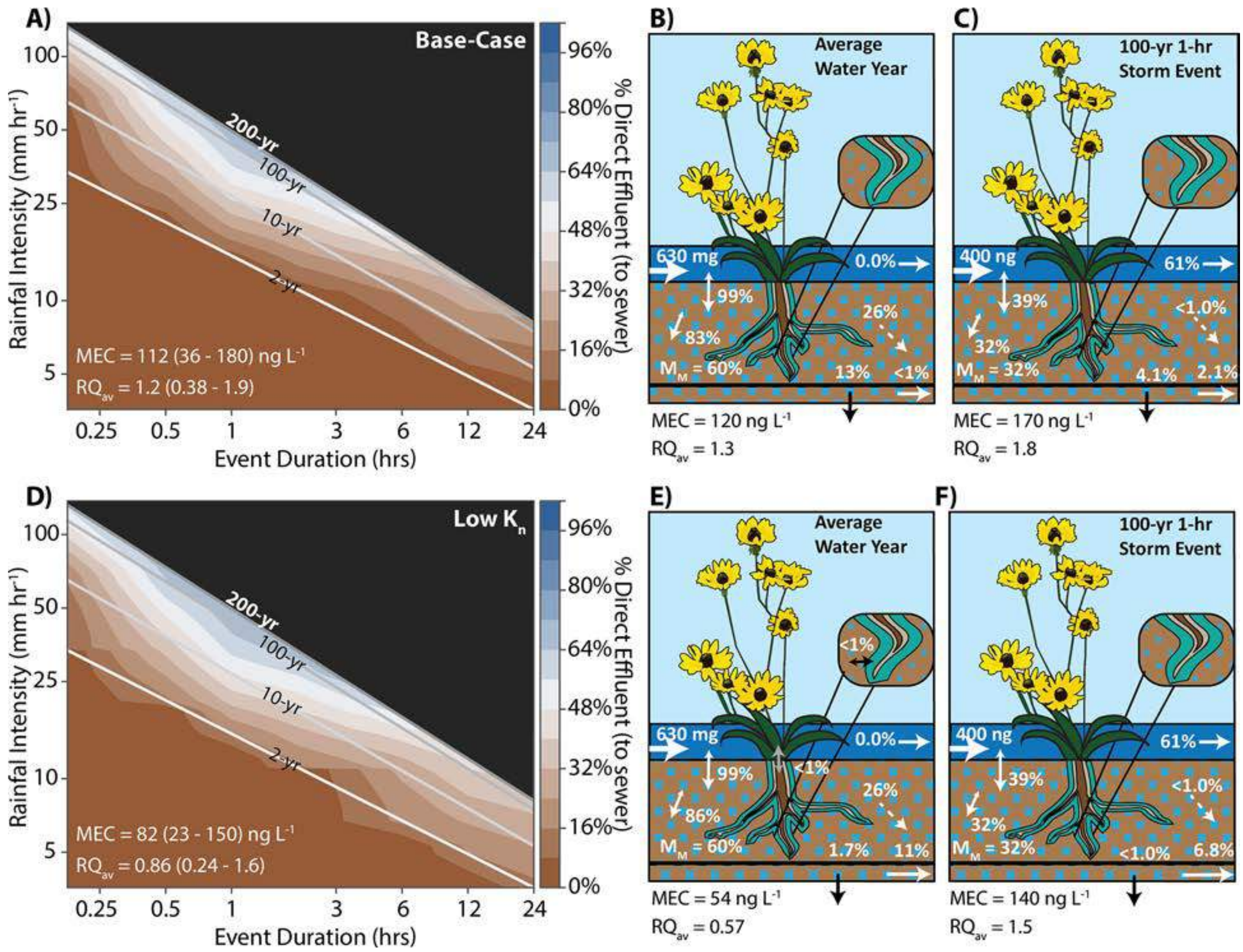

Figure 2. (A, D) Fate of 6PPD-quinone through the (A) studied and (D) low-K_n bioretention cell across the storm events defined by the City of Vancouver intensity-frequency-duration (IDF) curves. The contour colors (interpolated between the 28 simulated events) show the proportion of the influent mass that was advected through the bioretention cell to the sewer system, with brown colors representing less than 50% released and blue more than 50% released. The mean and range of the effluent concentrations (MEC) and the average risk quotients (RQ_{av}) are shown on the IDF figure. (B, E, C, F) Fate of 6PPD-quinone across (B, E) a synthetic "average" water year and (C, F) the City of Vancouver 100 year 1 h design storm event, respectively; E and F represent the low-K_n scenario. Solid arrows represent mass transfers between compartments or into and out of the system, as a percentage of the influent mass (shown entering the ponding zone with units in mg or ng); double-headed arrows indicate two-way processes with the larger arrowhead showing the dominant direction of exchange. Dashed lines represent primary transformation. M_m shows the percentage of influent mass retained by the soil.

formation in the soil compartment. SI Section S2.3 discusses limitations of our model and results.

Performance of Bioretention for 6PPD-Quinone. We ran the calibrated model for 28 events across the City of Vancouver intensity-duration-frequency (IDF) curves, assuming a constant 1000 ng L^{-1} influent concentration to represent a "worst-case" scenario, such as a system receiving effluent from a large highway (see SI section S1.5 for more details). Under these conditions, we predict that the as-built bioretention system would reduce mass-loadings of 6PPD-quinone to receiving systems by >90% for all events with a recurrence period of ≤2 years (Figure 2a). In an "average" water year, we predicted a reduction in annual mass loadings of >95%, with 26% of the influent mass predicted to transform (Figure 2b), although we note that little is known about how quickly 6PPD-quinone is transformed in soil. Some uptake by plants may occur,[38] although this is likely minor in a fast-draining bioretention system such as this one.[22] The system's RQ_{av} ranged from 0.38 for the 2 year, 10 min event to 1.9 for the 200 year, 1 h event. For larger events, there were substantial periods with an RQ > 1, indicating sustained effluent concentrations well above the LC_{50} for coho salmon.

The study system had a high exfiltration rate due to the high calibrated permeability (~125 mm h^{-1}) of the surrounding soil. To broaden the applicability of our results, we simulated the performance of a "low permeability" scenario consisting of an identical system situated in a soil with an infiltration rate of 3.3 mm h^{-1}, representing clayey or silty soils.[39] In this scenario, the system performed similarly to the as-built high permeability system, with more mass released to the sewer (e.g., 11% vs <1% for the studied system across the average water year), but a lower RQ_{av} of 0.24−1.6 across the 28 events due to the larger volume of underdrain flow diluting the effluent concentrations (Figure 2d). We note that since the Bioretention Blues model relies on system-specific calibrated parameters the uncertainty surrounding this simulated system is larger than for the as-built system.

For both the as-built and the low-permeability scenarios, this relatively high RQ_{av} (well above the US Environmental Protection Agency (EPA) threshold of >0.5 for a "high" risk) across all events was particularly driven by overflow of the

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system during larger events (Figure 2c); water that overflowed the system received only minimal treatment due to settling and diffusion, leading to high combined effluent concentrations. On entering a stream, concentrations would be reduced through dilution. However, depending on the size of the stream, localized high concentrations would still be possible. Tire-derived chemicals such as 6PPD-quinone are believed to be rapidly mobilized by the first flush of a rainfall event,[40] meaning that the excellent performance for both the as-built and low permeability scenarios for smaller events and across an "average" water year could substantially reduce the risks to salmon. Larger events still present a risk, however, as in many catchments 6PPD-quinone is believed to exhibit an additional "middle flush"[40] of elevated concentrations of 6PPD-Q throughout the hydrograph.[7] Design or management interventions could therefore improve the ability of bioretention systems to protect salmon from 6PPD-quinone during extreme events.

Environmental Implications. Overall, our results showed that mature, field-scale bioretention systems can effectively capture 6PPD-quinone in stormwater. Although finding safer alternatives to 6PPD will provide the most complete protection for salmonids and other potentially sensitive aquatic organisms, the efficacy of bioretention systems means that in the short term, stormwater managers can protect sensitive populations by redirecting runoff away from streams and toward engineered systems such as bioretention. Our modeling results indicate that under most "typical" storm conditions (e.g., <2 year return period) bioretention will greatly reduce the mass and concentration of 6PPD-quinone being directly released. Even during larger events, almost 50% of 6PPD-quinone may be captured, with the lower performance for the largest events driven mainly by overflow from the ponding zone. Although knowledge gaps remain regarding the transformation rates of 6PPD-quinone in soil, and the potential for transport through interflow and shallow groundwater flow, our results indicate that 6PPD-quinone is not likely to be remobilized from soil. Therefore, redirection to riparian zones or other vegetated areas may provide protection as well. By directing road runoff toward bioretention systems, stormwater managers and other environmental stewards can help protect salmonids and any other sensitive aquatic organisms from toxic road runoff and support socio-ecologically healthy aquatic environments.

■ ASSOCIATED CONTENT

Data Availability Statement

The data used in this paper, along with an archived version of the Bioretention Blues model code, is available from our data repository.[28] Current and future versions of the model are also available with an interactive tutorial from one of the lead authors' GitHub pages.[29]

Supporting Information

The Supporting Information is available free of charge at https://pubs.acs.org/doi/10.1021/acs.estlett.3c00203.

> Additional methodological details, including further information on the study site, experimental design, sample processing and analysis, and the model parametrization and calibration; additional results and discussion, including the calibrated model parameters, additional model evaluation details, and a discussion of limitations (PDF)

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Author Contributions

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Notes

The authors declare no competing financial interest.

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Fwd: PFAS Referenda - cities/towns

Susan D. Chapnick <s.chapnick@comcast.net>

Mon 2/26/2024 9:21 AM

To:mikeg125@gmail.com <mikeg125@gmail.com>;Claire Ricker <cricker@town.arlington.ma.us>;jobar@alum.mit.edu <jobar@alum.mit.edu>;BOH <BOH@town.arlington.ma.us>
Cc:David Morgan <dmorgan@town.arlington.ma.us>;Chuck Tirone <ctirone@ci.reading.ma.us>

CAUTION: This email originated from outside your organization. Exercise caution when opening attachments or clicking links, especially from unknown senders.

All:
Several neighboring towns have passed referendum on to ban purchase of PFAAS containing material.
Lexington has defined PFAS containing to be tested using total fluorine methods - rather than just the 6 PFAS compounds currently regulated in MA, because these 6 do not capture the thousands of PFAS compounds that can be in a product.
This is important information in terms of considerations of artificial turf materials - which contain PFAS compounds.

Susan

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---------- Original Message ----------
From: Wendy Heiger-Bernays <whb@bu.edu>
To: Jillian Tung <jilliantung123@gmail.com>, "Geller, David S.,M.D." <dgeller@partners.org>, Susan Wolf-Fordham <wolffordham@gmail.com>, Mark Sandeen <msandeen@lexingtonma.gov>, Rick Reibstein <rickreibstein@rcn.com>, Susan Chapnick <s.chapnick@comcast.net>, Margaret Peard <mpeard@lexingtonma.gov>, Joanne Belanger <jbelanger@lexingtonma.gov>, Alicia McCartin <amccartin@lexingtonma.gov>
Cc: libby-boh@email.toast.net
Date: 02/26/2024 8:19 AM EST
Subject: PFAS Referenda - cities/towns

Hello Lex BOH members and others,
Newton, Brookline, next is Cambridge.... referenda to ban municipal purchase of PFAS-containing materials.

The Newton PFAS Resolution passed nearly unanimously. Nearly identical to the one in Brookline.

It's Monday morning, so I will not start the week with my usual questions re definition, process, testing....

Wendy

Wendy Heiger-Bernays, Ph.D. | Clinical Professor
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CITY OF NEWTON

IN CITY COUNCIL

February 5, 2024

RESOLUTION

Resolution urging the City to avoid the purchase or use of products containing PFAS ("forever chemicals")

WHEREAS the City of Newton strives to implement policies to protect and improve the health and safety of its residents; and

WHEREAS fluorinated hydrocarbons (also known as organofluorines), including per- and polyfluoroalkyl substances ("PFAS"), are a group of thousands of primarily synthetic organic chemicals that contain carbon-fluorine bonds, a condition that occurs in nature only rarely; and

WHEREAS the carbon-fluorine bond is so strong, these chemicals persist in our environment, and are thus often called "Forever Chemicals;" and

WHEREAS some PFAS enter our food chain and accumulate in living organisms; and

WHEREAS some PFAS have been associated with severe health effects in humans at very low levels, i.e., parts per trillion (ppt), including:

- kidney, thyroid, and testicular cancers,
- hormone disruption and lowered sex and growth hormones in children, and altered mammary gland development,
- immune system effects, such as decreased response to vaccines in children, high cholesterol, thyroid disease, and hypertension; and

WHEREAS the production of synthetic petrochemicals is energy intensive and generates large amount of greenhouse gasses; and

WHEREAS PFAS are widely used to manufacture non-stick, grease, and stain-resistant coatings in a variety of industrial and consumer products, including propellants, food packaging, non-stick cookware, stain-resistant carpets and upholstery, furniture, construction materials, ski wax, floor wax, paint, lubricants, outdoor gear, synthetic turf, and firefighting foams and fire-protective personal protective equipment; and

WHEREAS over 6,400 PFAS-related lawsuits for endangering public health and harming and destroying natural resources have been filed in federal courts between July 2005 and March 2022; and

WHEREAS in 2022, a bipartisan coalition of 22 state attorneys general (AGs), which included then AG Maura Healey, filed a class action lawsuit against PFAS manufacturers such as 3M, DuPont, Chemours, and Corteva for drinking water pollution and other harms , which likely will be settled for an amount exceeding $10 billion; and

WHEREAS Massachusetts, Maine, Vermont, and Rhode Island have begun to regulate PFAS in drinking water, and Massachusetts, Rhode Island, and Vermont have done so for groundwater (all at levels not to exceed 20 ppt); and

WHEREAS the Newton Public Building and School departments purchase only Environmentally Friendly Cleaning Products through the GreenSeal certification that now includes PFAS-free products for all schools, City Hall and the Library; and

WHEREAS several municipalities across the country, such as the City of San Francisco, have adopted environmentally preferable purchasing policies that include the avoidance of PFAS; and

WHEREAS the Materials Buyers Club, of which the City of San Francisco and Harvard University are members, seeks to avoid the purchase of products that contain PFAS, PVC, and other chemicals of concern from building materials and furnishings; and

WHEREAS there are resources available to the City of Newton to guide their purchasing decisions, including the Harvard Sustainability Department Compliant Matrix Protocol and the San Francisco Approved list for various product categories; and

WHEREAS the Commonwealth's Operational Services Division (OSD) published, in May 2023, an extensive guide (prepared by the Responsible Purchasing Network) for all state procurement offices to assist them in avoiding PFAS in products purchased through state contracts, titled A Slick New Guide to Avoiding PFAS (Forever Chemicals) in Products Using Massachusetts Statewide Contracts (https://www.mass.gov/doc/pfas-free-buying-guide/download); and

WHEREAS President Biden issued Executive Order No. 14057 on Dec. 8, 2021, that incorporates the Federal Sustainability Plan to leverage the federal government's procurement powers to prioritize the procurement of products that contain no added PFAS; and

WHEREAS many other states have enacted laws to ban the presence of PFAS in a variety of products; and

WHEREAS the State of Maine became the first government body to require that as of January 1, 2023, manufacturers have been required to report the presence of intentionally added PFAS

in their products; and under the same law, the State has prohibited the sale of carpets, rugs, and
fabric treatments that contain intentionally added PFAS, also effective January 1, 2023; and effective January 1, 2030, any product containing intentionally added PFAS may not be sold in Maine unless the use of PFAS in the product is specifically designated as a currently unavoidable use by the Department. (Maine Public Law c. 477, An Act to Stop Perfluoroalkyl and Polyfluoroalkyl Substances Pollution, July 2021); and

WHEREAS Massachusetts is among the minority of states that has not yet enacted bans on the presence of PFAS in products, though such legislation currently has been filed during the 2023-2024 legislative session; and

WHEREAS the City of Newton Department of Health and Human Services aims to limit residents' PFAS exposure through community education and consumer awareness and will be making information on PFAS easily accessible by posting a series of education content pieces that include flyers, videos, and social media infographics, and a page on the City website; and WHEREAS City departments have already taken measures to reduce PFAS exposure in products purchased by the City, including the following:

- The Fire Department is actively engaged in reducing PFAS exposure to its firefighters and the public by purchasing Class B firefighting foam that is PFAS-free and is no longer having firefighters wear their PFAS-containing protective gear when responding to EMT calls;

- The Public Building Department requires suppliers to submit Environmental Product Declarations, which helps staff to weed out those products that have high VOCs, lead, PFAS or other carcinogens, poisons, or irritants; and

NOW, THEREFORE, BE IT RESOLVED, that:
1. The City of Newton purchase and use products that are certified free of PFAS where such products are available in the marketplace, and encourage its suppliers to develop PFAS-free versions of products that currently do not have ready substitutes; and

2. The Newton City Council urges the mayor and our state legislators to support state-wide regulation of products containing fluorinated hydrocarbons, such as S.1356 / H.2197 An Act to Protect Massachusetts Public Health from PFAS.

Under Suspension of Rules
Readings Waived and Approved
23 yeas 0 nays 1 absent (Councilor Humphrey)

~~(SGD) CAROL MOORE~~
Acting City Clerk

Health Working Group Outline

The Health Working Group is composed of the following Artificial Turf Study Committee Members: Marvin Lewiton, Jill Krajewski and Natasha Waden. This group identified the following three topic areas to study as it relates to both natural and artificial turf fields: 1) access to youth sports and its impact on mental and physical health; 2) heat impacts on human health as it pertains to field surfaces; and 3) health impacts associated with exposure to various chemicals associated with all natural and artificial turf playing fields. While our topic areas are listed from macro to micro, this does not indicate an order of importance or priority. We believe that each area should be considered and weighed individually in order to determine an overall decision.

TOPIC 1: ACCESS TO YOUTH SPORTS AND ITS IMPACT ON MENTAL AND PHYSICAL HEALTH

Exercise, and team sports in particular, improve the overall health of young people. Arlington should consider working on how to increase playing spaces to ensure equitable access to team sports for all its young residents. It should be considered that artificial turf may be uniquely positioned to allow for continuous play when adverse weather restricts play on natural grass fields.

It is important that Arlington youth can participate in youth sports. According to the Science Board that works in the President's Council on Youth Fitness and Nutrition, participation impacts many aspects of health. Equitable access to youth programs both promotes exercise and allows children to develop the social interactions that occur as part of a team. Exercise is linked to a reduced risk of many diseases including Type 2 diabetes, obesity, cancer, depression and anxiety. When the national youth sports survey looked at who isn't participating in sports, they found that BIPOC and low income households were particularly impacted by access to sports. While there are many factors related to this, one of their key bullets was lack of access to playing spaces. Arlington's outdoor recreation spaces and youth sports programs are accessible to families that cannot afford private sports clubs. Lack of field space can impact both enrollment and access to practice and playing times.

Complicating the numbers of children enrolled in programs and lack of field space is the seasonal New England weather. The wet weather conditions limit access to grass fields during the busy season, March 15-June 15 and August 15-November 15. According to Arlington's Department of Recreation, there are many closures for rain and resting periods after rain that require rescheduling of games and practice. Often, games can get played (or on occasion Arlington can move to an away site to make up a game), but there is little chance to make up practice. Turf fields do not have to be closed for rain and can allow for continuous play. In addition to disruptions within the season, artificial turf can be used earlier and later in the season and potentially in winter months. One question that is still outstanding is how much this would actually increase access to play in Arlington. In order to answer this question, it would be beneficial to have a set of data looking at actual grass and turf field closures due to weather conditions. Ideally, this would be for multiple years. Additionally, according to Ian Lacy from Tom Irwin Advisors, turf fields can increase usage by a factor of between 1.3 and 1.5X over natural grass fields. But, this assumes a natural turf field is appropriately rested. In our current situation, Arlington does not appropriately rest its fields. So while conversion from natural grass to artificial turf may dramatically increase the days where practices and games can be held, it may not significantly increase access to overall field time. In addition, the working group learned that there are mitigations such as sand injections that may improve drainage and allow for more playing time. These mitigations should be considered as well.

With the above information in mind, this report would suggest that carefully selecting sites for artificial turf when/if they can increase access to youth town sports programs or usability of playing spaces for those enrolled in the many town sports programs may be a benefit to the overall health of Arlington's youth.

1. President's Council on Youth Sports: Benefits of Youth Sports
2. National Youth Sports Survey: Federal Report
3. Data from Dept of Rec (if available)

TOPIC 2: HEAT IMPACTS ON HUMAN HEALTH

The impact of heat on human sporting activities may become an increasingly important issue as we continue to see the warming effects of climate change. The concerns are that artificial turf does have a higher heat load than natural grass. In addition, on all types of playing surfaces, exposure to high heat levels has a cumulative effect on the human body. Children are more vulnerable to high temperatures than adults. For these reasons, education and mitigation are essential.

Numerous studies have documented extremely high surface temperatures on artificial turf, and while there has been limited research on the temperature of the air above the field, data indicates that players on artificial turf fields have higher skin temperatures, indicating greater heat load, and perceive a greater degree of heat stress than when on natural grass fields. Arlington High School athletic department staff who have taken temperature readings on both artificial turf and natural grass fields at the same time have found the playing environment to be between seven and ten degrees hotter on synthetic fields than on natural grass fields. These temperatures were measured with a wet bulb globe thermometer (WGBT). Research on heat stress in college athletes has shown that a significant heat exposure on one day can result in additional physiological stress days later. We know that climate change is raising temperatures, and that this trend is expected to continue. (22, 23, 24, 26)

Children are not as able to adapt to changes in temperature as are adults and are also not as likely to accurately assess the degree of heat strain to which they're exposed. For children playing team sports, the desire to participate and compete may lead to them staying on the field despite a level of discomfort that might lead an adult to rest instead. (23)

There are several possible mitigation strategies that can improve heat safety on fields. Alternative infill materials (sand, coated sand, cork, Brockfill, etc.) have been suggested as alternatives to crumb rubber that are not only less toxic but may also result in cooler field surface temperatures (30). However, none of these can provide a surface that's comparable in temperature to natural grass, and they may have other issues, such as increased migration from the field, or the need for more frequent maintenance and/or replacement. Information from the

Penn State Sports Surface Research Center suggests that significant temperature reductions may not be possible with infill changes alone (29). One infill comprised of polymer-coated sand depends on regular watering to provide its evaporative cooling effect, and without this, is not likely to provide any significant degree of cooling (31). The grass “blades” of artificial turf also absorb heat, making that a factor in overall field temperatures.

The AHS athletic department currently monitors field temperatures (WGBT) during the hottest part of the year and has guidelines for when field use is safe. Practices and tryouts are scheduled for cooler parts of the day whenever possible. Annual training on recognizing heat strain is provided to coaching staff as a part of the department’s Emergency Action Plan. A five-day acclimatization program has been implemented for football players whose exposure tends to be greater due to their use of pads and uniforms, in accordance with MA Interscholastic Athletic Assn. guidelines.(27) There are currently few consistent requirements in terms of recognizing and responding to heat strain events for volunteer coaches in other sports. In addition, aside from high school events, it is unclear that there is consistent monitoring of field temperatures in the town of Arlington. Burlington, MA, has issued a set of heat guidelines for its artificial turf fields that are intended to reduce the potential for a serious heat exposure event. These guidelines use a combination of air and turf surface measurements to assess safe use conditions.

One factor to note about temperature is that the field crunch in Arlington is primarily during the fall (August 15 - November 15) and Spring (March 15 - June 15) seasons. During the summer months, where heat has the greatest impact, there is more ability to be flexible with field times and spaces. A final suggestion is that in the design of field renovations would be to include more shade structures such as dugout covers and shaded sideline seating. This should be considered regardless of field type as hot temperatures outside the summer season are becoming increasingly common.

<u>TOPIC 3:</u> CHEMICAL EXPOSURE

We know that artificial turf and its infills contain a wide variety of hazardous chemicals. What is not known at this point is how much exposure results from playing on these surfaces. In general, reducing exposure to hazardous materials has a positive health effect. One way to do this is to opt for PFAS-free turf carpet and to move away from crumb rubber and continue to research safer infills.

Exposure to hazardous materials comes in one of three ways: inhalation, ingestion, and dermal contact. While there is almost no data on the level of exposure to these materials in the context of artificial turf use, in general, when a product contains demonstrably toxic materials, minimizing possible exposure to them is always going to be better than not doing so. All things being equal, a reduction in potential exposure should lead to reduced harm to people and the environment.

Artificial turf fields in town will be used primarily by children, who eat, drink, and breathe more per pound of body weight than do adults. As their brains and bodies are continually developing during childhood, the effects of any hazardous exposures are more significant than would be the case for comparable exposures in adults. Recent research suggests that there is no safe level of lead exposure for children, as just one example. Their behavior also differs from that of adults, with more hand-to-mouth activity which can act to increase potential exposures.

In terms of duration of exposure, almost all the exposure studies to date have been done on adults, who are less susceptible to comparable adverse exposure levels to chemicals. Many more children participate in youth sports programs than was the case 20 years ago, and as a result will likely have longer periods of exposure to any hazardous components in artificial turf than would an adult. Exposure duration can be an important factor as diseases may have long latency periods (the time between exposure and disease).

Chemical exposure can lead to negative health outcomes. Chemical exposures can have cumulative impacts. Impacts are defined as toxicity risk, carcinogenic risks, endocrine disruption risks, and reproductive risks. The Health Working Group had a significant challenge in attempting to assess whether there might be adverse human health effects resulting from exposure to chemicals found in artificial turf. While there's an abundance of research that clearly illustrates the toxicity of components within these materials, there are few if any research studies that examine the potential for exposure to field users, nor do data currently exist that establish the exact level at which exposure to a particular hazardous material found in turf results in disease. While one cancer related study suggested there was no association between artificial turf field use and cancer in athletes, there were questions raised about the methodology used in the study and whether or not the study results were valid.

The health working group has recommended movement away from crumb rubber infill. Crumb rubber infills, used to soften the playing surface on artificial turf fields, are made from very finely shredded automobile and truck tires, and has been one of the ways in which old tires are recycled. Used tires contain a wide assortment of toxic materials which have been linked to adverse human health effects and environmental damage. The small size of these particles makes it easier for dusts to be generated during field use, which can then be aerosolized and inhaled, or deposited on clothing or body parts. Dermal contact with these dusts or solids can result in an ingestion exposure if food is eaten without handwashing. In addition to potential direct exposures, these materials are a source of "take home" exposures if they are transferred via clothing, shoes, on skin, or in the hair to field users' automobiles or homes. While the Recreation Dept. has stated that it does not plan to use crumb rubber infill in any yet to be installed artificial turf fields, we believe that it is important to provide information on the potential hazards involved with this material to help aid town officials in the decision making process for future projects. In addition, artificial turf fields contain other chemicals of concern, which are addressed in this report.

These hazardous materials include:

Polycyclic aromatic hydrocarbons (PAHs). PAHs are chemicals that exist naturally in coal, oil, and gasoline. They can be formed by the burning of these materials, along with wood, tobacco, and even food that is cooked at high heat, such as meat on a grill. Exposures can result from breathing tiny PAH particles or particles to which PAHs are bound, eating grilled or charred food, or food onto which PAH particles have deposited from the air. Some PAHs can be absorbed through the skin. Exposures to PAHs have been associated with skin, lung, bladder, liver, and gastrointestinal cancers. High rates of cancer among firefighters are thought to be due to PAH exposures. Animal studies have shown an association between PAH exposure and reproductive, neurologic, and developmental effects. (2, 3)

Heavy metals. Metals such as lead, zinc, and chromium as well as others are commonly found in crumb rubber. These metals can have a range of adverse health effects, including impairment of the nervous system, gastrointestinal and kidney issues, immune system dysfunction, reproductive system toxicity, and cancer. Indications are that the primary route of field users' exposure to metals would be through ingestion rather than inhalation. (5)

Per- and polyfluoroalkyl compounds (PFAS). PFAS is the umbrella term for the thousands of fluorinated compounds, which are commonly referred to as "forever chemicals" due to their extreme resistance to breaking down in the environment. They have been used in any number of products, including non stick cookware, firefighting foam, stain-resistant upholstery, and rainwear. It's been estimated that nearly all Americans have been exposed to PFAS through drinking water contamination, using products made with PFAS, or breathing PFAS in the air. A number of these compounds have been banned for use in children's toys and other consumer products, and many manufacturers are trying to come up with safer alternatives. However, for other consumer products, including artificial turf, compliance with the ban is totally voluntary. New fluorinated compounds are continually being developed and used. Because there are many opportunities for exposure, and PFAS are resistant to breaking down, they can accumulate in our bodies. Data suggests that the amount of PFAS in our blood can be one thousand times greater than the EPA's proposed level for drinking water. Adverse health effects include alterations in metabolism, altered thyroid function, higher risk of being overweight, lower fetal growth rates, and reduced effectiveness of our immune system. (6, 7, 8, 9, 10)

Phthalates are often referred to as "plasticizers. They can make plastic products flexible, and longer lasting. They are used in a wide variety of products including food packaging, medical products, personal care items, and sporting goods. The CDC states, "People are exposed to phthalates by eating and drinking foods that have contacted products containing phthalates. Some exposure can occur from breathing phthalate particles in the air. Children crawl around and touch many things, and then put their hands in their mouths. Because of that hand-to-mouth behavior, phthalate particles in dust might be a greater risk for children than for adults. Inside a person's body, phthalates are converted into breakdown products (metabolites) that quickly leave the body in urine." Research has documented a wide variety of adverse health effects resulting from chronic exposure to phthalates, including disruption of the endocrine system and abnormal functioning of some organ systems. This can affect pregnancy outcomes, child growth and development, and reproductive systems in both young children and adolescents. (12,13, 14, 15, 16)

Microplastics Comparable to investigations into the human health effects of PFAS and phthalates, research on the health effects of microplastics in both aquatic species and humans is extremely limited and in its early stages. Exposure to microplastics occurs through inhalation, ingestion, and food consumption, and is an increasing worldwide concern. Research indicates that ingestion of microplastics is harmful to aquatic and animal species, resulting in inflammation, oxidative stress and cytotoxicity among other adverse effects. Translocation of these tiny plastic particles has been found to occur in mice after ingestion, including passage through the blood-brain barrier. It is believed that these may be seen in humans as well. One study showed behavioral changes in mice following short-term microplastic exposures (18). In addition to the plastic particles themselves, there are concerns about the toxicity of compounds that have been either been added to or are adsorbed to the surface of the base plastic, such as colorants, phthalates, other chemicals which are used to provide specific properties, or heavy metals, which could result in other harmful effects. (19, 20, 21).

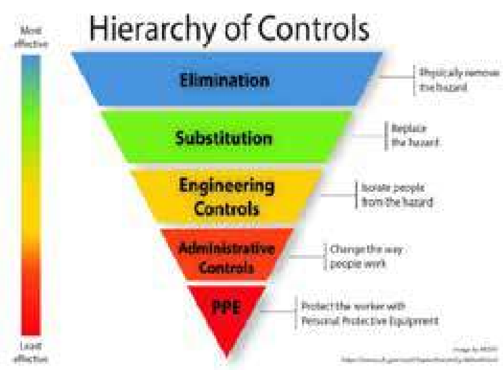
While the chemicals above are in the highest quantities in the crumb rubber, they also can exist in the grass blades. While nearly all Americans currently have some level of exposure to both PFAS and phthalates, virtually all of the papers addressing health issues around PFAS and phthalates in artificial turf acknowledge that there is inadequate research in terms of exposure, and that much more is needed. This is due to two primary factors- first, while there are standards for PFAS in drinking water, there are currently no definitive levels for PFAS or phthalates at which adverse health effects will occur, making it difficult to associate specific levels of exposure with disease.

An additional chemical that has recently been discovered in the grass blades is:

6-PPD Quinone 6-PPD is an antioxidant compound which is added to the rubber in automobile and truck tires to prevent cracking and early aging and increase their lifespan. When exposed to ozone and oxygen It transforms into 6PPD-quinone. Although 6PPD-quinone has been found to be highly toxic to coho salmon, testing on other aquatic species to date has not shown significant toxicity.

The limitations of existing personal sampling equipment make collecting inhalation exposure information during actual play or other representative field activities extremely challenging. New methods for both sampling and analysis are continually being developed and will hopefully be able to shed additional light on this important topic in the future. There's a long history of chemicals being found to cause harm at levels well below that originally thought to be problematic, and it's not unreasonable to ask whether we should voluntarily add to our existing exposure levels when it may not be absolutely necessary.

The use of less toxic materials will always be better than more toxic ones, even without exposure data, as that reduces the possibility of exposure to a toxin. This is the basis for OSHA's hierarchy of controls, which call for (in order of effectiveness) eliminating the hazardous material entirely, substituting safer chemicals for more hazardous ones, implementing engineering controls to capture emissions or guard against mechanical hazards, administrative controls such as work practice changes, and finally using personal protective equipment as the final and least preferred alternative.



As previously indicated, the health working groups recommend movement away from crumb rubber infill. As to what alternative is preferable, we recommend continued research on the different alternative infill materials. A portion of the TURI (Toxics Use Reduction Institute) comparison of infill materials is shown below.

Table 2: Comparing infills: Selected categories of chemicals of concern						
Category	**Tire crumb**	**EPDM**	**Shoe materials**[a]	**TPE**	**Acrylic-coated sand**	**Mineral- or plant-based**
Lead[b]	Present	Present	Present	Present	Below detection limit[c]	Absent in some cases
Zinc[b]	Present	Present	Present	Present	Present[c]	Present in some cases
Other metals[b]	Present	Present	Present	Present	One additional metal present[c]	Present
Vulcanization compounds[d]	Present	Present	Present	Generally absent	Expected to be absent	Zeolite, when present, poses serious respiratory hazard. Plant-based materials can pose concerns related to dust, fungi, or allergens. Vulcanization compounds and phthalates are expected to be absent; VOCs and PAHs are expected to be low or absent.[h]
Phthalates	Present[e]	Present (lower)[f]	May be present, but subject to RSL	Present[g]	Expected to be absent	
VOCs	Present[e]	Present (lower in some cases, higher in others)[f]	Expected to be present, but subject to RSL	Present (lower)[g]	Expected to be absent	
PAHs	Present[e]	Present (lower)[f]	May be present, but subject to RSL	Present (lower)[g]	Below detection limit[c]	
PAHs (TURI sample)[i]	Present (highest) (548 mg/kg)	Present (20 mg/kg)	Present (55 mg/kg)	Present (below 10 mg/kg)		

Aside from discontinuing use of crumb rubber infill, the health working group suggests the following mitigations. Pre-installation testing of field materials should be done to ensure that the materials are PFAS free. Since the major route of entry for PFAS and phthalates is ingestion, it should be considered which age groups are best suited to be scheduled on turf fields.

Safety Working Group Narrative

Artificial turf (or synthetic turf, as it is also known) presents a series of questions about its use as a playing surface for both professional athletes and casual users. From its first appearance as AstroTurf in the 1960s to its present format across fields all over the world, artificial turf provides both opportunities and challenges to those who use it. As part of this Committee's charge, we examined safety issues related to the use of artificial turf fields, including its impact on player injuries (head injuries/concussions, tears/breaks/sprains, etc.), heat stress, and skin abrasions and bacteria infections. We have found that artificial turf has taken great leaps with respect to athlete and user safety over the last six decades, though even modern synthetic turf has notable limitations in comparison to professionally maintained natural turf fields, albeit limitations that we feel can be managed or mitigated.

I. Injury

A long-running critique of artificial turf playing fields holds that they have a higher incidence of player injuries than natural grass fields. That was certainly true in the era of AstroTurf. Physicians and trainers noted that players were injured with a greater frequency on that turf, including ACL tears, concussions, and ankle sprains. In 1992, John Powell from the University of Iowa published a paper that showed that professional football teams had more major knee injuries on artificial turf when compared to professionally maintained natural grass. In that era, players complained of greater muscle soreness on artificial turf as compared to playing on a professionally maintained natural grass surface. (See https://www.hss.edu/conditions_artificial-turf-sports-injury-prevention.asp.)

But as we have noted, artificial turf has advanced considerably from its early AstroTurf days, and that includes improvements in lowering player injuries. Artificial turf manufacturers have made advancements in simulating more natural surfaces, particularly with the use of crumb rubber infill mixed with sand, often giving the turf a more grass-like feel. Nevertheless, criticism of artificial turf as it relates to player injuries remains, and it is not uncommon to hear players vocalize their opinions about the difference between the playability of artificial turf versus natural grass. (See https://www.hss.edu/conditions_artificial-turf-sports-injury-prevention.asp.)

Recent studies on player injuries provide a mixed picture. While some studies still see a greater likelihood of sports injuries with artificial turf over grass, other studies see the two playing surfaces as equivalent with respect to injuries, and one recent study even saw an advantage to artificial turf fields. It should be noted that these studies have been focused at the professional and collegiate levels, and very little study information is available for the casual or municipal user.

A 2023 review of research related to player injuries found that there is a higher rate of foot and ankle injuries on artificial turf, both old-generation and new-generation turf, compared with natural grass. That review also noted that high-quality studies suggest that the rates of knee injuries and hip injuries are similar between playing surfaces, although elite-level football athletes may be more predisposed to knee injuries on artificial turf compared with natural grass. (See https://pubmed.ncbi.nlm.nih.gov/35593739/.)

In contrast, a 2022 peer-reviewed study found that in a comparison of artificial turf to natural grass, injury rates were equivalent in most cases. A notable exception to that finding was higher rates of foot and ankle injuries in general, as well as higher knee injury rates among elite-level American football athletes, on artificial turf playing surfaces. But the study found that concussion rates on artificial turf are decreased compared to natural grass that is maintained by professional groundskeeping operations. (See https://www.intechopen.com/chapters/83186.)

And, as previously noted, a 2023 study of football (soccer) players actually found the overall incidence of football injuries to be lower on artificial turf than on grass. (See https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10139885/.)

In light of recent studies and research, it seems hard to definitively say whether modern artificial turf playing fields inherently present more risk of player injury than natural grass fields that are maintained to a professional standard. There seems to be a slightly higher risk of foot and ankle injuries on artificial turf fields versus natural grass fields, but the difference is not dramatic. And there is some indication that, with respect to sports injuries, artificial turf playing surfaces might even be better than natural grass, including in the area of concussions. In the end, although there may be many important differences between artificial turf fields and natural grass fields, player injuries is not an area that stands out in that regard.

With the benefit of first-hand local experience on both natural grass and artificial turf with crumb rubber infill, Arlington High School's head athletic trainer, Samantha Jones, concurred with that assessment. She stated that she has not seen any measurable difference in the type or number of injuries associated with playing surface, noting that more frequent injury types are attributable to factors like differing physiology or player preparedness.

It is also worth noting that studies of sports injuries sometimes compare artificial turf fields to pristine, professional athletic natural grass fields. In that comparison, it is not surprising that the artificial turf fields often have a modestly worse record on certain sports injuries. But it is rare outside of the collegiate or professional sports world to find pristine, impeccably maintained natural grass fields. In reality, most municipal grass playing fields across the United States are maintained to the level that is affordable for municipal budgets. Those fields often are stressed from heat and rain, and they can be much more likely to cause sports injuries.

Mark Cote, a Mass General Brigham Sports Medicine researcher who serves as director of Outcomes Research for Sports Medicine and Orthopeadic Surgery at Massachusetts General Hospital, summed up succinctly the state of research on these issues in 2024: "I don't think we're at a point yet where we can say an injury would have been avoided because a field is turf or natural grass, nor are we at a point where we should immediately switch every field in America to natural grass." Recognizing that artificial turf may increase the risk of non-contact injuries and that professional athletes often prefer natural grass playing fields, Cote stated: "While I'd prefer my own children to play on natural grass, I know an injury can happen on any surface without proper conditioning. At the end of the day, it's a part of the sport." (See https://www.massgeneralbrigham.org/en/about/newsroom/articles/turf-vs-grass-fields-sports-injury-prevention).

II. Heat

One area where there seems to be wide consensus is that artificial turf fields get hotter (and, in some cases, much hotter) in warm temperatures than natural grass fields. This point is not seriously disputed, even by the artificial turf industry. But a detailed analysis of artificial turf fields and their heat effects on their users reveals nuance and complexity to the issue.

Most reputable studies or analyses show that artificial turf fields with crumb rubber infill can get considerably hotter than natural turf on hot, sunny days. While natural grass fields rarely get above 100° F due to the release and evaporation of water vapor that leads to cooling, artificial turf fields, in comparison, regularly rise above 100° F. Penn State University's Center for Sports Surface Research conducted studies comparing surface temperatures of synthetic turfs composed of various fiber and infill colors/materials and found that the maximum surface temperatures during hot, sunny conditions averaged from 140° F to 170° F. Another study conducted at Brigham Young University found that the "surface temperature of the synthetic turf was 37° F higher than asphalt and 86.5° F hotter than natural turf." This is a concern for many reasons, including, as neuroscientist Kathleen Michels points out: "Any temperature over 120° F can cause skin burns with skin contact in two seconds." (See https://www.nrpa.org/parks-recreation-magazine/2019/may/synthetic-sports-fields-and-the-heat-island-effect/.)

The most extreme heat issues related to artificial turf fields have usually been documented in regions of the country where air temperatures are regularly above 80° F (e.g., Florida, Texas, California). Arlington's climate is changing, with warmer winters and more 90° days in summer, but it is still a long way from being comparable to those of communities in the southeastern and southwestern United States. For example, according to the National Oceanic and Atmospheric Administration (NOAA), the average high temperatures for Arlington in June, July, and August are 77, 83, and 81 degrees respectively. (The average high temperatures in May and September are 69 and 73 respectively.) Even with average temperatures rising, Arlington is a community that would face heat-limiting days on artificial turf playing fields far less than communities outside of New England. Extreme stories of athletes' cleats melting on artificial turf are most often reported from Texas or California, not New England (https://ftw.usatoday.com/2015/08/its-so-hot-in-texas-turf-is-melting-cleats).

It is noteworthy that most of the studies of heat and artificial turf fields were conducted on synthetic turf fields with crumb rubber infill. Crumb rubber is particularly pernicious with respect to heat effects on field users. Although there are a variety of alternative, organic infill materials, such as wood chips, coconut husks, cork, green sand, and BrockFILL, there is unfortunately very little published research relating to these materials' ability to moderate the heat effects of artificial turf. Industry-reported data indicates that an alternative like BrockFILL, an engineered wood particle infill, may effectively control the worst heat effects associated with artificial turf. For example, according to its manufacturer, BrockFILL absorbs natural rainwater and condensation into its core, so moisture is released slowly for extended cooling. The manufacturer's testing indicates that measuring two artificial turfs side-by-side on a hot day, one field with crumb rubber infill and one with BrockFILL, the surface temperature of the BrockFILL field was 33° F cooler than the crumb rubber field (121 degrees versus 154 degrees). Nevertheless, even the industry data acknowledges that the field with BrockFILL measured around 20 degrees warmer than the ambient temperature (https://www.brockusa.com/safety-matters-heat/). It appears that some communities have chosen BrockFILL infill specifically to limit the artificial turf's heat effect. For example, the City of Malden, Massachusetts recently chose to move forward on construction of an artificial turf field with BrockFILL infill at Roosevelt Park because of what it believes is that material's ability to mitigate increases in surface temperatures that are inherent with infilled synthetic turf fields (https://www.dropbox.com/s/dubwsudehfa7tmv/Appendix%20B%20%28final%29.pdf?dl=0).

While some research casts doubt on an automatic relationship between air temperature and surface temperature, there is clearly cause for concern related to the heat effects of artificial turf fields on their users. However, unlike some other issues related to artificial turf fields, the heat-related concerns are very capable of being mitigated, especially in a community like Arlington that is in the New England climate.

For example, although higher surface temperatures from artificial turf fields could be an issue throughout the year whenever the weather conditions are warm and sunny, the heat-related concerns over artificial turf fields in New England would be most acute in the hottest months of the year, namely June, July, and August (also known as meteorological summer). Fortuitously for the Town of Arlington, there are few organized athletic uses of Arlington fields during that time period, meaning far less concern with heat stress or heat exhaustion on athletes. Arlington's town and school athletic fields receive their greatest use in the "shoulder seasons" of spring (April-May) and fall (September-November), seasons where temperatures in Arlington do not regularly cross the 80° F mark.

That is, of course, not to say that there will not be very hot days even in the shoulder seasons, or that surface temperatures on artificial turf fields in Arlington could not reach very high levels even on more temperate days. And with the escalation of average temperatures in Arlington due to climate change, there is a greater possibility that heat will be a concern that must be addressed.

For those reasons, if Arlington were to install new or retain existing artificial turf fields of any kind, it would need to closely monitor air and surface temperatures at those fields every day of their operation. Such a policy is not unheard of and, in some circumstances, quite common. For example, local beach administrators (like the Massachusetts Department of Conservation and Recreation and the Arlington Board of Health) regularly monitor local beaches for elevated bacteria levels in the water; if the bacteria levels go above a certain level on a certain day, the authorities close the beach for that day. In the same way, it seems both logical and prudent for local officials (like the Department of Park and Recreation or School Department) to monitor air and surface temperatures at artificial turf fields in Arlington, especially during June-August; if surface temperatures go above a certain established level, then those fields would be closed to use for that day – much like natural grass fields are closed when rain or snowy conditions prevent their use. According to Arlington High School's head athletic trainer, Samantha Jones, local field conditions are regularly monitored by staff using wet-bulb temperature readings; during warm days in August, artificial turf temperatures tend to be 10 degrees warmer than natural grass.

Another approach is to adhere to the Massachusetts Interscholastic Athletic Association (MIAA) guidelines for the use of athletic fields of any kind during hot temperatures (https://miaa.net/wp-content/uploads/2022/09/MIAA-Heat-Modification-Policy-081821-amended-9-1-22CB.pdf). Such guidelines state that there should be no use of fields when the wet-bulb temperature goes above 86.1° F.

The Montgomery County Public Schools in Maryland has also developed the following guidelines for use of its artificial turf fields (see https://www.nrpa.org/parks-recreation-magazine/2019/may/synthetic-sports-fields-and-the-heat-island-effect/):

- Anytime the outdoor temperature exceeds 80 degrees, coaches exercise caution in conducting activities on artificial turf fields.
- When outdoor temperatures exceed 90 degrees, coaches may hold one regular morning or evening practice (before noon or after 5 p.m.).
- When the heat index is between 91–104 degrees between the hours of noon and 5 p.m., school athletic activities are restricted on artificial turf fields to one hour, with water breaks every 20 minutes.

Another mitigation strategy is to install signage around every artificial turf field. Often signage around fields includes warnings about damage to the turf field, but the emphasis should be on the safety of the field users. The signage should alert users to the health risks associated with use of the field on very hot, sunny days, as well as other health issues related to use of the field.

One possible mitigation strategy for extreme heat on artificial turf fields, suggested by Penn State's Center for Sports Surface Research, is heavy watering before the game to help reduce surface temperature (see https://www.nrpa.org/parks-recreation-magazine/2019/may/synthetic-sports-fields-and-the-heat-island-effect/). We do not recommend such a strategy, as it is only effective for a short period of time; temperatures usually rebound after only about 20 minutes (less time than it takes to play a regulation half game of soccer). Moreover, adding irrigation to this type of sports field is costly and, depending on the type of infill used, could be ineffective, as water could simply roll off the surface and not really soak in to provide that small window of temperature relief.

III. Skin/Bacteria

Closely related to the heat effects on athletes and users of artificial turf fields are the skin effects on them. Beyond the obvious effects from extreme surface temperatures on artificial turf fields, such as heat stroke, are other effects relating to an individual's skin.

Safe Healthy Playing Fields Inc. estimates that skin injury can result from a ten-minute contact with a surface that runs about 120° F (https://www.safehealthyplayingfields.org/heat-levels-synthetic-turf). Although that is a serious concern for users of artificial turf fields, there are obvious mitigation measures to address them. For example, it seems unlikely that someone using an artificial turf field is directly exposing their bare feet or skin to the surface for extended periods of time; moreover, signage can make clear that all users of the field must wear shoes at all times. And, as discussed in the prior section, there is no reason why the Town of Arlington, were it to have artificial turf fields, could not limit or close the fields to use on the hottest days of the year.

Artificial turf fields also raise questions of bacteria infections. The Massachusetts Department of Public Health addressed this issue directly:

> Some studies have measured the levels of bacteria on surfaces of different types of athletic fields. Very limited research has found fewer bacteria in [artificial turf fields] ATF than soil and the federal study reported indoor ATF having fewer bacteria than outdoor ATF. However, many factors (e.g., presence of bacteria, moisture, and temperature) influence the risk of bacterial infections following the use of any athletic surface. The frequency and severity of skin abrasions can also influence the risk of infection. California's Environmental Protection Agency reported that athletes experience more frequent turf burns (i.e., skin abrasions) on ATF relative to natural fields. Overall, practicing good hygiene is the best way to prevent getting and spreading infections. Washing skin abrasions with soap and water can decrease the risk of bacterial infections. https://www.mass.gov/info-details/artificial-turf-fields

As noted by DPH, the threat of bacteria infections from artificial turf is real but limited, and it can be mitigated through good hygiene practices. For this reason, the Mount Sinai

Children's Environmental Health Center similarly recommends that those who play on artificial turf surfaces wash their hands before eating, drinking, or adjusting mouth guards, as well as cleaning cuts and abrasions immediately (https://static1.squarespace.com/static/57fe8750d482e926d718f65a/t/593b15421e5b6c414467a03b/1497044293003/CEHC+Position+Statement+on+Recycled+Rubber+Turf+Surfaces+2017-5-10.pdf).

Arlington Artificial Turf Study Committee
Environmental Impacts of Artificial Turf Sports Fields
DRAFT 3/7/24

The Arlington Artificial Turf Study Committee was formed after a Town Meeting vote to delve into the topic of artificial turf (AT) in comparison to natural turf, and the Committee created an Environmental Subcommittee to explore how the latest environmental science relates to AT versus natural turf fields. Most research in this area focuses on understanding the numerous environmental concerns associated with artificial turf. The following topics were chosen by the subcommittee as representative of the body of contemporary environmental research into AT. The relationship of potential impacts to the state and local regulatory environment is also considered.

Chemical & Particulate Pollution (Runoff) Impacts

One of the most significant concerns surrounding AT fields is their impact on wetland resources and waterways. Artificial Turf fields can act as sources of harmful chemicals, including PFAS, metals, and polyaromatic hydrocarbons (PAHs)[1,2,3,6,13,17]. The State Wetlands Protection Act and its regulations, along with Arlington's Town Bylaw and its regulations, all require the protection of a variety of wetlands values and functions. These include groundwater supply, flood control and storm damage prevention, prevention of pollution, wildlife protection, plant and wildlife habitat protection, and protection of the natural character or recreational values of the wetland resources. A table outlining the potential negative impacts of AT fields on each protected wetland interest is attached to this report and a map showing the proximity of recreational facilities (existing athletic fields), to wetland resource areas is included to show likely sites in Arlington for AT.

Contamination can occur through leaching, airborne dust, volatilization, and physical migration of AT components. Contaminants of particular concern include polyaromatic hydrocarbons, phthalates, volatile organic compounds, metals such as zinc and lead, and Per- and Poly-fluoroalkyl Substances (PFAS). Elevated concentrations of PFAS have been shown to have adverse effects on aquatic organisms, and PFAS environmental impacts from artificial turf are under-studied, though part-per-trillion (ppt) levels have been shown to be harmful.[4] Elevated concentrations of the PFAS compounds PFOA and PFOS in aquatic ecosystems can result in death of aquatic organisms and affect their growth and reproduction.[5] PFAS has been shown to leach from AT fields and components [7,8,17]. Additionally, tire crumb rubber, present in both existing AT fields in Arlington, contains a newly discovered compound called 6ppd-quinone, which is acutely toxic to some freshwater fish [9]. These chemicals, individually and in combinations, pose a potential hazard to wildlife, water quality, and aquatic organisms, with an overall negative impact on the environment[6]. Furthermore, microplastic particles from infill and weathered grass blades can also enter waterways, causing additional harm[3,6].

Though there is recent scientific evidence of the potential to use bioretention cells to reduce 6ppd-quinone concentrations in stormwater runoff impacted from oxidized tires / tire crumb rubber[16], it is unclear if these systems could be scaled-up to provide stormwater mitigation for an 80,000 sq ft athletic field. Additionally, the Environmental subcommittee is unaware of any technology that can be practicably used for athletic fields that can reduce or eliminate the transport of PFAS or microplastics. The European Union recently acknowledged the negative impact of tire crumb rubber infills as microplastic pollution and in September 2023, enacted a ban on the sale of products containing intentionally added microplastics – specifically including in this ban “granular artificial turf infill” [17].

As observed in Arlington at the Catholic High School AT field and referenced in Arlington's Conservation Commission submissions to the May 2, 2023 Artificial Turf Forum and this committee, the tire crumb rubber infill from the school's field has migrated toward the nearby brook and within the protected wetland resource area of Mill Brook.

Natural turf fields can act as a natural filter for chemical and particulate pollution. AT fields typically do not contain systems to mitigate the chemical and particulate contamination in stormwater infiltration or runoff[10]. AT fields that border wetlands, waterways, and other sensitive areas and resources are of most concern. Other areas are also impacted by AT fields, as some chemicals can be volatilized and others may cling to clothing, shoes, and equipment, migrating off the fields to surrounding areas. It is important to note that any stormwater drainage from an AT field will eventually reach a wetland within Arlington. This extends environmental concerns beyond immediate proximity to sensitive areas. A field that drains to the public stormwater system may leak contaminants into a wetland or waterway downstream.

Alternative Infills

The environmental impact of AT infill has been identified as a known issue, particularly in terms of the use of tire crumb rubber[2,9,13]. In light of the findings above, however, the issue receives disproportionate attention compared with other environmental impacts. Nonetheless, the subcommittee sought expert guidance on the topic of alternative infills. The benchmark study in this area states the following[3].

> *No Infill material was clearly free" of 'concerns, but several are likely to be somewhat safer than tire crumb. Some alternative materials contain some of the same chemicals of concern as those found in tire crumb; however, they may contain a smaller number of these chemicals, and the chemicals may be present in lower quantities*.

Recently, several neighboring towns such as Lexington and Milton, have specified plant-based infills to help mitigate chemical pollution from the AT fields permitted.

Stormwater Management Impacts

How the stormwater is retained, infiltrated, or discharged is important to the consideration of the environmental impact of AT fields. Perhaps the most critical issue in this regard is the permeability of the playing surface, since permeable surfaces provide better stormwater management by allowing precipitation to infiltrate into the soil, rather than running off into storm drains or detention basins.

The Massachusetts Department of Environmental Protection (MassDEP) is considering officially classifying artificial turf fields as impermeable surfaces under the Wetlands Protection Act. This change would potentially affect the siting and maintenance of AT fields. MassDEP's latest proposed revision from December 2023 would define impervious surface for the "purposes of stormwater management (310 CMR 10.05(6)(k)-(q))" as follows:

> *any surface that prevents or significantly impedes the infiltration of water into the underlying soil, including, but not limited to artificial turf, Compacted Gravel or Soil, roads, building rooftops, solar arrays, parking lots, Public Shared Use Paths, bicycle paths, and sidewalks paved with concrete, asphalt, or other similar materials*.

Permeable surfaces provide better stormwater management by allowing precipitation to infiltrate into the soil, rather than running off into storm drains. This better ability to manage stormwater will become ever more important as precipitation events potentially become more severe and more unpredictable with expected climate change impacts.

The permeability of artificial turf fields is a subject of debate, with some sources stating that they can be made permeable with the proper design and maintenance, and others stating that as an artificially constructed field, they are difficult or impossible to make permeable. While artificial turf fields can certainly be designed to quickly drain stormwater off the field (in many cases, more effectively than natural grass fields), the stormwater generally drains to perimeter drains and then to a detention basin or some stormwater management system. Since artificial turf fields are typically constructed on top of another engineered surface (rather than directly on top of the underlying soil), the real question then becomes whether the stormwater drains to a permeable surface, which depends on the specific design of the field.

There are techniques and systems that can allow for the capture and storage of stormwater, which can then be allowed to infiltrate into the soil and/or be released more slowly into the stormwater system to avoid overwhelming the system and causing flooding. Currently, AT fields are at best partially permeable, although this may change in the future as better systems are developed for managing the stormwater and allowing for improved stormwater infiltration to occur.

At a baseline, natural grass fields are considered permeable since they consist of natural grass over soil (unless the subgrade of the field is more heavily engineered). However, it is important to recognize that maintaining true and effective permeability requires ongoing maintenance of the fields, including proper aeration and grooming. Without that, the dirt underneath the playing surface can become highly compacted, and therefore will not function as effectively as a permeable surface. Even under these conditions, a natural turf field may remain more permeability than an artificial turf field, but the exact comparison will depend on the design and maintenance of the field.

As this discussion illustrates, it is difficult to make general statements about the permeability and stormwater management performance of artificial turf and natural grass fields, since it is highly dependent on the design, construction, and maintenance of the individual field, along with other factors such as topography and adjacent land use.

Heat Impacts

It has been established that AT fields are hotter than natural turf fields[13]; therefore, the Environmental subgroup focused on the environmental issues related to excess heat / high temperatures on AT fields *vs*. natural grass fields.

There are areas of Arlington that are known heat islands. The Metropolitan Area Planning Council performed a heat analysis to ascertain the areas of Arlington that are most at risk of extreme heat [14]. The hottest 5% areas, or “hot spots,” generally follow the Massachusetts Avenue corridor, which is the most densely developed part of town with the greatest amount of impervious surface. There are also “hot spots” in parts of East Arlington, in a relatively dense residential area north and west of Massachusetts Avenue. At a minimum, it would make sense to avoid installing AT fields in or near the existing hottest 5% areas in Arlington.

Increased heat effects due to climate change will add, for example, 13 to 23 days of greater than 90 degrees F from the current 8 days per year in the town of Arlington.[14] The surfaces of AT fields have been shown to be significantly hotter than natural turf fields, contributing to the urban heat island effect[13]. Temperatures of over 150 degrees F have been routinely recorded on artificial turf fields during June and summer months, compared to natural grass fields with temperatures of less than 90 degrees F.[6]

The extreme heat inhibits wildlife movement and therefore disrupts ecosystems. Wildlife is exposed to surface temperatures of the fields, a different measurement than the "wet-bulb" temperatures used to evaluate human health and safety for high school and adult players. Surface heat would inhibit any wildlife movement across these fields during the hottest days of the year. Furthermore, extreme surface heat may affect the temperature of the stormwater runoff, which can also affect the ecology of the aquatic environments that are the receiving waters of this runoff.

Climate Change Resilience Impacts

Issues surrounding climate change resilience and adaptation are increasingly critical as it becomes clear that our climate is changing in real time and we need to adapt our natural and built environment to address the threats associated with climate change, including extreme heat and precipitation. MassDEP defines Climate Change Resilience in guidance documents as follows[15]:

> *The capacity to prevent, withstand, respond to, adapt to, and/or recover from climate change impacts and to build the capability and ability of an area/site/system to minimize the adverse impacts of climate change.*

Artificial Turf Fields are inconsistent with climate change resilience in that they do not minimize these anticipated adverse effects and, in fact, can exacerbate these climate impacts, as discussed below.

Arlington has long been a leader in climate change resilience and mitigation, meaning that the Town adopts strong policies to minimize greenhouse gas emissions. Leaving aside the sizeable carbon footprint associated with AT field construction, installation, and disposal, the subcommittee chose to focus on how the change from grass to artificial turf fields impacts climate change resilience of the environment. In short, natural turf fields offer some mitigation of greenhouse gas emissions, especially carbon dioxide, whereas artificial turf fields offer none. Carbon sequestration is the process of creating long term storage of carbon dioxide, either geologically or in terrestrial ecosystems such as forests, fields, and other natural carbon sinks. Natural turf fields create an opportunity for carbon sequestration in the field grass and soil, particularly if the field is well maintained and not regularly disturbed or fully replaced (since the removal and replacement of the turf will likely result in the release of some of the sequestered carbon). While the amount of carbon sequestration that is possible through a natural turf field is more limited than would be possible in an unbuilt naturally vegetated environment, there is still a meaningful amount of carbon sequestration[18]. In contrast, an artificial turf field is a fully artificial environment that does not provide any standalone opportunity for carbon sequestration.

Finally in the context of climate change, the subcommittee also considered the sustainability of AT field components. There is currently no evidence of meaningful recycling of AT fields in the Northeastern US. Artificial turf fields must be replaced every 8-10 years, when their components enter the waste stream (or are re-purposed, such as AT for indoor play surfaces – but then enter waste streams at a later date). The recurring need for replacement over the lifetime of an athletic field is inconsistent with the principals of sustainability and increases the likelihood that disposed components will migrate off site and become contaminants. If not recycled, components will be landfilled, incinerated, or subject to chemical decomposition; all of these options have negative climate change impacts and do not represent recycling into new plastic products. The Synthetic Turf Council states that "the carbon footprint of a particular recycle/end-of-life option (such as trucking long distances) may be integrated into the decision-making process and lead responsible parties to invalidate such an option"[19].

Ecological Effects

Habitat loss in urban settings is a significant threat to biodiversity and ecosystem health, including the systems that humans rely on for our quality of living**.** Artificial turf replaces habitats, leading to a loss of plant and animal species diversity in the area.

Without sufficient biodiversity, ecological systems are disrupted. This can lead to cascading effects on the entire ecosystem, potentially compromising its stability and resilience. For example, microorganisms in soil remove contaminants before they reach wetlands and waterways.[21] When their work is disrupted, contaminants like nitrogen and phosphorous build up in places like Spy Pond, where toxic algae will thrive on them, leading to pond closures. Or, to use another recent example, if birds of prey lose their hunting grounds, the rodents they feed on will be more plentiful, leading to pest control issues.

Habitat loss results from the change in land use and effects the site directly as well as the surrounding area. Plastic is not habitat. The ability of plants and animals to move through an urban setting is important to the ecological systems and functions described above. The corridors they use often are connected to natural open spaces, making these areas important hubs. The removal or diminishment of a hub in the natural network has consequences for the whole system.

Findings and Recommendations

In summary, the Environmental Subcommittee offers the following findings.

a. Artificial Turf Fields have negative impacts on the environment due to toxic chemical pollution impacts on aquatic ecosystems, particulate pollution, plastic pollution, increased heat impacts, lack of wildlife habitat and inhibition of wildlife corridors, and climate change resilience impacts to the environment including lack of carbon sequestration, fossil fuel use, lack of meaningful recycling, and subsequent environmental impacts due to required replacement every 8-10 years. Even in areas where Town and state wetlands regulations do not apply, artificial turf fields are not consistent with Town policies on reducing urban heat, reducing use of plastics, and reducing use of fossil fuels. Although most of these environmental impacts cannot be significantly mitigated through engineering or change in AT components, some mitigation of the chemical pollution can be achieved by using non-plastic and non-tire crumb rubber infills.
b. Tire crumb rubber and plastic infills should not be used in artificial turf fields in Arlington due to the toxic chemical and particulate pollution that negatively impacts the environment.
c. AT fields should not be installed in or near the existing hottest 5% areas in Arlington.
d. Traditionally managed natural turf fields often have adverse effects on nearby environmental resources from pesticides and herbicides but provide some important ecological functions and do have climate change resilience attributes.
e. Organically managed natural turf fields that are properly constructed and maintained with aeration can allow for improved drainage, a reduction in the need for application of chemicals, allow for some habitat functions including habitat for invertebrates and microorganisms and wildlife corridors, have no added heat effects, and are more climate resilient than artificial turf fields. Organically managed natural turf fields are pervious and may help to control flooding. Also, they can reduce the Town's overall carbon footprint by sequestering carbon and not use fossil fuels for generation of the fields or for replacement[6]. These fields have been installed in several Massachusetts communities, including Marblehead [11] and Springfield [12], with results that meet the needs of these communities.

f. For AT and natural turf fields, the full lifetime costs of installation, maintenance and replacement should be clarified and considered in the Town budget. Given the strong interest in the issues related to our recreation fields, adequate funding is essential.

Therefore, based on our evaluation, the Environmental Subcommittee recommends that new or reconstructed athletic fields should be constructed and maintained as organically managed natural grass rather than artificial turf fields.

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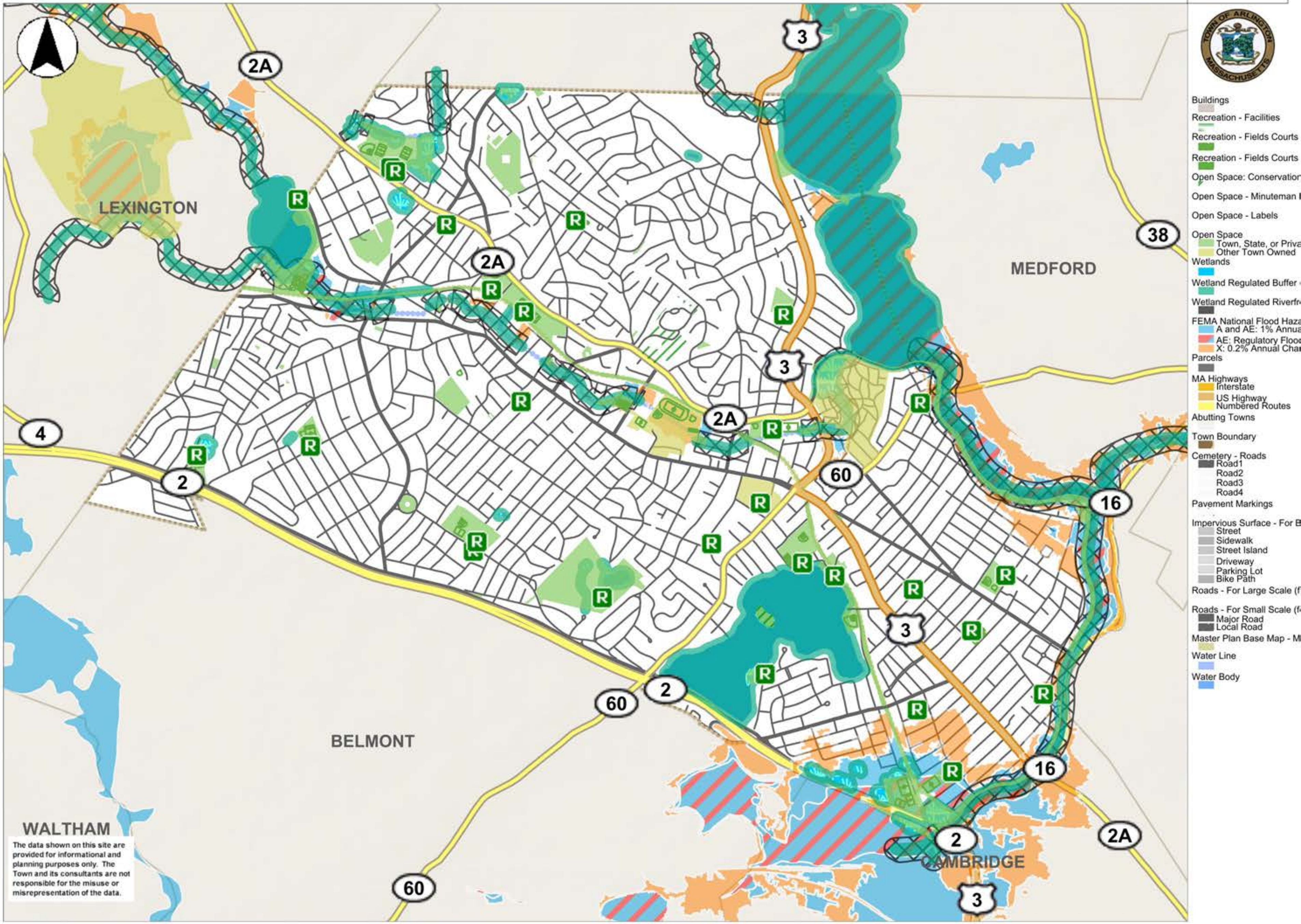
20. Schettler, Ted, MD, MPH, Science Director, Science and Environmental Health Network, CHE (Collaborative for Health & Environment), 2023. "Advance Recycling" of Plastics: Largely waste disposal by another name," (Part 1) and (Part 2), October & November 2023 https://www.healthandenvironment.org/join-us/blog/advanced-recycling-of-plastics-largely-waste-disposal-by-another-name-(part-1) https://www.healthandenvironment.org/join-us/blog/advanced-recycling-of-plastics-largely-waste-disposal-by-another-name-(part-2)
21. Philippot, L., Chenu, C., Kappler, A. et al. The interplay between microbial communities and soil properties. *Nat Rev Microbiol* (2023). https://doi.org/10.1038/s41579-023-00980-5

Notes on references for TURI:

Established by the Commonwealth of Massachusetts in 1989, the Toxics Use Reduction Institute (TURI) is an independent government agency with a mandate to help protect workers, communities and the environment from toxic chemicals and pollution. Working in close collaboration with businesses of all sizes, as well as government agencies, local communities and international organizations, TURI helps identify actions companies and communities can take to protect workers and public health.
The TURI fact sheets and reports provide information on Artificial Turf, chemicals of concern, heat stress, environmental concerns, and cost comparisons of installation and maintenance of artificial turf with natural grass. References and links are provided in each TURI document for further information and so that the original reference materials can be accessed.



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Recreation Facilities and Wetlands Jurisdiction

Table Comparison:	*Protects the Wetland Value / Interest?*		
Wetland Value / Interest1	**Organically Managed Natural Grass Field**	**Artificial Turf Field**	**Comment**
Public or Private Water Supply	Not applicable	Not applicable	
Ground Water Supply	Yes	No	Assume organic management does not use pesticides, herbicides, P-fertilizers potential for leachate of harmful chemicals including PFAS, Metals, PAHs, phthalates
Flood Control	Yes - pervious	No - impervious	
Erosion Control and Sedimentation Control	Maybe	Maybe	Dependent upon design of fields and controls during construction
Storm Damage Prevention	Maybe	Maybe	Dependent upon design of fields and stormwater management
Prevention of Pollution	Yes	No	Assume organic management does not use pesticides, herbicides, P-fertilizers; potential for leachate of harmful chemicals including PFAS, Metals, PAHs, phthalates and migration of infill & weathered grass blades causing microplastic & macroplastic particulate pollution
Wildlife Protection	Yes	No	Assumes organic management with no pesticides, herbicides, or Phosphorus inputs; loss of habitat for insects other invertebrates; loss of foraging potential for birds and small mammals; loss of wildlife corridor connectivity causing disrupted wildlife habitats; excess heat effects
Plant or Wildlife Habitat	Yes	No	
Aquatic Species and their habitats	Yes	No	Assumes organic management with no pesticides, herbicides, or Phosphorus inputs; leachate / surface water runoff of harmful chemicals including 6ppd-quinone, which is toxic to some freshwater fish, and potential for PFAS (eco-toxic effects), Zinc (toxic to freshwater fish), PAHs (carcinogens / neurotoxins), phthalates (endocrine disrupters) and migration of infill & weathered grass blades causing microplastic & macroplastic particulate pollution - plastic pollution is harmful to aquatic organisms
Natural Character or recreational values of the wetland resources	Yes	No	Assumes organic management with no pesticides, herbicides, or Phosphorus inputs; artificial turf fields negatively impact the natural character of the wetlands by adding 80,000 sq ft of plastic in or near resource areas, including 200 tons of infill and 20 tons of turf carpet (Synthetic Turf Council reference). Furthermore, artificial turf replaces natural habitats, leading to a loss of plant and animal species diversity in the area. This can have cascading effects on the entire ecosystem.

1 https://www.arlingtonma.gov/town-governance/laws-and-regulations/town-bylaws/title-v-regulations-upon-the-use-of-private-property#A8

Town of Arlington
Department of Health and Human Services
Office of the Board of Health
27 Maple Street
Arlington, MA 02476
Tel: (781) 316-3170
Fax: (781) 316-3175

Memo

To: Artificial Turf Study Committee Members

From: Natasha Waden, Clerk of Arlington's Artificial Turf Study Committee

Date: March 7, 2024

RE: Conversations with the City of Malden and Town of Brookline regarding Artificial Turf

---

Malden

On February 6, 2024 I spoke with Public Health Director Christopher Webb from the City of Malden to discuss a project approved by the city to install an artificial turf field using an organic wood infill material (alternative to crumb rubber). From my online record review, it appears that project, referred to as "Roosevelt Park", was proposed and approved with conditions back in 2020. Over the years, there seem to have been various concerns that had been raised by residents in the neighborhood. Some of these concerns may have played a part in stalling the initial start of the project. Attached for your reference are more specific details regarding the project history and status, which I obtained from the City of Malden's website.

My understanding is that neighbors of Roosevelt Park were concerns about the installation of artificial turf and the impacts it could have on their neighborhood, including heat island effects, storm water run-off, and exposure to chemicals found in the compounds of artificial turf and its effect on the elementary school children who attend the Salemwood School which is attached to Roosevelt Park.

My understanding is that the Board of Health was asked to review the project and potential public health concerns raised by the residents and to make a determination on health and safety concerns associated with the installation of artificial turf. As such the Board held multiple public hearings to discuss resident concerns, heard from a variety of health and industry professionals, and conducted their own literature review to understand the human health and environmental concerns associated with the installation of artificial turf. The Board of Health worked with all parties involved in the project to scale back the project so as to allow for more natural grass turf areas, but to also allow the installation of a slightly smaller artificial turf field. Additionally, to address heat concerns, all parties agreed to an alternative crumb rubber infill material called BrockFill. Although the project has been approved, the work has not yet begun and as such is also contingent on any new guidance issued by the EPA concerning artificial turf fields.

Brookline

On February 26, 2024 I spoke with Select Board Member Mike Sandman from the Town of Brookline. Mr. Sandman served on the Town of Brookline's Athletic Field Surface Task Force. Similar to Arlington, this Task Force was set up as a resolution at the conclusion of Brookline's Town Meeting in the spring of 2022. The task force reviewed literature and spoke with specialists who were experts in different aspects of artificial turf- including concerns about possible health effects from chemicals and heat on users of the field, as well as possible negative environmental factor such as recycling and water run-off

During my discussion with Mr. Sandman, we spoke specifically about PFAS in synthetic turf. Brookline's Task Force was unable to come to a consensus about the safety of PFAS and other chemical components of artificial turf.

<u>The majority view</u> as outlined in the report is that "there are PFAS compounds used in the manufacture of synthetic turf, but those compounds, which are forms of polyvinylidene fluoride (PVDF-HPF), are not water soluble, do not have an adverse effect on the water supply, and their molecules are of a size such that they are not absorbed through the skin. PVDF-HPF has long been used in medical products."

<u>The minority view</u> outlined in the report is that: "there are PFAS compounds used in the manufacture of synthetic turf. Those compounds are forms of PVDF-HPF, which are not water-soluble."

Attached please find Brookline's Interim Report to Town Meeting-12/17/2019.

For the full report, attached you will find Brookline's Interim Report to Town Meeting-12/17/2019. However I have highlighted some key outcomes from the study and recommendations from the Task Force. These highlights include but are not limited to the following:

- Natural grass and soil fields are the "gold standard"; but that properly designed and maintained, modern, synthetic turf fields are also acceptable for players' use, subject to heat considerations.
- Developed a decision guideline for the Town to be used specifically to guide the Parks and Recreation Departments and Schools when considering the use of synthetic or natural turf playing surfaces.
- Recommended that testing from an independent lab be conducted to ensure that no PFAS compounds are in their products that are regulated for toxicity by either the Massachusetts or the US EPA.
- Recommended following the heat guidelines established by the Massachusetts Interscholastic Athletic Association (MIAA).

- Recommended the irrigation of synthetic turf fields on hot days to partially close the gap between the surface temperature of currently available synthetic turf and grass.
- Recommended the use of grass at K-8 schools if the field will be used for less than 800 hours a year because of concern about the heightened risk of heat injury to young children from playing on synthetic turf on very hot days.
- Recommended that Brookline continue its policy on no longer installing crumb rubber infill.

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Roosevelt Park

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The Roosevelt Park improvement project will upgrade the existing athletic field with a new multi-use synthetic turf field with an organic wood infill. Improvements will include field and site drainage, removal and proper disposal of urban fill, an improved outdoor classroom, and new basketball shooting areas, accessible walkways, fencing, seat walls, shade trees, and landscaping. The new park will boast a state-of-the-art athletic field with significantly improved capacity for recreation.

The project is in the technical design phase. Construction is scheduled to begin at the end of the Salemwood School's 2023-2024 school year and is expected to last for 18 months.

Tree hearing. A tree hearing will be held on January 3, 2024. Learn more here. (https://cityofmalden.org/DocumentCenter/View/7809/Tree-Hearing-1-3-2024)

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Rendered site plan (September 8, 2022)

SUPPORTING MATERIALS

Rendered site plan (September 8, 2022) (/resource/cleargov-prod/projects/documents/23537f04201ed80bf38e.pdf)

Project Budget

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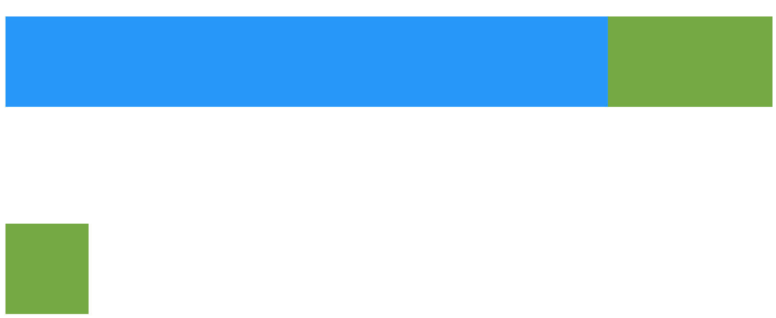
Projected expenditures are based on a January 2023 estimated cost that includes removal of historic fill to three feet below proposed finish grade.

Projected Expenditures

$5,976,046.00



Expenditures to Date

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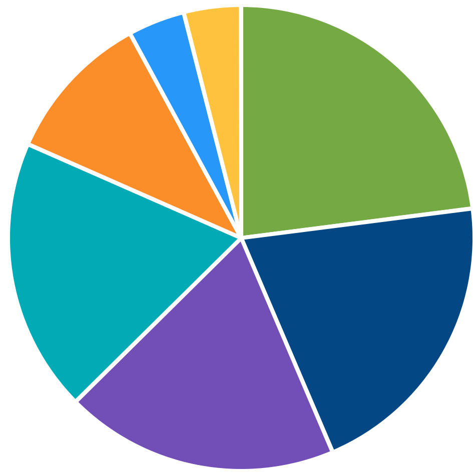
FUNDING SOURCES



Project Management

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PROJECT MANAGER

Deborah Burke
OSPCD Director

dburke@cityofmalden.org(mailto:dburke@cityofmalden.org)

781-324-5720(unsafe:tel:781-324-5720)

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History and Background

Roosevelt Park was originally constructed prior to 1910. For over 100 years the park has served the city and its residents well supporting a host of uses such as civic gatherings and community events; informal active and passive recreational activities; city recreation programs; and today's ever-growing school, youth and adult sports programs.

In the late 1990s city leaders decided to construct the Salemwood School on a portion of Roosevelt Park. This school construction was part of a robust citywide school building program implemented to address serious problems regarding the quantity and quality of classroom space available in its schools. For the past 20 years, the park has been shared with the Salemwood School and its 1,200-student population during the school day for before and after-school activities, gym classes, recess, lunch and other school related activities.

The park has suffered over the years due to its considerable use and the park's low-lying location and its grading, drainage, and soil conditions. Previous attempts to reconstruct the natural grass field have failed to address these underlying problems, including the site's topography. At the same time, the City's park system has seen an increase in demand for active recreation, especially heavy impact sports like soccer, lacrosse, field hockey, and football. After carefully considering its options, the City determined that an artificial turf field is the best solution for Roosevelt Park given the park's challenging topography, the increased demand for field space, and the pattern of field degradation when using natural grass. The new turf field will be able to sustain several times the amount of use as the existing grass field, and will be more resilient to both the recreational demand and the challenging site location.

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Portions of Roosevelt Park are located within Flood Zone A (100 Year Flood, No Base Elevation Determined) as depicted on FEMA/FIRM Map No. 25017 C0441E dated June 4, 2010. Because of this, the proposed project is subject to the provisions of MGL c. 131, § 40, the Massachusetts Wetlands Protection Act (the Act) and 310 CMR 10.00, the Massachusetts Wetland Regulations (the Regulations).
The flood zone at Roosevelt Park is considered Bordering Land Subject to Flooding (BLSF). BLSF provides storm damage prevention and flood control by temporarily storing flood water. The proposed project will protect these interests by providing a modest increase in flood storage available at Roosevelt Park and by controlling runoff from the site to pre-construction rates and volumes to protect against downstream flooding and storm damage.

As required by the Regulations, a Notice of Intent (NOI) was prepared for the project and filed with the Malden Conservation Commission (the Commission) on January 15, 2020. After reviewing the NOI, conducting a public hearing, and reviewing supplemental information requested by the Commission in response to public comment, the Commission issued an Order of

The City submitted the Environmental Review Record (ERR) to HUD on April 15, 2022, at which point members of the public were given the opportunity to submit objections to the City's Request for Release of Funds (RROF) directly to HUD. HUD received objections from members of the Malden community, and asked the City to address these objections in its update to the ERR. The City submitted its updated Environmental Review Record on October 17, 2022, which can be viewed below.

Note: The ERR and its supporting documents are generated and hosted on one of HUD's online platforms. Unfortunately, there are times when this information is suddenly unavailable. If you find that the above link is broken or that you don't have access to the ERR, please notify us of the issue by contacting apratt@cityofmalden.org (mailto:apratt@cityofmalden.org) and we will work to resolve.

Environmental reviews are required when federal funds are used in a project. As a part of the environmental review process, the City evaluates the project's compliance with various environmental factors, statutes, executive orders, and regulations, depending on the nature of each project. Environmental reviews result in findings, which may require the City to take steps to implement mitigation measures.

appealed by a group of more than 10 residents. The appeal was taken up by MassDEP Northeast Regional Office (NERO). After conducting a site visit, reviewing the matter and related documentation including the NOI, the Commission's OOC, and supplemental information provided the City upon MassDEP NERO's request, MassDEP NERO subsequently issued a Superseding Order of Conditions (SOC) on October 1, 2020 approving the project with conditions. An administrative correction to the SOC was issued by MassDEP NERO on October 9, 2020. In issuing its SOC, MassDEP NERO noted that *"compensatory storage has been provided in accordance with 10.57(4)(a)1."* MassDEP NERO further stated in issuing its SOC that it *"has also determined that the project, as currently proposed, complies with the Regulations pertaining to stormwater management."*

The same group of 10 or more residents appealed the SOC to the MassDEP Office of Appeals and Dispute Resolution (OADR). After receiving and reviewing pre-hearing statements from the Petitioner, the City and the MassDEP NERO and conducting a Pre-Hearing Conference, OADR issued an Order for Petitioner to Show Cause Why Appeal Should Not Be Dismissed. After considering the facts in the

Request Release of Funds (FONSI/NOI) dated March 18, 2022. That notice can be reviewed here. As part of this notice, the Environmental Review Record for Roosevelt Park was made available for public inspection. You can review the Environmental Review Record below. Information on the Environmental Review Record, the City's Finding of No Significant Impact, and the public comment period are included in the notice. Public comments received, including the City's summary of comments received and the City's responses, are available here. Note that this document makes reference to the Section 108 public comments and responses, which are available here.

Section 108 Loan

The City of Malden has been approved for financing under the Department of Housing and Urban Development Section 108 Loan program in the amount of $1.2 million to support the renovation of Roosevelt Park, pending the completion of the Environmental Review. The Section 108 Loan constitutes a Substantial Amendment to the Community Development Block Grant (CDBG) CDBG Annual Action Plan. Pursuant to HUD regulations and the City of Malden's Citizen Participation Plan, the City and MRA held a 30-day public comment period on the Substantial Amendment prior to its submission to HUD. The Section

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the MassDEP Commissioner dated March 8, 2021 that the SOC should be affirmed and the appeal should be dismissed.

In his Recommended Final Decision, the OADR Presiding Officer stated *"there is no evidence showing how the Project is inconsistent with the BLSF interests of storm damage prevention and flood control. Those wetlands interests are focused on prevention or reduction of flooding and flood damage; and the prevention of damage caused by water from storms, including, but not limited to, erosion and sedimentation, damage to vegetation, property or buildings, or damage caused by flooding, water borne debris or water-borne ice. 310 CMR 10.04 (flooding and storm damage prevention). Here, BLSF furthers those interests by allowing temporary storage for flood waters. There is no allegation or evidence that any component of the project would adversely affect the temporary storage of flood waters or that there is insufficient compensatory storage for any possible impacts in the BLSF."*

On March 24, 2021 the MassDEP Commissioner adopted the OADR Presiding Officer's Final Recommended Decision.

Public Comment Period

The Section 108 loan 30-day public comment period began January 25, 2021 and ended February 25, 2021. A public hearing was held February 9, 2021 at 6:00pm, which included a presentation on the Substantial Amendment and public comment. All comments received were included in the Section 108 application submitted to HUD along with the City's responses. This information is included in Appendix B of the application which is available for download below.

Public Involvement Plan

A release of oil and/or hazardous materials has occurred at this location, which is a disposal site as defined by M.G.L. c. 21E, § 2 and the Massachusetts Contingency Plan, 310 CMR 40.0000. On 30 January, the City of Malden received a petition from residents in Malden requesting that this disposal site be designated a Public Involvement Plan site, in accordance with M.G.L. c. 21E §14(a) and 310 CMR 40.1404. As a result, a public meeting was held via a publicly accessible remote Zoom video conference on April 15, 2021 at 6:00 p.m. to present the draft Public Involvement Plan, to solicit public comment on the draft Public Involvement Plan, and to provide information about disposal site conditions. Questions regarding this meeting and the PIP process should be addressed to James P. Parker, L.S.P. at 45 Dan Road, Suite 115, Canton, Massachusetts 02021, by telephone

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MassDEP website using Release
Tracking Number (RTN) 3-36025 at
https://eeaonline.eea.state.ma.us/portal#!/s
or at MassDEP, 205B Lowell Street,
Wilmington, Massachusetts 01887,
978-694-3200.

ATTACHMENTS

Title	Description
Public Involvement Plan meeting 4-...	
Public Involvement Plan meeting 4-...	
Public Involvement Plan (/resource/...	
Public Involvement Plan meeting 4-...	
Environmental Review Record (10-17...	This is the environmental review as submitted ...
Environmental Justice documentati...	
Section 108 application (/resource/cl...	
Section 108 application Appendix A ...	
Section 108 application Appendix B ...	
Section 108 public hearing 2-9-21 mi...	

Project Location

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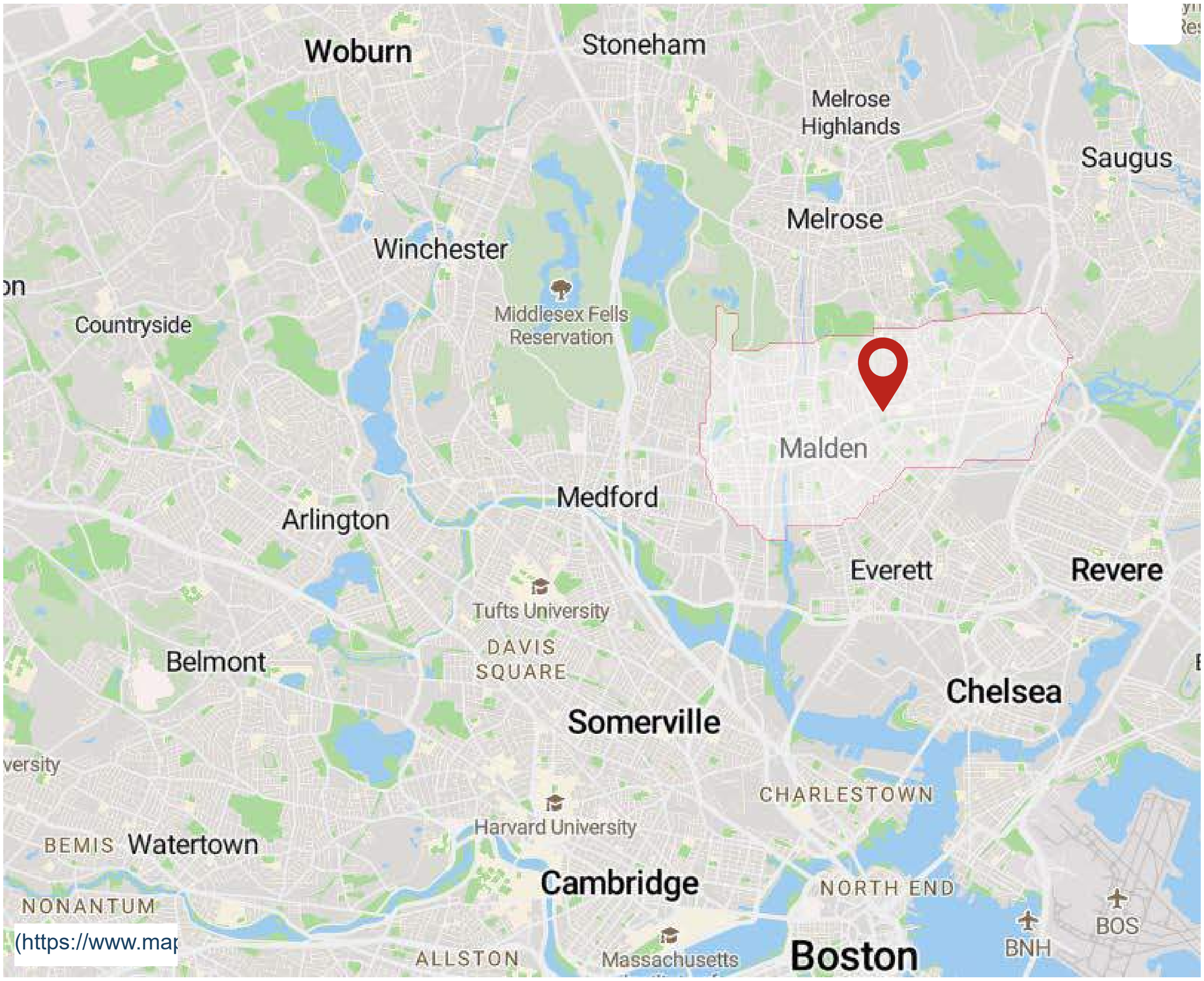

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Report of the Athletic Field Surface Task Force
October 16, 2023

In response to Town Meeting's Article 23 resolution at its May 2022 session, the Select Board appointed the Athletic Field Surface Task Force to develop criteria to guide the Town's decisions on whether and where to install playing fields with synthetic turf – sometimes called artificial turf or more commonly, AstroTurf®, although synthetic turf has evolved considerably since the original AstroTurf product was developed 58 years ago.

This report summarizes our evaluation of the concerns expressed at Town Meeting in May 2022 and in emails and hearings; and, perhaps more importantly, it provides a framework for the Town to use in considering whether, when, and where to use synthetic turf for athletic fields, whether existing or new.

Please note that we have strived for consensus whenever possible; but that we, like all people, weigh different factors differently, and so do not, indeed cannot, have identical views as to the advantages and disadvantages of synthetic turf fields versus natural grass and soil fields. Therefore, the Executive Summary includes both a majority view and a minority view.

In general, we have determined that natural grass and soil fields are "the gold standard;" but that properly designed and maintained, modern, synthetic turf fields are also acceptable for players' use, subject to heat considerations and the potential for new data demonstrating chemical toxicity.

<table>
<tr><td colspan="2">Where views differ is on the degree of caution needed in building synthetic playgrounds and fields for K-8 students.</td></tr>
<tr><td>The majority view is that synthetic turf poses no known risks to players' health, as far as we can determine at this time. That conclusion may need to change in the future, and for that reason we suggest that the Brookline Health Department review new information regarding both the toxicity of the components of synthetic turf and changes in the design and composition of the product.</td><td>The minority view is that we cannot be sure whether or not there are unknown risks from exposure to the chemical components of synthetic turf. We do know that on a hot day, the surface gets as much as 20°F hotter than the surface of a grass field. Therefore, synthetic turf fields should not be used for K-8 playgrounds and fields, since younger children are more vulnerable to heat injury. And broadly, we should prefer grass fields elsewhere.</td></tr>
</table>

However, the problems posed by rain, snow, and mud during the school year render exclusive reliance on natural grass and soil fields is limiting, given current and future demands of Brookline's students and other athletes for playing fields. Therefore, the Task Force was unanimous in urging that Brookline prioritize increasing the availability of playing fields, whether by acquiring new Town property or, more likely , by securing access to facilities owned by the educational institutions with such fields in or near Brookline.

In what follows, we present a series of factors to be considered, explicitly, by decisionmakers when faced with either replacing existing athletic fields, or when siting, designing, and installing new athletic fields.

EXECUTIVE SUMMARY

- The Task Force has reviewed the current literature and spoken with specialists who are experts in different aspects of artificial turf - including concerns about possible health effects from chemicals and heat on users of the field, as well as possible negative environmental factors such as recycling and water run-off. This interim report summarizes our evaluation of the above-mentioned concerns.

- Our conclusions are reflected in the decision framework we provide in this report for the Town to use in considering the use of synthetic or natural turf to guide the Parks and Recreation Departments and the Schools in making their decisions.

- ***The most important element in this report is the framework we offer for judging whether to use grass or synthetic turf on a playing field or playground.***

Task Force Findings	
Majority View	Minority View
Members of the task force agree that natural grass and soil fields are "the gold standard" and should be the preferred surface. Properly designed and maintained, modern, synthetic turf fields may be also acceptable for some activities, such as for competitive high school sports. There are drawbacks for natural grass - Brookline's lack of athletic fields makes them subject to overuse, and during periods of rain they cannot be used at all. The composition of artificial turf has changed significantly since its initial introduction in the 1950's; many harmful chemicals in artificial turf composites have been removed.	All would agree that artificial turf - its existence ,use , production, and destruction - warm the climate, release microplastics into the environment with wear and can cause heat injuries. Some task force members argue that of the ~40,000 existing PFAS the fact that none of the 5 PFAS regulated by Mass are found in artificial turf blades doesn't mean toxic PFAS is not present. California regulates 22 PFAS. Only ~200 PFAS can currently be tested for. Given that the risks of heat injury, environmental threats and potential chemical toxicity are all greatest for youth some task force members recommend artificial turf be used only for competitive high school sports

<table>
<tr><td>However, there are drawbacks to artificial turf – their composition makes recycling of worn-out artificial turf impossible on a large scale, at least currently, and some artificial turf composites have been shown to raise health concerns by exposing players to excessive heat and also to possible harmful chemical exposure.</td><td></td></tr>
<tr><th colspan="2">Joint Finding</th></tr>
<tr><td colspan="2">While the newer athletic artificial turf materials have not been shown to expose players to a significant health risk from a chemical standpoint, the task force recommends the use of natural grass wherever possible. As noted above, while the risk from PFAS chemicals in artificial turf has not been shown to be a health risk, only about 200 PFAS compounds can currently be tested for. Only ~200 PFAS can currently be tested for. Therefore, our conclusion may need to change in the future, and for that reason we suggest that the Brookline Health Department periodically review new information regarding both the toxicity of the components of synthetic turf and changes in the design and composition of the product.</td></tr>
<tr><th>Majority View</th><th>Minority View</th></tr>
<tr><td>The key conclusion is that fields at both schools and parks should be grass unless the level of use is above 800 hours a year, the number is supported by the Parks and Open Space Division. Use above that level makes it infeasible to keep a grass field in an acceptable condition. In that case, we recommend using the criteria in the Decision Guidelines to determine whether installation of a synthetic turf field can be appropriate.</td><td>When field use is above 800 hours a year, it is more arduous to keep a grass field in an acceptable condition. However, many municipalities have grass fields that get 800+ hours of use.</td></tr>
<tr><th colspan="2">Joint Finding</th></tr>
<tr><td colspan="2">The surface temperature of synthetic turf is typically twenty or more degrees higher that it would be in grass (although the air temperature two or three feet above the surface is not affected). Therefore, we recommend the use of grass at K-8 schools if the field will be used for less than 800 hours a year because of concern about the heightened risk of heat injury to young children from playing on synthetic turf on a very hot day. Older grades are less susceptible to heat injury, but the Task Force does not think it would be practical to restrict a synthetic field to the older grades.

Where field use is above 800 hours a year, we recommend that an area with a grass surface be adjacent to provide an option for PE and recess programming that does not expose children to unsafe temperatures.</td></tr>
</table>

Whether the field is grass or synthetic turf, the Mass. Interscholastic Athletic Association guidelines call for limiting team activity when the ambient wet bulb temperature reaches 81 F and closing down organized sports activity when the wet bulb temperature reaches 86F.[1] The Task Force endorses the use of that guideline.

- The primary concern of a majority of the Task Force members is the risk of heat injury. Members who support the minority report are also concerned about the potential risk of exposure to PFAS compounds present in turf that may be shown in the future to be toxic. The synthetic turf Brookline installs does contain a PFAS compound, but the polymer[2] has been used for decades in applications including medical devices and water filtration media. There are no PFAS compounds whose levels are currently regulated by either the Commonwealth of Massachusetts or the US EPA due to toxicity, or that are otherwise known to be toxic, in synthetic turf.

- Nonetheless, as noted above, decision-makers should understand that they may face a situation where new information emerges to the effect that a synthetic turf field contains a substance found to be toxic, and which therefore may need to be replaced well before its useful life. Environmental regulations based on new toxicological studies are evolving. The Health Dept. should review future studies regarding PFAS and other potentially harmful chemicals in artificial turf at least every three years and take action between its reviews if a risk of toxicity in the synthetic turf systems we install becomes known.

- Similarly, the design and composition of synthetic turf is evolving. There are infills made with natural products such a coconut fiber and pine tree fiber. These materials reduce the difference between the surface temperature of synthetic turf and grass on a hot, sunny day. The polyethylene blades may be woven rather that tufted, which eliminates the backing.

- We recommend the use of natural infills wherever synthetic turf is installed and the removal of crumb rubber infill at Soule and Skyline as soon as practicable, because it contributes to heat retention, and it deteriorates and sheds particles that are passed into the environment and may be inhaled.

- We recommend that a representative of the Brookline Health Department be a part of future design reviews that may result in the installation of synthetic turf.

---

[1] Wet bulb temperature combines the effects of heat and humidity. At a given temperature, risk of heat injury rises with increased humidity. The report includes a chart showing the effect as the wet bulb temperature increases. Brookline school staff have wet bulb thermometers available.

[2] PVDF-HFP -- Poly(vinylidene fluoride-co-hexafluoropropylene)

BACKGROUND

The primary focus of the debate at the May 2022 Town Meeting was on whether there are toxic chemicals in synthetic turf that present a hazard to humans - especially perfluoroalkyl and polyfluoroalkyl compounds – "PFAS." PFAS compounds are called "forever chemicals" because they do not break down over time, and water-soluble PFAS chemicals have contaminated water supplies in many locales. In addition, there were concerns about the environmental impacts of using an artificial surface on playing fields, and heat effects, including the health and safety of users of artificial turf fields in the heat as well as the environmental and public health impacts of heat and plastic microparticles.

Town Meeting's May 2022 resolution asked that the Select Board:

> "(1) Appoint an Athletic Field Surface Task Force, consisting not only of a few Parks and Recreation Commission members, but also other community and staff members that bring diverse perspectives such as athletics, recreation, the Public Schools of Brookline, environment/climate, toxicology, risk assessment, public health, children's socioemotional and physical development, capital planning, and perhaps other domains;
>
> "(2) Charge the Task Force to conduct its meetings in a manner that is consistent with the provisions and intent of the Open Meeting Law;
>
> "(3) Charge the Task Force with proposing a draft Athletic Field Surface Policy to the Parks and Recreation Commission by September 1, 2022;
>
> "(4) Hold at least one Public Hearing to receive feedback on the draft policy, notifying Town Meeting Members of the Public Hearing;
>
> "(5) Finalize the Athletic Field Surface Policy, and notify Town Meeting Members of its completion, by October 15, 2022."[3]

The Select Board appointed the following people to the Task Force:

Clara Bachelor - Parks & Recreation Commissioner; landscape architect
Antonia Bellalta - Parks & Recreation Commission; landscape architect
Michael Berger – Chemistry professor, Simmons University, and TMM, Precinct 15
Ida Fridland - Chemist (retired)
Nicole McClelland - Active in the Driscoll PTO; Precinct 11 TMM from 2017-2022
Peter Moyer – Physician (retired); Advisory Committee on Public Health associate member

[3] The Select Board expressed concern that the Task Force was not being given enough time to complete its reports, given that the task force members had to be recruited and start their work during the summer vacation season.

David Nardone - Landscape architect specializing in athletic field design
Michael Sandman - Select Board Member, Task Force chair

One member, toxicologist Laura Green, was a member of the Task Force but decided not to continue.

Ex-Officio Members:
John Lewitus, Recreation Department, Assistant Director
John Kleschinsky, Health Department, Public Health Policy Analyst
Scott Landgren, Public Works Department, Senior Landscape Architect

Scott Landgren left Town employment shortly before the report was completed, and he was replaced by two ex-officio members:

Michael Bartlett – Parks Department Operations Manager
Alexandra Vecchio – Parks Department Director

The Task Force began meeting in August 2022 and has held 14 meetings, usually at 9:00 AM on Fridays via Zoom. We reviewed several studies from a range of public and private sources, which will be included in an Appendix to the final report. We also heard from a modest number of residents who attended the Task Force Meetings, and from Sarah Evans, PhD, Assistant Professor of Environmental Medicine at Icahn School of Medicine, Mt. Sinai Hospital in New York.

Approved meeting minutes have been posted on the Town website. Minutes currently in draft form will be posted when they are approved. We will hold at least one public hearing before completing our final report.

DECISION GUIDELINES: DETERMINING WHAT SURFACE TO INSTALL

This section is the key takeaway from the Task Force's work. We recommend the use of these guidelines when deciding what type of field to install, whether at a Parks Department playing field or at a school.

DECISION GUIDELINES RELATIVE TO INSTALLING ARTIFICIAL TURF OR NATURAL GRASS IN THE TOWN'S ATHLETIC FIELDS

STEP 1: FIELD CAPACITY

- **Location of the field**: What is the appropriateness of the field location?
  - Neighborhood Context
  - Proximity to public transit
  - Proximity to underserved community neighborhoods

- **Size and character of open space**: - Does the field integrate well with the current character of open space?
  - Does the proposed open space maintain a balance between artificial turf and natural grass?
  - Are there options for diverse users in the same open space?
  - Is there sufficient space to provide shade and/or balance heat island effects?
  - What is the percentage of natural open space that would be covered with artificial turf?
  - What is an acceptable percentage of the open space to be transformed to artificial turf? (Look at environmental, horticultural context)
  - Can the installation of artificial turf be installed 5' away from any existing tree roots or newly planted trees and shrubs?
  - Does the field detrimentally affect the environment and/or aesthetic quality of the neighborhood?
    - Noise
    - Lights
    - Traffic
    - Parking

- **Type of usage**: What are the high or low impact uses on the field surface?
  - General community uses
  - Day care/use - infants and toddlers
  - High School sports
    - Football
    - Soccer
    - Lacrosse
    - Other sports
  - Elementary School sports
    - Soccer
    - Other sports
    - PE and recess
  - Dogs allowed or not allowed

- **Level of usage**: What is the "person hours per week" usage level of field?
  Work has been done in developing benchmarks for sports ground usage. Using this data in relation to the number of competition games and training schedules, usage rates are determined based on "person hours per week".
  - Number of registered teams
  - Number of competition games
  - Training schedules
  - Calculated number of person hours per week based on above data.
  - Other general uses

- Review the appropriate "person hours per week" for the specific sport on an artificial turf field and natural grass field.

STEP 2: LOCAL ENVIRONMENT What are the impacts of field to the local environment?

- **Determine the local climatic and environmental conditions in the area:**
  - Average temperature in the local environment, particularly during anticipated playing times.
  - What will be the primary water source be for the surface?
  - Does the proposed area have any drainage issues?
  - How will the added surface water be captured?
  - What is the impact on soil regeneration and dust stabilization?
  - What is the impact on local micro-environments?
  - What are the effects to the local biodiversity and habitat.

STEP 3: BROADER ENVIRONMENT Facts and Considerations of field surface options

- **Synthetic Turf Facts:**

  Water
  - **Usage**: Does not require irrigation for growth, some watering required for maintenance.
  - **Stormwater Capture**: Inhibits natural infiltration of water hence increasing runoff (artificial turf can include drainage systems to compensate for their inability to take in water and capture and storage systems that can harvest rainwater for re-use).
  - **Runoff Water Quality:** Potential for leaching of heavy metals, plastic microparticles, and other residues from artificial material and/or infill (depending on type of surface and materials used).

  Carbon
  - **Carbon Footprint**: The carbon and emissions come from the processing, production, transportation, installation, maintenance, and disposal stages of artificial turf. These materials impact over the entire lifecycle and significantly increase the carbon footprint.
  - **Carbon Sink:** Does not have the ability to remove carbon dioxide from the atmosphere

  Material
  - **Manufacture**: Petrochemical product which uses mostly virgin materials, some of the materials can be made from recycled content (e.g., rubber granules infill and shock pad).
  - **Transport:** Generally artificial turf is transported long distances resulting in high transportation costs. Consider local regulated manufacturers.

- **End of Life:** Ends up in landfill where it takes a long time to break down. High disposal costs. Consider more sustainable and local recycling or disposal companies.
- **Soil:** Heavily compacting of soil before installing artificial turf damages soil structure, soil microbes and soil life.
- **Dust Stabilization**: Covered surfaces with artificial turf are effective dust stabilizers.
- **Heat Dissipation:** Heat reflection. Absorbs and radiates heat. Heats the surrounding environment. Can be uncomfortable and unsafe in hot weather conditions. Color of the synthetic turf may influence the level of reflection.
- **Biodiversity and Habitat:** Does not provide natural environment for organic biodiversity in the soil.

- **Synthetic Turf Considerations:**
  - Are there any regulated PFAS or other harmful toxins present in the proposed artificial turf materials to be used?
  - Are only organic plant-based infills composed of materials such as organic and not chemically treated cork, coconut fibers, walnut shells, rice husks, or wood particles being considered?
  - Are there any antimicrobials materials being added to the infill which may be asthmagens?
  - Manufacturers usually recommend the use of a shock pad when using plant-based infills. These shock pads vary in composition and can introduce a number of chemicals of concern.
  - Avoid in-situ pads or prefabricated pads made of crumb rubber or PVC or other product containing any regulated PFAS.
  - Is staff available to effectively monitor and manage an artificial turf field 'fit for use' condition to minimize the risk to players and which supports the proposed hours of use?
  - What is the proximity of the artificial turf field to any waterways, flooding or ecologically sensitive areas?
  - Synthetic turf affects the natural infiltration of water. How will the increased runoff be addressed?
  - What is the impact on local microenvironments:
    - What measures will be taken to not adversely affect the decrease in water infiltration to the surrounding landscape or wildlife within the area?
    - How will heat islands be mitigated?
  - How will the artificial turf be disposed of or recycled at end of life?

- **Natural Grass Facts:**

  <u>**Water**</u>
  - **Usage:** Requires significant amounts of irrigation for growth.

- **Stormwater Capture:** Provides for natural infiltration of water through the soil profile reducing runoff.
- **Runoff Water Quality:** Potential for nutrient/chemical leaching from pesticide and fertilizers into waterways if not managed carefully.[4]

▪ <u>**Carbon**</u>

- **Carbon Footprint**: Carbon emissions generally come from the installation and maintenance stage (fertilizer production, mowing and lawn management). Tends to have lower carbon footprint over entire lifecycle.
- **Carbon Sink**: Helps remove carbon dioxide from the atmosphere through photosynthesis and stores it as organic carbon in soil, making it an important carbon sink.

<u>**Material**</u>

- **Manufacture**: Natural product grown from seed. Requires water and sometimes fertilizer and pesticides for growth and quality.
- **Transport:** Natural instant lawns have short shelf lives and can only be transported shorter distances, or they are planted from seeds which have minimal transportation costs.
- **End of Life:** Natural grass does not have a definitive end of life however may be replaced to enhance the current surface. Disposal is not normally required.
- **Soil:** Natural grass improves the soil by stimulating biological life and by creating a more favorable soil structure.
- **Dust Stabilization**: Well-maintained grass captures dirt and dust from the atmosphere. During severe drought periods and tight water restrictions natural grass can deteriorate and dust may become an issue.
- **Heat Dissipation:** Natural heat dissipation. Heat is absorbed by turf grass, Cools the surrounding environment.
- **Biodiversity and Habitat:** Provides natural environment for organic biodiversity in the soil.

- **Natural Grass Considerations:**
  - Natural Grass does not need to be disposed of or recycled at end of life
  - Are any regulated PFAS or other harmful toxins, such as lead are present beyond regulated limits in the soil?
  - Is staff available to effectively monitor and manage a natural lawn field 'fit for use' condition to minimize the risk to players and which supports the proposed hours of use.
  - What is the irrigation needs to provide a healthy natural grass field?
  -
  - What is the impact on local micro-environments?

[4] Brookline does not use pesticides (or chemical fertilizers) on grass fields except when they are first being established.

<u>STEP 4: HEALTH IMPACTS TO PLAYERS</u> - What are the players' and users' health impacts of the surface being proposed?

- **Synthetic Turf:** Health risks pertaining to accumulation of unregulated chemical exposure. Avoid use of fibers, infill, shock pad, or drainage materials containing regulated PFAS.
- **Injuries**
  - **Abrasions/friction** – burns, abrasions, and grazes
    - Ability to regularly monitor the surface and satisfy the requirements outlined by the sports appropriate governing body and manufacturer.
    - Dependent on fibers and infill choices.
  - **Traction** – Knee and ankle sprain, and muscle strains
    - Ability to monitor the surface and satisfy the requirements outlined by the sports governing body and manufacturer.
    - Footwear plays a major role in the amount of traction a player experiences. Consider imposing footwear rules on users to reduce the injury risk.
  - **Shock absorbency** – Concussions, fractures, shoulder dislocations
    - The selection of an appropriate shock pad with the artificial turf surface is important. Too soft can cause fatigue-related injuries and too hard can result in traumatic head injuries from falls.
    - Establish regular monitoring and reporting protocols of shock pads and infill surface weight material.
    - Ability to provide regular monitoring and maintenance to satisfy the requirements for proper surface weight material.
  - **Heat** - Heat–related injuries, particularly in players in Grades K-8 as heat exhaustion, heat stroke and death.
    - Synthetic turf surfaces create an increase in the heat island effect above the artificial surface. On a sunny hot day 90F artificial turf fields can exceed 150F. This has increased implications for users especially during the hot summer month activities.
    - Establish or review preventative measures to be protocolized that counteract heat-related injuries.
    - Ability to monitor artificial turf temperatures daily during warm months on each artificial turf field with on-site wet bulb temp to accurately determine temperature at any given location.
    - The selection of a heat-resistant fibers and a non-black infill will help reduce the risk of heat-related injuries.

- **Natural Grass:** Health risks pertaining to PFAS or other toxic material in soils. Provide soil tests for PFAS levels, lead and other toxic material before establishing a natural grass field.
- **Injuries**
  - **Abrasions/friction** – burns, abrasions, and grazes

        - As natural grass is generally soft and non-abrasive, this property is usually only a problem for injuries when the ground has become bare and dry.
        - Ability to monitor and apply good field management practices to provide a natural grass field suited for sports.
    - **Traction** – Knee and ankle sprain, and muscle strains
        - The current evidence suggests that the choice of grass type is important for traction as too much traction has been linked to an increased risk of severe knee injuries and too little of muscle strains and facial fractures.
        - Consider the appropriate grass type for each field and sport use.
    - **Shock absorbency** – Concussions, fractures, shoulder dislocations
        - The shock absorbency on natural turf fields comes from a combination of grass cover combined with the soil composition and is usually not a problem unless the ground is very hard and dry.
        - Ability to use and monitor good field management practices in order to provide a natural grass field suitable for sports.
    - **Heat -** Grass dissipates heat and naturally cools the environment so there is rarely a heat-related injury on natural grass.
        - Review heat policies that counteract heat-related injuries.

STEP 5: LIFE CYCLE MANANGEMENT AND COSTS

Consideration for management needs and lifecycle cost for playing surfaces.

- Life cycle costing – Consider the whole life implications of planning, acquiring, operating, maintaining, and disposing of an asset. Examine the full cost of each project component across the life of a project rather than choosing the cheapest option. This may lead to reduced ongoing operational, maintenance and disposal costs and a new lower ownership cost.
- Review maintenance levels of artificial turf and natural grass surfaces.
- Yearly operating costs – Cleaning, watering, mowing, testing, mending etc.
- Maintenance equipment
- Other

STEP 6: PROTOCOLS FOR TOWN STANDARDS

- Synthetic Turf – All materials used to install an artificial turf must comply with all federal and state standards related to regulated PFAS lead and heavy metal content. Manufacturers must provide analysis reports from an independent laboratory.
- Obtain samples and technical specifications and manufacturers disclosure that materials to be used are free of regulated PFAS in base layers, including drainage material, shock pad, artificial turf fibers and infill material.
- Natural Grass – Will all materials used to install a natural lawn must comply with all federal and state standards related to regulated PFAS lead and heavy metal content. Provide analysis reports.

- The Town of Brookline should reserve the right to require removal and or replacement of any material that does not meet the standards set forth by the Town of Brookline.

STEP 7: SOCIAL IMPACTS TO USERS

The following points are subjective and are based on insight into the various qualities both types of surface offer.

- **Synthetic turf:**
    - Consistent surface
    - Warmer and subject to glare when sunlight is present
    - Synthetic and unnatural feel
    - Strong odor particularly for artificial turf (with rubber granule infill)[5]
    - Visually appealing as it looks 'green' all the time
    - Suitable in many types of weather conditions
    - Durable and low maintenance
    - Provides environmental benefits in terms of water savings and reduced maintenance.
    - Allows for increased playing time for sports

- **Natural Grass:**
    - Cooler feel particularly in summer
    - Softer and more forgiving
    - Variable quality depending on the soil type and maintenance regime
    - Traditional and served the various sports well for many years
    - Natural and calming feel
    - Pleasant smells e.g., freshly cut grass
    - Visually appealing if well maintained
    - Provides environmental benefits in terms of carbon absorption and contribution to biodiversity.
    - Allows for diversity of uses as green space for wider community

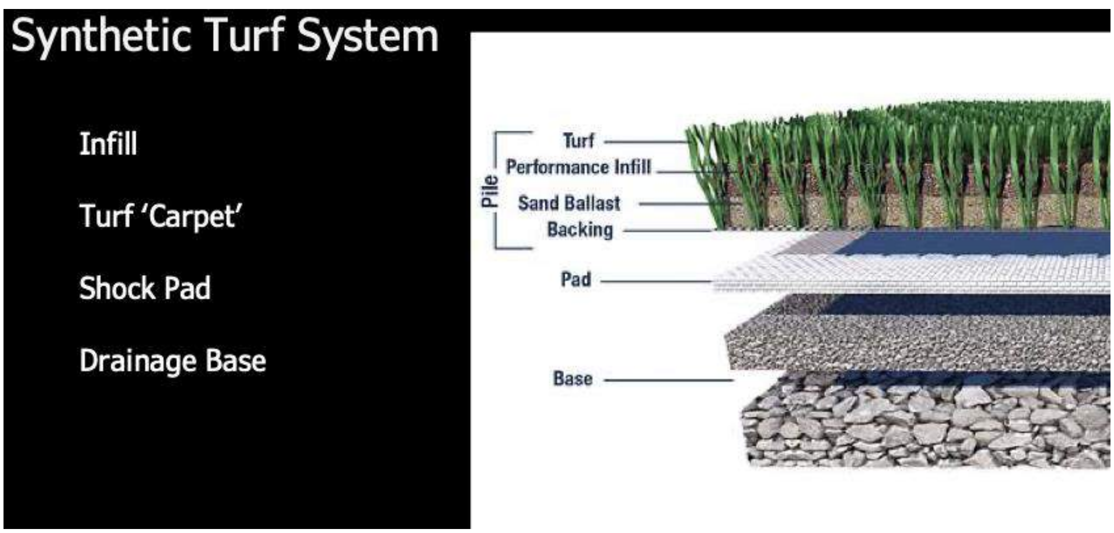
    Resource: https://www.dlgsc.wa.gov.au/sport-and-recreation/facility-management/natural-grass-vs-synthetic-turf-decision-making-guide

[5] Note that we have recommended that Brookline no longer install crumb rubber infill and that it be removed in the near future from the two fields where it is currently used.

STRUCTURE OF SYNTHETIC TURF

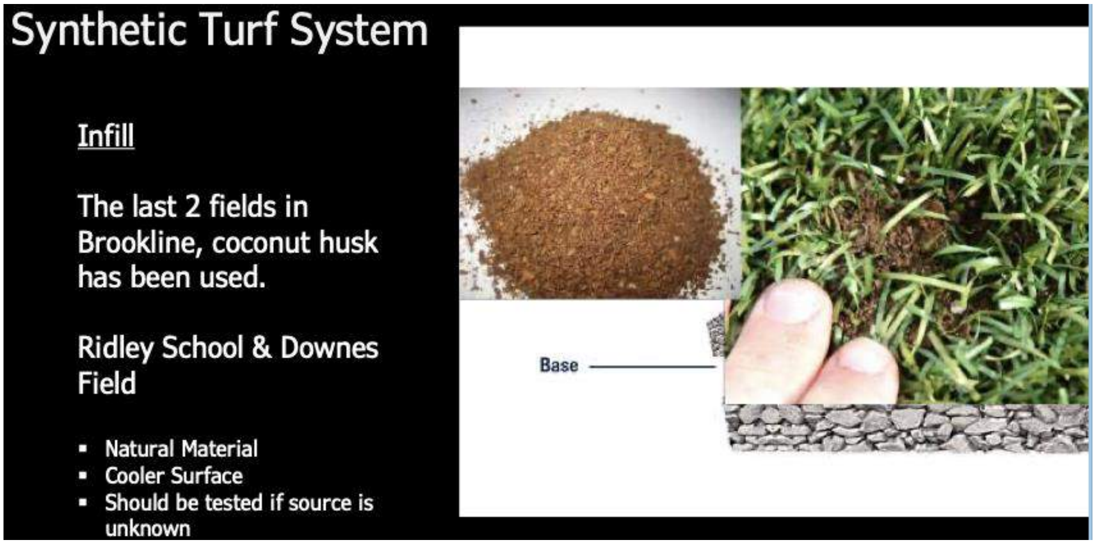
Synthetic turf is a multi-layer product. Its composition has evolved over time, and its composition has varied depending on the manufacturer. The diagrams below show a typical multi-layer structure, but the operative word is *typical*, since different substrates may be employed by different manufacturers. For example, the diagrams show a tufted turf "carpet", but woven surfaces have been developed recently that do not require a backing and that can be overlaid on a grass field.[6]

Moreover, the types of material being used have changed over time. Some synthetic turf fields including Downes Field and Skyline Park in Brookline, use an infill layer made of crumb rubber, which is made by grinding used tires. More recently installed fields use infill made from coconut fiber, including the Ridley School playing field, and pine fiber infill is used by some manufacturers.

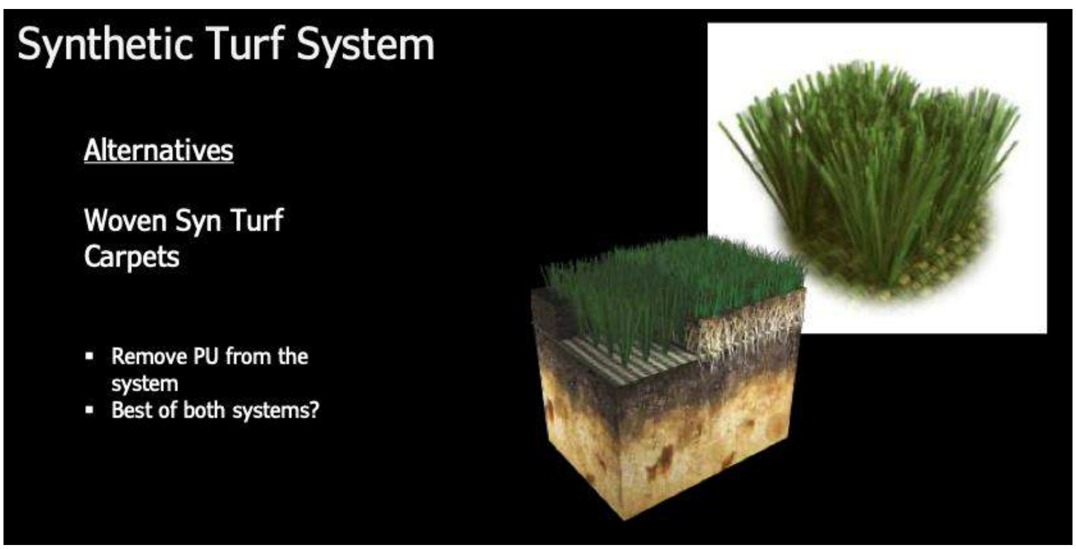


The synthetic turf carpet is made up of a polypropylene (PP) backing (a woven PP fabric), with the polyethylene turf fibers, turfed (pushed through) into the backing. The secondary backing is a polyurethane applied to the back of the primary backing to help hold the fibers in the carpet backing.

[6] Diagrams and captions provided courtesy of David Nardone



On the last 2 fields installed or renovated in the Town of Brookline, Brookline Parks has chosen a natural, coconut husk (again over sand). This material absorbs water but still drains into the base and when the weather it is warm the water evaporates keeping the surface cooler than the conventional rubber infill.



While the coconut husk and synthetic turf carpet is a good mix of natural and synthetic products, another alternative the Town could consider for the right project is a 'hybrid turf,' an open woven synthetic turf carpet is placed in a natural turf field. The turf fibers provide many benefits in the natural turf system. They protect the grass making it more resilient, they hold the soil in place as the nature fiber wear and protect the roots allowing them to comeback more quickly.

Where the level of use and other criteria in the Guidelines indicate that a grass surface is not a practical choice because it would not allow the field to serve its intended purpose, a synthetic field surface is acceptable, given the level of risk as we currently understand it. In that situation, if the facility will be used by children under the age of 15 should include an area surfaced with grass to provide an option for children whose parents do not want them to play on synthetic turf.

As noted below, the level of perceived risk may change over time as new data emerges, so risk should be reassessed periodically by the Brookline Health Department.

- We recommend that any Town or School agency contracting for synthetic turf, or contracting for maintenance products for synthetic turf, require the vendor to provide an analysis by an independent testing laboratory that there are no PFAS compounds in their product that are regulated for toxicity by either the Massachusetts or the US EPA.

The Task Force agrees that *at this time*, there is no basis for recommending a moratorium on the installation of new synthetic turf fields, if those fields meet the Decision Guidelines as to location, type of activities for which the field is designed, and the age of those whose use it. If a synthetic turf field is to be replaced, it should be replaced with synthetic turf only where it meets those same criteria.

TOXICITY RISKS AND REASSESSMENT

Since we do not always know what we don't know, we recommend no less frequently than every three years a review by the Brookline Health Department of what new information becomes known about the toxicity, if any, of the PFAS or other chemicals used in manufacturing synthetic turf, as well updated heat exposure guidelines and sports injury data. Toxicity risk should be judged by combination of exposure level and toxicity explained in the US EPA document, "A Framework for Assessing Health Risks of Environmental Exposures to Children"[7]

On the other side of the equation, the structure of synthetic turf and the manufacturing processes for making it continue to evolve. Products that are easier to maintain and recycle are becoming available, possibly including products that has less of a heat effect, so the recommended age restrictions should be reviewed simultaneously with the toxicity risk review.

HEAT RISKS

Although the task force found that synthetic turf fields are used nationwide for children of all ages, in Brookline, it may be appropriate to use only, or at least primarily, natural grass for playing areas that are used by K-8 students during hot weather

[7] See https://ordspub.epa.gov/ords/eims/eimscomm.getfile?p_download_id=459047

- We recommend following the guidelines of the Massachusetts Interscholastic Athletic Association (MIAA). Those guidelines limit organized sports activity on any field, whether grass or turf, including practice and workouts, at temperatures above 81°F and prohibit it at temperatures above 86°F. Above that temperature, *fields should be closed to organized activities***.** [8]

The surface temperature of synthetic turf is typically twenty or more degrees higher that it would be in grass even with water-absorbent natural infills. (The air temperature two or three feet above the surface is typically not elevated). Water-absorbent natural-fiber infill material that absorb both water and water vapor can reduce the temperature of the turf surface through evaporative cooling. Irrigating such fields when the ambient temperature is in the 80s helps cool the surface for some period of time following the irrigation, although the cooling effect may be limited by high humidity.

- We recommend the irrigation of synthetic turf fields on hot days to partially close the gap between the surface temperature of currently available synthetic turf and grass.

We recommend the use of grass at K-8 schools if the field will be used for less than 800 hours a year because of concern about the heightened risk of heat injury to young children from playing on synthetic turf on a very hot day. Older grades are less susceptible to heat injury, but the Task Force does not think it would be practical to restrict a synthetic field to the older grades.

- Where field use is above 800 hours a year, we recommend that an area with a natural surface be adjacent to provide an option for PE and recess programming that does not expose children to unsafe temperatures. The area could be either grass or mulch.

Whether the field is grass or synthetic turf, the Mass. Interscholastic Athletic Association guidelines call for limiting team activity when the ambient wet bulb temperature reaches 81 F and closing down organized sports activity when the wet bulb temperature reaches 86F.[9] The Task Force endorses the use of that guideline.

SPORT INJURIES

See the list of criteria listed in the Decision Guidelines regarding the risks of abrasion, traction-related injuries, and impact-related injuries present in all active sports.

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[8] See the Appendix for the current MIAA Heat Modification Policy.

[9] Wet bulb temperature combines the effects of heat and humidity. At a given temperature, risk of heat injury rises with increased humidity. The report includes a chart showing the effect as the wet bulb temperature increases. Brookline school staff have wet bulb thermometers ilable.

PFAS IN SYNTHETIC TURF, HEALTH, AND THE ENVIRONMENT

<table>
<tr><th>Majority View</th><th>Minority View</th></tr>
<tr><td>The Task Force recognizes that we cannot say with 100% certainty that there are no components in synthetic turf that might someday be found to be unsafe for human and/or wildlife. It is not possible to prove a negative.

What we can say is that there are PFAS compounds used in the manufacture of synthetic turf, but those compounds, which are forms of polyvinylidene fluoride (PVDF-HPF), are not water-soluble, do not have an adverse effect on the water supply, and their molecules are of a size such that they are not absorbed through the skin. PVDF-HPF has long been used in medical products.</td><td>There are PFAS compounds used in the manufacture of synthetic turf. Those compounds are forms of polyvinylidene fluoride (PVDF-HPF), which are not water-soluble. The Task Force did not come to consensus about the safety of PFAS and other chemical components of artificial turf.</td></tr>
<tr><td colspan="2">There are potentially or known toxic PFAS compounds in the soil and subsurface water under synthetic turf playing fields, but that is true of soils and water broadly, due to contamination from the manufacture, use, and disposal of products other than artificial turf.

Turf and turf dyes are no longer made with lead or cadmium. To be sure, there are detectable levels of lead contamination in soils under playing fields, but also and across much of the world, primarily due to the decades-long use of tetraethyl lead as an additive in gasoline. Lead-based dyes are no longer present in synthetic turf, but there may be dyes that use other heavy metals. Thus far, there are no indications that the dyes present a toxicity hazard.</td></tr>
</table>

Majority View	Minority View
In addition to input from Task Force members, the Task Force invited guest Dr. Sarah Evans, assistant professor of Environmental Medicine and Public Health and member of the Institute for Exposomic Research at the Icahn School of Medicine at Mount Sinai, to provide commentary on her research, which focuses on the impacts of early life exposures to environmental chemicals on child development. Dr. Evans noted that, to date, no studies have been completed on how PFAS and other chemicals move from artificial turf to children, and that materials deemed safe in manufacturing have the potential to break down into unsafe components over time, due to UV exposure, friction, and weather.	In addition to input from Task Force members, the Task Force invited guest Dr. Sarah Evans, assistant professor of Environmental Medicine and Public Health and member of the Institute for Exposomic Research at the Icahn School of Medicine at Mount Sinai, to provide commentary on her research, which focuses on the impacts of early life exposures to environmental chemicals on child development. Dr. Evans noted that, to date, no studies have been completed on how PFAS and other chemicals move from artificial turf to children, and that materials deemed safe in manufacturing have the potential to break down into unsafe components over time, due to UV exposure, friction, and weather. She directed the Task Force to the findings published in *Environmental Science & Technology* regarding fluoropolymers (of which PVDF is one), which concluded the following: *The evidence reviewed in this analysis does not find a scientific rationale for concluding that fluoropolymers are of low concern for environmental and human health. Given fluoropolymers' extreme persistence; emissions associated with their production, use, and disposal; and a high likelihood for human exposure to PFAS, their production and uses should be curtailed except in cases of essential uses.(cite)*

Joint Finding
There are PFAS compounds used in the manufacture of synthetic turf, but those compounds, which are forms of polyvinylidene fluoride (PVDF-HPF), are not water-soluble, they do not have an adverse effect on the water supply, and their molecules are of a size such that they are not absorbed through the skin. PVDF-HPF has long been used in medical products. There are potentially or known toxic PFAS compounds in the soil and subsurface water under synthetic turf playing fields, but that is true of soils and water broadly, due to contamination from the manufacture, use, and disposal of products other than artificial turf. Turf and turf dyes are no longer is made with lead or cadmium. To be sure, there are detectable levels of lead contamination in soils under playing fields, but also and across much of the world, primarily due to the decades-long use of tetraethyl lead as an additive in gasoline. In addition to PFAS, there are no-lead and non-cadmium chemical dyes used in the manufacture of synthetic turf. Thus far, there are no indications that the dyes present a toxicity hazard. Massachusetts and the EPS set regulatory limits for six PFAS compounds. California has been a leader in monitoring PFAS compounds. A list of the 22 compounds whose levels are either monitored or restricted by the State of California is included in the Appendix. The Task Force discussed that historically, the toxicity or other detrimental health effects of chemicals are revealed over time, often decades, and that there are hundreds of chemicals in synthetic turf that are not regulated. The EPA recently added additional PFAS and other chemicals to their list of potentially hazardous chemicals with long-term health effects; it is possible that some of the chemicals currently in artificial turf may eventually be determined to be hazardous to human health. ***This is an issue of community risk tolerance that should be considered when applying the Decision Guidelines recommended by the Task Force.***

INFILL TOXICITY AND ENVIRONMENTAL IMPACT

Crumb rubber infills break down with use, and some of the particles scatter into the environment. Thus, even though a 2021 study by the Haley & Aldrich, an engineering consulting firm, for the Buckingham Browne & Nichols School in Cambridge states that:

> "…over 100 scientific, peer-reviewed, published studies have been performed worldwide evaluating the potential health risks associated with using crumb rubber. We are not aware of and peer-reviewed scientific studies which draw an association between adverse health effects and use of crumb rubber,"[10]

We recommend that Brookline continue its policy of no longer installing crumb rubber infill. To the extent that we install synthetic turf, we recommend that the field be installed only with infill made with natural products. But natural products are not necessarily free of health hazards. Concerns have been expressed that coconut fiber infill is mixed with sand that is manufactured by crushing quarried quartz, and it may contain silica dust, which can be a cause of silicosis. There is no indication that there are health risks related to exposure from playing on a school or park surface with a coconut fiber and sand infill.[11]

NOTE: Subsequent to the last meeting of Task Force, in a memo dated July 31, 2023, Brookline DPW Commissioner Erin Chute announced that the turf selected for the Skyline Park Turf Replacement Project was Greenfields Iron turf, a woven turf product made in the USA and completely recyclable at the end of life. The product is also Cradle to Cradle Certified®. The infill product that is being used with the turf is BrockFill, a wood fill-based product that is sustainably grown in the USA, is 100% recyclable at the end of life, reduces heat by up to 40 degrees and is also Cradle to Cradle Certified.[12]

Artificial turf is made from plastics, and there are environmental effects from the manufacture of any plastic. The environmental impact of turf from the manufacturing process is most obvious, but the wear and tear on turf fields creates microplastics that can end up in rivers and ultimately in the ocean.

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[10] See the June 2, 2021, letter in the Appendix from Haley & Aldrich to the Chief Operating Officer of Buckingham Browne & Nichols School.

[11] Silicosis is a type of pulmonary fibrosis, a lung disease caused by breathing in tiny bits of silica, a common mineral found in sand, quartz and many other types of rock. Silicosis mainly affects workers exposed to silica dust in jobs such as construction and mining. Over time, exposure to silica particles causes scarring in the lungs, which can harm your ability to breathe. See https://www.lung.org/lung-health-diseases/lung-disease-lookup/silicosis.
https://www.lung.org/lung-health-diseases/lung-disease-lookup/silicosis

[12] Cradle to Cradle® is the registered trademark of the certification is awarded by the Cradle to Cradle Products Innovation Institute. See https://c2ccertified.org/the-institute

HEAT ISLAND EFFECTS AND HEAT INJURY RISK IN GENERAL

Majority View	Minority View
Synthetic turf creates a significantly higher surface temperature on a hot, sunny day is higher than that of a grass field – on the order of 20 - 30°F on hot, sunny days. The air temperature differential above the field reduces quickly, but as noted above, the heat effect is sufficient to present a hazard to children by exacerbating the risk of heat stroke, heat exhaustion, and other heat-related injuries on hot and sunny days. Separately, significant heat effects may be seen on any field when the ambient temperature exceeds 80-85 degrees, thus detrimental heat impacts may be seen during the school year as well as the summer on hot days.[13] Middle school-age school age and adults are not as affected, given their height and larger body mass but they are affected at the temperature rises beyond the mid-80s.	Synthetic turf surface temperature on a hot, sunny day is significantly higher than that of a grass field. The air temperature differential above the field reduces quickly, but as noted above, the heat effect is sufficient to present a hazard to children by exacerbating the risk of heat stroke, heat exhaustion, and other heat-related injuries on hot and sunny days. Significant heat effects may be seen when the ambient temperature exceeds 80-85 degrees, thus detrimental heat impacts may be seen during the school year as well as the summer on hot days.[14] Younger children are both shorter (so more of their body is in the "high heat zone" directly at or above surface level) and typically engage in activities that bring them closer to the "high heat zone," such as sitting, lying, rolling, or otherwise having more of their bodies directly on or close to the field surface. Middle school-age school age and adults are not as affected, given their activity type, height, and larger body mass.

Joint Finding
A further question is the extent to which the heat effects persist after sunset. Manufacturers' literature suggests that at least some types of synthetic turf do not retain heat and radiate it back to the atmosphere in the way that asphalt and buildings do, but this remains to be confirmed.

As previous noted, it is possible that newer generations of synthetic turf will not have a significant heat effect.[15] As previously noted, fields with infill made with natural products such as coconut fiber or wood fiber do not appear to heat up as much as fields made with various synthetic infills. Both types of natural fiber absorb water from dew, the humidity present in the air, and from rainfall, and the gradual evaporation of that water reduces the temperature on the surface by as much as 30°F *if the surface has been maintained so that is not pressed into a flat mass.* Sports injury data and experience suggests that a sport such as field hockey or lacrosse that involves running is safest on an even, uniformly dense surface, which is more characteristic of a properly maintained synthetic turf field than a grass field.[16] However, synthetic turf fields should be tested annually to ensure that the subbase has not compacted, and if it has, it needs to be worked over to restore its resilience. Brookline's DPW staff does the requisite testing of our synthetic turf fields, and the base is reworked as needed.

DOWNSTREAM AND UPSTREAM ENVIRONMENTAL IMPACTS

<table>
<tr><th colspan="2">Joint Finding</th></tr>
<tr><td colspan="2">Synthetic turf is more widely used in Europe than in North America, and in some European countries, product manufacturers are responsible for the costs of recycling. Currently an unquantified but very small percentage of artificial turf in the US is recycled in contrast to Europe. A current hindrance to recycling is that, while most components of turf fields are technically recyclable, the technology to separate the components and remove sand and other particulates that are not recyclable is lagging.</td></tr>
<tr><th>Majority View</th><th>Minority View</th></tr>
<tr><td>In the US, the Dutch company Tencate is working with Exon, a producer of the polyethylene used for the turf blades to build a pilot recycling facility that will recycle 50 turf fields, and Shaw, a US manufacturer, has a recycling plant in operation in Georgia. Other recycling plants are under construction in Ohio and New</td><td>In the US, the Dutch company Tencate is working with Exon, a producer of the polyethylene used for the turf blades to build a pilot recycling facility that will recycle 50 turf fields, and Shaw, a US manufacturer, has a recycling plant in operation in Georgia. Other recycling plants are under construction in Ohio and New</td></tr>
</table>

[15] "It is widely known that temperatures can become elevated on synthetic turf surfaces on warm sunny days. TenCate Grass set out to improve the comfort level of synthetic turf users by reducing the amount of heat that can be absorbed by the turf blades. In laboratory tests, TenCate XP Blade with HR technology has shown temperature reduction of 17.5° F. TenCate is the first to offer heat reducing products without any additional cost." - https://durafield.com/tencate-synthetic-grass-materials-to-incorporate-heat-reduction-technology/

[16] That is likely to be the main reason why synthetic turf is on fields for professional sports.

Jersey, but there is no assurance that there will be adequate recycling capacity in the near term in the US. Turf is sometimes repurposed by being trucked to secondary sites, such as batting cages, where it is used for a second life before being sent to a landfill. The average artificial turf field is made of 40,000 pounds of plastic (blades and backing; not including any plastics used in infills).[17]	Jersey. The reality is that, even when these additional facilities are open, the demand for artificial turf recycling will far exceed capacity in the United States, making the vast majority of turf effectively un-recyclable. Turf is sometimes repurposed by being trucked to secondary sites, such as batting cages, where it is used for a second life before being sent to a landfill. The average artificial turf field is made of 40,000 pounds of plastic (blades and backing; not including any plastics used in infills).
Joint Finding	
At the same time, synthetic turf engineering has evolved to the point where there are ways to increase recyclability. As noted above, synthetic turf typically has been made with a backing that functions much like the backing in a tufted carpet. It holds the blades in place in the same way as the tufting holds the surface fibers of the carpet. In contrast the Dutch manufacturer Tencate offers a form of turf that is woven without a backing.	

In the US, worn-out synthetic turf has often been sent to a landfill. Synthetic turf is more widely used in Europe than in North

OTHER QUESTIONS[18]

Although the main focus of people who express concerns about synthetic turf has been on toxicity, injuries, and the product's environmental impact, some people have expressed concern about whether bacteria, including MRSA bacteria, are present and could be absorb by playing field users. Brookline does not apply sanitizing products to our synthetic turf fields, relying instead on the antiseptic effect of the UV radiation in sunlight. ***MRSA has been shown through testing to be a non-issue on Brookline fields.***

Synthetic turf fields with natural product infills such as coconut fiber sometimes need to be irrigated (watered) to maintain proper moisture content. Ridley was watered once during the summer of 2022 and the irrigation system at Downes was not used. Others,

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[17] https://aesm.assembly.ca.gov/sites/aesm.assembly.ca.gov/files/letter%20from%20public%20synthetic%20turf%2C%20microplastics%2C%20Dianne%20Woelke.pdf

[18] Brookline has four synthetic turf playing fields: Harry Downes and Ridley, both of what are newer and have infills made with natural products, and Soule and Skyline, which have crumb rubber infills. For a detailed description of field maintenance policies, see the Brookline DPW document entitled *Natural & Synthetic Turf Field Maintenance* in the Appendix.

noting that "natural grass playing fields" are highly cultivated and do not occur in nature, expressed concerns about the use of chemicals in the maintenance of grass fields, but this is not an issue on Brookline, since we use organic products for grass field maintenance and do not use pesticides.