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# The Use of Artificial Turf in Parks and Schoolyards



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The findings, conclusions, and recommendations presented in this report are those of the authors alone, as well as any errors in the report.

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## TRUST FOR PUBLIC LAND GREEN PAPER SERIES

Each Green Paper is a rigorous analysis of a topic in support of TPL's mission of creating parks and protecting land for people, ensuring healthy, livable communities for generations to come. Collectively these papers advance TPL's goals and strategic commitments that parks and green spaces deliver healthier people, stronger communities, greater equity, and climate solutions. They are not an end-product; they are a starting point for change.

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Natural turf grass at Bregy Elementary schoolyard in Philadelphia, PA. © Elyse Leyenberger/TPL Staff

# Executive Summary

Artificial turf is widely used in many settings across the U.S., from professional sports facilities and parks to schoolyards and private yards. Artificial turf offers both benefits and potential risks. Trust for Public Land (TPL) is a major nonprofit partner in the renovation and construction of parks and community schoolyards across the U.S., and some of our park and schoolyard projects use artificial turf. As an organization, TPL is committed to:

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**Maximizing the benefits of artificial turf, and reducing and managing its risks;**

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**Diligently tracking the emerging evidence on artificial turf risks, transparently sharing the evidence of which we are aware, and basing our approach on that evidence;**

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**Centering community voices in all decisions regarding the choice of play surfaces;**

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**Advocating for the artificial turf industry to eliminate risks through the development of safe, sustainable products that prioritize public health and environmental stewardship.**

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This document describes TPL's approach to the use of artificial turf in schoolyards, sports fields, and other recreational surfaces, but not under playground equipment (where a range of other surfaces is available, such as resilient rubber surfacing, Corkeen, and Engineered Wood Fiber (EWF)). Both advantages and disadvantages are best considered in terms of "Compared to what?". The principal alternatives are natural grass turf and asphalt on these surfaces. Relative to each of these, artificial turf offers both advantages and disadvantages. This document outlines the evidence and general principles that can inform others in weighing the advantages and potential drawbacks of using artificial turf.



Artificial turf at Lafayette School playground in Newark, NJ. © Antoine Smith/ADS Photography

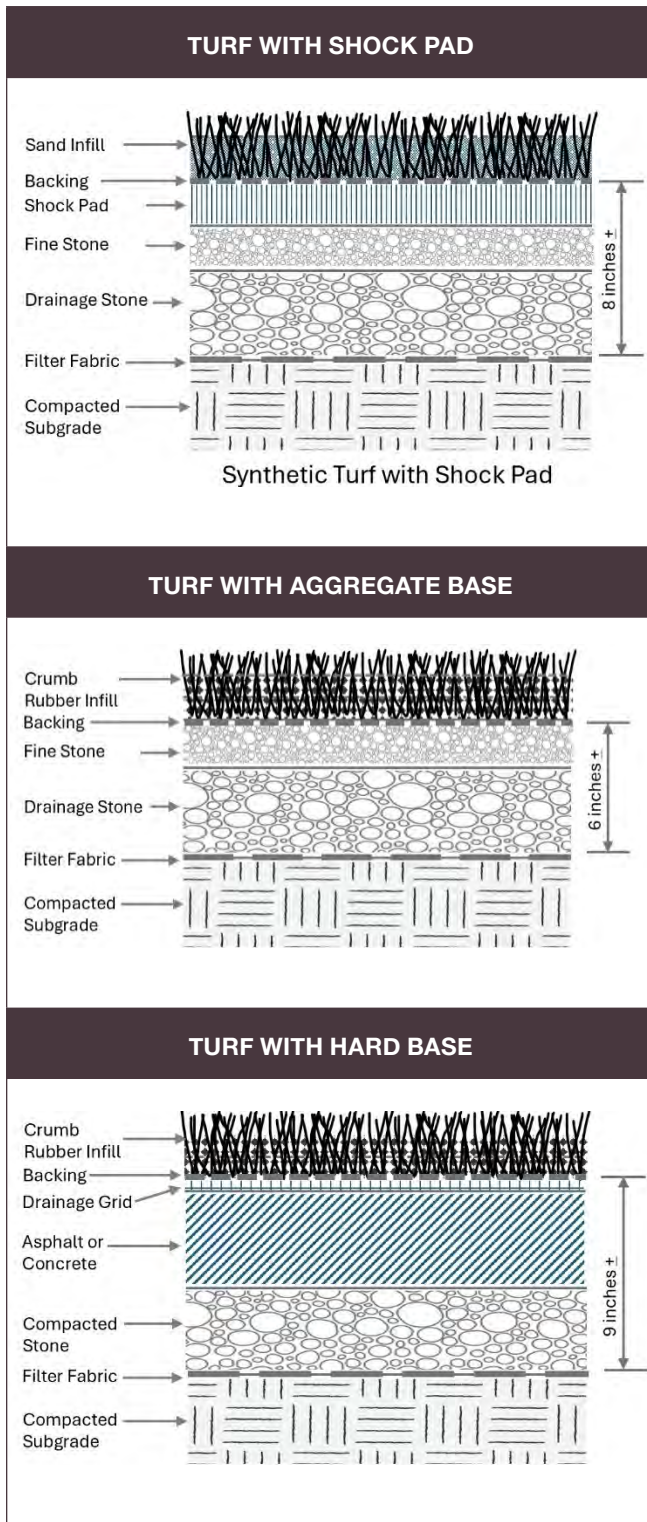
# Background

Artificial turf has been used for over 50 years in the U.S. and worldwide as a recreational surface. While many configurations have been used, three general types shown in Figure 1 are indicative: one that uses infill for shock absorption on an aggregate base, one that uses infill for shock absorption on a hard base, and a third that uses a base pad for shock absorption. Table 1 provides additional detail on the specific components of the three different types of artificial turf.

**Table 1. Components of various types of artificial turf**

COMPONENT	PROFILE TYPE		
	TURF WITH SHOCK PAD	TURF WITH AGGREGATE BASE	TURF WITH HARD BASE
Vertical filament “grass”	✓	✓	✓
Sand infill	✓		
Crumb rubber infill		✓	✓
Backing carpet	✓	✓	✓
Shock pad	✓		
Fine stone	✓	✓	
Drainage stone	✓	✓	
Drainage grid			✓
Asphalt/Concrete base			✓
Filter fabric	✓	✓	✓

**Figure 1. The images below show the general configurations of three types of artificial turf**



Component Descriptions:

- **Vertical filament “grass”** – The blades of artificial turf made from a plastic material, with the blades of filament.
- **Backing** – The vertical filament is tufted through (or glued on to) the porous plastic backing material.
- **Sand Infill** – Sand is distributed between the blades of grass to keep the blades upright and hold down the turf from wind lift. Other infill materials, such as wood, are coming into wider use.
- **Crumb rubber infill** – Crumb rubber, often from recycled tires, is distributed between blades of “grass” to keep the blades upright and to provide limited impact attenuation.
- **Shock Pad** – A permeable shock pad comprised of recycled materials is placed below the turf to provide impact attenuation when crumb rubber infill is not in use.
- **Drainage stone** – Many installations include a base layer of stone or aggregate
- **Filter fabric** – separates the stone from the compacted sub-base of the site.
- **Asphalt/Concrete based** – Some installations place turf directly over asphalt or concrete, but this practice creates issues with drainage and longevity.

The following sections discuss the advantages and disadvantages of artificial turf for recreational surfaces, followed by a discussion of TPL’s approach. Both advantages and disadvantages are best considered in terms of “Compared to what?” The principal alternatives are natural grass turf and asphalt on these surfaces. Relative to each of these, artificial turf offers both advantages and disadvantages.





Natural turf grass at Castellanos schoolyard playground in Los Angeles, CA. © Joe Sorrentino



Natural turf grass at San Jacinto Elementary School in Dallas, TX. © Jason Flowers

# Advantages

Relative to asphalt or concrete surfaces, artificial turf offers significant advantages: it is a more attractive and inviting surface for play and other forms of physical activity, less likely to cause injuries, and more pervious. Relative to natural grass, artificial turf offers advantages in terms of maintenance and durability. Each of these advantages is discussed below.

## Physical activity

Community parks and schoolyards are important locations for physical activity, a health promoting behavior beneficial with respect to a wide range of public health priorities across the lifespan including chronic disease prevention, healthy weight status, and mental health.<sup>1</sup> Replacing hard or unusable surfaces with artificial turf creates popular spaces for active play and sports. Artificial turf creates a firm, predictable ground surface that can support physical activity participation by those that use mobility equipment (e.g. walkers, wheelchairs) or have difficulty navigating uneven terrain. Improving public spaces with community input, especially in areas with poor access, has been shown to increase recreational physical activity.<sup>2-4</sup>

## Safety

Anecdotal accounts suggest that students run and play with fewer injuries on artificial turf compared with asphalt or concrete. Artificial turf can create safe and inclusive play areas that comply with the Americans with Disabilities Act (ADA) guidelines with a ground surface that is stable, firm, and slip resistant. Additional evidence is needed to better characterize differences in safety between ground surfaces for children.

## Stormwater management

Artificial turf is highly pervious, meaning that stormwater can flow through the surface to a subsurface stormwater basin. This feature offers significant advantages in communities that suffer from combined sewer overflows or localized flooding, because soil below artificial turf retains water during storm events. Asphalt, on the other hand, increases stormwater runoff, which contributes to combined sewer overflows and localized flooding. Artificial turf fields, where installed with proper drainage infrastructure, have become an important feature of localized stormwater management.

## Ease of maintenance

Regular grooming with a bristled brush is recommended for artificial turf, but unlike natural turf, it does not need to be mowed, watered, or fertilized on a regular basis, and reduces or eliminates the need for pesticide applications. These features reduce energy use and maintenance costs compared to natural turf.

## Reduced water requirements

In arid communities that face water scarcity, artificial turf can be an attractive solution relative to natural turf, which requires regular watering.

## Increased durability

Multipurpose fields in parks and schoolyards are intensively used, especially in dense urban environments. Artificial turf can stand up to this use far better than natural grass, making artificial turf the only feasible alternative to asphalt or concrete surfaces.

# Disadvantages

The four principal disadvantages of artificial turf are the potential for exposures to harmful chemicals, extreme heat, and injury risk, and challenges with disposal. Each of these is discussed below.

## Potential for harmful chemical exposures

Concerns about chemical exposures stem from both the infill materials and the synthetic fibers used in artificial grass.

Infill (also sometimes called top-dressing) can be made of a wide range of materials, including cork granules,

coconut fibers, wood, walnut shells, natural or synthetic rubber particles, synthetic polymer beads, synthetic polymer foam particles, and sand. Rubber particles have been widely used for infill. Considerable research has shown that these particles—typically obtained by grinding up old tires—may contain toxic materials, including metals, polycyclic aromatic hydrocarbons (PAHs), and semi-volatile organic compounds (SVOCs) including perfluoroalkyl and polyfluoroalkyl substances (PFAS), which derive from vulcanizing agents, extender oils, accelerators, plasticizers, antioxidants, and other additives used in rubber manufacturing.<sup>5-14</sup> These chemicals are linked with a range of health effects, from increased cancer risk to neurologic damage. Researchers have differed on the extent to which these chemicals are taken up by children playing on artificial turf fields, and on the associated level of risk.<sup>15-17</sup> The risk is not zero but is likely to be low. The risk associated with rubber infill can be avoided by choosing other infill materials, many of which pose significantly fewer chemical exposures.<sup>11</sup> Due to these concerns, many governments now limit or ban the use of crumb rubber infill.<sup>18,19</sup> TPL has not used crumb rubber infill in our projects for many years.

The fibers of grass in artificial turf are made of plastic materials such as polyethylene, a polyethylene-polypropylene blend, or nylon. These materials, like many plastic products, can contain other substances such as plasticizers and colorants, including lead chromate. Indeed, some studies have shown that artificial turf fibers can (but don't always) contain lead and chromium.<sup>6,20</sup> However, little information is available on the levels of contaminants in turf blades, on how much human exposure might result, and on levels of associated risk if any. Risk can be managed by choosing products with low levels of persistent, bioaccumulative,



Sand and engineered wood chips shown here are excellent options for a natural surface material, but consideration should be made regarding maintenance, especially in communities with a high population of rodents and stray animals. © Alexa Hoyer

and toxic substances, as confirmed by independent testing. For example, artificial turf products that are PFAS-free are now commercially available. In addition, it is good practice for children to wash up with soap and water after playing on an artificial turf surface.

## Heat

Artificial turf can become very hot on sunny days. Studies from the 1970s and 80s revealed surface temperatures approaching 200°F—in some cases more than 100°F hotter than natural turf,<sup>21-24</sup> and hot enough to burn skin. (Of note, pavement can also reach dangerously hot temperatures.<sup>25-27</sup>) Some recent research has replicated this finding,<sup>28,29</sup> although newer artificial turf products and the omission of crumb rubber infill may help avoid reaching such extreme temperatures.<sup>30-33</sup> Strategies for managing the risk of extreme heat on artificial turf include selecting infill materials and artificial turf products less likely to become very hot,<sup>30,31,33</sup> providing shade,<sup>34</sup> locating fields adjacent to existing shade, watering the artificial turf surface (although the cooling effect is short-lived),<sup>35,36</sup> and routinely measuring surface temperature on hot days and restricting children's access when the temperature is excessive.

## Injury risk

From the early years of its use, artificial turf was suspected to increase the risk of athletic injuries relative to natural grass playing surfaces. Some (but not all) studies over the last 50 years have found an increased risk of knee, ankle and foot injuries in high school, college, and professional football, soccer, and rugby players who play on artificial turf athletic fields.<sup>37-47</sup> Later generation artificial turf—with longer blades, more infill, and subsurface padding—may carry less risk. Much of the risk seems associated with the use of cleats, which do not release from artificial turf as readily as from natural grass, contributing to torque on the leg and resulting injury.<sup>48-52</sup> While there have been fewer studies of high school students playing on artificial turf, the picture is mixed, with some studies showing increased injury risk just as in older athletes<sup>53,54</sup> and others showing no increase.<sup>55,56</sup> Concerns about increased risk of skin burns and abrasions on artificial turf have also been raised, but studies comparing turf to other



Natural turf grass at Castellanos schoolyard playground in Los Angeles, CA. © Joe Sorrentino

surfaces are rare. No studies have looked at younger children's injury risk on artificial turf; given the smaller body size, lower energy transfer, and less frequent cleat use, the risk is likely to be lower than in older athletes. But for now, we lack evidence on injury risk among young children in relation to artificial turf, so until we know more, general playground injury prevention practices are recommended.<sup>57</sup>

## Disposal challenges

Artificial turf surfaces are considered to have a useful life of about ten years, although in some cases the surfaces may perform well for as long as 20 years. There is limited recycling capacity, so worn artificial turf is generally disposed of in formal or informal landfills. This raises environmental concerns, especially when crumb rubber infill is present. Emerging technologies may permit worn artificial turf to be disassembled, and its components re-used.



Artificial turf at Community Park in Sunset Park, Brooklyn, NY. © Seth Sherman

# The TPL Approach

TPL recognizes the tradeoffs associated with artificial turf. In our park and schoolyard projects, we take steps to minimize the risks and maximize the benefits of these surfaces, and we urge others to act similarly. Additionally, there may be differences in overall lifecycle costs associated with artificial turf installation and maintenance compared to natural grass, asphalt or other surfaces that need to be considered in the local context.<sup>58</sup> This process requires full, transparent information, community-centered decision-making, professional design expertise, and advocacy for improved technologies over time. TPL's approach consists of four principal commitments, described below.

## Maximizing benefits, and reducing and managing risks

Maximizing the benefits and reducing and managing the risks of artificial turf entail using the safest types of artificial turf and avoiding use of persistent, bioaccumulative, and toxic materials. It entails avoiding the use of crumb rubber infill and products that contain PFAS, and taking steps to avoid extreme heat exposure, as detailed on [page 11](#).

## Tracking, sharing, and learning from evidence

Through its Health, Parks and Community Schoolyards® teams, TPL closely follows the emerging science regarding artificial turf, and tracks and adheres to expert guidance from sources such as the U.S. Environmental Protection Agency, the Consumer Product Safety Commission, and the American Society for Testing and Materials. We share what we learn with our partners, including design professionals, school systems, parks departments, community-based organizations, and others.

We also call for independent research on artificial turf, especially on potential risks related to heat, harmful chemicals, and injuries, given their particular relevance to child health and development.

## Centering community voices in all decisions regarding the use of artificial turf

Ultimately, the decision to install artificial turf at schools and parks—like all major design decisions—belongs to the facility owner, be it a park department, city, school district or individual school. TPL is committed to sharing what we know with our community partners and design professionals and abiding by community decisions.

## Advocating for the artificial turf industry to eliminate risks through the development of safe, sustainable products that prioritize public health and environmental stewardship

TPL advocates for full transparency with regard to the materials used in artificial turf, as well as the development of innovative artificial turf products that eliminate risks to people and the planet. We're doing this both through our purchasing power and by urging manufacturers to prioritize safe and sustainable materials that safeguard public health and the environment. Through these efforts, we aim to drive accountability and set a higher standard for turf products overall.

**Note:** *This is a living document and will be edited to reflect current science and best practices as needed.*

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