

# COMMUNITY WORKSHOP 2

ATHLETIC FIELD IMPROVEMENTS AT  
DEERPATH COMMUNITY PARK

THURSDAY FEBRUARY 17, 7-8:30PM

# WELCOME!

- *2019: In development of the Parks and Recreation Department Master Plan, providing high-quality sports fields was one of the most highly prioritized amenities*
- *2020: Athletic Field Assessment*
- *2021: City Council directs staff to look into options for field improvements at Deerpath Community Park*
- *Currently gathering feedback through community engagement sessions*



# WHAT WE WILL COVER

## 1. Engagement Process

## 2. Theme Discussions (45min)

🌀 *Engagement Segment*

## 3. Design Options (45min)

🌀 *Engagement Segment*

## 4. Forward



# ENGAGEMENT PROCESS

## 1. Workshop 1 (December 15)

- *Community Thoughts & Concerns - Ranking Exercise & Table Discussions*
- *Workshop Summary & Video Available Online*

PRIORITY RANKING:		
PRIORITY LEVEL	IMPROVEMENT KEY TOPIC	COMMUNITY RANKING
1	PLAYER SAFETY	4.5
1	MAXIMIZE PLAYABILITY	4.5
1	MAXIMIZE FIELD USAGE & CONDITIONS	4.5
2	PLAYER/USER GROUP EXPECTATIONS	3.8
3	OPERATIONAL EFFICIENCIES	3.7
4	ENVIRONMENTAL SUSTAINABILITY	3.6
5	PARKING AVAILABILITY & TRAFFIC	3.5
5	ENHANCED/IMPROVED ON-SITE AMENITIES	3.5
6	FINANCIAL/OPERATIONAL COST	3.3
7	ECONOMIC DEVELOPMENT OPPORTUNITY	3.1

## 2. Workshop 2 (Today!)





**THEME  
DISCUSSIONS**

# PLAYER SAFETY

**Q** *What is the health and injury impact on player safety in normal sports participation occurring on natural grass versus synthetic turf surfaces?*

**A** *The American Journal of Sports Medicine<sup>1</sup>, University Hospitals Sports Medicine Institute<sup>2</sup>, and Orthopedic Journal of Sports Medicine<sup>3</sup> have found that the risk factor for injuries may increase on synthetic turf, though the type of synthetic turf and infill condition has not been specified in many of these studies. Risk of human exposure to metals and chemicals in tire crumb rubber is extremely limited according to the Environmental Protection Agency (EPA)<sup>4</sup>.*

## ADDITIONAL FINDINGS

- Orthopedic Journal of Sports Medicine found that maintaining an **infill weight above 6.0 pounds per square foot** can greatly **reduce risk of injury**.
- The EPA found that there are **metals and chemicals present in tire crumb rubber**. However, tests by the EPA have shown that the **risk of human exposure is extremely limited**.

*"Schools...need to adequately maintain the turf to the appropriate quality to reduce injury risk."*

- UNIVERSITY HOSPITALS SPORTS MEDICINE INSTITUTE

# MAXIMIZE FIELD USE & CONDITION / PLAYABILITY

**Q** *What did the community bring up during the theme discussions for maximizing field use & condition and playability?*

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**A** *The community didn't have direct questions related to maximizing field use & condition and maximizing playability but both themes were ranked top priority for the community. Below are some of the community's thoughts.*

*To ensure player safety and to maximize field usage, field maintenance was a top priority for the community overall.*

*Current field conditions have resulted in high cancellation rates. Community members expressed interest in maximizing playability.*

# PLAYER/USER GROUP EXPECTATIONS



*Is there a potential Lake Forest community park site that can share and alleviate the heavy usage of athletic fields in the community?*



*Townline Community Park is the only other park categorized as a community park in Lake Forest that is available to meet community needs.*

## TOWNLIN E COMMUNITY PARK



## STRENGTHS & WEAKNESSES

**SMALLER  
PARKING LOT**

**LOCATION & ACCESS  
TO MAJOR ROADS:  
INTERSECTION  
WAUKEGAN/RTE 60 +  
I-94 ACCESS**

**SMALLER  
FOOTPRINT  
(8.5 ACRES)**

**PROXIMITY TO  
NEIGHBORS**

**PROXIMITY TO  
SURROUNDING  
BUSINESSES**

**EASE OF  
MANAGEMENT/  
SECURITY**

**FIELD LIGHTS  
NOT ALLOWED**

# PLAYER/USER GROUP EXPECTATIONS

**Q** *Who are current users of the fields and who is benefiting from this public investment?*

**A** *The largest group of current users are Lake Forest youth sports programs and Deerpath Middle School athletics. The improvements are for the Lake Forest community, both residents and youth organizations to enjoy the fields.*



# ENVIRONMENTAL IMPACTS

**Q** *What are the environmental impacts of pesticides or micro-plastic/ rubber pellet particulates migration to the natural areas adjacent to the fields?*

**A** *Both natural and synthetic turf maintenance practices and materials can lead to potential contaminates migrating to the local creek or open space locations.*

## NATURAL GRASS

- Fertilizers used for natural grass turf management and maintenance can **introduce or create nutrient pollution** into adjacent waterways which can **introduce toxins into the environment, impacting native vegetation and wildlife** (EPA<sup>5</sup>).
- Nutrient pollution is the accumulation of excess phosphorus and nitrogen, which can lead to **algal blooms**. These algal blooms can eliminate oxygen in a body of water and **cause aquatic life to leave or die**.
- There are sustainable natural grass maintenance alternatives to fertilizers.

## SYNTHETIC TURF

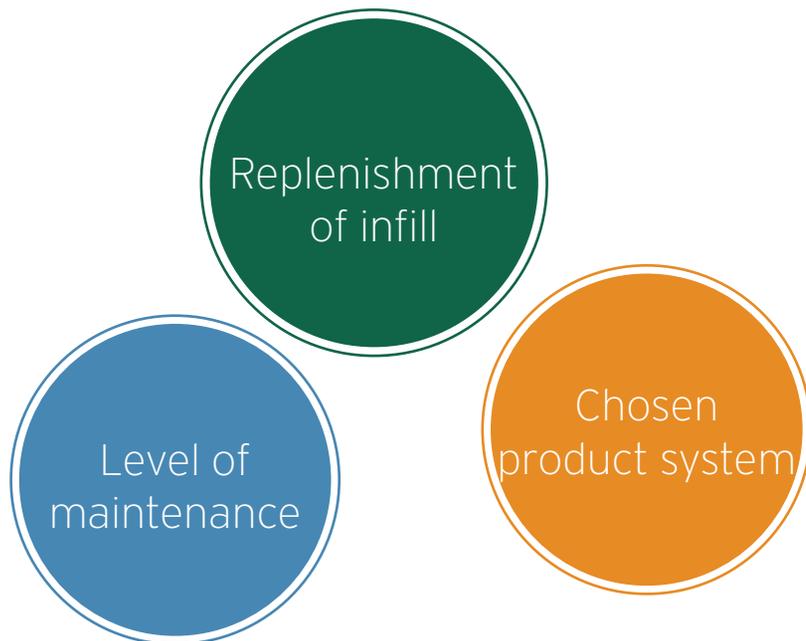
- It is **unlikely** that any chemicals and metals could leach into air or water from rubber granules **in concentrations that would pose serious human or environmental risk** (British Standards Institute and The Sports and Play Construction Association).<sup>6</sup>
- **Metals from crumb rubber can leach** back into the waterways over extended time but in concentrations that are within **ranges that could be expected to be found in native soil** (New York State Department of Environmental Conservation & New York State Department of Health).<sup>7</sup>
- **Breakdown of artificial turf** granules and fibers can **contribute to micro-plastic migration** into the environment, although alternative infill materials could mitigate the impact (International Journal of Environmental Research and Public Health).<sup>8</sup>

# ENVIRONMENTAL IMPACTS

**Q** *What is the lifespan of synthetic turf, based on the projected normal level of use?*

**A** *Industry experts from FieldTurf, AstroTurf, and MondoTurf, representing the Northern Illinois region and other Park and Recreation agencies suggest a normal lifespan of 10-12 years dependent on level of maintenance, periodic replenishment of infill, and quality of turf specification chosen.*

## FACTORS THAT INFLUENCE LIFESPAN



**Q** *What is the potential for recyclability for synthetic turf?*

**A** *According to industry experts from FieldTurf, AstroTurf, and MondoTurf, representing the Northern Illinois region, the technology does exist to recycle synthetic turf although the high cost and limited availability of recyclers in the US are barriers to recycling turf fields. The industry is actively working towards more sustainable products and practices.*

#### SUSTAINABLE PROPERTIES OF TURF

- Retired synthetic turf fields can be re-purposed for batting cages, landscaping, and dog parks.
- Recollected infill materials can be reused 2-3 normal life-cycles.
- Option to build on top of older fields so they can be recycled in the future.
- Current turf products are made of **recycled** plastic materials.



# ENVIRONMENTAL IMPACTS

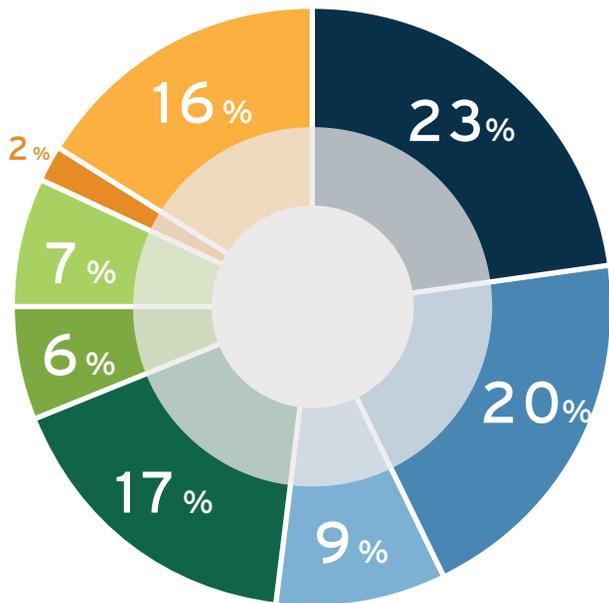


*What is Lake Forest's current household annual refuse tonnage usage and materials composition?*



*In 2021 the City of LF collected **6,523.78 tons** of household refuse from 6,550 homes or **125.46 tons/week** or **31.37 tons/day**. When the turf is replaced, it would result in an estimated additional **228 tons** or **1.82 weeks** of waste every 10-12 years.*

## YEARLY HOUSEHOLD REFUSE ESTIMATED COMPOSITION



- Food Waste
- Paper/Cardboard Packaging
- Metals
- Plastics
- Glass
- Wood
- Yard Trimmings
- Other  
(rubber, leather, textiles, diapers, inorganics, etc.)





*Are there micro-plastics in synthetic turf?*



*The International Journal of Environmental Research and Public Health<sup>9</sup> suggests that turf fields can be a secondary source of rubber or micro-plastics in the environment. Artificial turf blades are typically made of nylon, polypropylene, or polyethylene (all plastics). When these blades are broken off through normal wear and tear, they will inevitably enter the surrounding environment.*

*“Micro-plastics are small plastic particles (e.g., fibers, fragments, films, and pellets) less than 5mm across. Secondary Micro-plastics are a breakdown of larger plastic debris, tire wear, nylon/polyester fibers shed from laundry.”*

- ENVIRONMENTAL PROTECTION AGENCY<sup>10</sup>



# LET'S TAKE A BREAK AND HEAR FROM YOU!

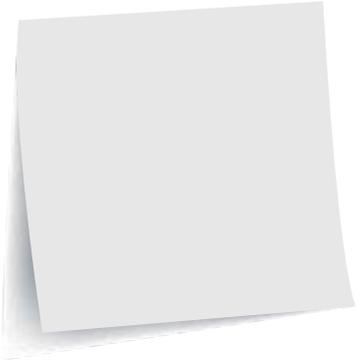


## *How to engage?*

1. Share your thoughts **using the Q&A** about the questions discussed thus far.
2. The planning team will **live comment** what we are hearing!

# WHAT ARE YOUR THOUGHTS?

*Write your thoughts in the Q&A!*



# ENVIRONMENTAL IMPACTS



What are the different infill material options for synthetic turf and the relative advantages and disadvantages of these products?



## ALTERNATIVE INFILL OPTIONS PROVIDED BY FIELDTURF REPRESENTATIVE

INFILL	DESCRIPTION	SHOCK PAD REQUIRED?	ADDITIONAL MAINTENANCE REQUIRED?	ADVANTAGES	DISADVANTAGES	NATIONAL AVG PRICE DIFFERENCE VS. SBR PER SQ FT
<b>COOLPLAY</b> 	Extruded composite made from polymer & mineral materials	No	No	<ul style="list-style-type: none"> <li>Proven heat reduction - Significant 30-35 degree heat reduction</li> <li>No change in playability vs. sand/cryogenic rubber system</li> <li>Natural UV resistance</li> <li>Good compression/compaction characteristics</li> <li>Least expensive option</li> <li>Made in North America</li> </ul>	<ul style="list-style-type: none"> <li>Crumb rubber still utilized in the system</li> </ul>	\$0.50*
<b>PUREFILL CORK</b> 	100% natural cork infill	Yes	Yes	<ul style="list-style-type: none"> <li>Fully natural material</li> <li>Good compression/compaction characteristics</li> <li>Proven heat reduction</li> <li>No water needed</li> <li>Natural UV resistance</li> <li>Infill looks like natural soil</li> <li>Fire-retardant</li> <li>No smell</li> </ul>	<ul style="list-style-type: none"> <li>Additional maintenance requirements</li> <li>Some migration of infill may occur</li> <li>Low density allows material to float, cling to fibers with static charge</li> </ul>	\$1.55
<b>PUREGEO COCONUT</b> 	Coconut peat and cork	Yes	Yes	<ul style="list-style-type: none"> <li>Fully natural material</li> <li>Proven heat reduction</li> <li>Natural UV resistance</li> <li>Infill looks like natural soil</li> <li>Natural product - not chemically produced</li> <li>Provides playing characteristics similar to natural turf</li> <li>Retains water for evaporative cooling</li> </ul>	<ul style="list-style-type: none"> <li>Fibrous material will break down over time</li> <li>Requires a watering system &amp; water to maintain playability</li> <li>Some migration of infill may occur</li> <li>Additional maintenance needed</li> <li>Higher price</li> <li>Requires more maintenance and refreshing than crumb rubber fields</li> <li>Limited resilience</li> </ul>	\$1.95 (Plus irrigation)
<b>PURESELECT OLIVE</b> 	Granulated olive cores US made	Yes	No	<ul style="list-style-type: none"> <li>Fully natural material</li> <li>Very durable infill, no replenishment needed</li> <li>No water needed</li> <li>Made in the USA</li> <li>Natural UV resistance</li> <li>Proven heat reduction</li> </ul>	<ul style="list-style-type: none"> <li>Limited Install History</li> </ul>	\$2.15 (Including CoolPlay)
<b>ECOSENSE EPDM</b> 	Alternative rubber made from virgin polymer	No	No	<ul style="list-style-type: none"> <li>Good resiliency</li> <li>No pad needed</li> <li>Similar feel and performance to SBR</li> <li>Made in North America</li> </ul>	<ul style="list-style-type: none"> <li>Limited Supply</li> </ul>	\$1.10
<b>ECOGRIND SHOEGRIND</b> 	Rubber mixture primarily from running shoes	No	No	<ul style="list-style-type: none"> <li>Not "SBR" rubber. Less public perception of health risks</li> <li>Play is similar to a sand/rubber field</li> <li>No pad needed</li> <li>Post-industrial recycled material</li> </ul>	<ul style="list-style-type: none"> <li>Still rubber, just not SBR tire rubber</li> <li>Multi-color rubber, different "look"</li> <li>Limited supply</li> <li>Unknown control over source of supply</li> <li>Waste from Asia</li> </ul>	\$2.00
<b>ECOMAX TPE</b> 	High quality TPE	Yes	No	<ul style="list-style-type: none"> <li>Great playability characteristics</li> <li>Good compression/compaction characteristics</li> <li>Tested rigorously for mechanical wear and weathering</li> <li>Heat reduction</li> <li>High quality TPE with a strong environmental story</li> <li>Made in North America</li> </ul>	<ul style="list-style-type: none"> <li>Expensive</li> </ul>	\$2.65
<b>EASYFILL COATED SAND</b> 	Acrylic coated sand	Yes	No	<ul style="list-style-type: none"> <li>Green color</li> <li>UV resistant</li> <li>Not SBR rubber</li> <li>Made in North America</li> </ul>	<ul style="list-style-type: none"> <li>Expensive</li> <li>Limited installation history</li> <li>Infill compaction</li> </ul>	\$3.65

# ENVIRONMENTAL IMPACTS

**Q** *What are the environmental impacts of normal maintenance practices for natural grass fields versus synthetic turf fields?*

**A** *The environmental impact of normal maintenance practices required for artificial turf fields is low in comparison to natural turf fields (National Science Foundation and BASF Eco-Efficiency Analysis).<sup>11</sup>*

## NATURAL GRASS

- *Emissions are produced* during normal maintenance practices for natural grass.
- Most of the *emissions produced* during the normal maintenance of natural grass fields are *offset by their CO-2 uptake*.
- Use of fertilizers and herbicides and regular water use for irrigation purposes will also contribute to the environmental impact.

## SYNTHETIC TURF

- *Reduces the use of machinery* that runs on bio-fuels.
- Most of the *emissions are released* during the *manufacturing of artificial turf*.
- Does not require the use of fertilizers or routine irrigation.

# PARKING AND TRAFFIC IMPACTS

**Q** *How will increased field usage and playability affect traffic and parking?*

**A** *No traffic increase is anticipated with normal programming. Peak period traffic impacts may be encountered with additional field usage/programming or tournaments but could be mitigated with traffic management strategies.*

## PEAK PERIOD TRAFFIC & PARKING PATTERNS

*Anticipated traffic pattern increase with increased programming and usage.*

**7 - 10PM**  
WEEKDAYS

**12 - 10PM**  
SATURDAYS

**8AM - 10PM**  
SUNDAYS

## AVAILABLE PARKING SPACES

RECREATION CENTER  
**142**  
PARKING SPOTS

DEERPATH MIDDLE SCHOOL BACK LOT  
**163**  
PARKING SPOTS

# SITE AMENITIES/OPERATIONS

**Q** *Do turf fields or natural grass fields require the property to be fenced in order to properly maintain and monitor usage?*

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**A** *Industry experts from FieldTurf, AstroTurf, and MondoTurf, representing the Northern Illinois region state that there are no requirements for fencing around synthetic turf or natural grass fields.*

## PROS & CONS OF FENCING A DEFINED SPORTS FIELD COMPLEX

### PROS

- Extend the life of the field material.
- Preserve the quality and condition of the fields.
- Reduce the amount of recurring repair or maintenance needed.

### CONS

- Limits general community access to the fields.

*Neither natural grass or synthetic turf precludes the use of the site for 4th of July celebrations.*

# FINANCIAL COSTS

**Q** *What is the cost comparison for natural grass versus synthetic turf as it relates to estimated initial investment?*

**A** *Estimated installation costs are higher for synthetic turf than for natural grass.*

ESTIMATED INITIAL INVESTMENT:				
TYPE	INSTALLATION COST	SITE AMENITIES (Site utility, building improvements, pavement rehab)	PROJECT COST	W/ CONTINGENCY (10%) & INFLATION (12%)
NATURAL GRASS	\$4,097,250	\$2,621,250	\$6,718,500	\$8,196,570
SYNTHETIC TURF	\$6,475,580	\$2,621,250	\$9,096,830	\$11,098,135

*The above costs represent an anticipated cost for installation of 10.5 acres of synthetic turf vs natural grass at Deerpath Athletic Fields. Costs assume removals, normal grading, drainage and installation of the surface turf area only.*

# FINANCIAL COSTS

**Q** *What is the cost comparison for natural grass versus synthetic turf as it relates to estimated maintenance and operations?*

**A** *Estimated maintenance and operation costs are lower for synthetic turf compared to natural grass.*

ESTIMATED MAINTENANCE & OPERATION COSTS:		
ANTICIPATED COSTS	ANNUAL COST	10-YR LIFE-CYCLE ESTIMATES
<b>NATURAL GRASS</b>		
Additional Staff (2)	\$256,000	\$2,994,510
Maintenance Supplies	\$50,000	\$500,000
<b>TOTAL</b>	<b>\$306,000</b>	<b>\$3,494,510</b>
<b>SYNTHETIC TURF</b>		
Additional Staff	\$0	\$0
Maintenance Supplies	\$15,000	\$150,000
Turf Replacement	\$0	\$2,500,000
<b>TOTAL</b>	<b>\$15,000</b>	<b>\$2,650,000</b>



# FINANCIAL COSTS

**Q** *What is the total cost comparison for natural grass versus synthetic turf as it relates to estimated initial investment of one-time costs and ongoing maintenance/operations?*

**A** *Estimated total costs (one-time investment and ongoing) for natural and synthetic turf are shown below.*

ESTIMATED TOTAL COSTS:		
COSTS	NATURAL	SYNTHETIC
TOTAL 10-YEAR COSTS (10-YEAR FINANCING)	\$13,007,947	\$16,291,311
TOTAL 15-YEAR COSTS (10-YEAR FINANCING)	\$15,191,268	\$16,398,337
TOTAL 15-YEAR COSTS (15-YEAR FINANCING)	\$15,931,513	\$17,406,167
TOTAL 20-YEAR COSTS (15-YEAR FINANCING)	\$18,462,580	\$21,914,004
TOTAL 25-YEAR COSTS (15-YEAR FINANCING)	\$21,396,780	\$22,057,837

*Total cost estimates include one-time costs, operating costs, and turf replacement. It is strictly a cost calculation and does not include any new, offsetting revenue potential.*

# ECONOMIC OPPORTUNITY



*What is the potential for on-going supportive revenue generation?*



*The City provided the following estimates for potential yearly revenue stream generated by public investment to the Deerpath Athletic Fields. Usage fees are based on current scheduling and extended availability for field rental use. The programming of potential tournaments would add additional revenue opportunities. The range anticipates either \$25/hr or \$60/hr cost for field rentals.*

## ESTIMATED ANNUAL REVENUE GENERATION

\$0

CURRENT REVENUE

\$144,000 -  
\$345,600

POTENTIAL REVENUE RANGE

# LET'S TAKE A BREAK AND HEAR FROM YOU!

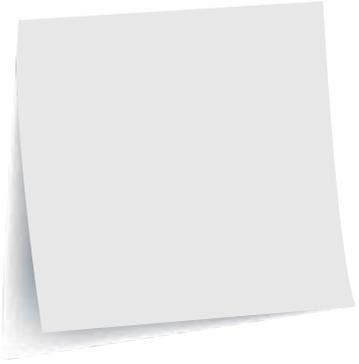


## *How to engage?*

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2. The planning team will **live comment** what we are hearing!

# WHAT ARE YOUR COMMENTS?

*Write your thoughts in the Q&A!*





**DESIGN  
OPTIONS**

# DEERPATH ATHLETIC FIELD IMPROVEMENTS

1

## BUSINESS AS USUAL



2

## NATURAL GRASS



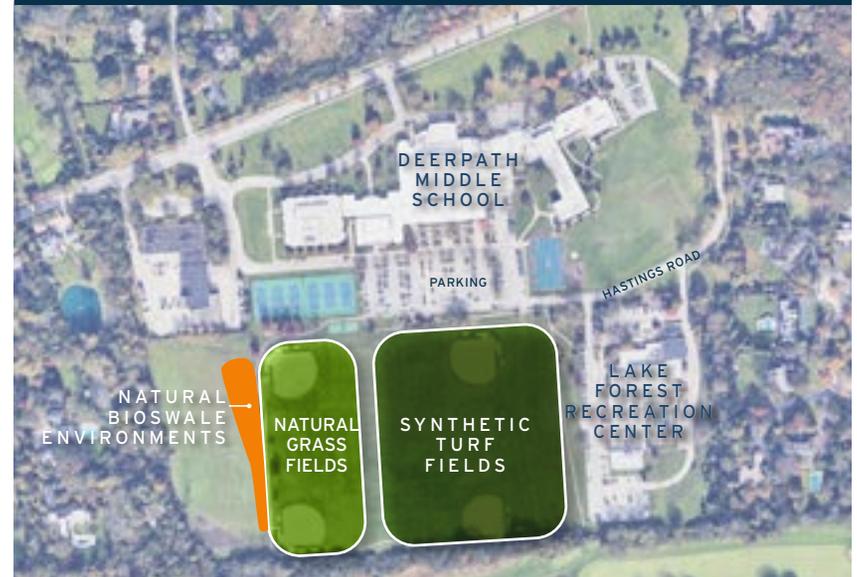
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## SYNTHETIC TURF



4

## HYBRID NATURAL/SYNTHETIC



# BUSINESS AS USUAL

## NATURAL GRASS MAINTAINED AS A PARK

### OPTION BENEFITS:

- Low cost option

### OPTION CHALLENGES:

- Requires on-going yearly effort
- Low playability and usability
- Natural grass maintenance practices



# LET'S TAKE A BREAK AND HEAR FROM YOU!

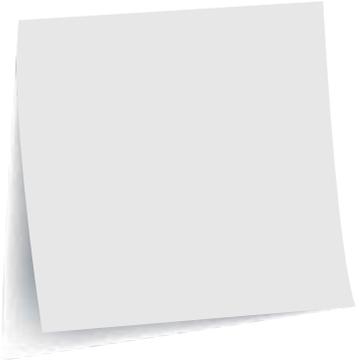


## *How to engage?*

1. Share your thoughts or comments **using the Q&A** about the **Approach**.
2. The planning team will **live comment** what we are hearing!

# WHAT ARE YOUR COMMENTS?

*Write your thoughts in the Q&A!*



# NATURAL GRASS IMPROVEMENTS

## REGRADE, REPOSITION FIELD, IMPROVE DRAINAGE, AND NATURAL LAWN

### OPTION BENEFITS:

- Implement best management sustainable standards
- Regrade, reposition and improve drainage conditions

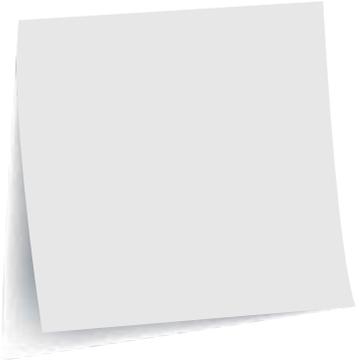
### OPTION CHALLENGES:

- Subject to weather-related cancellations
- High cost with less revenue stream potential
- Requires a higher level of maintenance
- Natural grass maintenance practices



# WHAT ARE YOUR COMMENTS?

*Write your thoughts in the Q&A!*



# SYNTHETIC TURF IMPROVEMENTS

## NEW ROBUST ARTIFICIAL TURF FIELD SPORTS COMPLEX

### OPTION BENEFITS:

- Minimize weather-related cancellations
- Implement best management sustainable standards
- Low maintenance and operations
- High revenue stream potential
- High playability and usability

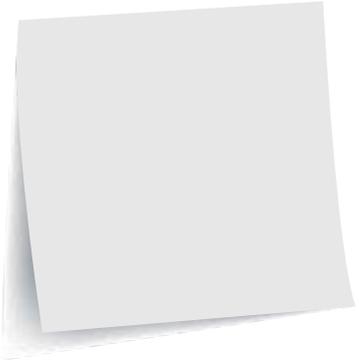
### OPTION CHALLENGES:

- High initial investment costs
- Removal costs at 10-12 years
- More heat generated



# WHAT ARE YOUR COMMENTS?

*Write your thoughts in the Q&A!*



# HYBRID NATURAL/SYNTHETIC IMPROVEMENTS

## HYBRID TURF/LAWN COMPLEX WITH IMPROVED DESIGN

### OPTION BENEFITS:

- Provides a balanced approach to meet playability, programming, and environmental needs or concerns.
- Allows for future expansion of turf facilities with further achievable benchmark metrics
- Implement best management sustainable standards

### OPTION CHALLENGES:

- Not maximizing playability and usability
- Not maximizing revenue streams
- Fertilizer and infill concerns



NATURAL BIOSWALE ENVIRONMENT

NATURAL GRASS FIELDS

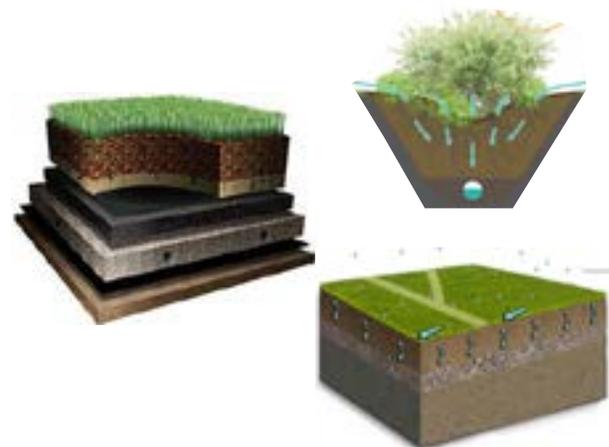
SYNTHETIC TURF FIELDS

LAKE FOREST RECREATION CENTER

DEERPATH MIDDLE SCHOOL

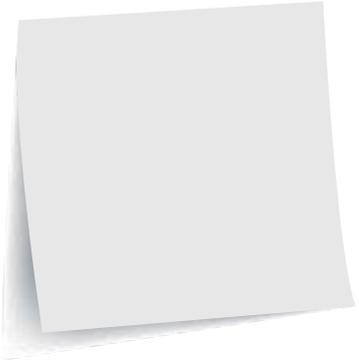
PARKING

HASTINGS ROAD



# WHAT ARE YOUR COMMENTS?

*Write your thoughts in the Q&A!*



# DEERPATH ATHLETIC FIELD IMPROVEMENTS

1

## BUSINESS AS USUAL



2

## NATURAL GRASS



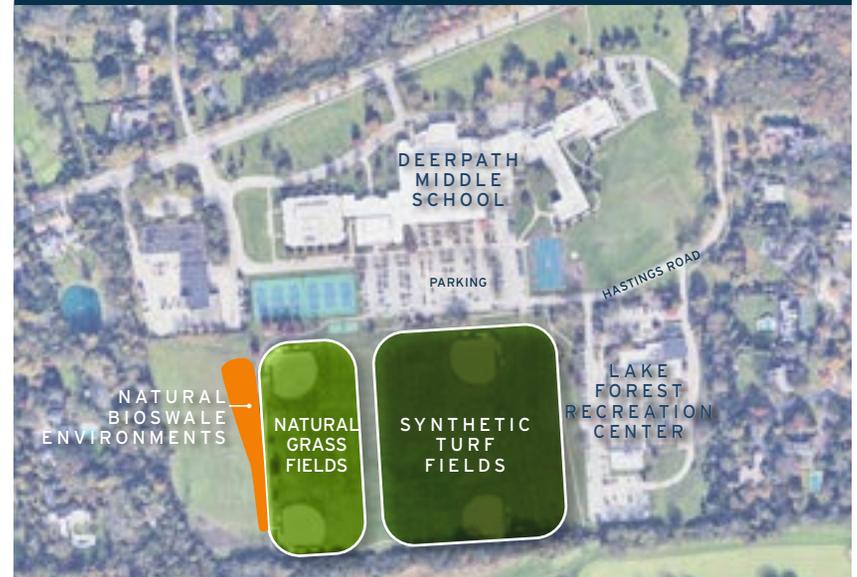
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## SYNTHETIC TURF



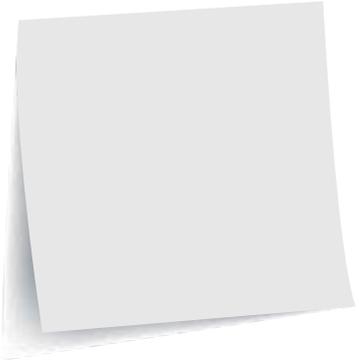
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## HYBRID NATURAL/SYNTHETIC



# WHAT ARE YOUR COMMENTS?

*Write your thoughts in the Q&A!*



# NEXT STEPS TO IMPLEMENTATION

- 1. Workshop #2 Presentation & Recording will be Available Online**
- 2. Follow-up Online Comment Form** *(open until Feb 24th)*
- 3. Park Board Meeting** *(March 15)*
- 4. City Council Meeting** *(April)*



**THANK  
YOU!**

**THE  
LAKOTA  
GROUP.**

# REFERENCE LIST

## Endnotes

1 The American Journal of Sports Medicine, 2018: Higher Rates of Lower Extremity Injury on Synthetic Turf Compared with Natural Turf Among National Football League Athletes. Christina Mack, PhD, et al. | The American Journal of Sports Medicine, 2019: Incidence of Knee Injuries on Artificial Turf Versus Natural Grass in National Collegiate Athletic Association American Football: 2004-2005 through 2013-2014 Seasons.

2 The American Journal of Sports Medicine, 2019: Incidence of Knee Injuries on Artificial Turf Versus Natural Grass in National Collegiate Athletic Association American Football: 2004-2005 through 2013-2014 Seasons.

3 Orthopedic Journal of Sports Medicine, 2019: Incidence, Mechanisms, and Severity of Game-Related High School Football Injuries Across Artificial Turf Systems of Various Infill Weights. Michael Meyers, PhD

4 Environmental Protection Agency, 2019. Turf Field Recycled Tire Crumb Rubber Characterization Research Final Report Presentation.

5 Environmental Protection Agency, 2021. Nutrient Pollution.

6 British Standards Institute and The Sports and Play Construction Association, 2007. Twenty Questions (and Answers) on Rubber Granulate.

7 New York State Department of Environmental Conservation & New York State Department of Health, 2009. An Assessment of Chemical Leaching, Releases to Air and Temperature at Crumb-Rubber Infilled Synthetic Fields.

8 International Journal of Environmental Research and Public Health, 2017. Wear and Tear of Tyres: A Stealthy Source of Microplastics in the Environment.

9 International Journal of Environmental Research and Public Health, 2017. Wear and Tear of Tyres: A Stealthy Source of Microplastics in the Environment.

10 Environmental Protection Agency, 2021. Microplastics: Emerging Trends and Research Gaps Presentation. Phillip Potter

11 National Science Foundation and BASF Eco-Efficiency Analysis, 2010. Synthetic Turf, Eco-Efficiency Analysis Final Report.