



# **CITY COUNCIL**

## **STUDY SESSION REPORT**

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MEETING DATE: SEPTEMBER 11, 2007    ITEM NUMBER: \_\_\_\_\_

**SUBJECT:**     **USE OF SYNTHETIC TURF FOR SPORTS FIELD APPLICATIONS**

**DATE:**       **SEPTEMBER 5, 2007**

**FROM:**       **PUBLIC SERVICES DEPARTMENT, MAINTENANCE SERVICES DIVISION**

**PRESENTATION BY:**     **BRUCE A. HARTLEY, MAINTENANCE SERVICES MANAGER**

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### **RECOMMENDATION:**

Receive and file report.

### **BACKGROUND:**

At the joint Study Session meeting of April 11, 2007, between the City Council and the Parks and Recreation Commission, the Council directed staff to provide information regarding the use of synthetic or 'artificial' turf for sports fields within the city.

Currently, all City and Newport Mesa Unified School District owned sports and recreational fields within the City of Costa Mesa are constructed with turfgrass as the play surface. Orange Coast College recently completed the construction of the first synthetic or artificial turf sports fields in the City.

An informal survey of several orange county cities on the use of artificial turf for athletic fields was performed by staff. The results are attached for Council's information (Attachment 1).

### **ANALYSIS:**

The following information is presented to provide an introduction to the various issues related to the construction, and maintenance of synthetic turf fields as compared to the traditional turfgrass fields now in use.

#### **Artificial Turf Fields**

Artificial turf sports fields are typically constructed with a layer of synthetic, fibrous material which creates the playing surface. The fibers are made of polyethylene lubricated with silicone, and are attached to a mat or backing. A layer of expanded polypropylene, recycled rubber granules, sand or a combination, is added over the top of the mat as an infill to add shock absorbency and to provide additional vertical support for the artificial turf "blades". The artificial turf mat is typically installed over a compacted sub-base made of aggregate (rock) to insure proper support and drainage.

This aggregate is approximately  $\frac{3}{8}$ " –  $\frac{1}{2}$ " in size, and is typically placed to a depth of 3 – 8 inches depending on the composition of the underlying soil. Underneath the sub-base, a drainage system is installed to move water away from the playing surface.

The life expectancy of newly developed artificial turf surfaces, which are typically being utilized world wide, are rated between eight (8) and twelve (12) years, with most surfacing materials guaranteed for at least eight years. Currently, since the newer 'state of the art' artificial sports turf products are generally less than five years old, no reliable data exists on the longevity of the surfacing. Most comparative studies are generally based on an eight year life cycle.

## **Design and Construction Cost Comparisons**

There are several costs associated with both artificial and natural turfgrass sports fields. There are the initial design and construction costs, on-going maintenance costs, conversion costs for changing natural turf to artificial turf, and renovation costs incurred annually on natural turf sports fields and every 8-12 years on artificial turf fields.

The design and construction costs associated with the initial development of the two fields differ significantly, as published in "Facts About Artificial Turf and Natural Grass", by the Turfgrass Research Council, 2007 (Attachment 2). Based on one full size soccer field without lighting, but including the necessary surrounding "run out" area, (for a total of approximately 80,000 sq. ft.), the comparable costs are typically in the following range:

- Synthetic Turf - \$625,000 to \$860,000
- Natural Turf - \$200,000 to 420,000

Some new artificial turf installations may exceed \$1,000,000 per field when lighting or other amenities associated with the development of the facility are included.

There are several reasons for the increased construction costs for the synthetic turf field. Extensive drainage improvements must be installed underneath the synthetic field in addition to specific aggregate layers to insure proper functioning of the drainage system and firm support of the synthetic surface. Typically soil material must be exported during grading operations to allow for the import of the required aggregate. Drainage systems may account for up to  $\frac{2}{3}$  the total project cost. Additionally, a complete irrigation system is prudent to insure the artificial turf may be 'cooled' as needed prior to use on hot days. The artificial turf material is costly as well.

## **Maintenance Costs Comparisons**

### **Artificial Turf Sports Fields**

There are several costs associated with the maintenance of artificial turf that should be considered and compared to the typical costs associated with the maintenance of natural turf sports field to make a fair analysis. The following costs for the maintenance of artificial turf fields were obtained from published studies from various institutions, as reported by The Turfgrass Resource Center (web site - [turfgrassod.org/trc/index.html](http://turfgrassod.org/trc/index.html)).

Artificial turf maintenance requires additional materials and labor for application of those materials and capital equipment costs, unique to that type field. The materials that are

required are: additional rubber 'infill' material, disinfection products and paint for touch up on the surfacing if worn or damaged and for field markings. There are costs associated with the application of the infill material and the disinfection chemicals, as well as minimal labor associated with surface and line maintenance. The total maintenance costs have a wide range, based on available information, but typically range from a low of \$8,500 up to \$29,000 per year, per field.

There are several specialized pieces of equipment required to properly maintain artificial turf fields. These include: A machine that brushes/grooms/rakes the surface to evenly redistribute the infill material; a vacuum for removing surface debris; a 'sanitizer' or boom sprayer for the application of disinfectant materials; a utility vehicle; roller; top-dresser; field magnet; and a line painter. The total one time cost to purchase the equipment is estimated to be \$75,000 - \$100,000. Annual fuel cost, maintenance costs and depreciation expense for these vehicles is estimated to be \$15,000 - \$20,000.

The maintenance of the field, including the purchase and application of materials; redistribution of infill material and sanitizing would be approximately \$27,000 per year, plus an estimated \$2,000 per year in water costs to cool the field in the summer months. The total cost per year for all necessary maintenance of an artificial turf field, including equipment, is estimated to be \$44,000 - \$49,000, and is broken down as follows:

- \$4,000 Grooming (redistribution of infill performed monthly)
- \$4,000 Sweeping (performed weekly)
- \$7,000 Sanitizing (performed monthly)
- \$1,000 Repair of surface
- \$2,000 Water cost (cooling)
- \$5,000 Infill material replenishment cost
- \$6,000 Miscellaneous maintenance (paint touch-up, magnetic debris removal, etc.)
- \$15-20,000 Vehicle maintenance & depreciation

The recommended maintenance services could be out-sourced to avoid the capital expenditure and on-going expense of equipment ownership. Material costs would not vary significantly. However, there are very few companies specializing in this type of service, but with the increase in the numbers of artificial turf fields being installed, it is anticipated that they will become more plentiful and cost effective in the near future. If maintenance services are not contracted, City staff would perform the maintenance of the fields. This would require specialized training to manage the artificial surface and appropriate certifications to allow for the application of disinfectant materials. Additional staffing would be required, as the existing fields are included in the City's landscape maintenance contract and do not require City manpower for mowing. Additionally, the maintenance of artificial turf fields would not be within the expertise of landscape maintenance contractors. However, there would be a potential cost savings as the fields would not require the twice per week mowing, annual renovation (aerification and de-thatching of turf), applications of pre and post-emergent herbicides, and the fertilizer necessary to keep the field growing aggressively throughout the playing season. Irrigation maintenance would still be required.

#### Artificial Turf Sports Field Renovation Costs

Not included in the maintenance cost estimates provided in the previous section is the renovation expense for artificial turf sports fields. While current fields in the area have

not been in use for the eight year warranty period that is typical for several brands of artificial turf, the fields at some point will need to be replaced. Considerations associated with the replacement of the surfacing include:

- Recycling cost of the playing surface or the potential for landfill disposal of man made surface and rubber infill material if not recyclable.
- Replacement cost of the surfacing
- Replacement cost of the infill material
- Repainting of field lines

Costs associated with the removal and replacement of the playing surface, including the cost to remove, transport, landfill, replace, install infill, and re-stripe are estimated to be approximately 30-40% of the original construction costs. The increase in these costs adjusted for inflation or the potential restrictions on landfilling the worn field have not been considered. For a typical artificial turf field costing \$625,000 to \$860,000 to construct, the estimated replacement cost would range from \$187,500 to \$344,000. With no replacement projects having been completed locally, no data is available to provide a more accurate estimate (Attachment 3).

### Natural Turf Sports Fields

Natural turf sports fields are less expensive to initially construct. They have a similar maintenance cost over their life as artificial turf fields, when irrigation maintenance, utility costs, weekly mowing, fertilization, aerification, and annual renovation are factored into the total life cycle costs. However, since natural turf fields are renovated annually, they do not typically require a major renovation (replacement of surface) after 8-12 years like the artificial turf sports fields. It should be noted that a poorly maintained turfgrass field may require expensive renovation at some point in its expected life.

The cost to provide the listed maintenance activities and pay for water and electrical utilities, excluding lights, for one typical soccer field, is approximately \$32,500 - 34,500 per year. This is a cost estimate based on the City of Costa Mesa's Farm Sports Complex operational costs for one of the six fields at that facility:

- \$10,000 per year per field for turf maintenance (contracted service cost)
- \$3,000 per year for fertilizer and miscellaneous amendments
- \$1,500 per year for irrigation, testing, repair and maintenance
- \$3 - 5,000 per year for turf renovation
- \$13,000 per year for irrigation water and electricity
- \$2,000 per year for staff administration and vehicle costs

### **Advantages and Concerns with Artificial Turf Sports Field**

Many southland cities, community colleges and school districts are considering, are in the process of, or have completed the conversion of one or more natural turf sports fields to artificial turf. There are economic advantages and disadvantages to this practice.

Advantages:

- Property is already owned and may already have supporting facilities, i.e. utilities, parking lots, lighting, restrooms, snackbar facilities, etc.

- Irrigation systems are already installed and may be adaptable for artificial turf use.
- Grading requirements may be less when converting an established field to artificial turf, depending on the site.
- Artificial turf fields are usable year around with minimal down time for maintenance and no renovation costs for 8-12 years. Natural turfgrass sports fields typically are rested 16-18% each year and are closed for renovation a similar amount of time, resulting in a usable field time of approximately 66% each year.

#### Disadvantages:

- Extensive drainage facilities must be designed and installed, possibly requiring additional grading and potential loss/relocation of irrigation or other underground improvements.
- Disposal costs associated with the removal of existing turf and soil.
- Conversion of existing facilities results in no increase in usable sports field acreage.
- Negative impacts of artificial turf fields on sports or recreational programs. (Discussed in greater detail later in report)
- Increased temperature of playing surface.
- Periodic disinfecting of playing surface required.
- Full size vehicles and cranes for sports field lighting repairs may not be driven on artificial turf fields due to potential damage to sub-base.

Typical costs to convert existing sports fields from natural to artificial turf may vary considerably, but typically are lower than the cost of new construction.

Orange Coast College recently completed the conversion of two fields from natural to artificial turf. The Le Bard football stadium field and the soccer field were re-constructed with artificial turf. The cost for the Le Bard Stadium project was \$2.5 million for approximately 110,000 square feet of surface, and the soccer field was \$1.7 million for approximately 130,000 square feet of surface. However, both of these cost figures included a variety of other improvements to the sites, including seismic work, drainage improvements, new fencing, minor landscaping, and walkways.

According to Orange Coast College officials, the comments from coaches, groundskeepers and players typically point out several advantages of artificial turf compared to natural grass. These include:

- Fields are always prepared for practices or games.
- Maintenance costs have decreased due to reduced use of water and chemicals on the field. While the fields have to be machined groom and vacuumed on a regular basis, the amount of hours per week required for this is probably one third of what is required for a well-maintained grass field.
- Reduction in material and labor costs due to the permanent lines on the field; eliminating the need to paint lines on a weekly basis.
- Fields 'absorb' multiple games, year-around and are not susceptible to damage from use when it is raining or muddy.
- Downtime is not required for renovation (reseeding, de-thatching, fertilization)
- The fields always look green and professional, regardless of the time of the year

## Concerns

The temperature of the artificial turf playing surface has become an issue at many sports facilities. According to studies completed at University of Missouri and Brigham Young University (BYU), ("Synthetic Surface Heat Studies" - by Drs. C. Frank Williams & Gilbert F. Pulley), artificial turf surfaces were found to be consistently hotter than natural turf playing surfaces. Studies documented differential temperatures up to eighty degrees (80°) degrees hotter on artificial surfaces in the sun as compared to natural turf. Artificial turf was found to be twenty-four degrees (24°) hotter than natural turf, in the shade. The use of irrigation systems is effective in temporarily cooling the surface. However, in the BYU study, the surface temperature rebounded from the low of 85° after irrigation, to 120° within five minutes, and 164° within twenty minutes. The highest recorded artificial turf surface temperature during the study was 200° on a day where the maximum air temperature was 98°.

In the same study, natural turf surfaces were found to be cooler, with a range of 78° to 88° under the same conditions. Concrete was measured at 94° with asphalt measured at 110°. Although it is difficult to project artificial turf surface temperatures in Costa Mesa, the air temperature typically is in the 80 - 85° range during much of the spring and summer months. It could be assumed that the surface temperatures would be a minimum of 100°, and may approach 120°, the maximum safe temperature established by the BYU Safety Office as a result of the study. This is the temperature that may cause skin injury if contact is maintained for ten (10) minutes.

The potential toxicity of infill rubber material has been suggested in the literature. This potential has not been tested or verified, but was based solely on the analysis of the composition of the motor vehicle tires that are typically used to manufacture the rubber infill material. The potential for the ingestion of infill material in conjunction with contact sports such as football and soccer is a concern, as there are 'heavy metals' and other components of the material that may not be suitable for ingestion. No test results analyzing long term effects of exposure to these materials were found.

The sanitation of the surface is very important and is a source of concern for field users and those responsible for maintenance. The removal of human bodily fluids such as blood, sweat, spittle, vomit and urine are critical to insuring a safe surface with a minimal pathogen level. Feces from birds or other animal is also a health concern. Typically crows and sea gulls are frequent visitors to sports fields and defecate while resting on the field or flying around the site. Gum or other sticky substances such as sports drinks, soda, juices and food may discolor the surface and must be cleaned using a variety of cleaning products and water. Feedback from various agencies maintaining artificial turf surfaces also report difficulty in removing sunflower seeds, a popular snack at sporting events.

To address the health and safety of the participants of sporting activities conducted on artificial turf fields, maintenance practices must include the frequent cleaning and sanitizing of the surface. Light duty utility vehicles mounted with spray tanks and a boom are utilized to apply disinfectants to the fields. Much in the same manner as fungicides and herbicides are applied to natural turf, the disinfectant materials are evenly applied to the artificial sports turf surface. No studies were found providing information on the safety or efficacy of the field disinfection process. As such, no recommended intervals, costs or other maintenance information is available. The main focus of disinfecting fields is to prevent the introduction of pathogens (bacteria) into

abrasions that result from contact with the artificial turf surfaces during contact sports such as football and soccer. The potential for infections from staphylococcus bacteria exists and may only be minimized by proper application of disinfecting products and the rotation of various products to minimize the potential for incomplete disinfection due to the increased resistance of the bacteria to the chemical applied.

According to a study conducted by Dr. Brad Fresenburg, of the University of Missouri, natural turf also has bacteria associated with it as well, as both the turf and soil harbor naturally occurring bacteria. However, the artificial turf surfacing harbors pathogenic bacteria more readily, and due to its increased tendency for abrading skin, results in more frequent reports of infection. No disinfection practices are normally performed on natural turf fields. Naturally occurring bacteria in soils actually break down human body fluids or other organic matter.

A concern that historically has fostered debates on the use of artificial sports turf surfaces is the rates of injury. However, due to the wide range of conditions found on natural turf fields it is difficult to make a fair comparison. Artificial turf fields typically yield more abrasions or 'rug burns' due to the friction of the material against the skin of athletes, as compared to natural turf surfaces. However, if the natural turf is in poor condition, with bare areas or compacted soils, the incidences of abrasions increases as well. Certain types of injuries are more frequently reported on artificial turf sports fields. 'Turf Toe', anterior cruciate ligament (ACL) injuries, concussions, turf burns and heat exhaustion have been found to be more prevalent.

The effect of the higher 'speed' of the artificial sports field surface on the rate or severity of injuries has been discussed in the literature, however, no studies were found confirming the anecdotal reports.

Although typically not found to be a frequent problem, it should be noted that when artificial turf fields are constructed and lines are installed for a particular sport, it is difficult and expensive to remove and re-stripe the field for other configurations. This may have an impact when fields are utilized by different sports during different times of the year, as additional maintenance funding would be required to have the 'change over' completed by a contracted service.

#### **ALTERNATIVES CONSIDERED:**

No alternatives were considered.

#### **FISCAL REVIEW:**

There are no fiscal impacts associated with this informational item.

#### **LEGAL REVIEW:**

No legal review is required for this informational item.

#### **CONCLUSION:**

In comparing artificial and natural turf sports field surfacing, very few comparable studies of installation and maintenance were found, making an accurate comparison of costs to develop and maintain artificial turf sports fields difficult. The disadvantages of both types of fields, natural turf and artificial turf, were well documented in the literature. The high

cost of repair and maintenance of natural turf fields and the extensive 'down time' required on an annual basis, were the primary drawbacks of the traditional type of sports fields. The "24/7" usability of artificial turf fields is the main attraction of this type of sports surfacing. The high cost of installation and replacement, are both significant and make the selection of artificial turf an expensive choice. Additionally, the many concerns associated with artificial turf fields as discussed in the report, make it apparent that regardless of the surfacing, the maintenance of either type of field is extensive and costly, when the frequency of use is high.

The information found supported the cost effectiveness of developing artificial turf sports fields as new construction and not a re-development of an existing site. Although there are some savings, the loss of existing infrastructure during construction and the final project yielding no increase in field space, were both deterrents that lessened the benefit and supported creating new fields specifically designed and constructed for artificial turf. The ability to program the fields twelve months each year, and the relatively mild summer temperatures found locally, support consideration of the benefits of making the more costly initial investment, as long as the concerns are well understood and the additional impacts on staffing and budget are included in the overall evaluation of both types of sports field surfacing.

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ATTACHMENTS: 1 [Informal Survey Of Local Cities Regarding Artificial Turf Sports Fields](#)  
2 ["Facts About Artificial Turf and Natural Grass", by the Turfgrass Research Council, 2007.](#)  
3 [Cost Comparison Artificial Versus Natural Turf Fields](#)