A Review of Benefits & Issues Associated with Natural Grass & Artificial Turf

Patch Reef Park
Multi-Use Sports Fields

Final Report

Prepared for:
The Greater Boca Raton Beach & Park District

Developed by:
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Preface

Motré researched various artificial turf systems for the possibility of implementing at Patch Reef Park’s multi-use sports fields. The costs of construction for the turf systems was gathered as well as the cost of renovating the fields with natural grass turf. The cost data was analyzed using project selection tools to determine the economic viability of pursuing the project.

Partnering with Stantec, both parties (“research team”) investigated leading studies on artificial turf and natural grass in order to examine various concerns as it relates to potential health and injury issues.

The following four points should be taken into consideration while reading this review. First, by undertaking this review and cost-benefit analysis, we are not advocating or endorsing the installation of artificial turf or otherwise. Second, this pursuit was initiated by our client, the Greater Boca Raton, Beach & Park District (“District”). Third, the research and findings are objective, and without any influence from third parties or the District. Finally, this study is by no means a scientific or medical report, but rather a compilation of information from research papers, academic journals and articles that are widely available to the public.

The key area to be addressed in this summary is the cost analysis relating to natural grass and artificial turf for potential improvements to the three multi-use sports fields at Patch Reef Park. Various project selection tools, such as cost comparison and breakeven analysis, are used in examining, analyzing and summarizing the cost data provided by product vendors and the data provided by the District and City of Boca Raton.

Furthermore, the review summarizes potential health and injury implications associated with artificial turf and natural grass based on investigations conducted by governmental agencies, universities and independent reports, as well as the input from the user groups at Patch Reef Park. This section presents an opinion based on the available research materials widely available to the public and should not be considered a scientific or medical report.

It is our sincere hope that this effort will be useful to the public officials when determining which type of playing surface best meets the needs of their community and athletic program.

Please contact Tinú Peña, PMP, LEED AP or Jeff Crews, P.E., LEED AP with any questions in association with this report.

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Table of Contents

<table>
<thead>
<tr>
<th>Sec</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
<td>4 - 6</td>
</tr>
<tr>
<td></td>
<td>Background</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Goals &amp; Objectives</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Methodology</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Existing Site Condition</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Key Findings</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Existing Field Condition</td>
<td>8 - 11</td>
</tr>
<tr>
<td></td>
<td>Natural grass composition, benefits &amp; drawbacks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Artificial turf composition, benefits &amp; drawbacks</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Health Concerns</td>
<td>12 - 15</td>
</tr>
<tr>
<td>5</td>
<td>Footwear</td>
<td>16</td>
</tr>
<tr>
<td>6</td>
<td>Potential Injuries associated with Artificial Turf</td>
<td>17 - 19</td>
</tr>
<tr>
<td></td>
<td>Heat Effects</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Field Availability &amp; Usage</td>
<td>20 - 24</td>
</tr>
<tr>
<td></td>
<td>Feasibility Review of Field Addition/Expansion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other Sports Programs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Public Involvement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Site Assessment of Sand Pine Park</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other Investigations</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Analysis Profile</td>
<td>25 - 32</td>
</tr>
<tr>
<td></td>
<td>Lifecycle Cost Analysis</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Findings</td>
<td>33 - 35</td>
</tr>
<tr>
<td></td>
<td>Recommendations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>References</td>
<td>36 - 38</td>
</tr>
</tbody>
</table>

Appendix

- FY 2013-2014 Field Calendar & Season Breakdowns
- Exhibit– Expansion Feasibility
- Field Usage Hours by groups
- Survey – User Group
- Survey – Municipalities & Others

Disclaimer

This report has been developed by Motré in collaboration with Stantec at the request of the Greater Boca Raton Beach & Park District in our capacity as consultants in accordance with the Terms and Conditions contained in the Consultant Agreement between Motré and the District.

The information, statements, statistics and commentary (together the 'Information') contained in this report have been prepared from data collected from the District, City of Boca Raton, vendors and publicly available materials. Such information received where it is represented by the client and other stakeholders as such, are believed to be complete and accurate. The Information must not be relied on by third parties, copied, reproduced, distributed, or used, in whole or in part, for any purpose other than detailed in our Consultant Agreement without the written permission of the Motré and the District.
Section 1

Introduction

The Greater Boca Raton Beach & Park District’s athletic fields at Patch Reef Park are actively used year round. There are nine youth groups, three adult groups and two schools that uses the field annually. According the City of Boca Raton, the fields are generally available for use 32 weeks out of the year with the remaining 20 weeks slated for maintenance.

Field schedule records for FY 2013-2014 indicated 32 weeks of availability to use the fields at Patch Reef Park. Of the 32 weeks, 20 weeks of actual scheduled sports activities was recorded with 11 weeks remaining and available for use by the user groups. Also, records showed 21 weeks of shut down for maintenance for the period. The field schedule for the period did not account for weather impacts such as field closure due to rain or lightning but information showed that the sports group season is generally January through May for Lacrosse, July through November for Tackle Football and October through early November for Soccer. Refer to Appendix for Field Calendar and Season breakdown in Appendix.

The November 12th, 2014 public engagement meeting, highlighted some patrons’ indignation over availability of the fields for use, others expressed concerns over crumb rubber and the material allegedly having cancer causing properties (as reported by the media) while others shared images of unidentified soccer players leg abrasions from playing on artificial turf. All the inputs from the patrons highlighted challenges the District and Staff faces in meeting the demand and addressing concerns.

Thus, in continuation of the qualitative cost-benefit analysis provided as part of the preliminary site assessment report submitted in July 2014 to the District, Motré was commissioned in August of 2014 to further investigate the use of artificial turf, its projected initial construction and maintenance costs, and provide a non-biased review on the health and injury issues as studied by independent sources and government agencies. In November 2014, at the direction of the District, Stantec – bringing experience from previous projects on artificial turf in South Florida - was engaged by Motré to aid in the research, review and development of the report associated with 1 artificial turf and natural grass. The scope and proposal was subsequently approved in the same month.

This review and analysis aims to provide an objective quantitative perspective as it relates to the associated costs, benefits, issues and concerns relating to artificial turf in comparison to natural grass. In addition, Staff from the District and City of Boca Raton assisted in the effort by providing information with regards to user groups, budget, field usage, field calendar schedule and current maintenance cost for the fields at Patch Reef Park.

1 Note: Artificial turf will be used interchangeably with synthetic turf and natural grass with natural turf.
Background
Patch Reef Park is located approximately 0.25 miles from the northwest corner of Military Trail Road and Yamato Road, Section 11, Township 47, Range 42 within the City of Boca Raton, Palm Beach County, Florida. The three rectangular fields at the Park have had natural grass covering since their completion in 1987. The NE field is approximately 85,320 square feet; the SW, 99,251 square feet and the SE 117,276 square feet. The fields are situated in the northern section of the park and function as multi-use sports fields year round with athletic programs such as lacrosse, tackle football, flag football, soccer and rugby.

Goal & Objectives
It is our understanding the District desires a review of the potential use of artificial turf on the three multi-use sports fields at Patch Reef Park to include examining the associated costs, as well as health and injury implications. Additionally, the District seeks to explore other opportunities with the fields including enlarging or adding a field and adding other athletic programs. The areas being addressed are as follows:

1. Review & summarize research conducted on health concerns and issues associated with both surfaces.
2. Review & summarize research conducted on the types of footwear.
3. Review & summarize research conducted on Injuries attributed to both surfaces.
5. Investigate other government agencies natural grass and/or artificial turf maintenance program.
6. Survey user groups to obtain public input.
7. Explore feasibility of increasing field size and/or adding an additional sports programs.
8. Develop a quantitative cost-benefit analysis.

Methodology
Research Paper Review
Several reports, academic journals and articles were examined while analyzing the various perspectives on possible health issues, findings and injuries attributed to artificial turf and natural grass fields. The review consolidates the many published ideologies and concepts to better understand the health and injury implications. It also examines the footwear best suited, if any, for use on artificial turf. This analysis is tailored to Patch Reef Park fields and its geographical climate, maintenance and programming practices.
**Project Selection Tools**

In populating the project selection tools, cost data on two different artificial turf systems were obtained based on a predetermined criteria. Furthermore, cost data was obtained on renovating the sports fields with new bermudagrass with new root-zone mix and upgrading the irrigation system. General assumptions were made regarding the product useful life and minimum attractive return rate and consideration was given to evaluating the fields in an “as-is” condition with its current maintenance program. In addition, information on field usage and availability and participants was reviewed, organized from records (provided by the City of Boca Raton) and used as necessary in the analysis.
Section 2

Existing Site Condition
The visual evaluation performed in June 2014 revealed the condition of the fields to be in need of additional attention in certain areas; considerable wear and improper sod placement were observed. These findings are in congruence with the agronomy report prepared by Dr. P. Busey on the fields in April 2014. It was reported that the physical properties, in particular the rectangular fields, experience poorer infiltration both because of poor soil conditions as well as high use. Rooting at the Patch Reef Park rectangular fields was found to be less than Spanish River Park, which may reflect somewhat worse soil conditions at Patch Reef Park. Thus, there is a possibility that there are compaction issues, inadequate aeration (as peripheral areas are heavily used as well), and poor installation of new grass turf, as evident by the patchy and lumpy conditions observed, with weeds taking root in many of the thin areas of the fields.

Furthermore, the agronomy report summarized that “Staff members should continue to do a good job maintaining turfgrass fields and should seek ways to improve and optimize conditions by reviewing irrigation practices, account for nitrate application in effluent irrigation water, and use more core cultivation to maintain air-filled pores (macropores) in the soil. There may be a way to measure field wetness to provide an independent assessment when fields are too wet to play. Users should continue to move goal areas as space allows, to redistribute wear. In general, the fields are at maximum usage capacity and additional capacity will come from developing additional fields.”

Key Findings
The District has dedicated sports groups that practice and have games at the Park each year. Information provided by the City of Boca Raton for FY 2013-2014 indicated that there were a total of 6,364 participants. Further, the number of times the participants practiced and/or played games at the fields totaled 68,643 - averaging 22,881 per field. The groups that consistently use the fields include the Boca Jets, East Boca Tackle Football, SABR, John Pope II High School, Spanish River High School and Pop Warner.

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2 Busey, P. 2014. Review of Athletic Field Maintenance and Usage for Greater Boca Raton Beach and Park District. The data used in the agronomy report is based on the calendar year 2013.
Section 3
Existing Field Condition
The evaluation of the various fields conducted by Dr. Busey in April of 2014 highlighted the soil conditions of all the fields. Patch Reef Park rectangular fields in particular, currently has Tifway” (T-419) Bermudagrass as sports turf and it was mentioned that the fields did not have enough medium sand. The medium sand, according to the report had a value that was 31.5% or less in which the value should be 50% or higher. The organic matter content of the fields was also indicated to be approaching or over 3% - a value at which water percolation begins to be negatively impacted. Further, the rooting conditions in comparison to the other fields evaluated reflected possible worse soil conditions at Patch Reef Park.

Furthermore, the report stated that all fields sampled were found to have inadequate air-filled pore (macropore) space, inadequate saturated hydraulic conductivity (percolation) which should be at least 6 inches/hour but was 1.4 to 5.5 inches/hour, and generally had inadequate in situ infiltration, at 0.76 to 1.48 inches / hour. While the fields are stated to be in good condition, the above mentioned conditions would not have been apparent based on a visual inspection only. Therefore, it is within reason to conclude that the rectangular fields experience poorer infiltration both because of poor soil conditions as well as high use.

Natural Grass Composition, Benefits & Drawbacks
Turf grass research continues to be conducted by higher education institutions and government agencies to improve on cultivars for various use to include sports turf. The type of turfgrass used for sports are primarily determined based on location and application. For sports fields, bermudagrass are commonly found in south and southwest of the United States and can also be used in gardens, landscapes, recreational and industrial areas. Bermudagrass have varieties that vary in overall quality, vertical and lateral growth rate, disease resistance and low-temperature hardiness. Other turf grass include Fescus and Kentucky bluegrass; these are generally blended and found primarily in the central and northern United States.

Tifway (Tifton 419) Bermudagrass
This turf type is considered a major turf species for sports fields, lawns, parks, golf courses, and general utility turfs. Tifton 419, Tifway bermudagrass, according to University of Georgia, Forage and Turf Grass research summary stated the natural turf is a highly disease-resistant selection with a very dark green color; it maintains a desirable green color longer and with less nitrogen than most other selections. It is more resistant to sod webworm and mole cricket attacks. Tifway makes a very dense sod and is more weed resistant than most bermudagrasses. Tifway has short seed stalks that bear heads with light reddish anthers which shed no pollen. Since Tifway never produces seed, it must be propagated by planting sprigs or laying sod.

Celebration Bermudagrass

Celebration Bermudagrass is known to require less mowing than typical bermudagrass varieties and has tough runners, rhizomes, and deep roots that provide excellent sod strength, wear-ability, and improved drought tolerance. This turf type tolerates many types of growing conditions, and is versatile enough to be used in golf, sports, commercial and home landscapes. Celebration will perform well in sand, sandy loam, clay or muck soils. Celebration has excellent fall color retention, as well as an excellent rate of spring greenup.

Nonetheless, to have high quality playing surfaces with natural grass such as bermudagrass, it is crucial that usage and maintenance be controlled. The agronomy report indicated that the criteria based on annual hours of use on a field can predict the condition of a field; hence at “… 200 hours or less, the field “sustains good field conditions”; 400 to 600 hours there is “fair to good field conditions, some thinning turf and localized wear areas” may be evident; and over 800 hours, there is “significant turf loss, field surface damage, and increased potential for athlete injury. Based on the annual hours of use for the fields during the FY 2013-2014, the NE field had 584 hours of use, SE field had 634 hours of use and SW field had 574 hours of use. It is evident that the condition of the rectangular fields at Patch Reef Park falls between the categories of fair to detrimental.

Therefore, in keeping the grass fields healthy and reducing athlete injury, instituting a maintenance and irrigating cycle programs remain key components of sustaining good conditions for the playing surfaces. These programs must go hand in hand with proper field drainage and most importantly, controlled use. In the absence of any one of these, the grass turf fields will deteriorate. As such, part of the comprehensive and practical maintenance and irrigating cycle programs must include training programs for Staff and users.

Benefits of Natural Grass

There has been an increased trend in the replacement of natural grass playing surfaces with synthetic turf at high schools and parks across the board. Such a shift is generally equated to low maintenance cost and year round availability. However, over time there has been improvements to sports turf cultivars and the developments in turf species has playing on natural turf bringing its own benefits such as:

- Provides higher traction, cushioning and resiliency.
- Preserves and improves groundwater and surface water quality.
- Emits heat at a lower temperature range.
- Enhances entrapment and biodegradation of synthetic organic compounds.
- Proper field maintenance leads to
  - the turf grass improving soil conditions.
  - lower surface hardness and safe playing surfaces.
  - reduced probability of athlete injury.

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Drawbacks to Natural Turf

There are a few drawbacks to having natural turf as a playing surface:

- Unavailability of field due to recovery time.
- Associated maintenance cost.
- Requires frequent irrigation and mowing.
- Weed and pest control may be required.
- Fertilization, verticutting and aerification are necessary for turf health.

Artificial Turf Composition, Benefits & Drawbacks

There are various types of synthetic turf systems on the market today that are installed for different uses. The artificial turf system that appears to be suitable for sports such as football, lacrosse, and soccer are systems that allow for bounce, softness on impact and the appropriate firmness for the intended use. This type of playing surface allows for year round use, longer playing hours, ease in maintenance, provides opportunity for other uses and is environmentally friendly.

However, due to a number of different manufacturers, different turf systems and varying installation methodology, the different turf systems products can vary greatly. Since the design of the turf system is generally linked to the intended use, it becomes crucial that the synthetic turf system used meet the quality level that addresses key criteria for usability and safety. As such, a turf designed for field hockey, may not be suitable for football or soccer due to the difference in the bounce.

An artificial turf system will generally comprised three distinct elements, with an occasional intermediary layer depending on the manufacturer and intended use. The top layer makes up the turf (called carpet) and is primarily polyethylene fiber woven into a backing material. The middle layer is comprised of the infill materials which can vary in depth and material depending on use. The infill materials provide directional stability and structural integrity and could be all-rubber, sand, biodegradable materials, or combination of the aforementioned materials. The bottom layer is generally the stabilizing and drainage material, which is typically aggregate materials with drainage piping.

Artificial turf with crumb rubber infill

Fields construction with artificial have the option of the type of infill of most turf systems will comprise of a mixture of silica sand and crumb rubber or rubber infill. The general system design and quality is closely linked to the manufacturer and the specified use. Typical profile of a sports field with artificial turf is shown with the polyethylene fiber treated for UV and abrasion resistant, infill – layered with silica sand (bottom layer), mixture of silica sand and cryogenic rubber (middle layer) and cryogenic rubber (top layer) and the backing system which binds the elements. The height of the fiber, infill (depth & layering) and padding system is primarily determined by the intended use.

Artificial Turf with Organic infill

Another option with artificial turf is the use of organic infill with the system. Like the turf system in the rubber infill, this system design is based on the intended use and the depth/mix of infill materials are defined by the same parameters discussed in the previous section. As depicted in the profile of the turf system, the sand - bottom layer is primarily for the stability of the backing mat, the middle layer is a mixture of cork and coconut fiber. The height of the fiber, infill (depth & layering) and padding system is primarily determined by the intended use.

Benefits of Artificial Turf

Artificial turf provides year round availability that is unmatched by natural grass. This key feature has increased synthetic turf appeal amongst education institution athletic programs and recreation facilities that experience a high usage demand for their fields. A review conducted by a collaboration of multiple government agencies in Montgomery County, Maryland, cited considerable benefits of synthetic turf, such as:

- High level of usage and low demand for maintenance.
- Availability for all year round for competitive sports and recreational events.
- Reduction in cancellation due to weather.
- Reduction in the amount of pesticides, fertilizers and herbicides leaching into ground water.
- Availability to meet schedule demand with minimum to no preparation time.
- Significant savings in maintenance costs.
- Playing surfaces being consistent without rut divots or bald patches.

Drawbacks to Artificial Turf

Detractors of the product disagree with the benefits of artificial turf as being cost effective and environmentally friendly. The claim by the University of Arkansas - Division of Agriculture propose that synthetic turf fields are not maintenance free as many are led to believe for the following reasons:

- Additional infill is necessary to keep turf system functioning as designed.
- Irrigation is required in areas that experience higher temperatures.
- Spraying may be necessary to reduce static cling and odors.
- Drainage and turf carpet repair may be necessary.
- Chemical disinfection spraying maybe required to reduce infections.

Other drawbacks include high surface temperature, leading to increase in heat injuries and coarse nature of pile cause skin abrasions.
Section 4

Health Concerns

The health implications of artificial turf in comparison to natural turf grass fields fall into a number of broad categories that are beyond the scope of this report. For the purposes of this review, the implications as they relate to the following general classifications are explored.

Cancer Causing Components

There has been widespread concern throughout communities due to recent news reports implicating the crumb rubber component of artificial turf as alleging having cancer causing properties. While the media report is a compelling, yet unscientific discussion of a particular group of affected individuals, there are no specific research or case studies by leading regulatory agencies or universities that support the claim. The media report relates anecdotal evidence that represents a sample size that is too small to accurately draw conclusions. Furthermore, a scientific approach would need to account for other potential contributing factors before being able to identify a statistically significant causal relationship between artificial turf crumb rubber and cancer.

Moreover, the anecdotal evidence seems to be limited to soccer players. While it is understandable that goalkeepers would have an elevated exposure compared to other soccer players, it is unclear how this relationship would extend beyond soccer. Artificial turf with crumb rubber as infill is widely used on football fields; however, to-date there has been no report supporting any evidence of elevated exposure of the players or increased incidence of cancer related to playing on artificial turf.

At this time indicate that there are no scientific studies to support or debunk if there is a direct link between crumb rubber and cancer. Conversely, it is difficult to prove that these connections do not exist. However, there have been a number of studies that have come to the conclusion that the use of artificial turf is safe.

Most notable is the EPA study published in 2009 that looked at sampling from existing facilities to determine if the conditions associated with artificial turf field were hazardous. The approach in the study included air sampling for particulate matter (PM) and volatile organic compounds (VOCs) to determine if the materials were creating measureable deterioration in air quality. The samples also included wet wipe samples and analysis of actual crumb rubber granules and turf blades for the presence of metals. The study concluded that the particulate matter and VOC concentrations at the artificial turf fields represented values that were consistent with ambient air concentrations. In regard to the extracted samples, the EPA found the amount of extractable Lead concentrations to be well below the allowable concentrations for Lead in soil. Likewise, the Lead concentrations from the wet wipe samples were found to be below the EPA concentrations allowed for lead in residential floor dust. It should be noted that the EPA indicated the study was very limited and could not be considered entirely conclusive. Additionally, the study was limited to six turf fields within a limited geographical area and it did not evaluate all of the potential compounds that could be present.
Ultimately, the study determined that they did not find evidence of harmful components at high levels of concentration. They offered limitations on the interpretations that could be drawn from the data developed. They concluded the study with this statement:

“On average, concentrations of components monitored in this study were below levels of concern; however, given the very limited nature of this study (i.e., limited number of components monitored, samples sites, and samples taken at each site) and the wide diversity of tire crumb material, it is not possible to reach any more comprehensive conclusions without the consideration of additional data.

In the end, the report provides some raw data on measureable health related substances that offer some understanding of the chemical environment at an artificial turf field. However, the EPA study is unable to fully relieve the concerns reported by media outlets. At this time, the EPA has not indicated any intention to further study this matter.

The California Office of Environmental Health Hazard Assessment (OEHHA) has authored two studies relevant to the chemical safety of the artificial turf playing environment. In the first of the Studies OEHHA investigated existing data for chemical exposure related to crumb rubber in an attempt to extrapolate lifetime exposure risk profiles for various chemicals. The analysis considered source data from several other studies with wide variations in conditions and readings. Among the sources, readings from indoor fields were orders of magnitude higher than outdoor facilities. As a result, risk profiles utilizing these figures would tend to overestimate the risk at outdoor facilities. From this data, the OEHHA decided that more research was needed. An additional study was undertaken to measure particulate matter and VOCs. It was determined that particulate matter was either below detectable levels or at similar concentrations to the upwind samples. Likewise, the large majority of the VOC samples were below the limit of detection. In the few samples where VOC’s were detected, further evaluation revealed them to be below health based screening levels. Ultimately, the report determined that there was no public health concern identified and that adverse health effects were unlikely to occur related to inhalation on an artificial turf field. However, here again, the extent of the investigation was limited and did not evaluate contact or ingestion risk.

Another relevant study was conducted by the New York State Department of Environmental Conservation and New York State Department of Health published in May 2009. This study looked at the risk associated with ingestion, particulate matter and VOCs on two artificial turf field installations. Analysis of samples of the crumb rubber indicated that Lead concentration was below the federal hazard standard for lead in soil, leading the researchers to conclude that the infill would not be a significant source of Lead exposure. The analysis for particulate matter indicated that there were no meaningful differences between particulate matter on the field compared to the samples upwind of the field. Furthermore, the analysis for VOCs indicated that readings on the field “do not raise a concern for non-cancer or cancer health effects for people who use or visit the fields”. Here again, authors of the report indicate the limitations of the study and caution that differing methodology could yield different results.

In Connecticut, four state agencies collaborated to study the health effects of artificial turf in one of the most comprehensive programs to date. Samples were taken for a wide variety of VOCs and other compounds as well as particulate matter. Sampling
included a variety of methodology including waste level personal collection devices worn by players in a simulated game environment. This data was analyzed by the Connecticut Department of Health utilizing conservative public health protective assumptions. The study concludes “the use of outdoor and indoor artificial turf fields is not associated with elevated health risks.”

The NBC report presents a compelling case that is a legitimate cause for concern among parents and the other members of the community. A substantial body of research, including the sampling outlined above, has generally found very little evidence that artificial turf can be linked to any elevated health risk. However, the extent of the studies is generally limited to small geographic areas with limited variations in age, condition, manufacturer and source of the crumb rubber being studied. Due to its origin as recycled used tires, crumb rubber is inherently variable. While the findings have been consistent in multiple studies, such limitations make it impossible to draw irrefutable conclusions industry wide.

**Pesticides**

It should be noted that natural turf may also have inherent dangers associated with chemical exposure. Natural turfs are often sprayed with pesticides and herbicides that are inherently toxic. The American Academy of Pediatrics has established a long list of health concerns associated with the use of the complex chemicals associated with pesticides. There is a great deal of research about pesticide and herbicide exposure to children; however, there is only limited study that attempts to isolate the exposure related directly to athletic fields. Since children are exposed to a wide variety of these chemicals in the home, lawns and through food sources, it is challenging to separate the specific contribution and risk from athletic fields. In one study from the University of Maryland entitled “Potential Health Effects Related to Pesticide Use on Athletic Fields” researchers attempted to isolate this factor. However, the study was focused on the level of use for pesticides on athletic fields and was only able to imply the link to widely known risks. In any event, the study authors concluded “Results indicate that there is a significant risk of exposure to pesticide for children engaged in sports activities.” Any analysis of the health concerns related to artificial turf should include a complete assessment of the health implications that are related to the maintenance of the natural turf as well.

**Alternate Infills**

The alleged health concerns linked to crumb rubber infill in artificial turf have heightened community apprehension about the use for the product; thus, the use of alternative infill materials may represent an opportunity to lower the community’s anxiety. There are a number of alternatives that fall into several broad categories.

- **Organic** – Organic fills are usually comprised of some mixture of an organic substance such as cork, corn husk or rice husk. These infills are generally proprietary in nature and include trade names such as “Infill Pro Geo” and “CoolPlay”.
- **Silicon Dioxide** - Silica sand is often a component of infill used in conjunction with crumb rubber. However, some manufacturers have introduced acrylic coated and colored sand particles that have a more rounded shape to avoid compaction. These infills are generally proprietary and include trade names such “Durafill” and “Envirofill”
- **Thermoplastic**- Some manufacturers are offering infills based on small plastic pellets. These infills are generally proprietary in nature and include trade names such as “Infill Pro TP”
Alternate rubber – Infills based on an alternative form of recycled rubber. “NIKE Grind” is an example of ground up athletic shoe soles.

Benefits to Alternative Infill

Heat – Alternative infills are often marketed with the advantage of reducing heat absorption on the field
Color – Alternative infills sometimes are colored (green, tan, brown) for the purposes of heat reduction and blending with the look of natural ground.
Re-use/Dispersion – Organic infill can be used as a thermal barrier in natural planting areas.
Environment – Organic infill are considered to be 100% environmentally friendly.

Drawbacks to Alternative Infill

Cost – The alternative infill products are generally more expensive than traditional crumb rubber. This price increase may be exacerbated by the current environment of concern surrounding crumb rubber.
Proprietary – Virtually all alternative infills are proprietary. Choosing one will tend to limit the manufacturers of the turf product available for project.
Resiliency – Some of the infill products lack the resiliency of crumb rubber, making them harder under impact. This makes them unsuitable for sports applications or requires a supplemental layer of padding.
Density – Organic infills tend to be a lighter specific gravity than crumb rubber and would be more prone to floating and subsequent horizontal migration in heavy rainfalls.
Durability – Organic infills will deteriorate and require replacement more often than inert rubber infills.
Weeds – Organic infills will be more prone to weed growth compared to inert infills.

It is important to be aware that artificial turf is marketed for many uses other than competition athletic fields. Not all infills are suitable for athletic uses. When evaluating these alternatives, the full system of turf, infill, sub-base and padding should to be evaluated to ensure that it would meet the specifications necessary for an athletic field.
Section 5

Footwear

The development of artificial turf has evolved since its initial introduction in the 1960s. The first generation fields were short nap carpet over padded concrete bases. The short fiber carpet behaved differently than natural turf and required specialized footwear. Development of the infill system of artificial turf has greatly improved the behavior of the turf such that footwear on the surfaces is largely interchangeable. Turf shoes or cleats come in two basic varieties; molded sole with integrated studs and screw-in studs. Any of the natural turf shoes can be used on artificial turf, however, the molded sole cleats tend to perform better due to their suitability for firmer ground conditions (often referred to as FG for firm ground). Screw-in studs are generally used in soft or wet natural field conditions where the stud length can make better penetration or can even be interchanged for longer studs (often referred to as SG for soft ground). The industry has developed a variety of molded cleats that are custom designed to be utilized on artificial turf (often referred to as AG for artificial ground). These shoes typically have more numerous but smaller studs in a molded sole. This design reportedly gives them minor advantages in the firm, consistent surfaces of artificial turf, however, they are less suitable for natural fields. These specialized artificial turf designs seem to be a matter of personal preference for some elite players who can afford multiple shoes for different playing surfaces.

Broadly speaking, among the three types of cleats referenced above, the standard molded cleats with FG and AG configurations work well with artificial turf. Meanwhile, natural turf fields generally work well with FG and SG configurations. Consequently, standard molded cleats are a good choice for recreation league players that play on a variety of fields.

As validation of the cross-over suitability of appropriate footwear, a study was performed at the Penn State Center for Sports Surface Research that tested footwear for use on artificial turf. Using mechanical test equipment specially designed to measure traction, tests were run on three different varieties of artificial turf and measured against a natural turf control. The tests included 8 different commercially available turf shoes, each tested for three different player weights. The study found that there was variability of traction across the different types of shoes, but very limited variability between the different types of turf. They concluded that “The differences in rotational traction among shoe types in this study was nearly four times larger than differences measured among playing surfaces. This data suggests that shoe selection has a greater influence on rotational traction and potentially lower extremity injury risk than the surfaces themselves evaluated in this study.” Hence, this study reveals that quality artificial turf can perform with very similar characteristics as its natural counterpart.
Section 6

Potential injuries associated with Artificial Turf

There is much debate within the industry about the physical safety of activities on artificial turf as compared to natural turf. A great deal of research has been performed with most of the studies concentrating on a particular sport and level of play. Part of the difficulty with studies of this nature is accounting for the evolving nature of artificial turf. While early varieties of turf were found to be prone to cause injuries, advancements in modern turf have vastly improved the performance relative to natural turf. Studies from older turf varieties should be excluded when assessing the safety of current 3rd and 4th generation turf products.

In 2005, the FIFA under 17 World championships were held in Peru on artificial turf, it was around that period that FIFA’s Medical Assessment and Research Centre (F-MARC) performed studies of the relative rate of injury compared to other U-17 championships played on grass. They indicated that “the research showed that there was very little difference in the incidence, nature and causes of injuries observed during games played on artificial turf compared with those played on grass.” A broader study of youth level soccer players was undertaken in Norway including over 60,000 players between 13 and 19 years of age. That study investigated the risk of acute injuries among youth male and female footballers (soccer) playing on modern artificial turf compared with grass. The study found “In conclusion, there was no difference in the overall risk of acute injury in youth footballers playing on third-generation artificial turf compared with grass.”

Additionally, several other studies in Scandinavian Countries looked at data from professional and elite soccer clubs. One study investigated data from Norwegian professionals and determined “No significant difference was observed in injury location, type or severity between turf types.” Similarly, twenty elite teams from across Scandinavia (including both men’s and women’s teams) were studied and it was determined that “There were no significant differences in the nature of overuse injuries recorded on artificial turf and grass for either men or women.”

Research in this subject is complex due to a large number of potential variables that span across multiple injury types, multiple sports, level of play, gender, age, turf brands and styles. For instance, injuries true for professional football players may not be relevant to youth soccer players. Individual studies in this field often take a narrow view within one level of a given sport in order to eliminate enough variables to form conclusions. As a result, these findings need to be considered within a broader picture to determine the overall safety of artificial turf and its relevance to the proposed use for any specific installation.

The above studies focused on certain subsets of athletes within particular sports. Studies involving a broader approach are much more complex and less common. A compilation study out of New Zealand looked at 11 independent studies in order to assess potential for injury amongst various sports, injury types, age groups, gender and level of play. The results were complex with varying degrees of indications in the various groups of athletes across multiple sports. For instance, they indicated that some of the studies showed evidence of an increased risk of ankle injuries on artificial turf while also noting that artificial turf was apparently beneficial with respect to muscular injuries. In the end they concluded “Studies have provided strong evidence overall for a trivial difference in injury incidence rate between third and fourth generation artificial turf compared with natural turf.”
A similar compilation study from the Stanford University Department of Orthopedic Surgery looked at 43 scientific papers addressing injury rates across multiple sports. Again, the analysis resulted in complex variations between different sports and injury types. Ultimately, the study concluded “though injury patterns may differ, it appears that there is not a significant difference between the overall injury rates on third-generation artificial surfaces and natural grass.”

While most of the above studies are related to skeletal muscular injuries, there are also concerns about contact injuries with turf. Artificial turf is widely considered to be more abrasive than grass fields and have been known to cause superficial abrasions when sliding. A study conducted by the California Office of Environmental Health Hazard Assessment (OEHHA) looked at data from more than 33 college soccer programs and concluded that turf burn abrasions were 2-3 times more prevalent in artificial turf than grass, but that seriousness of the abrasions was similar on the two surfaces. Such abrasions tend to be treated without professional medical attention and are generally considered zero day loss injuries.

Related to the issue of abrasions has been the question of bacteriological contamination of artificial turf. Turf products have been implicated in a higher prevalence of MRSA and other staph infections. In general, the environmental factors that are present in an artificial turf field are not friendly to the growth of microbial populations. This statement is supported by the report developed by the California OEHHA that determined that fewer bacteria were present on the artificial turf surfaces than in natural grass. However, the higher rate of abrasions would tend to increase potential for exposure to the bacteria that may be present. The report was unable to draw further conclusions from these two factors to determine if the overall incidence of infection was higher on artificial turf.

The one other factor that should be noted when assessing safety among turf options is the realistic quality of the natural turf. Often times, detractors point to preferences of pro level athletes as an indication that natural turf is desirable. An example of this has been the much publicized player reaction to playing the 2015 Women’s World Cup on artificial turf. However, the natural grass surfaces utilized at the elite level of play are maintained at a very high level with minimal playing time resulting in an idealized version of natural grass for comparison. It is impractical to expect heavily used natural grass fields in a municipal recreational environment to be kept in such a pristine condition. Consequently, any analysis and comparison between artificial turf and natural grass should take into account the reasonable expectations of the conditions of the grass fields.

Furthermore, natural grass is subject to a wider range of conditions due to weather, including saturated and muddy conditions; experience has shown that municipal recreational fields suffer from extensive wear and tear including bald patches and divots that could also be a source of additional injuries.

**Heat Effects**

One major factor that has been identified with artificial turf fields is the effect of heat. When compared to natural fields, the synthetic products absorb and emanate heat at a higher rate, causing elevated temperatures on the playing surface. Temperatures can reach levels that could result in heat stress and dehydration for the athletes and need to be considered in the planning and use of any artificial turf installation.
A number of studies have documented the temperature rise associated with turf. Various methodologies for measurement have been utilized resulting in a distribution of results. Some studies have directly measured the temperature of the turf system itself at the ground level. This methodology shows temperatures that are substantially higher than ambient air. By contrast, grass fields are generally the same temperature or slightly cooler than ambient air due to the transpiration effect of the grass. Penn State has performed extensive research on artificial turf heat effects, and found that artificial turf surfaces are generally 35 to 55 degrees hotter than natural grass. This approach reveals dramatic results. However, this methodology does not necessarily directly relate to the user experience. Other methodologies measure the air temperature at some elevation above the turf in order to get a measurement that is more relevant to the temperature felt by the users.

The study by Milone and MacBroom provided a combination of measurements including both surface and air temperature readings on two fields on particularly warm and sunny days. Readings on the turf surface indicated temperature increases of approximately 50 degrees. Meanwhile, the air temperature above the field varied in the range of 2-4 degree increases. Regardless of the measurement methodology, it is clear that elevated heat levels are a factor for artificial turf. A primary method of heat mitigation is to regularly irrigate the fields. Research has indicated that the addition of water has some short term improvements to heat effects. However, the length of time that the moisture is effective is limited and the temperature will rise again. The use of water for cooling relies on evaporative effects and is highly dependent on the air humidity. As a result, such cooling techniques can be much more effective in dry climates than in humid regions. Based on the levels of humidity in South Florida, irrigation cooling techniques would be expected to have limited effectiveness.

In order to combat the heating issues of turf, manufacturers have introduced a number of proprietary infill replacements that claim to have cooling effects on the turf. Some of the products are organic in nature and are comprised of cork, corn husk or rice husk. Others rely on colored variations of a non-rubber material to lower heat absorption. These products are relatively new and the effectiveness of temperature improvements are still under evaluation.
Section 7

Field Availability & Usage

Patch Reef Park’s three fields are available for use Monday – Friday from 3pm to 10pm, and Saturday – Sunday from 8am – 10pm. The fields undergo site preparation from 8am – 3pm during the weekdays. This time frame allows for 35 hours of programmed use per week during the weekdays and 28 hours of programmed use per week for weekends. Therefore, the total programmable use hours per field is 63 hours per week.

For FY 2013-2014, the reported hours of scheduled use of the fields was 1,796 hours with 6,362 participants reported for the same period. The activity calendar provided by the City of Boca Raton, showed the fields were available 32 weeks in which 20 weeks of use by the sports groups were recorded and 21 weeks of shutdown due to the maintenance (over various weeks in November, December, January, May, June and July).

Usage Assumptions:

1. Natural grass fields availability excluding rain days and other adverse weather conditions.
   a. Usage hours per week: 63 hours.
   b. Field availability: 32 weeks.

2. Artificial turf availability excluding adverse weather conditions.
   a. Usage hours per week: 63 hours.
   b. Field availability: 52 weeks.

3. Product useful life estimation: 8 years.

Table 1 summarizes the estimated annual available programmable hours and hours of availability over the assumed product life of 8 years. The available programmable hours does not necessarily translate to actual usage hours. Actual usage hours depends mainly on user groups scheduling activities.

Table 1: Programmable hours

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Natural Grass Field</th>
<th>Artificial Turf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Playable weeks (Annual)</td>
<td>32</td>
<td>52</td>
</tr>
<tr>
<td>Available Programmable Hours (Annual)</td>
<td>2,016</td>
<td>3,276</td>
</tr>
<tr>
<td>Assumed Product Life</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Estimated Programmable Hours (Product life)</td>
<td>16,128</td>
<td>26,208</td>
</tr>
</tbody>
</table>

Feasibility Review of Field Addition/Expansion

The dimensions of the existing fields as taken from the 2003 survey provided by the District are approximately 180’ x 360’ for the NE field, 210’ x 360’ for the SE field and 210’ X 360’ for the SW field. The current location of the fields depicted on the survey, shows physical constraints to expansion. This is primarily due to the fields being land-locked to the east by the Park’s access road and to the west by the baseball field(s). In the agronomy report, it was suggested “to square off baseball outfields
as at ESPN /Disney / Wide World of Sports to create additional temporary rectangular fields…” This may prove advantageous, as the use of the existing baseball field(s) may pose concerns for users, be disruptive during its construction, and may require major modification to the existing playground area, berm and fitness trail. Should a different location within the Park be considered for the addition of a new field, it may change the Park’s dynamics as redesigning certain areas may be necessary which may impact existing parking areas and structures.

Nonetheless, the field dimensions for the sports currently played at the Park are depicted in Table 2. In consideration of an additional field, a 210’ x 360’ field size could be an appropriate size for multi-use purpose; that is, if an additional field is deemed necessary. Also, upon review of the Parks’ aerial, baseball field No. 1 appeared to better site this consideration. The other areas within the Park pose constraints to the recommended dimensions. It is important to note that a detailed exploration of the feasibility of adding a new field is an undertaken that should be well-thought-out to determine its necessity based on usage demand, site layout and cost. Refer to appendix for Possible Field Location.

Table 2: Sports field dimensions

<table>
<thead>
<tr>
<th>Sport</th>
<th>Width</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Football</td>
<td>160</td>
<td>360</td>
</tr>
<tr>
<td>Lacrosse</td>
<td>180</td>
<td>330</td>
</tr>
<tr>
<td>Rugby</td>
<td>≤210</td>
<td>310-366</td>
</tr>
<tr>
<td>Soccer</td>
<td>180+</td>
<td>300+</td>
</tr>
</tbody>
</table>

Other Sports Programs

Currently the rectangular fields at the Park supports the sports depicted in the Table 2. Investigation of other sports programs revealed that outdoor field hockey as an athletic program could possibly be a consideration. According to Florida Field Hockey Association (FFHA), outdoor field hockey has a wide popularity in the northern, central and some parts of south Florida. There are no leagues registered with FFHA from Palm Beach County or Boca Raton.

The dimensions for a field hockey field is 180’ wide by 300’ long which falls within the current size of the fields at the Park. The sports’ equipment used relative to contact on the field include a ball and hockey sticks. There are youth and adult leagues which could be co-ed. Tournaments can be played throughout the United States, regionally and locally. The FFHA league tournaments are generally played in March and November. To institute this program, it would be prudent to evaluate the current field usage demand, interest in the community and the overall cost that may be associated with implementing the program.

Public Involvement

The District hosted a public discussion on November 12th, 2014 with the intent to better comprehend the needs of the community as it relates to the user groups’ position on the implementation of artificial turf in lieu of natural grass on the Patch Reef Park rectangular fields. Residents in attendance provided views on the subject matter with the majority of those that spoke in favor...
of artificial turf. Their position was based on artificial turf's ability to provide year round use, thus meeting the groups' usage demand. Those in opposition stated concerns about possible health issues and increased injuries. To further gain input from the patrons, the District provided the email list of their user groups. The survey was sent on November 21st, 2014 to those on the email list for additional inputs/opinions. The survey comprised of nine questions with an additional comment section. Eight of the nine questions were specific to the subject matter. Of the thirty-two persons that the survey was sent to, only nine individuals responded representing only 28% of those surveyed. The following graph summaries the response to questions 8 and 9.

The survey responses highlighted the high usage demand needs of the fields, as the different user group seasons require the field to be available all year round. Refer to Appendix for FY 2013-2014 Field Calendar & Season Breakdowns. Further responses indicated concerns about the possibility of carcinogen in crumb rubber infill used with artificial turf; more specifically, concerns about heat and odorous gas given off from the turf and the lack of a complete study on the possible health issues tied to crumb rubber was expressed. Some respondents recognized the fifty-two week availability of the fields (should artificial turf be installed), financial benefits and reduced injury rates as a plus. Others suggested the District exercise caution, and wait for more conclusive studies from federal regulatory agencies. Other information gathered identified different types of injuries associated with playing on natural grass, types of footwear generally used for their applicable sport, and typical monthly practice and game schedules. For full responses to the survey by the participants, refer to the Appendix.
Site Assessment of Sand Pine Park Athletic Fields

A site visit was conducted by Motré on November 13th, 2014. It was mid-morning, dry and the temperature around 82°C. Motré was met by the Assistant Director of Greater Boca Raton Beach & Park District, Athletic Programs Administrator and Staff. The Park’s two fields (west - 178’ x 298’, east – 200’ x 330’) are artificial turf with crumb rubber infill. General maintenance of the field includes weekly brushing and sweeping. Only issue reported was a drainage problem that was corrected and is no longer an issue.

The fields are available for use from 8 am – 11 pm every week for a total of 52 weeks. Fields are primarily used between 3 pm – 11 pm on weekdays and 8 am – 11 pm on weekends. Sports played at the fields include soccer, football and baseball. The field is irrigated and to date there are no reported injuries in association with playing on the turf. Since the NBC report aired, the soccer group has ceased use of the field.

The field conditions observed during the site visit are as follows:

- Fields appeared to be cleaned and well kept.
- Inline marking along the goal area appear to be loosened.
- Odorous smell observed.

The overall visual assessment of the two fields’ condition did not indicate any major issues on the day of the walk through nor were there any evidence that the turf system was adversely damaged from use. Overall condition per inspection is good.

Other Investigations

Other investigations were conducted with municipalities/institutions that have installed artificial turf on their fields. The general consensus was that no more than one to two inquiries had been made inquiries regarding the alleged link of cancer to crumb rubber infill since the NBC report aired. They also stated there was no change nor decline in participation or use of the fields. The park representative acknowledged low maintenance costs, stating little to no repairs were performed since installing...
synthetic turf and in the cases where repairs were required, it was either covered by warranty or was at a minimum cost. Moreover, they commended on the ability to be able to provide their users access to the fields from the morning to the later part of the evening, seven days a week. Only one source cited the field availability as 50 weeks per year and all others were 52 weeks.

When contacted for the purposes of this review, the City of West Palm Beach, Parks Director stated during the phone inquiry that the City is not considering installing artificial turf at all. The City of Palm Beach Garden expressed the same sentiment and maintains their fields with natural grass.
Section 8

Analysis Profile

The intent of this analysis is to provide information to aid the decision makers in identifying the best project that would meet the patrons’ needs from the set of possible alternatives. The District has not identified any capital budget constraints; however, user groups identified the presence of a high demand for using the fields which the current inventory is not adequately meeting. The alternatives being considered are reconstructing the fields with natural grass - will most likely include the removal of existing ground covering and certain depth of soil, re-grading the site, installing sub-surface irrigation and new sod; reconstructing the fields with artificial turf - will likely involve design, construction and installation of the turf system and the option to keep the field “as-is” and institute a maintenance program that will improve the roof zone mix and irrigating cycle as well as agronomic care of the fields as highlighted in the agronomist report of April 2014.

For this analysis, two synthetic turf system are being considered with different infills. The minimum attractive return rate (MARR) for this analysis is approximated at 5% (%3.25% interest rate as of November 2014 and inflation rate of 1.7%). For the calculations, the maintenance cost will be assumed to remain constant over the examined period for annuity conversion and will be considered with the inflation rate for cost comparison projections.

It is important to note that this analysis is focusing on cost and usage. Due to the different vendors solicited for quotes on the fields (with fields sized rounded up as NE 86,000 s.f., SW 100,000 s.f. and SE 118,000 s.f.) there is evident variation in the price quoted based on the criteria/parameters set. Also, the maintenance cost for the natural grass used in the analysis is indicative of the current maintenance costs to include labor as provided by the City of Boca Raton and that of the artificial turf maintenance cost is as represented by the vendors.

Lifecycle Cost Analysis

The lifecycle cost is a key element in deciding whether a project is a viable endeavor. In this case, the determination on whether to implement artificial turf or continue with natural grass will be based solely on financial and usage factors. It is important to understand what associated costs are being considered in this analysis, such as implementation cost or initial cost (construction costs, site preparation etc.), maintenance, operational and replacement costs. In order to develop the lifecycle cost analysis, an 8 year product useful life is assumed as it is estimated that the product should show evident of wear between a 7-9 year period based on the information gathered from other municipalities/institution (and does not represent the product life of the turf systems used in the this analysis) and the MARR used is as mentioned in the previous paragraph.

The initial cost data depicted in Tables 3 - 5 is per field and provides a budgetary cost to construction the three turf systems based on data provided by vendors. The total up-front cost to reconstruct the fields with natural grass is $814,742.50;

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8 Interest rate as reported by Bank Rate for November 2014 and inflation rate as reported by Coinnews media as of October 2014
with artificial turf (crumb rubber infill) at $2,591,100.00; and artificial turf with Organic Infill (a bio-degradable material made from coconut fibers, cork and rice husk) at $3,731,910.00.

Table 3: NE Field: 86,000 s.f.

<table>
<thead>
<tr>
<th>Description</th>
<th>Natural Grass</th>
<th>Synthetic Turf (Crumb Rubber Infill)</th>
<th>Synthetic Turf (Organic Infill)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimated</td>
<td>Estimated System</td>
<td>Estimated System</td>
</tr>
<tr>
<td></td>
<td>Reconstruction with new sod</td>
<td>Installation</td>
<td>Installation</td>
</tr>
<tr>
<td>(US dollars)</td>
<td></td>
<td>(US dollars)</td>
<td>(US dollars)</td>
</tr>
<tr>
<td>Construction Cost</td>
<td>$ 10,000.00</td>
<td>$ 44,000.00</td>
<td>$ 50,000.00</td>
</tr>
<tr>
<td>Site Clearing &amp; Disposal</td>
<td>$ 29,875.00</td>
<td>$ 58,000.00</td>
<td>$ 47,300.00</td>
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<tr>
<td>Site preparation</td>
<td>$ 52,700.00</td>
<td>$ 277,900.00</td>
<td>$ 451,000.00</td>
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<tr>
<td>Turf installation</td>
<td>$ 96,500.00</td>
<td>$ 352,600.00</td>
<td>$ 473,000.00</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$ 189,075.00</strong></td>
<td><strong>$ 732,500.00</strong></td>
<td><strong>$ 1,021,300.00</strong></td>
</tr>
<tr>
<td>Construction Contingency</td>
<td>$ 18,907.50</td>
<td>$ 20,000.00</td>
<td>$ 51,065.00</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$ 207,982.50</strong></td>
<td><strong>$ 752,500.00</strong></td>
<td><strong>$ 1,072,365.00</strong></td>
</tr>
</tbody>
</table>

Table 4: SW Field: 100,000 s.f.

<table>
<thead>
<tr>
<th>Description</th>
<th>Natural Grass</th>
<th>Synthetic Turf (Crumb Rubber Infill)</th>
<th>Synthetic Turf (Organic Infill)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimated</td>
<td>Estimated System</td>
<td>Estimated System</td>
</tr>
<tr>
<td></td>
<td>Reconstruction with new sod</td>
<td>Installation</td>
<td>Installation</td>
</tr>
<tr>
<td>(US dollars)</td>
<td></td>
<td>(US dollars)</td>
<td>(US dollars)</td>
</tr>
<tr>
<td>Construction Cost</td>
<td>$ 15,500.00</td>
<td>$ 50,000.00</td>
<td>$ 57,000.00</td>
</tr>
<tr>
<td>Site Clearing &amp; Disposal</td>
<td>$ 34,350.00</td>
<td>$ 60,000.00</td>
<td>$ 55,000.00</td>
</tr>
<tr>
<td>Site preparation</td>
<td>$ 95,850.00</td>
<td>$ 315,000.00</td>
<td>$ 500,000.00</td>
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<tr>
<td>Turf installation</td>
<td>$ 110,900.00</td>
<td>$ 410,000.00</td>
<td>$ 550,000.00</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$ 256,600.00</strong></td>
<td><strong>$ 835,000.00</strong></td>
<td><strong>$ 1,162,000.00</strong></td>
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<tr>
<td>Construction Contingency</td>
<td>$ 25,660.00</td>
<td>$ 20,000.00</td>
<td>$ 58,100.00</td>
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<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$ 282,260.00</strong></td>
<td><strong>$ 855,000.00</strong></td>
<td><strong>$ 1,220,100.00</strong></td>
</tr>
</tbody>
</table>
### Table 5: SE Field: 118,000 s.f.

<table>
<thead>
<tr>
<th>Description</th>
<th>Natural Grass</th>
<th>Synthetic Turf (Crumb Rubber Infill)</th>
<th>Synthetic Turf (Organic Infill)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimated</td>
<td>Estimated System</td>
<td>Estimated System</td>
</tr>
<tr>
<td></td>
<td>Reconstruction with new sod</td>
<td>Installation</td>
<td>Installation</td>
</tr>
<tr>
<td>Construction Cost</td>
<td>$ 15,500.00</td>
<td>$ 55,000.00</td>
<td>$ 67,000.00</td>
</tr>
<tr>
<td>Site Clearing &amp; Disposal</td>
<td>$ 38,850.00</td>
<td>$ 70,800.00</td>
<td>$ 64,900.00</td>
</tr>
<tr>
<td>Site preparation</td>
<td>$ 112,150.00</td>
<td>$ 365,800.00</td>
<td>$ 590,000.00</td>
</tr>
<tr>
<td>Turf installation</td>
<td>$ 128,500.00</td>
<td>$ 472,000.00</td>
<td>$ 649,000.00</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$ 295,000.00</strong></td>
<td><strong>$ 963,600.00</strong></td>
<td><strong>$ 1,370,900.00</strong></td>
</tr>
<tr>
<td>Construction Contingency</td>
<td>$ 29,500.00</td>
<td>$ 20,000.00</td>
<td>$ 68,545.00</td>
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<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$ 324,500.00</strong></td>
<td><strong>$ 983,600.00</strong></td>
<td><strong>$ 1,439,445.00</strong></td>
</tr>
</tbody>
</table>

### Grand Total

|                           | $ 814,742.50 | $ 2,591,100.00 | $ 3,731,910.00 |

### Annual Maintenance Cost

There are considerable differences in the maintenance approach to each system, thus a variation in the estimated annual maintenance cost should be expected. This projection examines the maintenance based on the information provided the City of Boca Raton for the three fields and the artificial turf vendors.

### Table 6: Estimated annual maintenance cost per field.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor (mowing or brushing)</td>
<td>$24,562.00</td>
<td>$4,000.00</td>
<td>$2,000.00</td>
</tr>
<tr>
<td>Tech Labor (Spray)</td>
<td>$2,489.00</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>Irrigation labor</td>
<td>$6,257.00</td>
<td>$500.00</td>
<td>$500.00</td>
</tr>
<tr>
<td>Mechanic Labor</td>
<td>$1,531.00</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td><strong>Total Maintenance Labor</strong></td>
<td><strong>$34,839.00</strong></td>
<td><strong>$4,000.00</strong></td>
<td><strong>$2,500.00</strong></td>
</tr>
<tr>
<td>Equipment Parts</td>
<td>$833.00</td>
<td>$40.00</td>
<td>$40.00</td>
</tr>
<tr>
<td>Equipment (Depreciated)</td>
<td>$4,564.00</td>
<td>$200.00</td>
<td>$200.00</td>
</tr>
<tr>
<td>Field Testing &amp; Repairs</td>
<td>$100.00</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>Fuel</td>
<td>$2,154.00</td>
<td>$100.00</td>
<td>$100.00</td>
</tr>
<tr>
<td>Sprinkler supplies</td>
<td>$1,625.00</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td><strong>Total Maintenance Equipment</strong></td>
<td><strong>$9,276.00</strong></td>
<td><strong>$340.00</strong></td>
<td><strong>$340.00</strong></td>
</tr>
<tr>
<td>Irrigation or cooling system</td>
<td>$7,500.00</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
</tbody>
</table>
## Annual Maintenance Cost (per Field)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizer or Disinfection</td>
<td>$3,000.00</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>Chemicals (pesticides, weed control)</td>
<td>$2,500.00</td>
<td>$50.00</td>
<td>$50.00</td>
</tr>
<tr>
<td>Seeding</td>
<td>$960.00</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>Sod Replacement or carpet Repair</td>
<td>$10,512.00</td>
<td>$100.00</td>
<td>$100.00</td>
</tr>
<tr>
<td>Total Maintenance Supplies</td>
<td>$24,472.00</td>
<td>$150.00</td>
<td>$150.00</td>
</tr>
<tr>
<td>Top Dressing (sand or infill)</td>
<td>$1,500.00</td>
<td>$1,500.00</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>Aeration</td>
<td>$435.00</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>Field Paint</td>
<td>$6,440.00</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>Total Field Upkeep</td>
<td>$8,375.00</td>
<td>$1,500.00</td>
<td>$3,000.00</td>
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<tr>
<td>Total Annual Maintenance Cost</td>
<td>$76,962.00</td>
<td>$6,490.00</td>
<td>$5,990.00</td>
</tr>
</tbody>
</table>

Therefore, the estimated total annual maintenance cost for the three fields based on the above table yields for each system $230,866.00 for natural grass fields; $19,470.00 for artificial turf with crumb rubber infill and $17,970.00 for artificial turf with organic infill.

Table 7 depicts the projected operational cost associated with each turf system for the fields over the assumed product life of 8 years, factoring a constant inflation rate of 1.7% over that period, yields a **projected total operational cost for each system** as $1,960,806.89 for natural grass; $165,349.61 for artificial turf with crumb rubber infill and $152,610.81 for artificial turf with Organic Infill.

### Table 7: Projected Operational Cost

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 0</td>
<td>$ -</td>
<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td>Year 1</td>
<td>$ 230,886.00</td>
<td>$ 19,470.00</td>
<td>$ 17,970.00</td>
</tr>
<tr>
<td>Year 2</td>
<td>$ 234,811.06</td>
<td>$ 19,800.99</td>
<td>$ 18,275.49</td>
</tr>
<tr>
<td>Year 3</td>
<td>$ 238,802.85</td>
<td>$ 20,137.61</td>
<td>$ 18,586.17</td>
</tr>
<tr>
<td>Year 4</td>
<td>$ 242,862.50</td>
<td>$ 20,479.95</td>
<td>$ 18,902.14</td>
</tr>
<tr>
<td>Year 5</td>
<td>$ 246,991.16</td>
<td>$ 20,828.11</td>
<td>$ 19,223.47</td>
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<tr>
<td>Year 6</td>
<td>$ 251,190.01</td>
<td>$ 21,182.18</td>
<td>$ 19,550.27</td>
</tr>
<tr>
<td>Year 7</td>
<td>$ 255,460.24</td>
<td>$ 21,542.28</td>
<td>$ 19,882.63</td>
</tr>
<tr>
<td>Year 8</td>
<td>$ 259,803.06</td>
<td>$ 21,908.50</td>
<td>$ 20,220.63</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$1,960,806.89</td>
<td>$165,349.61</td>
<td>$152,610.81</td>
</tr>
</tbody>
</table>

Year 0 covers the initial or total construction cost and is not factored into operational cost.
Table 8 highlights the average cost anticipated per hour use of the rectangular fields at Patch Reef Park with the different ground coverings. It is evident based on usage that artificial turf provides more hours per annum and the cost of artificial turf relative to natural grass per hour use is lower.

Table 8: Overview of the cost per use of the field over the assumed product useful life of 8 years.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation/Construction Cost (Initial)</td>
<td>$814,502.56</td>
<td>$2,591,100.00</td>
<td>$3,731,910.00</td>
</tr>
<tr>
<td>Estimated Operational Cost over Estimated Product Useful Life</td>
<td>$1,960,806.89</td>
<td>$165,349.61</td>
<td>$152,610.81</td>
</tr>
<tr>
<td>Total Cost over Product Useful Life</td>
<td>$2,775,549.39</td>
<td>$2,756,449.61</td>
<td>$3,884,52081</td>
</tr>
<tr>
<td>Estimated Annual Programmable hours</td>
<td>2,016</td>
<td>3,276</td>
<td>3,276</td>
</tr>
<tr>
<td>*Estimated 8-year Programmable hours</td>
<td>16,128</td>
<td>26,208</td>
<td>26,208</td>
</tr>
<tr>
<td>Average Usage cost per hour</td>
<td>$172.10</td>
<td>$105.18</td>
<td>$148.22</td>
</tr>
</tbody>
</table>

*Based on the Park's 63 hours of availability.

Equivalent Uniform Annual Cost Analysis (EUAC)

This analysis involves examining the alternatives based on cost and benefits to determine which alternative best meets economic needs. In the case, the initial cost is converted to an annual cost using the compounded interest for the period and MARR and this is then added to the estimated maintenance to obtain the equivalent annual cost. Table 9 depicts the cost data for each system and rates used in deriving each EUAC.

Based on the derived EUAC, the natural turf system is the alternative with the lowest cost; hence more economical. However, the “as-is” scenario with maintenance cost remaining constant at $230,866.00 implies that continued maintenance of the current condition of the fields will be the most economical route. It should be recognized that the natural grass being the economical alternative is relative to the other alternatives from an annual cost stand point.

Table 9: Equivalent Uniform Annual Cost Comparison.

<table>
<thead>
<tr>
<th></th>
<th>Natural Grass</th>
<th>Artificial Turf (Crumb Rubber Infill) (US Dollars)</th>
<th>Artificial Turf (Organic Infill) (US Dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Cost</td>
<td>$814,742.50</td>
<td>$2,591,100.00</td>
<td>$3,731,910.00</td>
</tr>
<tr>
<td>Maintenance cost</td>
<td>$230,886.00</td>
<td>$19,470.00</td>
<td>$17,970.00</td>
</tr>
<tr>
<td>Period, 8yrs</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>MARR</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>EUAC</td>
<td>$356,967.40</td>
<td>$420,442.73</td>
<td>$595,483.07</td>
</tr>
</tbody>
</table>
However, from a benefit standpoint, the increase in availability provided by the artificial turf system yields more hours which translates to meeting the usage demands and possibility of accommodating the addition of a new sports league which in turn could essentially lead to increase in revenue.

**Break-even Analysis**

This project selection tool allows decision makers to evaluate project alternatives based on the costs and at which point two alternatives will be equivalent. In this case, the alternatives are examined from two point of references 1. Annualized initial and annual maintenance cost and 2. Usage cost per hour over the assumed product useful life.

**Table 10: Cost Comparison: EUAC**

<table>
<thead>
<tr>
<th>Year</th>
<th>Natural Turf (US Dollars)</th>
<th>Artificial Turf (Crumb Rubber Infill) (US Dollars)</th>
<th>Artificial Turf (Organic Infill) (US Dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>$356,926.66</td>
<td>$420,313.17</td>
<td>$595,296.48</td>
</tr>
<tr>
<td>Year 2</td>
<td>$360,851.73</td>
<td>$420,644.16</td>
<td>$595,601.97</td>
</tr>
<tr>
<td>Year 3</td>
<td>$364,843.51</td>
<td>$420,980.78</td>
<td>$595,912.65</td>
</tr>
<tr>
<td>Year 4</td>
<td>$368,903.16</td>
<td>$421,323.12</td>
<td>$596,228.62</td>
</tr>
<tr>
<td>Year 5</td>
<td>$373,031.83</td>
<td>$421,671.28</td>
<td>$596,549.95</td>
</tr>
<tr>
<td>Year 6</td>
<td>$377,230.68</td>
<td>$422,025.35</td>
<td>$596,876.75</td>
</tr>
<tr>
<td>Year 7</td>
<td>$381,500.91</td>
<td>$422,385.45</td>
<td>$597,209.11</td>
</tr>
<tr>
<td>Year 8</td>
<td>$385,843.73</td>
<td>$422,751.67</td>
<td>$597,547.11</td>
</tr>
</tbody>
</table>
It is important to note that the initial cost was converted to an annuity in order to evaluate the cost on an annual basis over the assumed product useful life and summed with the projected annual maintenance cost. Due to the high initial cost for artificial turf there appears to be no breakeven point within the time frame evaluated. Further examination of the alternatives over a 10-year period (using the compounded interest for the period) indicated a breakeven point between natural grass and artificial turf with crumb rubber at approximately the 6 year point. However, over a 15-year period (using the compound interest for that period) there appears to be no breakeven point between the alternatives examined. The 20-year period (using the compound interest for that period) shows a breakeven point exists only between natural grass and artificial turf (with organic infill) at approximately the 6 year point. It is important to note that the 15 and 20 year evaluation exceeds the manufacturer’s product useful life of 10 years and the assumed useful life of 8 years. Hence, from an implementation standpoint, the investment is not realized over those periods. Additionally, the replacement of the turf system will be under consideration in about the 8th or 9th year mark in which the turf and infill may have to be replaced.

Based on the cost per square foot as provided by the vendors, the total projected replacement cost for artificial turf with crumb rubber is $1,595,500.00 for the three fields at $5.25 per square foot and $1,520,000.00 for artificial turf with organic infill for the three fields at cost per square feet of $5.00. According to Turfsolutions, natural grass fields would need to be re-sodded only if there are water quality issues that have damaged the grass turf over time or lock up the soil. Even if soil lock up becomes an issue, there are steps that can be taken to balance the soils pH level. Good soil (root zone mix), drainage, irrigation and agronomic care of natural grass fields can ensure the fields thrive for many years, far longer than the life of a synthetic field.

Examining the data from an availability and maintenance viewpoint, artificial turf’s 52 weeks availability outweighs the current field availability of natural grass at 32 weeks which also takes into consideration that the labor requirements for the field maintenance will be drastically reduced with the use of artificial turf.

Nonetheless, Table 11 shows the annual cost per hour of use for each system - which evidently shows natural grass as having a higher cost per hour in comparison to the other alternatives. Also, the cost per hour use comparison, indicates a breakeven point between natural grass and artificial turf with organic infill at approximately 3.5 years at a cost of approximately $181.00 per hour. While the cost per hour for artificial turf with crumb rubber appears to be considerably less than the other alternatives, a breakeven point between this product and natural grass does not seem to exist within the period evaluated. However, from a cost per hour perspective, artificial turf with crumb rubber appears to be the suitable alternative.

Table 11: Cost Comparison: Annualized hourly usage cost.

<table>
<thead>
<tr>
<th></th>
<th>Natural Turf</th>
<th>Artificial Turf (Crumb Rubber)</th>
<th>Artificial Turf (Organic Infill)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>$177.05</td>
<td>$128.30</td>
<td>$181.71</td>
</tr>
<tr>
<td>Year 2</td>
<td>$178.99</td>
<td>$128.40</td>
<td>$181.81</td>
</tr>
<tr>
<td>Year 3</td>
<td>$180.97</td>
<td>$128.50</td>
<td>$181.90</td>
</tr>
<tr>
<td>Year 4</td>
<td>$182.99</td>
<td>$128.61</td>
<td>$182.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product Useful Life</th>
<th>Natural Turf</th>
<th>Artificial Turf (Crumb Rubber)</th>
<th>Artificial Turf (Organic Infill)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 5</td>
<td>$185.04</td>
<td>$128.72</td>
<td>$182.10</td>
</tr>
<tr>
<td>Year 6</td>
<td>$187.12</td>
<td>$128.82</td>
<td>$182.20</td>
</tr>
<tr>
<td>Year 7</td>
<td>$189.24</td>
<td>$128.93</td>
<td>$182.30</td>
</tr>
<tr>
<td>Year 8</td>
<td>$191.39</td>
<td>$129.05</td>
<td>$182.40</td>
</tr>
</tbody>
</table>

Graph 4
Section 9

The review of several reports, academic journals and articles were conducted in consolidating and analyzing the various perspectives on possible health issues and injuries attributed to artificial turf and natural grass fields and alternate infill materials. Data obtained from various entities mentioned in previous sections of the report aided in developing the cost comparisons and subsequent cost analysis using project selection tools. These efforts culminates with the following findings:

Findings

- There is a need to meet user groups’ usage demand by the District.
- FY 2013-2014 usage hours per field indicates possible field conditions being between fair to detrimental based on the agronomist report. Refer to Appendix for Usage Table.
- The NBC report appears to be limited to soccer players and it is unclear how this alleged health issue relates to others sports.
- It is difficult to prove or debunk concerns about possible health issues as there are no conclusive findings by any governmental agencies on this matter.
- Health concerns should include a complete assessment of not only artificial turf but natural grass as well due to the use of pesticides.
- Alternate infill materials are propriety and should be evaluated to ensure conformance to athletic use.
- The standard molded cleats are good choice for footwear for use on a variety of fields.
- According to Penn State research, footwear selection has a greater influence on rotational traction and potentially lower extremity injuries than the playing surface themselves.
- Studies from older turf varieties should be excluded when assessing the safety of modern turf products.
- The subject of injury is complex due to a large number of potential variables that span across multiple injury types, multiple sports, level of play, gender, age, turf brands and styles.
- Research shows that there are no significant difference in the nature of overuse injuries recorded on artificial turf and grass for either women or men.
- It is evident that turf burn are more widespread in artificial turf than grass; however, fewer bacteria are stated to be present on the artificial turf surfaces than in natural grass.
- Immediate attention is necessary from abrasions due to turf burn.
- Recreational fields tend to suffer from extensive wear and tear which could be a source of injuries.
- Based on the level of humidity in South Florida, irrigation cooling techniques would be expected to have limited effectiveness.
- To combat the heating issues of turf, manufacturers have introduced a number of proprietary infill replacements that claim to have cooling effects on the turf. These products are relatively new and the effectiveness of temperature improvements are still under evaluation.

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Based on direct cost comparison only, the fields remaining “as-is” and instituting a comprehensive and practical maintenance program is the lowest cost option.

Based on direct cost comparison for the operational cost only, the estimated annual maintenance cost for artificial turf (organic infill) appears to be the suitable project to undertake.

Based on the equivalent uniform annual cost, the natural turf system is the economical option in comparison to the other alternatives.

Based on usage cost per hour only, the estimated average hourly use cost for artificial turf (crumb rubber) appears to be a suitable alternative.

The breakeven analysis yielded the following:

- Annualized initial cost over the assumed product life summed with the maintenance cost shows no breakeven point between natural grass and either of the two artificial turf alternatives (within the examined period).
- Annualized usage cost per hour over the assumed product life shows a breakeven point between natural grass and artificial turf (organic infill) at 3.5 years and no breakeven point between natural grass and artificial turf (crumb rubber) within the period examined.

Considering replacement cost at the end of the product useful life,

- Artificial turf (crumb rubber) is approximately $5.25 per square foot resulting in an approximate total replacement cost for all three fields of $1,595,500.00
- Artificial turf (organic infill) is approximately $5.00 per square foot, totaling a replacement cost of approximately $1,520,000.00.
- Natural grass system can provide longer use if a maintenance program is instituted that provides proper agronomic care and good irrigation cycle.

Based on the user group survey conducted, 44% of the participants that responded considered the implementation of artificial turf to be advantageous since that would address the high usage demand.

Based on the user group survey conducted, 78% of the participants that responded expressed that health concerns are of high importance.

Based on the user group survey conducted, 22% of the participants that responded expressed that the implementation of a more user friendly product that has low heat emission is considered desirable.

The possibility of adding an additional field is limited due the current location of the rectangular fields. One option to further explore would be combining the baseball field with a rectangular field.

The municipalities and institutions contacted regarding their artificial turf systems expressed contentment with the decision, and confirm that the low cost of maintenance and infrequent need to maintain the field is a positive.

Two different municipality representatives highlighted users concerns over heat during summer months. It is important to know that these fields do not have an irrigation or mist system installed nor is there sufficient evidence that a mist or irrigation system completely cools down artificial turf.
One municipality representative suggested using a different infill material in lieu of crumb rubber due to heating issues during summer.

All municipalities that participated indicated that the observed injuries at the level of use at their fields is no different from playing on natural grass field.

**Recommendations**

The agronomist report of April 2014, suggested that the fields overall condition at Patch Reef Park to be in an excellent state from a visual vantage point. However, the report highlighted concerns about the fields being used at high capacity which can eventually lead to poor draining and possibly requiring frequent re-sodding; consequently leading to more down time and less capacity. Based on the aforementioned perspectives from the user groups and survey responses, it is suggested that decision makers consider in addition to the recommendations the agronomy report provided on fields, the other facets in the decision making process to include cost, usage, maintenance program, safety and education on field use.

The following are options to consider in the decision making process:

**A. Gradual integration of artificial turf**

   In order to meet the usage demand stated by patrons, the option to convert a field into artificial turf can be considered. This integration will address two key items. 1. Address usage demand and 2. Address health concerns. The availability of both field types can possible balance the need for more access while lessen the apprehension about artificial turf as the other natural grass fields will be available to those patrons that prefer natural grass. This also presents an opportunity to consider an alternate infill that may help reduce the apprehension about artificial turf. It is important to keep in mind that the findings show that these alternate infills may be relatively new and the effectiveness of temperature improvements are still under evaluation. Additionally, it is essential to recognize that to date no regulatory/government agency study has provided any conclusive data to prove or debunk the alleged carcinogen properties that may be associated with crumb rubber. It is acknowledged that further research and study may be necessary regarding this area in a continued effort to provide information to users and patrons in order to make informed decisions.

**B. Do nothing**

   In the event health concerns outweighs the usage demand, it is suggested that decision makers consider the option to keep the rectangular fields “as-is”. However, it highly recommended to seek alternative resolutions that would address user groups stated capacity needs.

**C. Institute the recommendations by the Agronomist to keep the fields healthy**

   For the fields to remain natural grass, it is imperative that a maintenance program that incorporates the recommendations made by the agronomist be examined accordingly and incorporated as needed.

**D. Further explore field combination**

   As demand increases, further exploration of the feasibility of reconfiguring one of the existing baseball field to include a rectangular field is suggested.
References


**Budgetary Cost Data:**

All cost data provided by the vendors solicited are budgetary and subject to changes based on actual site conditions.

Budget on Artificial turf with crumb rubber:
Fieldturf, USA
1231 Legendary Blvd.
Clermont, FL 34711

Budget on Artificial turf with organic infill:
Geoturf by, Limonata Sports USA
224 West 30th Street
Suite 606
New York, NY 10001

Budget on Bermudagrass:
Turfsolutions
3523 West Willow Knolls Drive,
Peoria, IL 61614
<table>
<thead>
<tr>
<th>FY</th>
<th>Months</th>
<th>FY 2013-2014 Field Calendar</th>
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<tbody>
<tr>
<td></td>
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<td>Availability (Days)</td>
</tr>
<tr>
<td>2013</td>
<td>October</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>31</td>
</tr>
<tr>
<td>2014</td>
<td>January</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>February</td>
<td>28</td>
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<td>Total Days</td>
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</tr>
<tr>
<td></td>
<td>Total Weeks</td>
<td>52</td>
</tr>
</tbody>
</table>

<p>| FY 2013-2014 |</p>
<table>
<thead>
<tr>
<th>User Groups</th>
<th>Seasons</th>
<th>Actual Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boca Jets Lacrosse</td>
<td>Mid January - Early May</td>
<td>1/13/14 – 5/4/14</td>
</tr>
<tr>
<td>East Boca Tackle Football</td>
<td>Late July - Mid November</td>
<td>7/28/14 – 11/15/14</td>
</tr>
<tr>
<td>Boca Jets Tackle Football</td>
<td>Late July - Mid November</td>
<td>7/28/14 – 11/15/14</td>
</tr>
<tr>
<td>Pop Warner Tackle Football</td>
<td>Late July - Mid November</td>
<td>7/28/14 – 11/15/14</td>
</tr>
<tr>
<td>Spanish River High School Soccer</td>
<td>October - Early November</td>
<td>10/7/14 – 11/6/14</td>
</tr>
<tr>
<td>Pope John Paul High School Soccer</td>
<td>October</td>
<td>10/6/14 – 10/30/14</td>
</tr>
</tbody>
</table>

Note:
The information summarized above is based on the actual activity calendar provided by the City of Boca Raton and represents only the period indicated above.
Appendix II

Patch Reef Park - Multi-use Sports Fields and Baseball Fields

Figure 1: Site for field combination consideration
### Hours of Scheduled Usage - Rectangle Fields (FY 13/14)

|                     | deHoernle-N1 | deHoernle-N2 | deHoernle-S1 | deHoernle-S2 | deHoernle-S3 | deHoernle-S4 | deHoernle Total | Patch Reef NE | Patch Reef SE | Patch Reef SW | Woodlands N | Woodlands S | Woodlands Total | Sandpine E | Sandpine W | Sandpine Total | Entridge | Hillsboro | Lake Wyman | FAU Glades N | FAU Glades S | FAU Game | FAU Total | YEARLY TOTAL |
|---------------------|--------------|--------------|--------------|--------------|--------------|--------------|----------------|---------------|---------------|---------------|-------------|-------------|----------------|-----------|-----------|----------------|----------|----------|------------|-----------|-----------|-----------|------------|------------|-----------|-----------|-------------|
| Adult Flag Football| 123          | 123          | 127          | 60           | 433          |              |                | 0             | 0             | 0             |            |             | 0              | 0         | 0         | 0              | 0        | 0        | 0          | 0         | 0         | 0         | 0          | 0          | 0         | 0          | 0          |
| Adult Rugby         | 0            | 0            | 0            | 0            | 0            | 106          | 0              | 0             | 0             | 0             | 16          | 0           | 16              | 0         | 0         | 0              | 0        | 0        | 0          | 0         | 0         | 0         | 0          | 0          | 0         | 0          |
| Adult SABR (soccer)| 16           | 16           | 0            | 4            | 4            | 297          | 300            | 597           | 78            | 101           | 70          | 16          | 12              | 52        | 80        | 946             | 0        | 0        | 0          | 0         | 0         | 0         | 0          | 0          | 0         | 0          |
| Permits (mostly soccer) | 0          | 1            | 1            | 187          | 6            | 193          | 397            | 263           | 660           | 107           | 336         | 29          | 24          | 660             | 107      | 336       | 29             | 0        | 0        | 0          | 0         | 0         | 0         | 0          | 0          | 0         | 0          |
| **Adult Total**     | 16           | 0            | 123          | 123          | 127          | 60           | 449            | 0             | 1             | 0             | 1           | 191         | 6              | 197       | 263       | 694             | 1257     | 437      | 99           | 16        | 12       | 52          | 80        | 2,811     | 645        | 0          | 0          | 0          |
| Youth SABR (soccer)| 751          | 709          | 498          | 615          | 129          | 2,702         | 0              | 57            | 47            | 104           | 316         | 319         | 635             | 41        | 890       | 843             | 420      | 2,153    | 5,635       | 0         | 0        | 501         | 0          | 0         | 0          | 0         | 0         | 0          | 0          | 0          |
| EBT (tackle football)| 87           | 91           | 87           |              |              | 265          | 84             | 132           | 86            | 302           | 38          | 8           | 46              | 16        | 16        | 16              | 32       | 0         | 0           | 0         | 0         | 0           | 0         | 0         | 0          | 0         | 0          |
| Boca Jets (tackle football) | 0           | 51           | 51           | 53           |              | 155          | 176            | 153           | 329           | 11            | 6           | 17              |            | 0         | 0              | 0        | 0         | 0           | 0         | 0         | 0           | 0         | 0         | 0          | 0         | 0          |
| Pop Warner (tackle football) | 52          | 28           |              |              |              | 80           | 167            | 171           | 163           | 501           | 4           | 4           | 4               | 4         | 0         | 0              | 0        | 0         | 0           | 0         | 0         | 0           | 0         | 0         |
| Lacrosse            | 0            | 236          | 270          | 263          | 769          |              |                | 0             | 0             | 0             | 0           | 0           | 0               | 68        | 0         | 0              | 0        | 0         | 0           | 0         | 0         | 0           | 0         | 0          |
| Youth Rugby         | 0            | 0            | 0            | 2            | 2            | 110          | 0              | 0             | 0             | 0             | 0           | 0           | 0               | 0         | 0         | 0              | 0        | 0         | 0           | 0         | 0         | 0           | 0         | 0          |
| COBRA (Yth Flag,T-Ball,golf) | 0           | 0            | 0            | 190          | 171          | 361          | 0              | 0             | 0             | 0             | 0           | 0           | 0               | 0         | 0         | 0              | 0        | 0         | 0           | 0         | 0         | 0           | 0         | 0          |
| Maccabi Games (soccer) | 36          | 36           | 36           | 36           |              | 144          | 0              | 0             | 0             | 0             | 0           | 0           | 0               | 0         | 0         | 0              | 0        | 0         | 0           | 0         | 0         | 0           | 0         | 0          |
| Private School (mostly soccer) | 0           | 46           | 46           |              |              | 0            | 59             | 16            | 75            | 138           | 46          | 0           | 0               | 0         | 0         | 0              | 0        | 0         | 0           | 0         | 0         | 0           | 0         | 0          |
| Public Schools (mostly soccer) | 0           | 9            | 9            | 18            | 27           | 35           | 62             | 113           | 65            | 178           | 75          | 32          | 0               | 0         | 0         | 0              | 0        | 0         | 0           | 0         | 0         | 0           | 0         | 0          |
| **Youth Total**     | 787          | 745          | 673          | 770          | 216          | 0            | 3,191          | 584           | 633           | 574           | 1,791       | 298         | 247            | 545       | 707       | 597            | 1,304     | 289      | 143          | 78        | 890       | 843         | 420       | 2,153     | 9,493       | 0         | 0          |
| **Grand Total**     | 803          | 745          | 796          | 893          | 343          | 60           | 3,640          | 584           | 634           | 574           | 1,792       | 489         | 253            | 742       | 1,401     | 1,160           | 2,561     | 580      | 580          | 177       | 906       | 855          | 472       | 2,233     | 12,304       | 0         | 0          |

Pop Warner hours (80) at deHoernle reflects their flag football season

Q:\Athletics\Facility Requests & Field Permits\13-14 Field Usage Hours by group.xlsx
Unless artificial turf is specifically mentioned, all questions are in reference to natural grass.

Participant #1

Survey Participants Name, Position and Title
Michael Schmidt, President Boca braves

Which age group does your team represent?
Youth

Explain your sport's season and duration (i.e. time of year)
February to November, nights, 1-3 nights per week, 2 hours per night

How many hours does your team have for practice and games on the field monthly? Please explain your schedule (indicate if your usage includes evenings).
32 hours per month during the season

What type of injuries, if any, have you observed playing on the fields?
Sprained ankles from slippage on wet grass or bare spots

Which of the following best describes the type of footwear the team members generally wear?
Firm Ground (FG) or Molded

Has your group played on artificial turf before? If so, where?
Yes, throughout our league there are some artificial turf fields

What are your concerns about playing on artificial turf?
None

Is artificial turf suitable for your sport?
Yes

Additional Comments: (Concerns, suggestions, or observations)
Artificial turf allows greater field usage which results in more practice and less injuries, artificial turf requires less financial upkeep over time and therefore provides better value to the tax payer
Unless artificial turf is specifically mentioned, all questions are in reference to natural grass.

Participant #2

Survey Participants Name, Position and Title
Claire Lutkewitte  
SABR Adult Coordinator

Which age group does your team represent?  
Adult

Explain your sport's season and duration (i.e. time of year)  
Our adult groups play year round. Some just do pickup games while others have leagues in fall and spring.

How many hours does your team have for practice and games on the field monthly? Please explain your schedule (indicate if your usage includes evenings).  
Our groups play several nights a week year round.

What type of injuries, if any, have you observed playing on the fields?  
Typical soccer injuries due to the nature of the sport.

Which of the following best describes the type of footwear the team members generally wear?  
Firm Ground (FG) or Molded

Has your group played on artificial turf before? If so, where?  
Yes at Sand Pine

What are your concerns about playing on artificial turf?  
It's hard on the body, especially for keepers. It isn't fun to slide on. Not sure if there is any significant study linked to it, but I did recently read an article linking turf fields to cancer in soccer players.

Is artificial turf suitable for your sport?  
I am not sure.

Additional Comments: (Concerns, suggestions, or observations)  
I've had several conversations about this with the players who play in the adult groups and the majority prefer grass fields.
Unless artificial turf is specifically mentioned, all questions are in reference to natural grass.

Participant #3
Survey Participants Name, Position and Title
Kevin Clarke
Team Manager
Soccer Association of Boca Raton

Which age group does your team represent?
Adult

Explain your sport's season and duration (i.e. time of year)
3 games/week 52 weeks of the year

How many hours does your team have for practice and games on the field monthly? Please explain your schedule (indicate if your usage includes evenings).
Mondays 8p - 10p  Wednesdays 6p - 8p
Saturdays 8a - 10a

What type of injuries, if any, have you observed playing on the fields?
Hamstring tears, Ankle sprains,

Which of the following best describes the type of footwear the team members generally wear?
Firm Ground (FG) or Molded
Other (please specify) soccer cleats

Has your group played on artificial turf before? If so, where?
Yes, Sand Pines Park, Boca Raton, Fl.

What are your concerns about playing on artificial turf?
Knee, Hip, Ankle & Back injuries, Skin cuts or abrasions, with possible infection from sliding on artificial turf.

Is artificial turf suitable for your sport?
No

Additional Comments: (Concerns, suggestions, or observations)
Artificial Turf loses its "give" or bounce, then feels like playing on concrete covered with indoor/outdoor carpeting.
Unless artificial turf is specifically mentioned, all questions are in reference to natural grass.

Participant #4

Survey Participants Name, Position and Title

Dennis Frisch
GBRBPD Commissioner
Adult rugby player

Which age group does your team represent?

Adult

Explain your sport’s season and duration (i.e. time of year)

October thru April

How many hours does your team have for practice and games on the field monthly? Please explain your schedule (indicate if your usage includes evenings).

Practice Tuesday/Thursday evening 2 hrs/night
Saturday is game day. Home matches 3-4 hours

What type of injuries, if any, have you observed playing on the fields?

Lacerations and abrasions, also knee and ankles with occasional shoulder

Which of the following best describes the type of footwear the team members generally wear?

Skipped

Has your group played on artificial turf before? If so, where?

Yes, Atlanta

What are your concerns about playing on artificial turf?

Damage to field due to cleats, inability to have away teams wear specific cleats if that is ultimately a requirement, abrasion injury, placement of goal posts, size of field (true rugby field is larger than a football field)

Is artificial turf suitable for your sport?

No

Additional Comments: (Concerns, suggestions, or observations)

Because rugby requires tackling and a lot of sliding on ground there will be lots of abrasions. Scrum require a lot of "digging in"
Unless artificial turf is specifically mentioned, all questions are in reference to natural grass.

Participant #5

Survey Participants Name, Position and Title
Geoff Solomon, Director of Girls Soccer / SABR
(Soccer Association of Boca Raton)

Which age group does your team represent?
Youth

Explain your sport's season and duration (i.e. time of year)
Preseason registration and pickup games in September, Practices start October, Games played November thru February

How many hours does your team have for practice and games on the field monthly? Please explain your schedule (indicate if your usage includes evenings).
A single recreational SABR soccer team practices 1 hour per week (typically on a Monday thru Thursday night) and plays one game (typically on a Friday night, Saturday or Sunday, 1 hour to 90 minutes, depending on age of player) per week. The Girls Divisions for which I'm responsible has 80+ teams and nearly 1,000 players. There are another 90+ teams and over 10,000 players in our Boys division, and our Travel program ("Team Boca") has hundreds more.

What type of injuries, if any, have you observed playing on the fields?
Soccer injuries run the gamut. Common injuries include twisted knees, sprained ankles, hip injuries, Achilles heel injuries and though rare, concussions.

Which of the following best describes the type of footwear the team members generally wear?
Firm Ground (FG) or Molded

Has your group played on artificial turf before? If so, where?
Yes, our Under 11 and Under 12 age groups (both boys and girls) have played in the past at Sand Pine park, which has an artificial turf surface. Our adult league (35+) also has played there.

What are your concerns about playing on artificial turf?
1) Possible Health Threats. The Environmental Protection Agency would not even be interviewed by NBC News recently saying only "more studies are needed" to determine if the materials used in artificial turf (including crumb rubber with 4 known carcinogens) may cause certain cancers and lymphoma after a player has prolonged exposure to these elements on artificial turf. 2) Increase in injuries and in significant "burning" and bruising of the skin for players that fall or slide on the artificial surface. Many people who say artificial turf is fine to play on typically have not played on it, nor have they experienced the increase in knee, ankle and heel injuries that many players report when playing on that surface. 3) The game of soccer is fundamentally different on artificial turf. The ball behaves very differently. It bounces higher, it rolls much faster and farther and makes controlling the ball much more difficult. Because of the aforementioned injuries and the more common "burns and skin abrasions" players suffer they become more tentative and do not play the game the way they want to play it in fear of those injuries or abrasions.

Is artificial turf suitable for your sport?
No

Additional Comments: (Concerns, suggestions, or observations)
At the recent meeting at Sugar Sand, one of our adult league members said only a few of the people in his group have a problem with artificial turf and that most of them like to play on the surface. What this gentleman failed to mention is that we have seen a major decline in the number of players in our adult league in recent years and a major reason for that decline is that many of our former players hated the artificial turf surface and so they have left our league and now play in other communities that have natural grass fields.
Unless artificial turf is specifically mentioned, all questions are in reference to natural grass.

Participant #6

Survey Participants Name, Position and Title
Craig Ehrnst
Boca Raton YMCA Board Chair and Resident

Which age group does your team represent?
Youth

Explain your sport’s season and duration (i.e. time of year)
All sports, all seasons

How many hours does your team have for practice and games on the field monthly? Please explain your schedule (indicate if your usage includes evenings).
Yes. Working hours and after.

What type of injuries, if any, have you observed playing on the fields?
Typical youth sports injuries from concussion to broken bones. Older players ACL (including me)

Which of the following best describes the type of footwear the team members generally wear?
Hard Ground (HG) or MultiGround (MG)

Has your group played on artificial turf before? If so, where?
For Soccer, Sand Pine turf.

What are your concerns about playing on artificial turf?
Rubber pellets - new information provides cause for legitimate concern until studies completed.

Is artificial turf suitable for your sport?
Yes

Additional Comments: (Concerns, suggestions, or observations)
I support both natural and turf fields. Pros and cons of each. However, recent information (NBC study) is support enough to either replace pellets with something else or wait until federal review is complete. Risk to city/parks rec is removal of new expensive turf fields. Just wait until federal study is done.
Unless artificial turf is specifically mentioned, all questions are in reference to natural grass.

Participant #7

Susan Vogelgesang
Commissioner, Greater Boca Raton Beach and Park District and Administrator for SABR/TOPSoccer

Which age group does your team represent?
Youth

Explain your sport's season and duration (i.e. time of year)
TOPSoccer runs from early January to the last week in February...8 weeks

How many hours does your team have for practice and games on the field monthly? Please explain your schedule (indicate if your usage includes evenings).
4 1/2 hours each Saturday from 12:30 p.m. until 5:00 p.m. at University Woodlands Park

What type of injuries, if any, have you observed playing on the fields?
None reported last season

Which of the following best describes the type of footwear the team members generally wear?
Other (please specify) Do not have this information

Has your group played on artificial turf before? If so, where?
No

What are your concerns about playing on artificial turf?
Potential carcinogenic effects, 'road rash' if the player falls, turned ankles, too hot for this group of special needs athletes

Is artificial turf suitable for your sport?
Skipped

Additional Comments: (Concerns, suggestions, or observations)
I cannot say whether this is suitable for the special needs athletes or not. We do play when it is very hot even in the winter months and the athletes are not happy about the conditions even on grass. There are 150 athletes, 225 buddies, and 46 coaches who participate in the program. We do not utilize Patch Reef Park, however.
Unless artificial turf is specifically mentioned, all questions are in reference to natural grass.

<table>
<thead>
<tr>
<th>Participant #8</th>
</tr>
</thead>
</table>
| **Survey Participants Name, Position and Title** | Karl Zimmerman  
President  
East Boca Tackle Football |
| **Which age group does your team represent?** | Youth |
| **Explain your sport's season and duration (i.e. time of year)** | Fall Football (Aug-Nov) |
| **How many hours does your team have for practice and games on the field monthly? Please explain your schedule (indicate if your usage includes evenings).** | 16 hours/mo Practice  
32 hours/mo Games |
| **What type of injuries, if any, have you observed playing on the fields?** | Typical Tackle Football injuries |
| **Which of the following best describes the type of footwear the team members generally wear?** | Firm Ground (FG) or Molded |
| **Has your group played on artificial turf before? If so, where?** | Yes  
Sand Pine Park, Boca Raton |
| **What are your concerns about playing on artificial turf?** | Extensive Heat in Florida, Petroleum Outgassing and smell of Black Rubber |
| **Is artificial turf suitable for your sport?** | Yes |
| **Additional Comments: (Concerns, suggestions, or observations)** | Black Rubber Petroleum-based Substrate is too hot and unhealthy. Recommend more natural and non-petroleum-based substrate. |

Collector: Web Link 1 (Web Link)  
Started: Friday, November 21, 2014 3:47:26 PM  
Last Modified: Friday, November 21, 2014 3:53:10 PM  
Time Spent: 00:05:43
Unless artificial turf is specifically mentioned, all questions are in reference to natural grass.

Participant #9

Survey Participants Name, Position and Title
Paul Giers
President of Boca Jets Football and Cheerleading

Which age group does your team represent?
Youth

Explain your sport’s season and duration (i.e. time of year)
We have conditioning the month of May. And our practice starts in June the season runs through December.

How many hours does your team have for practice and games on the field monthly? Please explain your schedule (indicate if your usage includes evenings).
2 hour a night Monday through Friday until school starts then 2 hours a night Tuesday through Friday. So 10 hours a week till school starts then 8 hours a week after school starts on Saturdays game starts at 9 finish around 6 o’clock depending on weather. Monthly about 38 to 40 hours.

What type of injuries, if any, have you observed playing on the fields?
Toledo ankles, dislocated shoulders, and an occasional hurt knee.

Which of the following best describes the type of footwear the team members generally wear?
Other (please specify) Football cleats

Has your group played on artificial turf before? If so, where?
Yes, Carter Park, Coral Springs and Miami

What are your concerns about playing on artificial turf?
None

Is artificial turf suitable for your sport?
Yes

Additional Comments: (Concerns, suggestions, or observations)
Go to Turf is cheaper, has less down time and helps me prepare my kids for the next level.
## Background
The City of Boca Raton was incorporated in 1925 as a city is a suburban community in Palm Beach County, Florida, United States with a population of 89,407 (as of 2013). The City's parks & recreation department maintains over 40 park and recreational facilities.

## Park
- **Sand Pine Park**

## Field Type
- **Soccer, football, baseball**

## Field Size
- 2 West - 178’ x 298’, East – 200’ x 330’

## Year of Installation
- June, 2010

## Type of Infill
- Crumb rubber

## Installation Cost
- Trying to determine cost for fields only. Turf installation part of park renovation project cost of $1,661,312.

## Annual Maintenance Cost
- $8,800/field

## Maintenance Program
- Brushing and sweeping

## Irrigation System Installed
- Yes

## Frequency of watering
- Irrigated once each month.

## Number of repairs
- Average of 2 repairs each year

## Type of Sports Played on Field
- Soccer, Football, T-Ball/Baseball, Kickball

##Playable Time
- 8:00am – 11:00pm M - Sat and 8:00am – 6/8pm Sun.

## Number of Playable weeks
- 52

## Number of Injuries
- None reported

## Reception of field by users
- The patrons and neighborhood loved the crisp clean look of the fields. The facility users liked the fact that they had increased playability with no rain outs and that the fields didn’t close for three month to replace the sod. The other benefit was that the fields had consistent playing conditions and the fields did not severely degrade as the season/year went on.

## Additional Comments
- None.

## Contact Person
- **Kevin Beckman**
  - Athletic Programs Administrator, Recreation Services
  - City of Boca Raton
  - E:KBeckman@ci.boca-raton.fl.us
  - P:561-393-7859 | F:561-347-5191
## Artificial Turf Field

**Background**
The City of Weston established in 1996 as a city is a suburban community in Broward County, Florida, United States with a population of 68,388 (as of 2013). The City’s parks & recreation department maintains 14 park and recreational facilities.

<table>
<thead>
<tr>
<th>Field Type</th>
<th>Hockey Rink</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Size</td>
<td>145’ X 72’</td>
</tr>
<tr>
<td>Year of Installation</td>
<td>July 2014</td>
</tr>
<tr>
<td>Type of Infill</td>
<td>Pro-Geo (cork, rice husk, and coconut)</td>
</tr>
<tr>
<td>Installation Cost</td>
<td>$100000 with $950000 being the quote for a full size football field complete installation.</td>
</tr>
<tr>
<td>Annual Maintenance Cost</td>
<td>$6000~ not including watering approximately 60,000 gal of water per year.</td>
</tr>
<tr>
<td>Maintenance Program</td>
<td>Dragging and irrigation. Water 2 x per week for 5 mos. per year (40 gal per min for 40 min) to maintain 50% moisture level.</td>
</tr>
<tr>
<td>Number of repairs</td>
<td>N/A</td>
</tr>
<tr>
<td>Type of Sports Played on Field</td>
<td>Smaller field used for multi-purpose training, not games</td>
</tr>
<tr>
<td>Playable Time</td>
<td>8am – 11pm</td>
</tr>
<tr>
<td>Number of Playable weeks</td>
<td>52 weeks</td>
</tr>
<tr>
<td>Number of Injuries</td>
<td>None reported</td>
</tr>
<tr>
<td>Reception of field by user</td>
<td>Those who played on artificial turf, say this is the best they’ve used.</td>
</tr>
<tr>
<td>Additional Comments</td>
<td>They will be completing 4 more fields with similar turf by the end of 2016. Parks division sought out an alternative to crumb rubber to get a more similar shock response to natural turf and soil. The most important criteria for the selection of the organic infill was the reduced temperature over crumb rubber; an important consideration for us here in South Florida. The shock response, playability, etc. is all good too but reduced heat so that we could play during the peak temperatures of our summers was the most important criteria.</td>
</tr>
</tbody>
</table>

**Information Provided by**
Don Decker  
Director of Parks & Recreation  
THE CITY OF WESTON  
20200 Saddle Club Road  
Weston, Florida 33327  
E: DDecker@westonfl.org  
P: (954) 389-4321 | F: (954) 389-5430
Florida Atlantic University is a public university located in Boca Raton, Florida with five satellite campuses located in the Florida cities of Dania Beach, Davie, Fort Lauderdale, Jupiter, and in Fort Lauderdale. The FAU track and field facility was built on the site of the previous track and includes a state of the art synthetic track surface, an artificial turf field surface and facilities for all field events. The track and field has an NCAA-certified surface and is used not only by the FAU track team, but by the Campus recreation department, additional sports and academic classes.

<table>
<thead>
<tr>
<th><strong>Field or Park</strong></th>
<th>FAU Track &amp; Field Complex</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Field Type</strong></td>
<td>Open recreational field, Multi-Use Field</td>
</tr>
<tr>
<td><strong>Field Size</strong></td>
<td>215’ x 386’</td>
</tr>
<tr>
<td><strong>Year of Installation</strong></td>
<td>2007</td>
</tr>
<tr>
<td><strong>Type of Infill</strong></td>
<td>Crumb rubber</td>
</tr>
<tr>
<td><strong>Installation Cost</strong></td>
<td>Unknown. Replacement cost for the turf should cost only 300,000-500,000</td>
</tr>
<tr>
<td><strong>Annual Maintenance Cost</strong></td>
<td>Contracted out for campus-wide maintenance</td>
</tr>
<tr>
<td><strong>Maintenance Program</strong></td>
<td>Unknown, contracted out</td>
</tr>
<tr>
<td><strong>Irrigation System Installed</strong></td>
<td>No response</td>
</tr>
<tr>
<td><strong>Frequency of watering</strong></td>
<td>No response</td>
</tr>
<tr>
<td><strong>Number of repairs</strong></td>
<td>Once since installation</td>
</tr>
<tr>
<td><strong>Type of Sports Played on Field</strong></td>
<td>Various type of sports related activities</td>
</tr>
<tr>
<td><strong>Playable Time</strong></td>
<td>6am -11pm</td>
</tr>
<tr>
<td><strong>Number of Playable weeks</strong></td>
<td>50</td>
</tr>
<tr>
<td><strong>Number of Injuries</strong></td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Reception of field by user</strong></td>
<td>Well received by users.</td>
</tr>
<tr>
<td><strong>Additional Comments</strong></td>
<td>No issues at FAU with the fields.</td>
</tr>
<tr>
<td><strong>Contact Person</strong></td>
<td>Craig Decker</td>
</tr>
<tr>
<td></td>
<td>Associate Director of Facility Operations</td>
</tr>
<tr>
<td></td>
<td>Florida Atlantic University</td>
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<tr>
<td></td>
<td>Department of Campus Recreation</td>
</tr>
<tr>
<td></td>
<td><a href="mailto:deckerc@fau.edu">deckerc@fau.edu</a></td>
</tr>
<tr>
<td></td>
<td>(561) 297-4512</td>
</tr>
<tr>
<td>Background</td>
<td>Coral Springs, officially the City of Coral Springs, is a city in Broward County, Florida, approximately 20 miles northwest of Fort Lauderdale. As of the 2010 United States Census, the city had a population of 121,096.</td>
</tr>
<tr>
<td>---</td>
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</tr>
<tr>
<td>Park</td>
<td>Cypress and Mullins Parks</td>
</tr>
<tr>
<td>Field Type</td>
<td>2 Soccer fields at Cypress and 1 Multi-use sports field at Mullins Park</td>
</tr>
<tr>
<td>Field Size</td>
<td>Not Provided</td>
</tr>
<tr>
<td>Year of Installation</td>
<td>Cypress: 2004 and Mullins: 2008</td>
</tr>
<tr>
<td>Type of Infill</td>
<td>Crumb Rubber</td>
</tr>
<tr>
<td>Installation Cost</td>
<td>Cypress: $600,000 each field and Mullins: $500,000</td>
</tr>
<tr>
<td>Annual Maintenance Cost</td>
<td>Cypress: ~$2000 (repairs mainly) Mullins: No associated cost other than labor</td>
</tr>
<tr>
<td>Maintenance Program</td>
<td>Brushing and Sweeping</td>
</tr>
<tr>
<td>Irrigation System Installed</td>
<td>No</td>
</tr>
<tr>
<td>Frequency of watering</td>
<td>N/A</td>
</tr>
<tr>
<td>Number of repairs</td>
<td>2-3 at Mullins Park. Repairs was covered under warranty</td>
</tr>
<tr>
<td>Type of Sports Played on Field</td>
<td>Cypress: Soccer and Mullins: Football and Soccer.</td>
</tr>
<tr>
<td>Playable Time</td>
<td>8 am – 11pm 7 day per week</td>
</tr>
<tr>
<td>Number of Playable weeks</td>
<td>52</td>
</tr>
<tr>
<td>Number of Injuries</td>
<td>None associated with the turf; mainly sports related injuries like sprained ankles.</td>
</tr>
<tr>
<td>Reception of field by users</td>
<td>Well received by users.</td>
</tr>
<tr>
<td>Additional Comments</td>
<td>No major concerns about the artificial turf with the crumb rubber. Inquires after the NBC report were answered but no issues with the fields. Complaints during summer about the heat.</td>
</tr>
</tbody>
</table>
| Contact Person | Rick Engle  
City of Coral Springs  
Director, Coral Springs Gymnasium  
2501 Coral Springs Drive  
Coral Springs, FL 33065  
Email:rengle@coralsprings.org  
Phone:954-345-2200 | Fax: 954-345-2111 |
**Background**

Parkland is an affluent city in Broward County, Florida, United States, where zoning laws are designed to protect the "parklike" character of the city. The Parks and Recreation Department manages and maintains nine parks within the City.

**Park**

Pine Trails Park

**Field Type**

2 - Multi-use sports fields

**Field Size**

160’ x 360’ each field

**Year of Installation**

1 – 2008 and 1 – 2010

**Type of Infill**

Crumb Rubber

**Installation Cost**

Not available

**Annual Maintenance Cost**

Ranges between $800 - $1000 per field

**Maintenance Program**

Brushing and sweeping

**Irrigation System Installed**

No

**Frequency of watering**

N/A

**Number of repairs**

1 repair on one of the field and it was a seam issue.

**Type of Sports Played on Field**

Soccer, tackle football, Football, Lacrosse. The fields have been open to any type of sports.

**Playable Time**

7am – 10 pm 7 days a week.

**Number of Playable weeks**

52

**Number of Injuries**

None associated with artificial turf. Just regular sports injury as you will find playing on natural grass.

**Reception of field by users**

From good to indifferent. Mainly positive because the field has been used without major downtime due to potholes or the likes.

**Additional Comments**

Since the NBC report only one parent has expressed concern. One main complaint is the heat. I would recommended using the more biodegradable e material for the infill.

**Contact Person**

Parks & Recreation Director
Philip Biscorner, CPRP
6600 University Dr
Parkland, FL 33067
Phone: 954-757-4104
Email: pbiscorner@cityofparkland.org
City of Palm Beach Gardens, Parks & Recreation

Natural Grass Field

| Background | Palm Beach Gardens is a city in Palm Beach County in the U.S. state of Florida. As of the 2010 United States Census, the population was 48,452. The Parks & Recreation Department manages and maintains 11 parks. |
| Park | PGA Park |
| Field Size | 6 acres (3 full-size multiuse fields) |
| Year of Established | Field was renovated in 2009 |
| Type of grass (i.e Bermuda) | Celebration Bermudagrass |
| Annual Maintenance Cost | N/A |
| Maintenance Program | Twice a year aerification; twice a year verticutting; bi-monthly fertilization; 2-3 weekly mowing; |
| Irrigation program | Field is irrigated twice a week |
| Annual number of sod replacement | Minimal |
| Type of Sports Played on Field | Football, lacrosse, soccer |
| Playable Time (i.e. 8:00 am – 10 pm) | Weekdays: nightly programming with parks open daily outside of 2 maintenance closures Weekends: all day programming with parks open all day outside of 2 maintenance closures |
| Number of Playable weeks | 36 weeks |
| Number of Injuries & frequency | N/A |
| Any consideration of use artificial turf? | We are very pleased with the durability and playability of this park |
| Additional Comments | This is an example of one park; various other parks that weren’t constructed as well require more maintenance, sod, and down time. If constructed properly, natural grass fields are cheaper, safer, and better for the environment than artificial fields. The City has not during my tenure made any indication of a need to consider any artificial turf fields. |
| Contact Person | Matt Eggerman Operations Manager, Parks and Grounds City of Palm Beach Gardens Office:(561) 804-7035 meggerman@pbgfl.com |