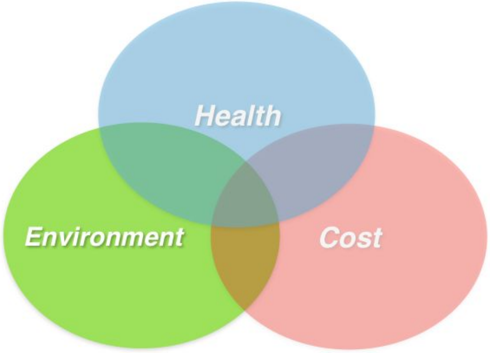
Progress Update 8-21-2019

School Committee Fields Working Group,
Members Andrea Prestwich and Kate Bowen



The School Committee is responsible for providing a safe environment for students; select members are in the process of reviewing the topic of playing fields, considering the comprehensive health, environmental, and financial aspects of existing and proposed areas in Belmont. The outdoor environment is an integral educational space for Belmont schools, serving as active and passive recreational places, as well as immediate examples of environmental stewardship and science.

In consideration of the financial impacts of additional artificial surfaces and adequate upkeep of school play areas, a clear trajectory of support is prudent. Belmont has two synthetic fields: Harris and Wellington, and an additional exterior carpet surface installed at Burbank. Two school's playgrounds, Wellington and Butler, have departed from customary mulch to experiment with "pour-in-place" recycled rubber surfacing for the areas under the playground equipment.

Playing fields and play equipment have long been a part of school environments and park provisions. Artificial fields have been normalized from their initial pro-athlete stadium uses; it is common to see one in any given municipality. However, multiple municipalities and school districts are re-evaluating the materials in artificial playing fields, as needed replacement recurs, typically every 8 to 10 years. Research continues to evolve on the health and environmental issues related to artificial fields, particularly with respect to undesirable chemicals, metals, and plastics. The New York City parks department and the Los Angeles Unified School District both stopped using crumb rubber in new fields 10 years ago. Local municipalities in Massachusetts, including nearby Concord and Westfield, have implemented moratoriums on further installations of artificial fields. Well known to soccer fans, FIFA has agreed to player demands and will only allow natural grass fields at its soccer games.

Concerns for cost, health, and environmental issues exist with natural grass playing fields – they vary by practice. Regarding use of pesticides and herbicides, the Massachusetts Pesticide Reduction Act addresses these concerns, particularly in school environments. Excessive fertilizer use are a concern of natural grass fields managed synthetically, phosphorus in particular. This issue is addressed by attentive management practices, most often exemplified by communities who have their water supplies in direct relation to fields. Innovations in natural grassturf continue to evolve with improved seeds and management practices, including tools for aeration and soil technology. In general, organic management practices improve field quality, strengthening root structures to make the field more resilient and playable while reducing potential exposures to harmful chemicals. Belmont has employed such practices in the past successfully.

While the Building Committee evaluates the criteria necessary to determine the final design of the new school landscape, these considerations will have long-term impacts, as well as inform recreational spaces as a whole. Belmont residents currently enjoy the use of many recreation areas, including those that are on school grounds, with some exclusive scheduling accommodations.

Belmont prides itself on pragmatism and responsible financial management, as well as environmental stewardship and valuation of recreation and conservation areas.

This update includes some of the questions raised and resources available.

Natural Turfgrass Management

Questions of management of natural turfgrass have been raised as to performance, cost, and existing practice.

Pesticides

In May 2001, Massachusetts signed into law “An Act to Protect Children and Families from Harmful Pesticides,”(CFPA) which affects all private and public schools, day care centers, and school-aged childcare programs. The main provisions of the law restrict pesticide use, honor informing the public, and incorporate safer, non-toxic alternative methods of pest management, including outdoor areas. Outdoors, CFPA prohibits pesticides applied for purely aesthetic purposes; prohibits pesticides classified by the EPA as known, likely or probable human carcinogens; and prohibits pesticides with ingredients categorized by the EPA as “inerts of toxicological concern.” The intent of CFPA is a call for a change in attitudes and procedures regarding pesticides. Several towns have switched to organic lawn care methods, including Lowell, Marblehead, Martha's Vineyard, Natick, Newton, Northampton, Springfield, Townsend, Wellesley, and Westford, among others, in the wake of these regulatory changes.

Provided are two case examples of organically manage natural grass fields in Massachusetts. The key elements to organic management of fields include: field construction, soil maintenance, and grass maintenance. Organic grass management practices focus on soil health. Plans combine soil aeration, grass selection, timing and measured inputs. Modest annual maintenance costs can include consultants and contracted labor when needed, as well as education for local employees. Having a comprehensive land care management program can provide the lowest long-term cost to taxpayers.

Sample maintenance programs include, but are not limited to 1) taking soil nutrient samples once per year; 2) tracking field conditions (wear spots); 3) periodically testing for compaction, moisture, organic and salt content to determine needs; 4) working with professional to devise a plan for each field. Such actions may include: a) surface decompaction of whole field, up to 4 times per year (Redexim Level Spike aerator is new technology); b) surface decompaction of high traffic areas 1/month; c) slit seeding with high quality perennial ryegrass and Kentucky bluegrass 2x year; d) improvement of mowing practices; e) management of irrigation in relation to weather (Natural Grass Advisory Group).

Soil compaction is the biggest issue with any lack of maintenance. This is easily resolved with regular aeration; diseases disappear with increased aeration. While mechanical impact (g-max) testers can be used, compaction is also evident by simple “indicator” species such as broadleaf plantain. Modeling organic management practices can improve residential practices, providing an overall lower presence of phosphorus and bacteria in the stormwater system. Residential run-off accounts for the majority of these imbalances by acreage.

Because of soil porosity (humus can hold 60x its weight in water), a healthy grass field can both absorb huge amounts of rainwater and slowly release this moisture upward through grass roots and leaves into the atmosphere, where it lowers temperature and improves air quality, and downward through filtering rainwater and recharging groundwater. (Sachs, P. Managing Healthy Sports Fields)

Natural grass fields are estimated to sequester carbon at an average rate of 1,072 pounds per acre per year, equivalent to removing 3,934 lbs of CO2 from the atmosphere every year. Research suggests that this rate can be increased by as much as 50% with a compost-based organic management practice. (Rodale Institute) Do note that residents are composting already; a formal Town program could cycle compost back to the town.

Springfield, MA Organic Management Transition Pilot Summary

Between 2014 and 2018, Springfield doubled the number of properties in their program and experienced an increase in overall recreational use due to the improvement in soil and grass conditions. This was accomplished by frequent aeration of the fields, and the creation of field-specific product application plans according to performance needs and soil testing for each field. Field management costs, including irrigation, maintenance, products, and all labor costs, are $1,500 per acre across all the properties.

Springfield has found that properties in their organics program have higher quality grass and soil than those outside of the program. The Parks Director notes that field needs have changed over time. In the past, there were few or no formally scheduled sports after the baseball season ended in early July. Today, sporting requirements continue throughout the year. **The fields never shut down during open hours, and game cancellations are rare.**

For 2018 use information, this case study focused on three fields: Forest Park, Blunt Park, and Treetop Park. Formal use of the Forest Park sports complex totaled 2,870 hours by baseball and soccer teams, and 3,262 hours per year with estimated informal use included. Blunt Park sports complex totaled 3,236 hours of use by baseball, football, and lacrosse teams, and 3,628 hours with estimated informal use included. Treetop Park was used 855 hours by soccer teams, and a total of 1,247 hours with an estimated informal use included. Treetop Park is the best field to use for comparison of playable hours on an individual field, as it is composed of a single, full sized soccer field.

The Parks Department notes that their choices affect water quality in the Connecticut River, so there are broad advantages to choosing the organic approach. The Parks Department has set a goal of reaching out to homeowners to educate them about the advantages of organic grass management, further expanding the benefits of this project. (TURI 2019)

Martha's Vineyard, The Field Fund

In collaboration with local municipalities, The Field Fund supports and supplements improvements and maintenance of playing fields throughout the island. For a high use field, they spend $15-20,000 per year, for lesser used fields $7-12,000 per year, and for small sized fields primarily serving recreation they spend $5-7,000 per year. With a 30% mark-up factored for their geographic location, the correlating costs to a landlocked municipality would be $10,500-14,000, $4,900-8,400, and $3,500-$4,900 respectively.

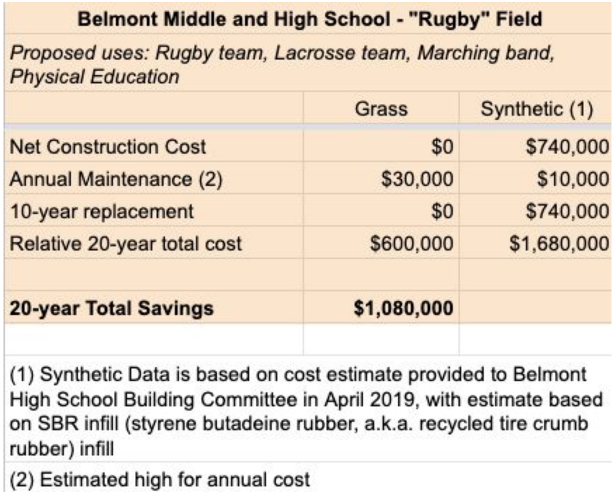
Typical upkeep includes soil testing, supplemental mowing, surface and subsurface decompaction (6-8 times/year), slice seeding, high quality seed, fertilizer, and irrigation tweaking. Some fields do not use fertilizer due to their proximity to public well and water sources.

COSTS

Costs of synthetic turf and natural grass are defined as Capital Expenses - construction and installation - and Operating Expenses - care and maintenance, irrigation and repairs.

Tax Dollars for Capital Expenses

Reconstruction or new construction of fields - either synthetic or natural grass - are capital expenses. Comprehensive capital planning is currently underway; however, a plan has not yet been made for financing the existing or proposed artificial fields, including the costly replacement of Harris Field and the field at Wellington Elementary in the next five to ten years. Historically, debt exclusions, operating budget funds, private fundraising, and Community Preservation Act (CPA) funds have been used for recreation areas; unique restrictions exist for individual projects. CPA money may fund field construction in the specific forms of irrigation, drainage, soils, sod, and seeds; however, it may not fund synthetic fields in the form of the shock pads, infill material, or plastic carpet components.



Belmont Middle and High School - "Rugby" Field

Proposed uses: Rugby team, Lacrosse team, Marching band, Physical Education

	Grass	Synthetic (1)
Net Construction Cost	$0	$740,000
Annual Maintenance (2)	$30,000	$10,000
10-year replacement	$0	$740,000
Relative 20-year total cost	$600,000	$1,680,000
20-year Total Savings	**$1,080,000**	

(1) Synthetic Data is based on cost estimate provided to Belmont High School Building Committee in April 2019, with estimate based on SBR infill (styrene butadeine rubber, a.k.a. recycled tire crumb rubber) infill

(2) Estimated high for annual cost

Tax Dollars for Operations

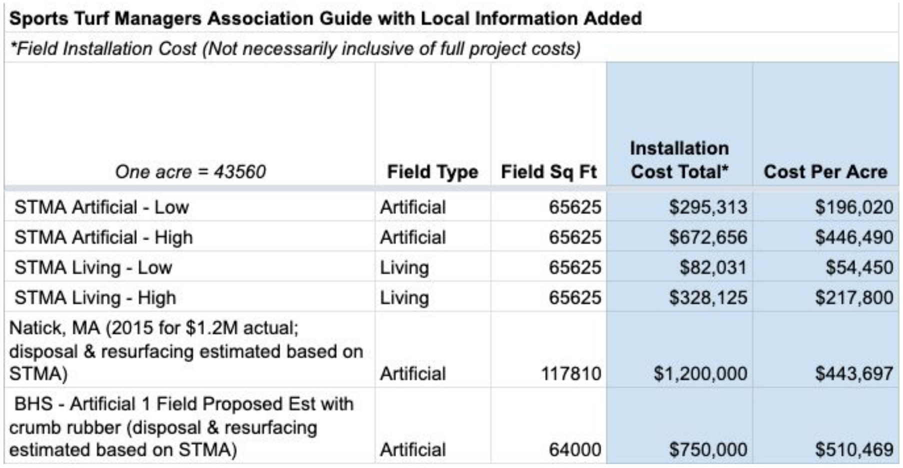
Maintenance for all parks, playgrounds and playing fields is funded from the annual operating budget. Field management practices vary within Belmont. Four departments: School Department, Department of Public Works Division of Parks and Recreation, Department of Public Works Highway Division, and the Facilities Department maintain the parks, playing fields, playgrounds, and islands. Supplies and lawn equipment may or may not be shared across departments; synthetic fields have different equipment from grass fields.

The University of Missouri estimates installation and maintenance of natural grass fields to be one-third the cost of installation and maintenance of a synthetic field when annualized over 16-years. They estimate a sand-capped field at 46% less than a synthetic field (or 44% of the cost of synthetic).

16-year annualized costs at U of Missouri

- $33k for natural grass - 33% of synthetic
- $49k for sand-capped natural grass - 44% of synthetic
- $109k for premium synthetic fields

The Sports Turf Managers Association provided high and low construction estimates for natural and synthetic fields. Using their estimates, a construction cost per acre for synthetic fields in Belmont would be $510,469. Spread over a 16 year period, would be equal ~$31,900 per year for an acre.



Sports Turf Managers Association Guide with Local Information Added

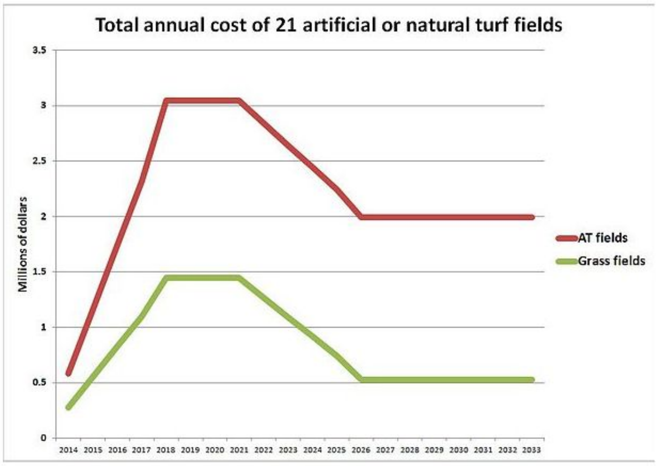
**Field Installation Cost (Not necessarily inclusive of full project costs)*

One acre = 43560	Field Type	Field Sq Ft	Installation Cost Total*	Cost Per Acre
STMA Artificial - Low	Artificial	65625	$295,313	$196,020
STMA Artificial - High	Artificial	65625	$672,656	$446,490
STMA Living - Low	Living	65625	$82,031	$54,450
STMA Living - High	Living	65625	$328,125	$217,800
Natick, MA (2015 for $1.2M actual; disposal & resurfacing estimated based on STMA)	Artificial	117810	$1,200,000	$443,697
BHS - Artificial 1 Field Proposed Est with crumb rubber (disposal & resurfacing estimated based on STMA)	Artificial	64000	$750,000	$510,469

Montgomery County, Maryland sought state funds for replacing their natural grass fields with artificial turf, thus requiring a cost comparison of both materials. The natural grass field costs are at the high end with the assumption that all fields would need full replacement. The artificial turf fields include best guesses at rising costs over the 20 years of estimates.

COST COMPARISON FOR MONTGOMERY COUNTY

COST OF SYNTHETIC HIGHER THAN GRASS



Health

Two epidemiological studies exist in relation to cancer and synthetic turf; other studies are purely risk assessments. The Washington State Department study acknowledged the gaps in their analysis in an addendum, addressed in summary: Washington State Department of Health published a report entitled Investigation of Reported Cancer among Soccer Players in Washington State. No systematic effort to identify cases of disease. The Department did not make any effort to identify other soccer players with cancer. The authors note: "Notably, this investigation is not designed to add to our understanding of the risks or benefits of crumb rubber fields or to discover the causes of cancer among the people reported to the project team." The calculations presented in this report do not provide information on the possible relationship between playing on artificial turf and risk of developing cancer. However, the information gathered for this report could be useful in designing future studies to address this question. (TURI, 2017)

Dr. Richard Clapp, of Boston University School of Public Health and Former Director of the Massachusetts Cancer Registry, has cautioned that while studies have been conducted on crumb rubber tire materials and artificial turf, they were risk assessments versus epidemiological studies. "Studies that have been done that claim there is no harm, or no health effects from crumb rubber, are what are called risk assessments. They are estimates of what the exposure might be and then mathematical calculations as to what the human health risk might be. The studies that claim there have been no health risks shown from crumb...are estimates that depend on a lot of assumptions."

He explains that there is a significant period of time to market belief with epidemiology studies; testing must be done after enough cases are found to cause a concern, peer review, publication, and distribution follow and could take years while our children are being exposed to harmful substances. Children have several considerations when looking at these harmful or cancerous materials; children have immature immunology to fight toxic effects, have organs that grow wildly faster than adults; and ingest and breathe more toxins per body weight. Mr. Clapp strongly recommends that parents and adults consider alternatives to crumb rubber tire.

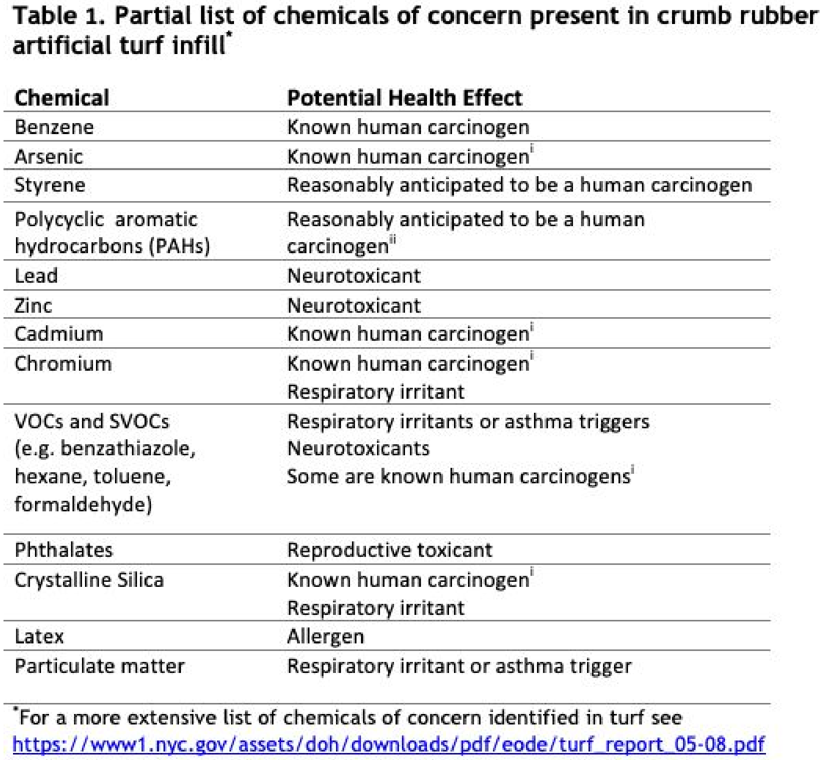


Table 1. Partial list of chemicals of concern present in crumb rubber artificial turf infill*

Chemical	Potential Health Effect
Benzene	Known human carcinogen
Arsenic	Known human carcinogen[i]
Styrene	Reasonably anticipated to be a human carcinogen
Polycyclic aromatic hydrocarbons (PAHs)	Reasonably anticipated to be a human carcinogen[ii]
Lead	Neurotoxicant
Zinc	Neurotoxicant
Cadmium	Known human carcinogen[i]
Chromium	Known human carcinogen[i] Respiratory irritant
VOCs and SVOCs (e.g. benzathiazole, hexane, toluene, formaldehyde)	Respiratory irritants or asthma triggers Neurotoxicants Some are known human carcinogens[i]
Phthalates	Reproductive toxicant
Crystalline Silica	Known human carcinogen[i] Respiratory irritant
Latex	Allergen
Particulate matter	Respiratory irritant or asthma trigger

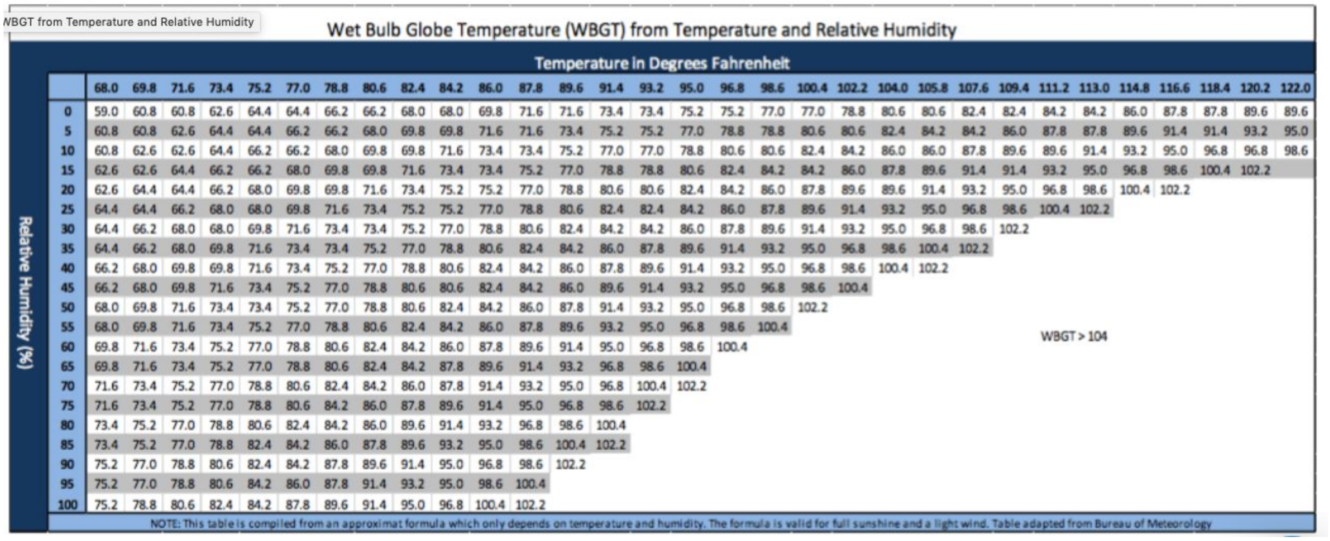
*For a more extensive list of chemicals of concern identified in turf see https://www1.nyc.gov/assets/doh/downloads/pdf/eode/turf_report_05-08.pdf

Mt Sinai Children's Environmental Health Center supports a moratorium of installation of tire crumb rubber fields.

Heat is a significant factor in considering the health benefits of natural playing fields or the management of synthetic fields. With changing climate patterns, we are experiencing more extreme temperature shifts, as well as seasonal shifts in temperature patterns. It is reasonable to anticipate longer, hotter days in the fall season.

Communities have tried to cope with the excessive heat of artificial turf by watering; however temperatures are found to quickly rebound. Alternative materials are being created within the industry to address this issue. The Burlington School Committee policy on the use of artificial fields addresses practices for heat exhaustion and stroke risks for all student user groups. Notes include: if the air temperature is ≥85º with humidity ≥60º, only a grass surface may be utilized for physical education; for the marching band members the artificial field and track may not be used when surface temperatures exceed 100º. Thermal burns occur on humans when soft tissue is exposed to temperatures above 115ºF (46°C) with the extent of damage depending on the duration of contact. Existing guidance and usage may take into account this safety issue.

Infrared sensors are recommended as the best way to measure surface temperatures. (J. Abraham, Saint Thomas University) Currently, most programs rely on Wet Bulb Globe Temperature, a combination of measurements.



WBGT from Temperature and Relative Humidity

Wet Bulb Globe Temperature (WBGT) from Temperature and Relative Humidity

Temperature in Degrees Fahrenheit

Relative Humidity (%)	68.0	69.8	71.6	73.4	75.2	77.0	78.8	80.6	82.4	84.2	86.0	87.8	89.6	91.4	93.2	95.0	96.8	98.6	100.4	102.2	104.0	105.8	107.6	109.4	111.2	113.0	114.8	116.6	118.4	120.2	122.0
0	59.0	60.8	60.8	62.6	64.4	64.4	66.2	66.2	68.0	68.0	69.8	71.6	71.6	73.4	73.4	75.2	75.2	77.0	77.0	78.8	80.6	80.6	82.4	82.4	84.2	84.2	86.0	87.8	87.8	89.6	89.6
5	60.8	60.8	62.6	64.4	64.4	66.2	66.2	68.0	69.8	69.8	71.6	71.6	73.4	75.2	75.2	77.0	78.8	78.8	80.6	80.6	82.4	84.2	84.2	86.0	87.8	87.8	89.6	91.4	91.4	93.2	95.0
10	60.8	62.6	62.6	64.4	66.2	66.2	68.0	69.8	69.8	71.6	73.4	73.4	75.2	77.0	77.0	78.8	80.6	80.6	82.4	84.2	86.0	86.0	87.8	89.6	89.6	91.4	93.2	95.0	96.8	96.8	98.6
15	62.6	62.6	64.4	66.2	66.2	68.0	69.8	69.8	71.6	73.4	73.4	75.2	77.0	78.8	78.8	80.6	82.4	84.2	84.2	86.0	87.8	89.6	91.4	91.4	93.2	95.0	96.8	98.6	100.4	102.2	
20	62.6	64.4	64.4	66.2	68.0	69.8	69.8	71.6	73.4	75.2	75.2	77.0	78.8	80.6	80.6	82.4	84.2	86.0	87.8	89.6	89.6	91.4	93.2	95.0	96.8	98.6	100.4	102.2			
25	64.4	64.4	66.2	68.0	68.0	69.8	71.6	73.4	75.2	75.2	77.0	78.8	80.6	82.4	82.4	84.2	86.0	87.8	89.6	91.4	93.2	95.0	96.8	98.6	100.4	102.2					
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40	66.2	68.0	69.8	69.8	71.6	73.4	75.2	77.0	78.8	80.6	82.4	84.2	86.0	87.8	89.6	91.4	93.2	95.0	96.8	98.6	100.4	102.2									
45	66.2	68.0	69.8	71.6	73.4	75.2	77.0	78.8	80.6	80.6	82.4	84.2	86.0	89.6	91.4	93.2	95.0	96.8	98.6	100.4											
50	68.0	69.8	71.6	73.4	73.4	75.2	77.0	78.8	80.6	82.4	84.2	86.0	87.8	91.4	93.2	95.0	96.8	98.6	102.2												
55	68.0	69.8	71.6	73.4	75.2	77.0	78.8	80.6	82.4	84.2	86.0	87.8	89.6	93.2	95.0	96.8	98.6	100.4													
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100	75.2	78.8	80.6	82.4	84.2	87.8	89.6	91.4	95.0	96.8	100.4	102.2																			

WBGT > 104

NOTE: This table is compiled from an approximat formula which only depends on temperature and humidity. The formula is valid for full sunshine and a light wind. Table adapted from Bureau of Meteorology

WBGT READING	**ACTIVITY GUIDELINES & REST BREAK GUIDELINES**
Below 76°F	Normal activities. Provide at least 3 separate rest breaks each hour for a minimum duration of 3 minutes each during workout.
76.1-81.0°F	Use discretion for intense or prolonged exercise, and watch at-risk players carefully. Provide at least 3 separate rest breaks each hour for a minimum duration of 4 minutes each.
81.1-84.0°F	Maximum practice time is 2 hours. For football: Players should be restricted to a helmet, shoulder pads, and shorts during practice; all protective equipment should be removed for conditioning activities. For all sports: Provide at least 4 separate rest breaks each hour for a minimum of 4 minutes each.
84.1-86.0°F	Maximum length of practice is 1 hour. No protective equipment should be worn during practice, and there should be no conditioning activities. There should be 20 minutes of rest breaks provided during the hour of activity.
Above 86.1°F	No outdoor workouts. Cancel activity; delay practice until a cooler wet-bulb globe temperature/heat index reading occurs.

2018 Season Segments	**Days in Period**	**Weather: Days High Temp recorded ≥85°**	**Days Synthetic Turf Temp Estimated ≥100°**	**% of Days Synthetic Turf Temps Estimated ≥100°**
Days of Play During Spring Season School Year: April 1 to June 30	91	8	87	96%
Days of Play During Summer: July 1 to August 15	45	23	45	100%
Days of Play During Fall Season School Year: August 16 to Nov 16	93	12	77	83%

Estimation of days where synthetic field temperatures are anticipated to have required closure for some period of time.

Hand-washing
Parents routinely express concerns for hand-washing in school, particularly before eating. Hand-washing with soap and water is the only way to remove residual chemicals and dirt, as well, it removes most bacteria. Hand-sanitizer kills bacteria, however it does not remove dirt. Hand-washing is also recommended by health professionals after use of synthetic turf fields and "pour in place" playground surfaces, in order to remove residual chemicals from infill material. Eating or drinking anything other than water is not recommended on synthetic fields both to keep the surface clean and to avoid inadvertent ingestion of the field material. These practices are recommended by MA Department of Public Health and others. Enabling best practices and educating users can be improved.

Bacteria
Artificial turf is known to harbor significant levels of harmful staph bacteria, at levels well above those of natural turf emplacements. The EPA report presented findings of 70% of the 40 artificial fields tested to have at least one sample for methicillin (staph) resistance. 42% had at least one sample of Staphylococcus aureus bacteria. Artificial turf carries a demonstrated greater risk of abrasion injury, which when combined with the occurrence of staph increases the risks associated with otherwise minor scrapes. CA OEHHA found more frequency of skin abrasions for athletes playing on synthetic turf than natural turf. Recommendations were made for protective clothing coverage for use of synthetic turf. There is concern in the medical community about the overuse of antibacterial substances in society at large, as regularly prescribed antibiotics are met with increasingly resistant strains of bacteria.

VOCs
Volatile organic compounds (VOCs) are known for causing irritation and allergic reactions in humans, and have also been associated with more severe health conditions after prolonged exposure. Semi Volatile Organic Compounds in tire crumb from indoor fields were 1.5 to 10 times higher than outdoor fields, similar differences were seen for VOC emissions. Potential impact on exposures would need to be evaluated through additional testing. (EPA 2019)

Lead

Considering Risks	*"...the best 'treatment' for lead poisoning is to prevent any exposure before it happens"* – Dr. Jennifer Lowry, MD, FAACT, FAAP, Chair AAP Council on Environmental Health

Risk is inherent in every aspect of daily life. With respect to play areas, the most common risks associated are presence of lead and other chemical contaminants and preventing injuries, such as falls and scrapes, and potential bacterial infections.

The American Academy of Pediatrics considers there to be no safe level of lead exposure for children. Lead in play areas can present a risk through direct ingestion or tracking indoors. They attribute every 1 in 5 cases of ADHD to lead exposure, and estimate an annual cost of lead exposure to be $50 billion in the United States. The National Toxicology Program finds there to be sufficient evidence for adverse health effects in children *and* adults at <5 micrograms per deciliter (µg/dL). The Consumer Product Safety Improvement Act places the allowable level at 100 mg/kg for children's products. (2015 MA DPH)Play areas that often have high lead levels are those found close to high traffic volumes such as urban highways, adjacent to old painted residences, or where related industry was on the site. Soil for newly constructed areas are screened to meet lead level standards. Where related activities would not warrant testing, preventative measures may be adequate. Verifying no or low lead level certifications related to lead content is warranted.

Environment

Belmont has moved to ban single-use plastic bags in recognition of the effects of plastic pollution and need to reduce unnecessary uses of petroleum-based plastics. It is estimated that one artificial field carpet is equal to 3.2 million single-use plastic bags. When used with synthetic infill, it is equal to 32 million single-use plastic bags. Microplastics are an increasing concern for human health, as they permutate the food production and supply system through soil and water ways.

A synthetic turf surface acts as an impervious surface. It necessitates water detention structures or other flow controls to prevent direct drainage into the stormwater system. Envirofill, Durafill, and other coated sand products are infused with an antibacterial triclosan to preserve the product. Triclosan is an endocrine disruptor and associated with liver and inhalation toxicity.

Heat Island Effects

Urban areas are known for being warmer than their rural counterparts, due to a phenomenon called the "heat island effect." Heat islands are caused when an abundance of buildings and pavement results in conditions that cause land surface temperatures to exceed air temperatures. Vegetation and trees are most effective in heat island mitigation planning, as they reduce runoff and provide cooler surfaces. This map view shows the heat island effect of the current BHS campus and fields. The roof and synthetic field here (red areas) register annual average temperature of 108º. (Mayors Map)

Waste

The cost of disposing a synthetic turf field into a landfill is $30-60,000 for an 80,000 sq ft field, according to the Synthetic Rubber Council. The economics of recycling are still developing. Waste tires can be used as fuel ('tire-derived fuel') as well as in a variety of civil engineering applications in landfills and highways, and at playgrounds, horse arenas, and running tracks. Generally in Massachusetts, waste tires are shredded before they are recycled. Shredding reduces the volume of tires, eliminates the compaction problem at landfills and eliminates mosquito-breeding locations. The number of waste tires stockpiled in this country, plus the number being generated each year, still exceeds the market demand. (DEP)

> *"The best solution in my mind, to having decent playing fields that don't involve toxic materials, is to put in one of these properly drained, multi-layer natural grass fields. There are now companies that make these fields, that are beautifully set up, they've figured out what type of grass, the right species of grass for the right part of the country, they require minimal or no pesticides. Properly maintained they will last for years and no hazardous waste at the back end."*
>
> – Philip J. Landrigan, MD, MSc, DIH, FAAP, Dean for Global Health, Professor of Environmental Medicine, Public Health, and Pediatrics Artnol Institute for Global Health, **Icahn School of Medicine at Mount Sinai**

Sports Turf Alternatives Assessment: Preliminary Results
CHEMICALS IN ARTIFICIAL TURF INFILL: OVERVIEW

Massachusetts Toxics Use Reduction Institute
February 2017

Introduction

The Massachusetts Toxics Use Reduction Institute (TURI) conducts alternatives assessments as part of its overall mission to help Massachusetts companies, communities, and municipalities identify and implement toxics use reduction options that will provide safer solutions to the use of toxic chemicals.

TURI has received numerous requests for information about artificial turf fields as an alternative to natural grass fields. In response, TURI is developing an alternatives assessment for sports turf. Preliminary sections of the assessment are being published in the order in which they are developed.

The section presented here provides an overview of issues related to chemicals in artificial turf infills. Subsequent sections will provide additional detail on the individual infill types.

Overview: Infill Materials

The most commonly used artificial turf infill is made from recycled tires. This material is frequently referred to as crumb rubber, or as styrene butadiene rubber (SBR). For purposes of the present discussion, the recycled tire material is referred to as “recycled tires” or “tire crumb.”

A number of materials are currently marketed as alternatives to recycled tires. Some are based on synthetic materials, while others are mineral- or plant-based, or contain a mixture of natural and synthetic materials. As shown in Table 1, below, alternative synthetic infills include ethylene propylene diene terpolymer (EPDM), thermoplastic elastomer (TPE), and proprietary products made from waste athletic shoe materials, among others. Mineral-based and plant-derived materials used in infill can include sand, cork, and coconut hulls, among other materials. Among infills that include a combination of sand and synthetic materials, one example is a product made from acrylic-coated sand.

Table 1: Synthetic turf infill materials: Overview

	Material	Comments
Synthetic	Recycled tires	Principal material is generally styrene butadiene rubber (SBR). May be referred to as “crumb rubber,” “tire crumb,” or “SBR.”
	Ethylene propylene diene terpolymer (EPDM)	Also referred to as ethylene propylene terpolymer, ethylene propylene diene monomer, or ethylene propylene elastomer.
	Waste athletic shoe materials	Proprietary material; may contain a variety of polymers.
	Thermoplastic elastomer (TPE)	Broad category; can refer to a variety of materials.
Mineral- or plant-based	Sand	May be used in combination with one another or with other materials.
	Cork	
	Coconut hulls	
Combinations	Acrylic-coated sand	A variety of other combinations may be available as well.

Understanding rubber and plastic products: Key concepts

When working to understand the variety of materials that may be used in infills, it is helpful to understand some key concepts related to rubber, plastics, and other polymer materials.

Polymers. Rubber and plastic materials are polymers. Polymers are materials that are composed largely of many similar units bonded to one another.

Multiple materials. Within a given category of infill, a variety of specific materials may be used. For example, the broad categories of EPDM, TPE, and waste athletic shoe materials each can include a variety of specific materials, with a variety of additives and a variety of toxicological profiles. For this reason, it is difficult or impossible to make broad statements about the safety of a given product in any of these categories unless one has access to more detailed information.

Additives. Each material may be used with a variety of additives. These additives can include cross-linking agents, accelerators, stabilizers, plasticizers, fillers, or antimicrobials. The additives can have adverse health and environmental effects. The full list of additives is frequently not disclosed, although it may be possible to obtain guarantees that specific additives are absent, or are below a specified threshold.

Understanding rubber and plastic products: Additional terminology

For those interested in understanding more about rubber and plastic products, the following terminology may be useful.

Thermosets vs. thermoplastics. Both natural and synthetic rubbers are **thermosets**. A key characteristic of a thermoset is that although heat is used in the initial manufacture of the material, once the material has been formed, it cannot be melted. For this reason, tires and other products made from thermosets cannot be melted and re-formed into new products. Among the materials used in artificial turf infills, SBR, EPDM and shoe sole materials are all thermosets.

Thermoplastics, in contrast, are materials that can be melted and re-formed into new shapes. Thermoplastic elastomers (TPEs) are one broad category within the larger category of thermoplastics.

Curing/crosslinking/vulcanization. Thermosets gain their stability through a process of **curing**, also referred to as crosslinking or vulcanization. Curing is a process of creating links among polymer strands in order to create a stable, three-dimensional structure. In the case of a thermoset, these links are composed of irreversible chemical bonds.

A variety of chemicals can be used in the curing process. These include chemicals that become part of the crosslinking bond, as well as chemicals that catalyze or accelerate the crosslinking process. The term “vulcanization” is often used specifically to refer to crosslinking with sulfur.

In contrast to the large molecules of a polymer, the molecules added in the curing process are often relatively small. Some of these molecules may remain present as free molecules in the final material, and these may be released during product use.

Plasticizers. Plasticizers are added to stiff or rigid materials to make them more pliable. One important category of plasticizers is the pthalate esters, also referred to simply as phthalates. Mineral oil can also be used as a plasticizer. The specific plasticizers used in a given product are frequently not disclosed.

Other additives. A variety of other additives may be used in rubber and plastic products. **Fillers** such as carbon black or silica can be used to attain specific material properties or simply to extend the volume of the material. **Stabilizers** can be added to decrease the effect of light, heat or other environmental conditions on the material. A range of chemicals can be used as stabilizers. Other additives that may be used include **pigments** and **antimicrobial agents**.

In summary, a variety of chemicals can be found in materials that are marketed for use as infill. Therefore, it is important to conduct thorough research on the materials. In addition to understanding what type of polymer the material is, it is important to investigate what additives are present in it.

Regulatory standards

When testing artificial turf infills for the presence of toxic chemicals, manufacturers, regulators and others sometimes compare their results to a variety of regulatory standards. In the absence of a comprehensive regulatory regime developed specifically for artificial turf, those testing the materials have made an effort to determine which of existing standards may be relevant.

TURI's approach is to seek opportunities to reduce or eliminate the use of toxic chemicals whenever possible; this approach does not require application of any specific threshold or standard, and does not employ any assumptions about acceptable levels of exposure. However, it is useful to note which standards have been used to evaluate a given product, and to consider the relevance and utility of these standards. Therefore, some background information is provided here.

Environmental standards. Some studies compare the infill testing results with regulatory standards for contamination of soil. For example, a study by the Norwegian Building Research Institute compared the infill with regulatory standards developed by the Norwegian Pollution Control Authority for "most sensitive land use," encompassing "areas intended for housing, gardens, nurseries, schools, etc." For chemicals not covered by this standard, the researchers made reference instead to Canadian guidance values for agricultural soil, and to Predicted No Effect Concentrations developed through a European Union risk assessment program.[1]

A study conducted in Connecticut checked lead levels in the artificial turf infill and fibers against values considered by the US EPA to pose a "soil-lead hazard" in play areas.[2] A related study in Connecticut checked zinc levels in stormwater samples from the artificial turf field against federal and state regulatory levels for drinking water, surface waters and groundwater.[3] Other environmental standards sometimes used as a measure against which to compare infill include the Toxic Characteristic Leaching Procedure (TCLP), a standard that simulates leaching conditions that could occur in a landfill and is used to determine whether a material is subject to regulation as a hazardous waste under the Resource Conservation and Recovery Act (RCRA).[4] Reference is also made in some cases to a German standard for artificial turf, DIN V 18035-7.[5] Individual manufacturers have also cited a variety of other standards.

California Proposition 65. Other tests have compared the artificial turf results with standards for reporting under California's Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). This law requires disclosure of the presence of chemicals that are identified by the state of California as causing cancer or reproductive harm.

European Toy Safety Standard. A number of tests have been designed to examine infill in relation to the European Standard EN 71-3 – Safety of Toys Part 3: Migration of certain elements. EN 71-3 "specifies requirements and test methods" for migration of 19 metals or categories of metal compounds from "toy materials and from parts of toys."

Since this test is cited frequently, it may be useful to understand its structure. As shown in Table 2, below, the standard divides toy materials into three categories: Category I ("dry, brittle, powder like or pliable materials"), Category II ("liquid or sticky materials"), and Category III ("scraped-off materials").[6]

For each category, certain assumptions have been made about the amount a child may ingest in the course of play. For Category II, the standard is based on an assumption that a child may ingest 400 mg per day of the material. For Category III, the standard is based on an assumption of a much lower level of ingestion of the material, at 8 mg per day. Category I makes an intermediate assumption that a child may ingest 100 mg per day. [7]

Corresponding to these assumptions about ingestion, Category III has the highest values for each metal (i.e. it is the easiest standard for a material to meet) and Category II provides the lowest values (i.e. it is the most difficult standard for a material to meet). For example, for lead, Category III allows the presence of up to 160 mg/kg of lead in the material, while Category II allows up to 3.4 mg/kg.

A number of manufacturers have compared the results of their infill tests against the Category III values. For purposes of TURI's analysis, we have checked those same results against the somewhat more stringent Category I values. Regardless of the category used, it is important to note that the EN 71-3 standard was designed for toys, and may have limited applicability to synthetic turf infill.

Table 2: Categories of toy materials under EN 71-3

	Category 1	**Category II**	**Category III**
Category description	"Dry, brittle, powder like or pliable materials"	"Liquid or sticky materials"	"Scraped-off materials"
Additional	"[I]ncludes solid *toy*	"[I]ncludes fluid or	"[I]ncludes solid *toy*

information	*material* from which powder-like material is released during play. The material can be ingested. Contamination of the hands with powder contributes to enhanced oral exposure.”	viscous *toy material* which can be ingested and/or to which dermal exposure occurs during playing.”	*material* with or without a *coating* which can be ingested as a result of biting, tooth *scraping*, sucking or licking. This category includes those materials which are not covered by category I and II.”
Categorization of “common toy materials”: Examples	• “Compressed paint tablets, materials intended to leave a trace … (e.g. the cores of colouring pencils, chalk, crayons)” • “Pliable modelling materials, including modelling clays”	• “Liquid paints” • “Glue sticks”	• “Coatings of paints • “Polymeric and similar materials, including laminates” • “Paper and board” • “Textiles” • “Glass, ceramic, metallic materials,” • “Other materials … (e.g. wood, fibre board…)”
Assumed ingestion (mg/day)	100	400	8
Sample value: Lead (mg/kg)**	13.5	3.4	160

Source: European Standard EN 71-3:2013+A1. October 2014. ICS 97.200.50. *Safety of Toys – Part 3: Migration of Certain Elements.* Available at https://law.resource.org/pub/eu/toys/en.71.3.2015.html,viewed October 4, 2016. Information shown here is drawn from Table 1 (Cross-reference table for determining category), Table 2 (Migration limits from toy materials), and Annex H (Rationale).

ASTM standard. In 2016, ASTM International issued a standard for testing infill for certain metals, measuring the amount to which players could be exposed in case of accidental ingestion of the infill.[8] A number of industry groups announced in November 2016 that they would voluntarily adopt the standard, ASTM F3188-16.[9] (Business Wire 2016)

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 to reduce the use of toxic chemicals.

In response to information requests from municipalities, TURI is currently developing a detailed alternatives assessment for sports turf. Preliminary sections of the assessment are being published in the order in which they are developed, and are available on TURI's website at www.turi.org.

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Natural Grass Playing Field Case Study: Springfield, MA

Organic Grass Fields Meet Athletes' Needs and Protect Connecticut River Watershed

THE CITY OF SPRINGFIELD, Massachusetts, manages 12 properties, or a total of 67 acres, organically. This includes sports fields, park areas, and other public properties. Springfield's organically managed fields fully meet the community's needs for sports and other recreational activities, with high quality grass and soil.

Since starting the organic program in 2014, the city has doubled the number of properties in the program and experienced an increase in overall recreational use due to the improvement in soil and grass conditions.

This case study provides detailed information on the number of hours played at three parks in Springfield: two large complexes and one single, full-sized soccer field. Communities wishing to estimate the number of playable hours on a soccer field can use Treetop Park, the full-sized soccer field, as the most relatable model of the three parks discussed here. Treetop Park is used for approximately 1,050 hours of practice, play, and informal activity annually.

Children playing a pick-up soccer game on an organically-managed field in Springfield.

Aeration of the fields is a central element of successful organic maintenance. Other key elements include product application plans based on performance needs and soil testing for each field. Field management costs in 2018, including products, irrigation maintenance, and all labor costs, were just under $1,500 per acre across all the properties.

Springfield's organic management of natural grass has eliminated the need for pesticides, while providing a practical playing surface that fully meets the needs of athletes and others who use the parks. The Parks Department also notes that their field management choices help to protect water quality in the Connecticut River.

June 2019

TURI
TOXICS USE REDUCTION INSTITUTE
UMASS LOWELL

Introduction

This case study has been developed by the Toxics Use Reduction Institute (TURI) as part of an effort to provide information to municipalities, schools, and other institutions as they make decisions about play surfaces. TURI has documented information on the materials often used in artificial turf playing fields.[1] TURI has also gathered information on natural grass fields and has developed a series of case studies to share experiences.

This case study focuses on the organic management of natural grass on city properties, including sports fields, by the Department of Parks, Buildings, and Recreation Management in the city of Springfield, Massachusetts ("the Parks Department"). This large, city-wide program includes management of nearly three million square feet, or 67 acres. However, the organic practices described in this case study can be used on grass properties of any size.


Forest Park baseball outfield. This area is converted to a soccer field in the fall.

Communities often have questions about whether natural grass can meet their athletic and recreational needs, and whether organic management of natural grass is cost-effective. TURI has compiled this case study so that other communities can learn from the successes in Springfield.

Overview

In 2014, the Springfield Department of Parks, Buildings, and Recreation Management made a commitment to begin organic management of its natural grass fields and parks. Springfield received support through a TURI grant to design and implement organic land care and grass turf management practices on municipal and school properties.

The city began with six pilot sites. Over time, the city expanded organic care practices to additional school properties and public land. As of June 2019, these properties include 12 organically managed sites (Table 1). The Parks Department hopes to expand the program city-wide within the next few years.

This case study provides information on maintenance and costs for all the fields currently under organic management. It also provides detailed use information on three individual field areas. Each of these fields is used for scheduled sports team activities. In addition, each field is used for other activities, such as concerts, pick-up games, and informal picnics.

Communities may have a variety of reasons for choosing organic practices for grass maintenance. For Springfield, the motivation was to protect the surrounding watershed and provide healthy playing spaces for youth.

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[1] Massachusetts Toxics Use Reduction Institute. "Artificial Turf: Seeking Safer Alternatives for Athletic Playing Fields." Available at www.turi.org/artificialturf.

Table 1: Springfield organically managed properties in order from largest to smallest, June 2019

Park	Area (sq. ft.)	Sports/Other Information
Blunt Park	757,508	Baseball, softball, football, soccer, lacrosse, and concerts
Forest Park Playing Field	733,165	Baseball, softball, football, soccer and concerts
Van Horne	459,994	Baseball, soccer, rugby concerts
Nathan Bill Park	306,662	Baseball, softball, soccer
Central High School	231,739	Baseball, soccer; two separate fields included in organic program
Treetop Park	117,771	Soccer
Sweeny Athletic Field at High School of Commerce	104,108	Athletic play and physical education classes
Court Square	74,862	Park in downtown Springfield across the street from City Hall; heavy foot traffic
Camp Wilder	64,577	Park with playground, pond, and small playing field; leisure sports; organically managed since construction
Terrace at Mason Square	25,350	Irrigated small park in downtown Springfield
Merrick Park	24,956	Small park in downtown Springfield
Mary Troy Park	22,700	Small park in the city; includes playground
Total organically managed area	**2,923,392**	

Project Design and Startup

The first steps in the organic management program were to conduct soil testing, identify priority actions to improve soil health, and allocate staff time for maintenance activities. Chip Osborne of Osborne Organics designed the testing protocol, analyzed results, and developed a detailed maintenance plan for the city.

Soil Testing

The soil testing provided information on physiochemical characteristics of the soil such as texture and acidity (pH), and levels of key nutrients such as phosphorus, potassium, nitrogen and calcium (Table 2). Soil testing also provided information on microorganisms in the soil, including bacteria, fungi, and nematodes. The correct balance of physiochemical and biological variables is essential to healthy soil and a healthy grass root system.

Since the project startup, Springfield has repeated selected soil tests every two to three years in order to estimate an accurate amount of fertilizer and other soil amendments to add to fields throughout the year.

Table 2: Variables measured during soil testing (examples)

Physiochemical	Nutrients	Biological
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.

Hours of Activity: Examples from Three Sports Fields

One of the questions frequently asked by decision-makers is how many hours of activity they will be able to schedule on a natural grass playing field. According to the Parks Department, organic management has improved the overall condition of these fields. Many hours of both formal and informal sports play occur on these fields, and there are few cancellations due to weather-related field conditions.

The Parks Department provided TURI with scheduled sports team use hours for two sports field complexes, Forest Park and Blunt Park, and one full-sized soccer field, Treetop Park.

Youth and adult (high school and adult league) sports teams generally use city fields from late March through late November. Hours of sports team use were estimated by multiplying the number of scheduled practices and games per week by the number of hours booked for each activity. Table 3 shows the number of weeks each sport is played per season, and the amount of time allotted for practices and games for each sport and age group.

Table 3: Weeks per season, hours of use per practice, and hours of use per game for each sport played on case study fields

Sport	Age Group	Weeks per Season	Hours per Practice	Hours per Game
Baseball/softball (Mid-March to June)	Adult	14	2	3
	Youth	14	1.5	2.5
Football (Mid-Aug to Nov)	Adult	14	3	3
	Youth	14	2	2
Soccer (Mid-Aug to Nov)*	Adult	14	2	2
	Youth	14	1.5	1
Lacrosse (Mid-April to June)	Adult	10	2	none **

*Soccer is played in both the spring and fall at Treetop Park. Treetop is the only park with a longer soccer season.

**Lacrosse games are not played on case study fields; only practice is held on these fields.

These fields are also used by Springfield residents for informal activities, such as pick-up games, or passive recreation, such as picnics. These activities take place during open park hours that have not been scheduled for team use, or on areas of the complex that are not in use during formally scheduled activities. Though this type of use is not formally tracked, the Parks Department noted steady use for unscheduled activities throughout the year. In the absence of data on informal activities, TURI estimated that Forest Park and Blunt Park were used for an additional 14 hours per week, and Treetop Park an additional seven hours per week, of informal/ unscheduled activity.

Cancellations

Baseball games and practices are rescheduled during active rain. In general, baseball field use is cancelled during rain because puddles form on the clay areas in the infield. This is unrelated to the organically managed grass, and is standard for baseball fields. An estimated total of 30 baseball games/practices were cancelled in 2018 in both Forest Park and Blunt Park, primarily due to rain at the time of the scheduled activity.

In contrast, soccer, football, and lacrosse generally do not need to be cancelled due to rain. Cancellations occur only if there has been heavy rain for an extended period of time (a full day or more). For soccer, football and lacrosse in 2018, there were 10 individual game or practice cancellations at Forest Park, zero cancellations at Blunt Park, and 12 individual game or practice cancellations at Treetop Park.

Forest Park: Baseball and Soccer Complex

The playing field area at Forest Park is around 730,000 square feet and includes four 60-foot diamonds and two 90-foot diamonds with converging outfields.[2] The fields are open seven days a week from dawn until dusk. Scheduled play occurs each weekday from 2 p.m. to 8 p.m., and weekend days from 9 a.m. to 7 p.m. During these time periods, the area is in continuous use by sports teams.

In the spring and summer, the sports complex is used primarily for baseball and softball team games and a few weeks of pre-season practices. An average of 20 adult and 25 youth baseball and softball team games were played weekly in the spring/summer season of 2018.

In the fall, the baseball outfields are merged together to form three soccer fields used for both team practices and games. In 2018, adult teams used the fields for 10 games and 10-15 practices per week. Youth teams used the fields for 15 games and 10-15 practices per week.

Over the course of 2018, sports teams used the Forest Park sporting complex just over 200 hours per week, or nearly 2,900 hours for the entire year, for sports practice and games. Adding estimated informal use time leads to an estimated total of nearly 3,300 hours per year. Table 4 shows the total number of hours used by adult and youth teams for each sport per season.

Table 4: Forest Park baseball and soccer complex (733,165 sq. ft.): Hours of use for sports practice and games, 2018

Sport	Age Group	Season	Total Use: Hours per Week*	Total Use: Hours per Season
Baseball/softball	Adult	Spring	67	940
	Youth	Spring	68	950
Soccer	Adult	Fall	40	560
	Youth	Fall	30	420
Total documented sports team use – all seasons			**205**	**2,870**
Estimated informal recreation hours			14	392
Estimated total hours – all seasons			**219**	**3,262**

*Baseball/ softball and soccer seasons were 14 weeks each. Informal use hours were calculated for 28 weeks. Hours do not account for cancellations. There were approximately 60 hours of baseball cancellations and 20 hours of soccer cancellations in 2018.

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[2] "60 foot" and "90 foot" refers to number of feet between bases. The sizes of these fields are standard for baseball and softball diamonds.

Blunt Park: Baseball, Soccer, Football, and Lacrosse Complex

Blunt Park's field area measures around 760,000 square feet and is open from dawn until dusk. The sports complex contains four 60-foot fields and two 90-foot diamonds, along with space for other recreation. The complex is mainly used for baseball/softball, football, soccer, and lacrosse practices and games. The park is also used for pickup games and many other non-sports events, such as concerts, throughout the year. Table 5 shows the total number of hours used by adult and youth teams for each sport per season.

In spring and summer 2018, the fields were used for 35-40 adult baseball/softball practices per week before the start of the season. During the game season, they were used for an average of 20 adult games per week. Youth teams used the fields for 15-20 youth practices and an average of 10 games per week. Blunt Park outfields were also used for five youth lacrosse practices per week during the spring.

In the fall, these baseball/softball outfields are combined and converted into two football fields and one combination field area for soccer, football, and lacrosse. During the 2018 football season, the outfield complex was used for 15 adult and five youth football practices per week. The field was also used for eight adult and five youth football games per week. During the fall soccer season, the field was used for five adult and five youth practices per week throughout the season. In addition, the field was used for five adult lacrosse practices per week during the fall. The estimated hours of use by sports teams on the complex totaled just over 230 hours per week and just over 3,200 hours for the year. Including estimated informal recreation, the field complex was used for about 3,600 hours in 2018.

Table 5: Blunt Park baseball, soccer, football, and lacrosse complex (757,508 sq. ft.): Hours of use for sports practice and games, 2018

Sport	Age Group	Season	Total Use: Hours per Week*	Total Use: Hours per Season
Baseball/softball	Adult	Spring	70	980
	Youth	Spring	48	665
Lacrosse	Adult	Spring	10	100
Football	Adult	Fall	69	966
	Youth	Fall	20	280
Soccer	Adult	Fall	10	140
	Youth	Fall	8	105
Total documented sports team use – all seasons			**234**	**3,236**
Estimated informal recreation hours			14	392
Estimated total hours – all seasons			**248**	**3,628**

*Baseball/ softball, football, and soccer seasons were 14 weeks each. Lacrosse season was 10 weeks. Informal use hours were calculated for 28 weeks.

Hours do not account for cancellations. There were approximately 60 hours of baseball cancellations in 2018.

Treetop Park: Full-Sized Soccer Field

Treetop Park is around 118,000 square feet and is primarily reserved for scheduled soccer practices and games in the spring, summer, and fall. The field is used less frequently for informal recreation than Forest Park and Blunt Park, as the entrance to the parking lot is locked. Table 6 summarizes the number of hours used for each sport and age group in 2018.

Forest Park and Blunt Park both include multiple overlapping fields. In contrast, Treetop Park is a single, full-sized soccer field. Communities wishing to estimate number of playable hours on a soccer field can use Treetop Park as the most comparable model.

In spring 2018, the field was used for five adult and 10 youth practices per week, two weeks prior to the start of the official spring playing season. During the official season, the field was used for five adult and 10 youth games per week. In the fall, Treetop was used for five practices and five games by adult teams, and five practices and 10 games by youth teams per week. The soccer field was estimated to have been used by sports teams for about 60 hours per week and just over 850 hours for the year. If estimated informal use is included, usage in 2018 totals about 1,050 hours.

Table 6: Treetop Park soccer field (117,771 sq. ft.): Hours of use for sports practice and games, 2018

Sport	Age Group	Season	Total Use: Hours per Week*	Total Use: Hours per Season
Soccer	Adult	Spring	11	160
	Youth	Spring	12	170
Soccer	Adult	Fall	20	280
	Youth	Fall	18	245
Total documented sports team use – all seasons			**61**	**855**
Estimated informal recreation hours			7	196
Estimated total hours – all seasons			**68**	**1,051**

*Soccer is played year-round at Treetop Park. Spring and fall seasons were 14 weeks each. Informal use hours were calculated for 28 weeks.

Hours do not account for cancellations. There were approximately 24 hours of soccer cancellations in 2018.

Maintenance

Maintenance occurs throughout the playing season, and includes aeration and the application of organic products including fertilizer and soil amendments. Soil amendments are materials added to soil to improve physical and/or chemical properties. Table 7 shows the 2018 schedule for aeration and application of organic products for the three parks highlighted in this case study.

Aeration

Aeration is accomplished by pulling up plugs of soil and grass using a riding or push machine. This process relieves compaction of soil and thatching of grass and allows air, water, and added nutrients to penetrate the soil. Aeration can be a time-consuming process, but is arguably the most important step for maintaining healthy, organic grass.

All of the organically managed fields in Springfield are aerated four times per year (Table 7). The Park Environmental Specialist aerates all the fields, at times with the assistance of one additional staff member. Choosing the type of aerator to use depends on the size of the grass area. A riding aerator is used for large, open areas with space for wide, gradual turns. A smaller push aerator is used for smaller areas or tight spaces near sports equipment or trees.

Springfield's tractor-led aerator used for large areas

Fertilizers and Soil Amendments

Springfield uses organic fertilizers and soil amendments and utilizes services provided by PJC Organics, a small consulting company and fertilizer producer/distributor in Massachusetts. PJC organizes soil testing and recommends products and their application schedules for each park based on these results along with performance needs. Recommendations include how many pounds of product are needed per field, per acre, and per application. These site-specific recommendations help avoid over-application of products.

Springfield uses an organic granular fertilizer made from soybean meal, feather meal, and potassium sulfate. Fertilizer is added to each field twice per year: once early in the summer, and again in late summer (Table 7). Springfield uses a Lely Broadcast Spreader to apply all products to fields.

Springfield also uses soil amendments including a soil conditioner and lime. The soil conditioner is made with biochar (charcoal), kelp, molasses, and soybean and is used to improve the chemistry, structure, and biological activity in the soil. Conditioner is added to the fields in the spring or early summer to jump-start microbial activity. Lime is added to the fields in October to adjust soil pH.

Key elements of Springfield's organic grass management:

- Soil testing for physical, chemical, and biological characteristics
- Aerating grass and soil
- Using organic fertilizer & soil amendments
- Mowing regularly

Table 7: Aeration and organic product applications schedule, 2018

Location	Field Aeration				Fertilizer		Conditioner	Lime
	Round 1	Round 2	Round 3	Round 4	Round 1	Round 2		
Blunt Park	May	Jun	Sep	Nov	Jun	Sep	Jun	Oct
Forest Park	Apr	Jun	Sep	Oct	May	Sep	Jun	Oct
Treetop Park	May	Jun	Aug	Oct	Jun	Oct	spring	Oct

This table shows only the fields highlighted in this case study. The other organically managed properties follow a similar schedule.

Costs

The majority of costs fall into three main categories: products, irrigation maintenance, and staffing. In general, costs associated with organic grass management often decrease after the first few establishing years, as the health of the soil and vegetation improves. The following are cost figures for 2018, the fourth year of Springfield's organics program.

Products

Products include organic fertilizer, soil conditioner and lime. The amount of product needed for a field depends on soil properties and intended use of individual fields. Grass seed was used to fill in small areas of heavy use, such as the areas in front of soccer goals. The amount of grass seed needed to accomplish this was small, and the cost was negligible for the year.

In 2018, Springfield used 440 pounds of fertilizer (total for two applications), 420 pounds of soil conditioner, and 230 pounds of lime per acre of land (Table 8). Springfield spent a total of $670 per acre, or $45,280 total, on soil products in 2018. A further breakdown of product cost estimates per organic property is shown in Table 9.

Irrigation Maintenance

Maintenance costs associated with irrigation include repairs on sprinkler heads and water lines, as well as the winterization of the system during months when the ground freezes. Springfield spent a total of $7,200 on irrigation maintenance in 2018 (Table 9).

The total cost for the Parks Department's organic management of 12 grass properties was $98,080 in 2018 (Table 9). Broken down by acre of land, the city paid around $1,460 per acre.

Table 8: Annual amount of soil products used and associated costs per acre in Springfield's organic management program, 2018

Product	Pounds Used per Acre	Cost per Acre
Fertilizer (two applications)	440	$410
Conditioner	420	$200
Lime	230	$60
Totals	**1,090**	**$670**

Totals are rounded to the nearest 10.

Table 9: Estimated annual costs for 12 organically managed grass properties in Springfield

Location	Acres	Fertilizer (per acre)		Soil conditioner (per acre)		Lime (per acre)		Total Cost
Products								
		Pounds	Cost	Pounds	Cost	Pounds	Cost	
Blunt Park	**17.4**	**7,650**	**$7,190**	**7,220**	**$3,500**	**3,830**	**$1,030**	**$11,720**
Forest Park Playing Field	**16.8**	**7,410**	**$6,960**	**6,990**	**$3,390**	**3,700**	**$1,000**	**$11,350**
Van Horne	10.6	4,650	$4,370	4,380	$2,130	2,320	$630	$7,130
Nathan Bill Park	7.0	3,100	$2,910	2,920	$1,420	1,550	$420	$4,750
Central High School playing field	5.3	2,340	$2,200	2,210	$1,070	1,170	$320	$3,590
Treetop Park	**2.7**	**1,190**	**$1,120**	**1,120**	**$540**	**600**	**$160**	**$1,820**
Sweeny Athletic Field at High School of Commerce	2.4	1,050	$990	990	$480	530	$140	$1,610
Court Square	1.7	760	$710	710	$350	780	$100	$1,160
Camp Wilder	1.5	650	$610	620	$300	330	$90	$1,000
Terrace at Mason Square	0.6	250	$240	240	$120	130	$40	$400
Merrick Park	0.6	250	$240	240	$120	130	$30	$390
Mary Troy Park	0.5	230	$220	220	$110	120	$30	$360
Annual total for products on 12 fields								$45,280
Maintenance								
Irrigation maintenance	Includes all repairs: broken sprinkler heads, lines, startup, shutdown and winterization							$7,200
Labor								
Labor costs for all fields	Includes full-time staff and assistant for 120 days of work							$45,600
Annual total for products, maintenance, and labor on 12 fields								$98,080
Annual total for products, maintenance, and labor per acre								**$1,460**

Totals have been rounded to the nearest 10. Case study fields are highlighted in green text.

Summary and Lessons Learned

Between the beginning of the program in 2014 and the end of 2018, the city has doubled the number of properties in its organic program and experienced an increase in overall recreational use due to the improvement in soil and grass conditions. These results were accomplished through frequent aeration of the fields, and the creation of field-specific product application plans based on performance needs and soil testing for each field. Field management costs in 2018, including products, irrigation maintenance, and all labor costs, were just under $1,500 per acre across all the properties.

Springfield's experience is that the organically managed fields fully meet the community's needs for sports and other recreational activities. They have also found that all of the organically managed properties have higher quality grass and soil than those outside of the program.

The Parks Director notes that field needs have changed over time. In the past, there were few or no formally scheduled sports after the baseball season ended in early July. Today, sporting requirements continue throughout the year. The fields never shut down during open hours, and game cancellations are rare.

For 2018 use information, this case study focused on three fields: Forest Park, Blunt Park, and Treetop Park. Formal use of the Forest Park sports complex totaled about 2,900 hours by baseball and soccer teams, and about 3,300 hours per year with estimated informal use included. Blunt Park sports complex totaled about 3,200 hours of use by baseball, football, and lacrosse teams, and about 3,600 hours with estimated informal use included. Treetop Park was used about 850 hours by soccer teams, and a total of about 1,050 hours with an estimated informal use included. Treetop Park is the best field to use for comparison of playable hours on an individual field, as it is composed of a single, full-sized soccer field.

> "The organically managed fields are definitely in better condition than they were before organic management. When you look at a natural meadow, it's self-sustaining. That's what we're replicating with our organic fields. And our parks are part of the Connecticut River watershed, all of our choices affect that broader ecosystem."
>
> – Patrick Sullivan, Director, Springfield Parks Department

The Parks Department Director recommends using organic management as soon as a field is constructed, when possible. Camp Wilder, a field measuring 64,577 square feet and used for general recreation by a summer camp, has been managed organically since it was constructed. Planning for organic management at the beginning of the field's life saved Springfield time and money on restructuring soil and grass in the future.

Staff working on the organic program note that the process is time-consuming but that they derive satisfaction from the process and its results. They consider field aeration to be the most essential element of the program.

The Parks Department notes that their choices affect water quality in the Connecticut River, illustrating that there are broad advantages to choosing the organic approach. The Parks Department has set a goal of reaching out to homeowners to educate them about the advantages of organic grass management, further expanding the benefits of this project.

To view our video documenting the Springfield Parks Department's experience, visit:

www.turi.org/Our_Work/Community/Organic_Lawn_Care

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