The

SMART GUIDE

to

SYNTHETIC SPORTS SURFACES

Volume 3: Environmental and Sustainability Considerations

smart connection consultancy

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Disclaimer
Smart Connection Consultancy do not accept any liability for the accuracy of the information provided. All material and information that is provided from the third parties is done so in good faith to assist organisations understand the key issues around synthetic sports surfaces. We will continually update the Smart Guide to attempt to keep the industry updated.

About the Smart Guide to Synthetic Sports Surfaces
Smart Connection Consultancy is committed to sharing knowledge and learnings with the industry and has produced a number of volumes of the Smart Guide to Synthetic Sports Surfaces which can be downloaded free of charge from our website www.smartconnection.net.au.

The volumes of the Smart Guide to Synthetic Sports Surfaces include:

- Volume 1: Surfaces and Standards (2019)
- Volume 2: Football Turf – Synthetic and Hybrid Technology (2019)
- Volume 3: Environmental and Sustainability Considerations (2019)
- Volume 4: Challenges, Perceptions and Reality (2019)
- Volume 5: Maintenance of Synthetic Long Pile Turf (2019)

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Welcome and Purpose

The popularity of synthetic sports surfaces used by many sports, local governments and within the education sector in Australia has significantly grown in the last two decades to complement their natural turf fields. This enables the local community to participate in sport when the demand on natural fields cannot be accommodated.

The key football codes in Australia have all embraced synthetic sports surface technology for their community clubs and some for their elite players. Their aim is simply to provide more opportunities for communities to play sport and appreciate that the synthetic sports fields is one way of creating significant additional playing hours in many areas where fields are in short demand.

The aim of this ***Smart Guide to Synthetic Surfaces Volume 3: Environmental and Sustainability Considerations*** is to provide guidance to organisations who are interested in understanding the options available to them for adopting synthetic sports surface technology. It explores the sustainability issues that should be considered as part of the planning, design, procurement and ongoing management of the technology.

Smart Connection Consultancy is passionate about working with organisations that are keen to encourage their community to be more active. Sport is one of the vehicles to achieve this and provides many physical, community and health benefits.

Smart Connection Consultancy has embraced the use of sports surface technology, whether that be natural, hybrid, synthetic or alternative sports surfaces to complement natural fields, as a vehicle to promote and provide the community with opportunities to be more active more often.

Photo 1: Football (Soccer) Gosnells LGA - WA (ABS installation)

Photo 2: Rugby Union - Latham Park - NSW (Polytan installation)

Photo 3: AFL & Football - ELS Hall Park - NSW (installed by Turf One)

Photo 4: Football, AFL ad Cricket - St Kevin's College - Vic (installed by Tuff Turf)

Gore Hill Oval, providing sustainability to community use as the natural turf field couldn't not cope with the usage and the continued flooding (Source: Willoughby City Council)

1. Introduction

The growth of the Australian population over the past 21 years has seen an increase of over six million[1] (33%) from approx. 18 million to 24 million people. The expected population in the next 15+ years will rise to be over 31 million[2] (approx. 40% increase) and this will seriously impact on sports field provision and accessibility in many cities around Australia.

This demand will continue to place significant pressure on sports field infrastructure around key cities in Australia where demands for additional playing fields and additional hours per field continue to exceed the hours available for natural surfaces.

Photo 5: Typical sports field in NSW half way through football season with natural grass

The ability to cater for the growing demand of natural playing fields is causing concern to many inner-city local governments. These natural turf fields are under greater capacity pressure and this results in increased stress levels to the natural turf. Many local governments are embracing the synthetic sports turf technology to complement natural turf and satisfy community need.

Many are embracing the synthetic technology to reduce the stress on natural sports fields by decreasing the intensity of training to allow them to recover during the week as the training is then on synthetic surfaces.

The benefits of synthetic sports turf cater for increased playing capacity, often more than 60 hours a week, and offering a consistency that is not detrimentally impacted by drought or excessive rain. Football codes in Australia benefit from this technology and the growth in synthetics fields for Soccer, Rugby (Union and League), AFL and multi-sports fields, continues to increase.

Smart Connection Consultancy are committed to designing and procuring synthetic sports surfaces in a manner that is environmentally sustainable for the community. Many Councils consider such investments against a Triple Bottom Line benefit to these organisations and community.

Appreciating that the impact of such an installation can provide benefits to the community through extended usage and playing capacity of the surface compared to natural grass. Economically the initial investment may be more costly, but when considered the number of hours use per year of a typical synthetic field would comfortably accommodate 3,000[3] hours of use compared to grass being 1,000[4] per annum, the cost per person per hour of use is significantly less than natural turf per person and per hour of usage.

Many Councils are becoming more conscious of the environmental impact of such developments. This Smart Guide explores the key environmental approaches that Smart Connection Consultancy would encourage Councils and Sports to consider before embarking on such a development.

[1] ABS, Australian Demographic Statistics (cat. no. 3101.0), Data extracted on 21st December 2016 http://abs.gov.au/ausstats/abs%40.nsf/94713ad445ff1425ca25682000192af2/1647509ef7e25faaca2568a900154b63?OpenDocument

[2] ABS, http://www.abs.gov.au/AUSSTATS/abs@.nsf/mf/3222.0

[3] 3,000 hours' use is based on 60 hours per week for 50 weeks per annum

[4] 1,000 hours' use is based on natural turf accommodating 25 hours over 40 weeks

2. Planning for a Sustainable Future

2.1 Introduction and Context

Within Australia there has been an embracement of synthetic sports surfaces over the past decade to support the continued demand for additional sporting, recreational and play surfaces that cannot be addressed with just natural turf, especially within inner metro areas. It is estimated that there are over 200 full Football fields, dozens of Hockey fields and athletic tracks, thousands of Tennis courts (grass and acrylic) and tens of thousands of play parks.

Australia is currently seeing the start of the replacement of the third generation (3G) fields that were installed in 2008-2010 as part of the GSF State Government funded of sports facilities in Victoria (approximately 50), and also early adopter of fields in NSW (less than 10). When combined with Hockey fields, Tennis courts and other hard and rubber surfaces the impact on the environment is becoming prevalent.

Recent challenges regarding recycling in Australia is resulting in strategic review of waste, green engineering and principles of sustainability. This section explores four key aspects and predominantly this section explores the synthetic grass fields and those with infill.

- Components of synthetic sports turf system
- Environmental impacts – perceptions and reality
- Recycling at the end of life considering
- Sustainability Principles protecting of future

2.2 Components of Synthetic Sports Turf System

By exploring the components of a typical synthetic spots surface, one can appreciate the impact that each can have on the environment allowing strategic decisions to be embraced environmentally. With 3G long pile sports fields the components include:

- Synthetic carpet – including yarn, performance infill, stabilising infill, primary and secondary backing
- Shockpad – whether Insitu, foam or prefabricated
- Pavement, sub-base and drainage components

Photo 6: Oi Hockey Stadium will be constructed in Oi Central Seaside Park Sports Forest and the yarn is made out of 65% sugar cane ©Getty Images

A recent Environmental Impact Study published by FIFA[5] identified that 49% of the system composition was stabilising infill (sand) and 44% performance infill, with the carpet backing and yarn being 8%, by weight. It is expected that in Australia the composition would be slightly different due to the high number of systems that have a shockpad, which reduces the amount of performance infill needed.

The performance infill in Australia is still dominated by recycled SBR (car tyres) with it still being over 75% of all fields, although premium infill is growing due to perceived concerns by the community for recycled SBR. Premium infills including EPDM (Ethylene Propylene Diene Monomer) and TPE (Thermoplastic Elastomer) and organic natural (predominantly cork) are being

[5] Environmental Impact Study on Artificial Football Turf (Eunomia Research & Consulting Ltd: March 2017)

embraced. These infills often help to define the type of recycling route that is required.

2.3 Environmental Challenges – Perceptions and Reality

2.3.1 Perceptions of Negative Impacts on the Environment

There has been significant research globally on the impact of recycled SBR on local ecosystems. These research projects[6] [7] including those representing the California Environmental Protection Agency, the Norwegian Institute of Public Health, the French National Institute of Environment and Risk, and Auckland Council, all have similar conclusions.

The conclusions are best summarised by the Swiss Study[8] by the Ministry of Environment, Traffic, Energy and Communications. The study was on the Environmental Compatibility of Synthetic Sports Surfaces which explored the secretion of synthetic surfaces from disintegration by UV radiation, mechanical destruction by abrasion, and diffusion of ingredients and washing off by rainwater.

The testing was in a controlled environment with rain washing through the synthetic and natural turf systems over a two-year period then collected and measured for the secreted substances. The report summarises there is no risk for the environment from Poly Aromatic Hydrocarbons (PAH's) or heavy metals including Mercury, Lead, Cadmium, Chromium, Zinc, and Tin, which were all lower than the required European safety levels.

Heavy Metals

Photo 7: Swiss Study collecting rainwater through various synthetic sports surface systems

Historically Lead Chromate was used for pigment colouring in yarn, and after research was conducted in 2008 the use of Lead Chromate as a pigment for the grass was stopped in 2009[9] for all sports turf on a voluntary basis by all the major manufacturers. The use of heavy metals is not common in the infill, although some cheaper yarns or infills may use lead chlorate as colouring.

The European standards including the Swiss and German Regulation DIN 18035 parts 6 and 7 and ESM105, state the requirements of metals need to be less than:

- Mercury ≤ 0.01 mg/l,
- Lead ≤ 0.04 mg/l,
- Cadmium ≤ 0.005 mg/l,
- Chromium ≤ 0.008 mg/l,
- Zinc ≤ 3.0 mg/l, and
- Tin ≤ 0.05 mg/l.

Synthetic systems purchased should therefore meet these standards or the alternative standard, European

6 Humphrey, C., & Katz, L., (2000). Water-Quality effects of tire shreds placed above the water table: Five-year field study. Transportation Research Record: Journal of the Transportation Research Board, 1714, 18-24. DOI: http://dx.doi.org/10.3141/1714-03http://dx.doi.org/10.3141/1714-03

7 Hofstra, U. (March, 2009). Zinc in drainage water under artificial turf fields with SBR. Summary ITRON Report. http://c.ymcdn.com/sites/syntheticturfcouncil.site-ym.com/resource/resmgr/Docs/Zinc_in_Drainage_Water_-_200.pdf

8 Muller, E. (2007). Results of a Field Study on Environmental Compatibility of Synthetic Sports Surfaces. Swiss Ministry of Environment, Traffic, Energy and Communication Authority of Environment Section Water.

9 STC: Lead Chromate in Synthetic Turf, Though Safe for kids per CPSC, was discontinued in 2009 (20/3/2015 - STC Website)

Standard EN71-3 (2013) Table 2 Category III, which is the standard for Safety of Toys – Part 3 Migration of certain elements, and Category III (Scraped-off materials). In the US, the equivalent is the ASTM F3188 – 16: Both the European and US alternative standards measure the possible heavy metal migration of material that may be hazardous if ingested. Smart Connection Consultancy recommend that all turf procured in Australia adopts this standard.

2.3.2 Carbon Footprint Impacts of Synthetic Surfaces

This section is included to account for differences in energy and material use (i.e. recycling versus non-recycling) and consequently presents differences in greenhouse gas emissions between various systems. It is mainly based on a Canadian study of Meil and Bushi, 2007. This guide has sourced key information from the Bureau REACH, National Institute of Public Health and the Environment (RIVM) and their Report Section E2.8.7.1 (19th July 2018)[10]. Key paragraphs are reproduced here (*in italics*) to ensure accuracy of the summation of their comparison and conclusion.

2.3.3 CO_2 emissions natural grass system compared to a synthetic grass system

"To estimate the CO_2 emissions of a natural turf pitch to have a net negative carbon footprint ***(-16.9 tons $C0_2$ equivalent over ten years)*** *due mainly grass system, the boundaries and elements attributable to the natural turf systems based on Meil and Bushi (2007). The main phases of installing grass pitches are: i) installation of the pitch; ii) use and maintenance and iii) transportation. The 5 elements related to CO_2 emissions in natural grass (NG pitches) as in Meil and Bushi (2007); NG1) grass seed production, NG2) organic plant matter production, NG3) transport, NG4) natural grass carbon sequestration potential of the grass and NG5) natural grass itself.*

As these figures are based on European test results there will be differences that need to be considered for Australia – but this section provides an overview of limited research that is available.

To estimate the CO_2 emissions of an artificial grass system, the boundaries and elements attributable to the artificial turf systems based on Meil and Bushi (2007). The main phases are: i) production of the main components of the artificial turf system; ii) use and maintenance; iii) disposal phase (recycling) and iv) transportation.

As in Meil and Bushi, we include the following ten main components used to construct the artificial grass (AG) system; AG1) the synthetic turf pitch, on the other hand, emitted +55.6 tons of CO_2 equivalent over ten years. This figure itself; AG2) primary backing material, AG3) joints and bonding (assembly of turf rolls); AG4) polyurethane production (secondary elastomeric coating) and AG5) rubber granule infill. The rubber infill granules are derived from recycled tyres. Other elements necessary to estimate the CO_2 emissions of an artificial grass system are AG6) PVC piping to provide pitch drainage, AG7) Top-soil excavation, AG8) synthetic turf maintenance system, AG9) recycling and AG10) transport.

The overall estimate of CO_2 emissions would have been almost twice as high (108.2 tons CO_2) if the authors had not assumed that the pitch would be recycled at the end of life (which gave a carbon credit of 52.6 tons CO_2 equivalent). Assuming that the pitch is eventually recycled, its greenhouse gas emissions (GHG) relative to those of natural turf (which are negative) could be offset. Recycling of synthetic turf is theoretically possible but not

[10] Annex XV Restriction Report Proposal for a Restriction (Version 1.0-19th July 2018)

without further treatment and consequently additional CO_2 emissions. Furthermore, recycling of artificial turf systems is possible, however, it currently only happens on small scale in the EU. Therefore, the recycling step has been taken out of the analysis. As no further information on the balance of GHG emissions of end of life treatment of artificial turf is available, this stage was left out of this analysis."

The greenhouse gasses calculated as part of this report indicate that with the following:

- *Synthetic turf with SBR recycled tyres 89 Ton CO_2*
- *Synthetic turf with EPDM infill 118 Ton CO_2*
- *Synthetic turf with TPE infill 180 Ton CO_2*
- *Natural grass - 2 Ton CO_2*

According to Carbon Neutral (https://carbonneutral.com.au/about-us/) in their FAQ section (Accessed 19/03/19) they state:

" Carbon sequestration is measured on a per hectare basis. That may vary from 100 to 300 tonnes CO_2-e per ha at year 30 depending on site and rainfall. Tree density also varies from 500 to 2000 stems per hectare. Measuring trees per tonne CO_2 is therefore highly variable.

As a rule of thumb, we currently adopt 15 trees per tonne as a conservative estimate, though this may vary from 10 to 15 depending on the site, terrain and rainfall. It is important to remember this is an estimate from our Planting Contractor and Developer; it can deviate from this number due to several factors."

With this in mind, to compensate for the greenhouse gasses used that on a 10 tree per tonne model the purchaser would have to plant 9 trees per year for an SBR filled synthetic field for each year it is in operation.

2.3.4 Water uses comparison between natural and synthetic systems

Natural grass requires water to grow and remain in good condition. The amount of water required for irrigation of a natural grass pitch depends on climate conditions, the conditions of the pitch and the way in which irrigation is carried out. Two US studies provide estimates of 2-11 million litre water each year per 7600m^2 pitch per year (Simon Rachel, 2010; Cheng et al. 2014)117. The website of the Government of Western Australia provides an estimate of 4.8 million litre water for an 8000m^2 soccer pitch.

Comparing natural grass with artificial turf it can be said that artificial turf essentially requires no irrigation, so it is fair to assume that only a fraction of the water used in case of natural grass pitch will be used on a synthetic sports field. Especially in areas where there is limited fresh water available, the use of synthetic turf will be preferred when it comes to water use.

2.3.5 Urban Heat Island Effect

The urbanisation of Australia has radically transformed environments from native vegetation through farmland to present day's urban footprints of towns and cities with an urban sprawl. Away from the coastal areas, where the natural land receives a moderating influence of cooling sea breeze, population heartlands in urban areas are now showing 'Urban Heat Island' effects.

Urban surfaces such as roads and roofs absorb, hold, and re-radiate heat; raising the temperature in our urban areas. This effect is often worsened by

development activity when green spaces are replaced with more hard surfaces that absorb heat.

This Urban Heat Island (UHI) shows that the area is significantly warmer than its surrounding rural areas due to number of direct and indirect causes including:

- Absorption of short-wave radiation, in concrete, asphalt and buildings and then slow release during the night;
- Change in surface materials which do not have evapotranspiration properties (e.g. concrete v grass vegetation);
- Increase of carbon dioxide, through increases in traffic pollutants and people, with reduced trees capturing carbon dioxide in cities; and
- Use of building materials – pavements and roofs has significantly different thermal bulk properties and surface radiative properties (e.g. shade and evaporation). Also, high buildings normally reduce wind penetration, which also acts as a coolant and assists in the disbursement of pollutants.

A recent case study by the Western Sydney Regional Organisation of Councils (WSROC) and have been integral to the development of the Turn Down the Heat, Strategy and Action Plan (2018) which has been used in this guide as a reference (https://wsroc.com.au/projects/project-turn-down-the-heat).

Urban heat is a more general term that refers to high temperatures that pose a risk to our communities and infrastructure. This report uses urban heat to refer to temperatures 28°C and higher because that is where negative health impacts are shown to begin.

According to Greening Australia[11], who has examined the temperatures for Western Sydney found that:

- Over the last 40 years all Western Sydney weather stations have experienced a rise in annual temperatures over and above what would be expected through global warming
- Using Parramatta as an example, there has been a 12% increase in the average annual number of hot days (above 30°C) and a 27% increase in the average annual number of very hot days (above 35°C).
- The gap between coastal Sydney temperatures and western Sydney temperatures has widened.
- The number of extreme temperature events has risen dramatically

The following analysis is taken from the climate records from Western Sydney (Penrith Lakes and Parramatta North) and Observatory Hill (Coastal Sydney).

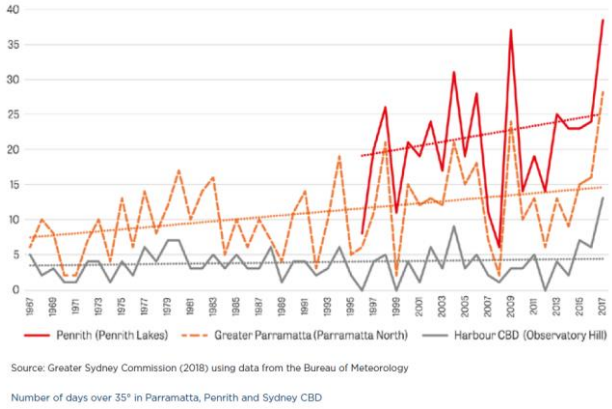


Figure 1: Heat temperatures in Sydney over time

The Urban Heat Island Effect has the potential to adversely impact a city's public health, air quality and energy use, including:

- Poor Air Quality: Hotter air in cities increases both the frequency and intensity of ground-level ozone (the

[11] Greening Australia Urban Heat Island Effect Report (2013)

main ingredient in smog). Smog is formed when air pollutants such as nitrogen oxides (NOx) and Volatile Organic Compounds (VOCs) are mixed with sunlight and heat. The rate of this chemical reaction increases with higher temperatures.

- Risks to Public Health: The Urban Heat Island effect intensifies heat waves in cities, making residents and workers uncomfortable and putting them at increased risk for heat exhaustion and heat stroke. In addition, high concentrations of ground level ozone aggravate respiratory problems such as asthma, putting children and the elderly at particular risk.
- High Energy Use: Hotter temperatures increase demand for air conditioning, increasing energy use when demand is already high. This in turn contributes to power shortages and increasing carbon dioxide emissions.

(Source: http://www.hotcities.org/ and www.bom.gov.au/info/leaflets/urban_design.pdf)

Other documented impacts as a result of the Urban Heat Island Effect include impacts to agriculture, biodiversity, increased water demand, decreased productivity and even increased rates in domestic violence. From the WSROC Strategy the following considerations should be prioritised to assist with their Strategy.

1) Take Action Together
    - Explore funding to monitor the impacts of heat before and after installation of a synthetic sports field
2) Design and Plan to Cool the Built Environment
    - Ensure that the design integrates into the broader environment to create opportunities for additional cooling designs, including additional trees, water harvesting into wetlands etc.
    - Explore Green Engineering technology and blue and green infrastructure building methods into each project
    - Explore how the drainage strategy can replace water into the soil as opposed to storm water to keep the ground close to the field moist
    - Develop light coloured paths, rooves and other hard standing areas to reduce the propensity to capture heat radiation from the normal black surfaces
    - Landscaping to reduce solar radiation
    - Encourage innovation from the contracts to drive opportunities
3) Cool with Green Space and Water
    - Invest in water harvesting and keep as much water on site for alternative uses
    - Increase the tree canopy in the area around the parkland to provide both shade and other green benefits to the environment
    - Include water bubblers around the field to reduce heat impacts on players
    - Water sensitive urban design (WSUD)

The considerations for any project may include the use of light-coloured infill, WSUD and water harvesting, use of trees for shade around the field and connection to Council's bike paths to reduce the needs for vehicle traffic. Specific heat island impacts should be considered for any large developments of multi-field communities, or where the construction would significantly impact on the 'green lungs' of an area.

2.3.6 **High UV Radiation**

Due to the intensity of UV radiation over Australia the UV radiation test results are critical. The yarn is tested using the Extended Test Method. This has been adopted by the majority of International Federations to at least 5,000

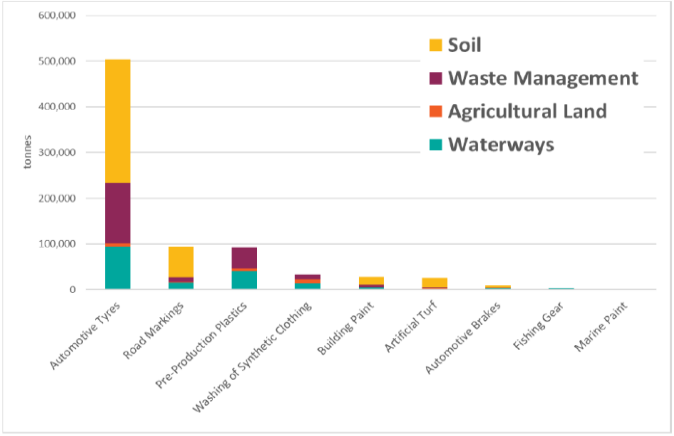
hours as some infills have been found under the Australian heat and UV, to lose its performance properties.

The AFL introduced this UV standard in 2009 as part of its Quality Manual for synthetic turf being used for community Australian Rules Football fields[12]. FIFA has followed in recognising this level in the 2015 Quality Manual for the football turf performance standards[13]. There is a view that in Australia where the UV is strongest that these 5,000 hours should be a base level and we should be exploring the impact of the testing number being much higher. Further research is needed to ascertain that standard by the peak bodies.

2.3.7 **Micro-plastics**

Micro-plastics is a term commonly used to describe extremely small pieces (less than 5mm in all directions) of synthetic or plastic material in the environment resulting from the disposal and breakdown of products and waste materials. The concerns around micro-plastics centres on their potential to cause harm to living organisms in the aquatic and other land-based environments.

The European Commission received a report (DG Environment) in February 2018[14] which explores this in detail and provides the most extensive study to date. It specifically explores synthetic sports surfaces as part of a broader sector of micro-plastics. Synthetic fields are " …a relatively small source…" [15] as shown in the table below.



Source: Eunomia modelling

Figure 2: Sources of microplastics found in Europe

Soil is the largest single sink for microplastics and may over time be washed into waterways. The key aspects from a synthetic sports field that could be classified in this category would be the tips of the grass over time as they breakdown, due to UV Radiation which could be between 0.5 and 0.8% and also the infill.

The report suggests that the level of infill that needs topping up over a year would equate to 1-4% of the total infill installed initially. Although some of that is caused from compression other is lost to the environment. From assuming that on a typical mid-ranged football field (7,500m^2) with a typical infill of 10kg per metre^2 this would equate to 75 tonnes, with a range of 0.8 tonnes to 3 tonnes per annum. It is envisaged that the 'loss' of infill can be seen to migrate as follows:

- Migration to the surrounding soil area;
- Migration to surrounding paved areas and then subsequently released into the sewerage system via grates etc.;
- Into indoor environments (including washing machines) on kit, shoes and bags of participants,

[12] AFL and Cricket Australia Handbook for Testing of Synthetic Turf (2013) page 21: http://www.aflvic.com.au/wp-content/uploads/2013/10/AFL-CA-Testing-Manual_September-2013.pdf

[13] FIFA Quality Program for Football Turf, Handbook of Requirements (Oct 2015) http://quality.fifa.com/globalassets/fqp-handbook-of-requirements-2015.pdf

[14] Investigating options for reducing releases in the aquatic environment of microplastics emitted by (but not intentionally added in) products

[15] Section E1.1. Estimating Microplastics

which again will be released into the sewerage system; and

- Release into drains and water ways.

To counter this Smart Connection Consultancy, recommend the following design and management changes to reduce the probability of increased micro-plastics finding their way into the surrounding natural environment and waterways from a synthetic field:

i.) Explore tape systems or a mix of monofilament and tape yarn system that encapsulates the infill, reduces ball splash and infill migration across and off the field

ii.) Design a plinth for the fence line to fit into which is approximately 100-150mm above the pile height to reduce the probability of the infill migrating from the field of play

Photo 8: Containment strategy example 1: Curb to reduce the infill being dispersed outside of the field of play

iii.) At pedestrian gates ensure that there is a brush carpet that is large enough (two strides) for people who leave the field of play to capture infill from boots etc.

Photo 9: Containment strategy example 2: Pedestrian gates mates that capture the infill

iv.) Vehicle gates are also fitted with a grated system to capture infill from the field of play from the vehicle tyres

v.) The drains should have filters in to capture any infill before it progresses to the storm water outlets

Photo 10: Containment strategy example 3: Drains fitted with filter

Regular maintenance of the field of play and the areas surrounding the field to reduce the level of migration off the field of play.

2.3.8 **Heat Stress**

Natural turf has a significant component make up of water, so in hot weather the water evaporates from the natural grass and can act as a cooling agent. There is no

such mechanism in the synthetic sports turf for long pile fields.

The temperature of artificial surfaces rises significantly more than natural turf surfaces, especially on a hot sunny day (20-40 percent hotter). The key challenge is not so much the heat, but the level of Ultraviolet Radiation (UV Radiation). The UV Radiation is shown as *High to Very High* depending on each part of Australia and this will impact on the use of hard surfaces, whether that be for sport, play, or indeed walking and rubber, acrylic and grass surfaces will have similar impacts.

It is important to consider heat stress as a holistic approach for weather stress. In the same manner that owners of natural grass fields have to close many grass fields in the wet weather to protect both the field of play and the plyers, it may be similar to consider a similar approach for synthetic surfaces. Whether that is rubber (athletic tracks), acrylic (Tennis, Netball or Basketball) or synthetic grass (Hockey, Football codes) a heat policy by the sport is normally used to determine an appropriate level of heat (and humidity) for people to play in. Sports Medicine Australia produce a Hot Weather guideline that has been adopted by many sports in the development of their own Heat Policies[16].

Reported surface-to-air temperature ratios are approximately one for both natural turf and artificial turf under overcast conditions[17]. According to one research on synthetics the mean (range) of ratios for natural grass was 1:41 (1.38 to 1.44) whilst the mean (range) for artificial turf was 1:62 (1.3 to 1.81).

Various studies are available that look at heating of artificial turf systems and natural grass in warm weather. TURI, Nov 2016 (US focus, Physical and biological hazard) reviewed a number of studies looking at the heat of artificial turf systems. Increased temperatures of 35-42F (average) and 102F (peak) have been reported at the surface. Peak surface temperature of 156F (69°C) was reported for the artificial grass fibers itself (polyethylene and polypropylene) and 200F (93°C) on a 98F (37°C) day for artificial turf. The highest surface temperature observed for natural grass was 60F (16°C).

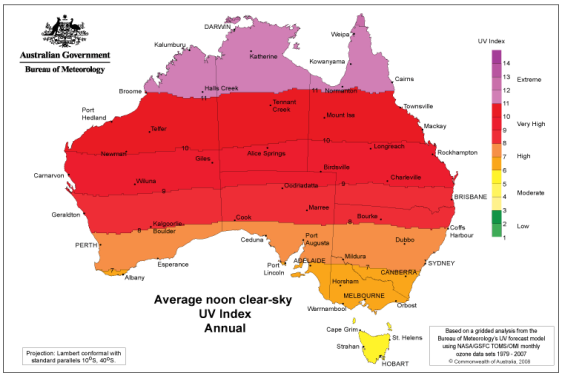


Figure 3: Average Solar Ultraviolet (UV) Index (source: BoM)

Synthetic turf reaches higher temperatures than natural grass, regardless of the type of infill material used (Turi, 2016). Studies however differ in whether types of infill used affect the heating effect of artificial turf. Irrigation is said to be able to reduce the temperature increase on artificial turf, however, this effect was not maintained for the length of an average sport event. Heating of the surface is said to lead to heat stress and skin injuries (blisters and burned skin). (TURI, Nov 2016). Jim, 2017 (Asian study) shows that on a sunny day artificial turf materials heat to over 70°C, attained at noontime and maintained in the early afternoon. The retained heat is in turn transferred to near-ground air by conduction and convection to raise air temperature to above 40°C. Their joint impact on athletes can induce heat stress to exceed the safety threshold and harm their health and

[16] https://sma.org.au/resources-advice/policies-and-guidelines/hot-weather/
[17] Milone and Macbroom, Environmental Effects of Synthetic Turf Athletics Field (2008)

performance. It is important to therefore evoke the sports own heat policy at these points.

Currently, technologically advanced cool climate synthetic products which claim to reduce surface temperature of synthetic turf are available. Petrass et al., 2015 (Australia) compared surface temperatures of typical third-generation synthetic turf with a cool climate product and to natural grass. Mean surface temperatures were significantly lower (40.79°C) on a cool climate pitch compared to a typical third-generation pitch (44.91°C), although both synthetic pitches were considerably warmer than natural grass at the same venue (by 12.46°C at the metropolitan venue and 22.15°C at the regional venue). Villacañas et al., 2017 says that improvements in third generation of artificial turf are still unable to prevent the turf from reaching higher temperatures than natural grass.

In this study, the results of the temperature measurements obtained from the fields studied in Connecticut indicate that solar heating of the materials used in the construction of synthetic turf playing surfaces does occur and is most pronounced in the polyethylene and polypropylene fibres.

Maximum temperatures of approximately 68.9°C were noted when the fields were exposed to direct sunlight for a prolonged period of time. Rapid cooling of the fibres was noted if the sunlight was interrupted or filtered by clouds. Significant cooling was also noted if water was applied to the synthetic fibres in quantities as low as one ounce per square foot. The elevated temperatures noted for the fibres generally resulted in an air temperature increase of less than five degrees, even during periods of calm to low winds.

The rise in temperature of the synthetic fibres was significantly greater than the rise in temperature noted for the crumb rubber. Although a maximum temperature of 68.9°C was noted for the fibres, a maximum temperature of only 38.3°C, or approximately 9 degrees greater than the observed ambient air temperature, was noted for the crumb rubber.

FIFA as the International Federation for Football has introduced a heat standard for be classifying the heat of synthetic surfaces, so that the consumer and purchaser can relate to the heat risk from a particular purchase.

There are heat categories (1-3) with half categories in between, namely 1.0; 1.5; 2.0; 2.5 and 3.0.

The heat issue is being considered by many of the synthetic grass manufacturers with a number of initiatives being promoted, including:

i. Yarn and cool grass technology

A number of synthetic yarn manufacturers are using specific polymers to offer cool grass technology that can (according to their marketing) reduce heat by up to 5 percent compared with traditional synthetic grass. The author is not convinced that this is making a huge difference that is material.

It seems that the turf systems that have some fibrillated tape that encapsulates the dark infill reduces the amount of UV radiation that is captured by the black SBR and therefor the surfaces remain slightly cooler.

ii. Water on grass

The has been discussion for a number of years as to the benefits of spraying the long pile grass fields with water to cool it down. The impact is normally immediate cooling, which lasts for 20 minutes on a warm day depending on ambient temperature and level of UV radiation. The water also evaporates quickly, and this causes very humid areas which is very dangerous to

young people as the humidity mainly stays at around a 1m height above the surface. So, the consensus is not to embrace this short-term cooling strategy.

iii. Infill

There was a clear move from many infill suppliers to provide options that move away from the very cost effective black SBR (*Styrene-Butadiene-Rubber)*. The move to infill's such as coated SBR coated and/or cryogenically frozen infills, EPDM (*Ethylene-Propylene-Diene-Rubber)*, TPE (*Thermoplastic Elastomers*) and natural organic infills. The Penn State research project explored the heat issue and identified that the coolest to hottest types are listed as:

Surface temperatures of various infill after 1 hour under heat lamp

Infill	Surface Temperature (F)
Black Rubber	156.0 a†
Tan Rubber	153.4 a
Green Rubber	147.9 b
Ecofill	141.6 c
TPE	136.4 d

†Temperatures that do not share the same letter are significantly (statistically) different

High surface temperatures can lead to heat stress related conditions, especially in children. In hot climates artificial surfaces are often watered to reduce the surface temperature; however, this can increase the humidity, which is not desirable for participants. A heat policy (e.g. restrict play when surface temperatures reach a certain level) may be required in hot climates.

There is some technology available where a wetting agent is used to capture the water (rain etc.) and then slowly releases it into the system over a week. The wetting agent can be applied post installation but needs to be 'charged' weekly to be effective in hot weather. The supplier of this has indicated that this will reduce the heat by 25%. This has not been verified at all and then are doing this currently. The challenge is that this wetting agent needs to be 'charged' every 4-7 days and in the public parks this may be a challenge. In addition, the agent has a warrantee of four years and is approximately \$9-\$10pm^2 which equates on a typical AFL field (18,000m^2) would add a further \$180,000 for each application.

Organic solutions have been introduced into Australia over the past 5-6 years and we have seen field with the following options:

- Cork and coconut husk as the early option – the coconut husk has a tendency to break down and needs to be kept damp to maximise its performance. In Sydney (APIA Stadium) this is accepted by the Football (Soccer) fraternity as being one of the best fields. The coconut husk does breakdown significantly and needs continual top-up and regular spraying with water.
- Cork infill – in the recent 2 years we have seen a manufacturer introduce organic infills and when damp they are very well received by all players as they embrace the water. If there is a larger amount of hot and dry days over a period, say 3-4 weeks the fields are being monitored to see if there are any adverse effects, such as harshness and breakdown of the cork.
- Wetting Agent where the wetting agent collects the water, as explained previously) and has been applied in Brisbane to University of Queensland and is being independently tested in Australia currently by the supplier.

Hybrid Surfaces – this is being explored by many local governments and the City of Casey (Vic) has just installed the first two community sports fields and with the additional durability of adding 8-10% of synthetic fibre should increase the durability. That said is still cannot meet the hours that the synthetic sports surface technology can achieve.

Research from results to date:

- Natural Turf - irrigated
- Geo infills requiring watering
- Cork infills – subjected to watering
- Lightly coloured EPDM infill treated with a polymer coating & watering
- Cork infills – without watering
- Lightly coloured EPDM or TPE infills
- Black SBR treated with a polymer coating
- Coated SBR
- Black SBR

To mitigate these concerns, it is suggested that the following be considered in the design:

- Light colour infill and cool grass technology for the yarn
- Shade structures around for spectators
- Adopting the sports heat codes for the facilities of when the facilities are used
- Aligning water bubblers to pedestrian access gates allowing users to access cooler water while playing
- In Europe and the USA, a number of organic combinations including:

- Cork and olive tree pips
- Cork and TPE
- Walnut husk
- No infill
- Composite

2.3.9 Civil Engineered Solutions

The engineered base according to some manufacturers can anecdotally provide some benefit, the suggestions that have been put forward include:

- An aggregate vertical draining base (which has up to 40% void space) can hold the water and then stays damp and if damp when the ambient temperature increases can offer some cooling by the moisture evaporating through the system
- Use of a drainage cell with large vertical channels that hold a little water can be used as above to a lesser extent
- The shockpad being kept damp in the same manner as above also offering the same benefit

3. Flooding

Many local governments and sports consider investing in the use of synthetic sports surface technology across a city to satisfy the growing demand for sports as the population increases. Some sports fields are built on a floodplain, which means we will never be able to prevent flooding. Storms and flooding are a natural part of living in that area during winter months.

Organisations should consider as to whether these flood types would most likely impact or even preclude synthetic surfaces being installed and flooding challenges may curtail the ability to install and manage a synthetic sports field and what mitigation should be considered by themselves and community clubs and organisation's as part of their site feasibility and prior to any investment.

The key consideration is that organisations who are interested in embracing the technology need to

appreciate the position on when a known flood risk or site identified as being contaminated poses too high a risk for a synthetic field project to be feasibly delivered and financially sustainable or is likely to be damaged and require replacement because of the geographical siting or the land that is being explored to build upon.

With modern technology and ongoing flood modelling, Councils are able to better understand risk and respond appropriately and has developed tools to support organisations in their knowledge and decision making.

3.1. Types of and Impacts of Flooding

Some councils have invested significant resources to assist with understanding the impact of flooding on property and provides detailed resources for them to read and appreciate. Council and State Governments have identified the various types of flooding that would typically be expected, including:

- **Overland flow flooding**

Overland flow is excess rainfall runoff from homes, driveways and other surfaces. Overland flow flooding is water that runs across the land after rain, either before it enters a creek or stream, or after rising to the surface naturally from underground. Overland flow flooding tends to affect localised areas rather than the whole city at once. Overland flow flooding can be unpredictable, and its severity will depend on the amount of rainfall.

It is critical to understand overland flow flooding by exploring the natural overland flow path through each specific site or property and taking appropriate steps to prepare and protect the site, where possible.

- **Creek flooding**

During rainfall, water from roofs, driveways, parks, footpaths and other surfaces makes its way to the underground stormwater pipe network. The rain runoff exits the stormwater pipe network into creeks and waterways.

The combination of rainfall, rain runoff and the existing water in the creek causes creek levels to rise. How high the creek level rises depend on the amount and duration of rainfall. Heavy rainfall can cause the creek level to exceed its capacity. This is when creek flooding occurs. Floodwaters may flow over the banks into properties, roads and parks. Storm surge can also cause creek levels to rise. Creek flooding is difficult to forecast, as floodwaters can rise and fall quickly without warning.

- **River flooding**

River flooding happens when widespread, prolonged rain falls over the catchment area of the river. As the river reaches capacity, excess water flows over its banks, causing flooding. This can occur hours after the rain has finished. The level of flooding depends on the speed and volume of water carried in the river.

The frequency of river flooding depends on the severity of weather. The impact on sports fields depends on how close they are to the river and how high the fields are built above ground level.

- **Storm tide flooding**

Storm tide flooding happens when a storm surge creates higher than normal sea levels. A storm surge is caused when a low atmospheric pressure meteorological system and strong on-shore winds force sea levels to rise above normal levels. Flooding can also occur from king tides in some parts of Australia, where the tides occur regularly throughout the year and are noticeably higher than regular tides. King tide information is predictable and readily available in tide books and online.

3.2 Flooding and Drainage Considerations for Synthetic Fields

Introduction

Synthetic sports fields are designed to manage the typical rainfalls that are expected in the geographical area, to ensure that there are no flood waters that interact with the sports system, as flooding can seriously damage the performance surface (grass) and the pavement base.

To minimize this possible effect of flooding impacting on the surface, the aim of any design must be to:

- Ensure that there is no water seeping into the base in a manner that would impact the integrity of the pavement base which the performance surface sits upon, failure to do this could result in the integrity of the pavement/sub-base and movement of the base which would therefore mean the field not meeting its performance standards against the International Federation playing standards
- Move the rainwater flows through the synthetic sports field by designing the best drainage strategy to the storm water discharge to meet the International Federations porosity standards (e.g. FIFA is 180 ml/hr) and to a specific Annual Rain Intensity (ARI) event (e.g. 1 in a 10-year ARI etc.)
- Ensure that the storm water discharge is capable of discharging the ARI agreed flow rates and if not design a retention strategy until it can discharge that rate of water.

Flooding Considerations

Flooding is normally defined as "a situation in which an area is covered with water, especially from rain". This normally means that the level of water or rain cannot be released with the normal drainage discharge channels. In relation to synthetic sports fields the four council defined flood scenarios impact as follows, and may include:

- ***Drainage back-fill*** – where the drainage pipes, whether around the field or the storm water discharge pipes can cope with the level of water that its holding. If it cannot, then the water will back up firstly through the pipes and then through the grass systems before puddling and then flooding. Once the water can be discharged the flooding will decrease, normally leaving a maintenance issue for rectification. The field performance infill, which is normally lighter than water will float and can be blown around the field. This is a maintenance issue and can be rectified prior to the next use.
- ***Flood basin –*** some sports fields are designed to collect and retain excess water from an area in the event of a significant rain event especially in local government owned sites. These are not good for the surface of the sports fields and an option is to raise the field and develop a retention base under the field through either storage cell/basin or in the design of the field pavement being made with stone aggregates (which have void spaces up to 40%). This solution is easy to design and holding the water under the field should have no impact on the playing surface.
- ***Flood path –*** this is the most troublesome of the three scenarios' as the flood path normally brings dirt with it and crosses a field and so disrupts the base if not designed to cope with the movement of the water and also the surface. Again, a solution is to encourage the water through a drainage strategy and under the field before possible retention and discharge
- ***Wear –*** the impact of flooding on or across the surface of the synthetic playing field could be detrimental to the systems pavement integrity, the carpet and infill. This could also negate any warrantee (normally 5 years for the system), as the majority of warrantees preclude flooding being covered.

- It is critical then that the design embraces any likelihood of floods, so that appropriate mitigation can be addressed. Failure to design around this or if a Design and Construct specification, would most likely negate any obligation on the contractor and their warrantees.
- ***Impacts of standing water –*** The likelihood of water pooling would be due to drainage back-fill which meant that the water cannot drain away quick enough. The consequence is that there could be a level of standing water on the field of play until the drainage an accommodate the discharge of water.
- The impact on the surface will be linked to the time standing and the amount of water on the field. It is highly unlikely that this would be for long if the drainage strategy has been developed accordingly. Normal challenges when this happens, and the consequential actions include:
  - ***Playing environment*** – this would probably be unsafe and so games/training should be cancelled
  - ***Infill*** – whatever infill is lighter than water, that will float, if there is a wind while the infill is lifted from within the carpet to be resting on top, then it could be blown across the field and rectification maintenance would be needed. Although this may be time consuming, it is unlikely to be detrimental to the system
  - ***Carpet*** – the carpets are normally not glued to the base as they are either sewn or glued together, if sewn there should be no impact. The adhesive is waterproof and so the water should not have a significant impact, if the water is standing for a long period of time (unlikely) then this may release some if the adhesive properties. I am not aware of any research conducted to provide accurate guidance on this.
  - ***Pavement base*** – the impact on the pavement base could be nil. If the design ensures that it does not impact on the pavement's integrity. Normally an impermeable sheet is used to stop water seeping into the sub-base etc. Depending upon the level of water, this shouldn't create a negative problem with the weight.
- ***Impacts of flowing water –*** This would be the most significant challenge that a field would have and the most likely to cause problems for the whole system if mitigation is not designed into it. The flowing water, similar to the 'standing water' would impact on infill migration and pavement base considerations.
- The added challenges are:
  - ***Silt transfer*** – if silt is brought from outside the field of play and across the synthetic system it would leave a train of sand and silt, that when it dries actually creates a 'crust' level on top of the system and can clog up drainage portals. This can destroy the system, resulting in the whole system being replaced. At best when this happens the major manufacturers would suggest keeping it wet so that they have an opportunity to vacuum it up. If it goes dry and hard the carpet will most likely be destroyed
  - ***Mitigation of infill*** – it is possible that the infill will be moved with the pace of the water. This is a maintenance rectification issue and as with the standing water scenario earlier, this should only be a maintenance issue and not a major rectification issue. The operator would normally use a specialist brush (e.g. A SMG Grass Master brush system, which is towed behind a small ride on machine). If it was to settle in the local creek

there is no evidence that this would be detrimental to the environment.

- ***Water under the carpet*** – sometimes if water is under the carpet on some synthetic surfaces (e.g. bowls and water-based hockey fields) round bubbles occur after water is trapped under the surface. If the design of the synthetic field is correct, then this should not be an issue on 3G long pile surfaces as the weight of the surface (normally 30 - 40kg/m^2) would keep it stable. In addition, if the drainage is working the under carpet will lie flat and dry out as the water recedes.

Synthetic sports fields can be significantly damaged from flooding and careful consideration needs to be sort if there is any likelihood of them being impacted by a flood event.

There are two flooding scenarios that can impact synthetic sports fields:

I. ***Standing Water Flooding*** – where the water cannot leave the field due to the storm water drainage system not being able to cope with the level water on the field. This can be caused by creek and river flooding or storm water flooding where they block the drainage exit strategy. To mitigate this would consider options such as a retention pavement (using aggregate with void space etc.) or retention tank under the field to cope with the expected rain and volume.

II. ***Overland Flow Flooding*** – where the water levels would rise and pass over the synthetic field and with it the water would contain silt and or be at a flow rate that would damage the pavement and or lift the carpet. This is the most dangerous and should be avoided at all costs as the likelihood that this could, depending on the level and speed of movement destroy the pavement and carpet beyond use. This mitigation for this scenario could include:
    - Build above the probable flood levels
    - Re-route the water flow path around the field
    - Build the field elsewhere

The risk of flooding and impact needs to be considered prior to any request for Council and appropriate mitigation strategies identified. These mitigation strategies will impact on the cost of the field and so need to be considered early to establish its affordability. There are very few sites that would be precluded due to flooding, but the impact would be financial and possibly considerate.

3.3 Flood Planning Considerations for Synthetic Sports Surfaces

When planning for a future synthetic field an organisation should consider the following prior to determine the probability of a site that may be prone to flooding:

Step 1: Flooding probability - Does the site have a history of flooding or the probability of flooding in the future and use Council information and knowledge.

Although there are mitigation solutions for most flood scenarios the cost implications would significantly increase as the Residential Flood Level (RFL) increases which would make them unviable economically. It is therefore suggested that this should be considered immediately and any flood level over Councils recommended minimum RFL would mean a significant investment that most likely would preclude a viable economic solution being sought.

Step 2: Type of flood – What type of flood would it be prone to? Explore the type of floods, namely overland flow, river and creek floods and storm tide. From these four types appreciate the impact on the field surface

(section 2.2.2) to ascertain if the field can have mitigation strategies applied in a manner that is affordable and workable for that site.

Step 3: ***Mitigation*** – If an organisation at this stage is still considering synthetic fields in such an area then they would need to engage with a specialist sports surface engineer or Hydrology Engineers (https://www.engineersaustralia.org.au/Communities-And-Groups/National-Committees-And-Panels/Water-Engineering) and consider the mitigation opportunities as listed below (Section 2.4)

Step 4: ***Consultation with Council*** - If mitigation is possible and the organisation can afford the solution the solution would meet Council planning guidelines, explore the appetite with Council staff to verify this prior to any substantial work and investment being committed to the opportunity.

- Mitigation Strategies

Council can mitigate these scenario's (left column) by embracing proven design solutions (right column), such as these below:

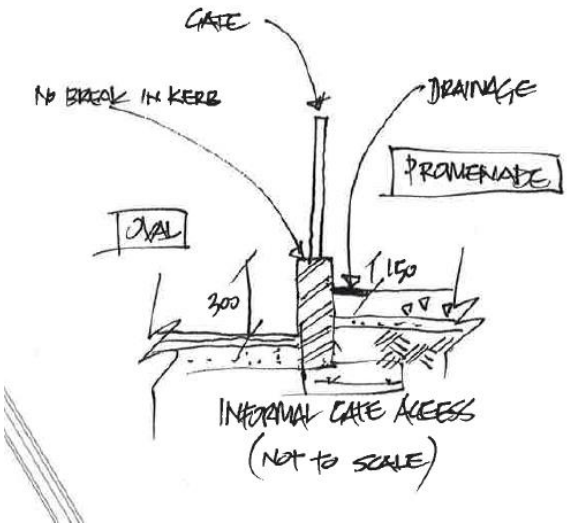
Drainage back-fill

- Calculate the level of water needed to discharge in an hour from the agreed ARI event, 90% of fields in Australia are aligned with this simple procedure
- Design drainage strategy (size of pipes, level of retention etc.) that will be needed to move that amount of water through the synthetic sports surface system
- Ensure that the storm water discharge can cope with the volume of water, If not build a retention/holding tank

Recommendation: Organisations to identify the ARI event needed to ensure that the storm water can cope with the discharge needed. If not possible explore the level of retention needed under the field to cope with the water

Flood basin

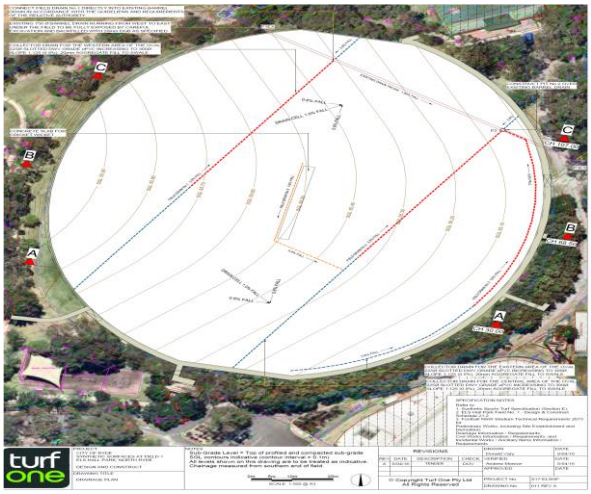
- Calculate the level of water that would expect to be held and for how long in a typical flood that is experienced (e.g. 1,000mm of water for 3 days etc.) and identify that as cubic meters of water that needs to be retained
- Identify if the field can be built up and the retention space (aggregate base or tank) so that this can hold the water
- Ensure that any flood flow is curtained by having drains on outside of path and field of play to take the water under the field etc
- Example (below) of Gore Hill NSW which was designed to cope with a 1m flood annually – under the field



Recommendation: Design the pathways to ensure that the water does not enter the field of play. In addition, ensure that the retention levels of the pavement base can cope with the required flood

Flood path

- Create a drainage strategy by taking the water away from the field of play before it gets there
- If can't redirect by using banks, then capture the water and take under the field of play
- ELS Hall Park and the water was taken of the hill (north west) and designed to go under the field to reduce any impact on the field of play
- Lip on side of paths and also sandstone blocks used to redirect



- Figure 4: Typical Design for an Overland Flood Scenario by Redirecting the Flood Path Under the Field of Play (Source Turf One)

Recommendation: Design the pathways to ensure that the water does not enter the field of play. In addition, ensure that the retention levels of the pavement base can cope with the required flood strategy

4. Green Engineering

4.1 Introduction

The principles of Green Engineering are based on the design, processes and products used, the sustainability of the product and protection of human health without sacrificing economic viability and efficiency.

When considering Green Engineering in association with synthetic sports surfaces one should consider the following aspects:

4.2 Recycled Components

How much of the 'new' project can be created from recycled products in the construction and installation of the surface. This may include aspects such as:

- Sub-base and Pavement – explore how much of the pavement and sub-base could be used form recycled products including recycled concrete, recycled asphalt etc.
- If using a drainage cell could this be sourced from a recycled source?
- Is the shockpad made from recycled rubber as either an Insitu shockpad or a pro-forma pad. Use of a shockpad may reduce infill between 30-50%
- Has the sand ballast been used in other systems and is recycled into this system?
- Is the performance infill from a previous field, re-tested and recycled for this project?
- Some manufacturers are developing yarn from some components of recycled yarn polymers.

4.3 Recyclable Components

Ideally to reduce waste, the system components should be able to the re-used or recyclable after their initial primary use. This could include:

- Yarn to be broken down into its core polymer and reconstructed as yarn for another field or as pellets for other rubber/plastic products
- Carpet backing – this should be able to be stripped from the yarn and infill and the secondary baking, whether latex or PU reused to minimise the waste.
- Infill – as this is over 75% (by weight) the sand ballast should be recycled for other systems or other uses, such as in concrete etc. The rubber should look as being recycled as well

- The shockpads need to be recycled

4.4 Re-use Components

By extending the life of key components of the system will significantly reduce the waste associated with the surface. Key aspects for consideration would be:

- Shockpad – over the last five years shockpad guarantees have increased from 15 to 23-30 years. Realistically three cycles of the pad should be expected. It is important after the 23-30 years expected that the pad is then recycled.
- Infill – Australia has seen two 3G fields have some of the performance infill re-used, with quality infill. It is expected that if the sand and infill can be separated that will allow nearly 75% of the system to be re-used from 10-20 years at least.
- Re-use the topsoil on site and do not take to the dump.
- Repurposing – some companies are "repurposing" the carpet and yarn to other projects such as golf driving ranges or schools. This is just moving the responsibility from one client to another who needs to address it at a later date. Many responsible clients are now taking the responsibility themselves and therefore do not want repurposing options.

4.5 Embracing Natural Resources

Some manufacturers are already embracing natural components in the development of the system of components. These are summarised below:

CoCreation Grass has launched their 100% recyclable grass with no latex, no polyurethane and no coatings for the carpet.

FieldTurf have invested in organic infills including olive cores, cork and coconut peat, and cork.

As a company they are committed to low environmental impact this photoltaic solar power system reduces power needs by more than 50%. In addition, they offer natural performance infill 'Infill Geo', 100% natural organic infill.

Polytan have developed a Hockey field for Tokyo Olympic Games (2020) that is made from 60% sugar cane, requires 2/3 less water and saves CO_2.

Launched in early 2018, TigerTurf is TenCate's construction approach to sports-based systems. The TenCate Ecocept™ is manufactured onsite using 80-90% recycled end of life waste plastics and rubber mixed with a binder.

The manufacturers are committed, the Australian industry needs to embrace the options and resource the aspirations of the community to have more sustainable options.

Although many local companies have stated that they are committed to the environmental aspirations, there is a lack of technical equipment in Australia currently and investment is needed to achieve this from both the companies and more importantly the purchasers of the systems. From 2020/21 Smart Connection Consultancy will be offering a "cradle to cradle" design and build strategy.

5. Sustainability Principles to Protect Our Future

5.1 Sustainability considerations

To ensure that any development has minimal negative impact on the natural environment a vision for a

sustainable sports venue needs to be created. This discussion has explored several frameworks around sustainability and has embraced the 'One Planet' initiative.

Their vision is based on the international standard ISO 20121:2012 Event Sustainability Management System[18] as well as the principles of Green Engineering[19] and the business of AS Environmental Management Shield 14000 and the Australian Governments Environmental Sustainability Policy.

A summary of how these and other initiatives should be embraced in the design, development, procurement and management of such projects include:

The 'One Planet Sport' initiative provides a simple and coherent statement of what genuine environmental sustainability really means for sports organisations and planning. Many of the initiatives were embraced by the London 2012 Olympic and Paralympic Games and have been built on since.

Their vision is for a world in which we are living happy, healthy lives within the natural limits of the planet. They have 10 principles which is used as a framework to examine the sustainability challenges faced and develop appropriate solutions. Building on this the implementation for a sports hub/field, pavilion and infrastructure may include:

- **Zero Carbon** – making buildings more energy efficient and delivering all energy with renewable technologies

Minimising demand through efficiency savings reduces costs and has an essential role to play in ensuring that supply can meet future demand. Meeting remaining energy demand through renewables has the potential to provide a clean and secure source of energy that isn't dependent on finite resources. This can help to precent average global temperatures rising by more than 2^{o}C, causing dangerous climate change.

Renewables should include wind turbines, solar panels and embracing and the planning of more trees to offset any reduction of vegetation or increase in the built footprint.

- **Zero Waste** – reducing waste arisings, reusing where possible and ultimately to send zero waste to landfill

Waste management systems should be designed around the waste hierarchy, prioritising waste prevention above all else; followed by reuse, recycling and composting, then lastly efficient energy recovery to avoid all but unavoidable disposal to landfill. Smart Connection Consultancy are working with some clients and the industry to develop a 'Cradle to Cradle' solution.

- **Sustainable Transport** – encouraging low carbon modes of transport to reduce emissions, reducing the need to travel

Facilitating and promoting walking, cycling and use of public transport among participants, staff and spectators. Where vehicles are required these should be highly efficient and run on renewable fuels. Both our health and the environment benefit as a result of cleaner and more active travel. This can be influenced greatly by the siting of playing areas in each community so that the need for travel is significantly reduced.

- **Sustainable Materials** – using sustainable products that have a low embodied energy

[18] ISO 21012:2012 specifies requirements for an event sustainability system for any type of event or event-related, and provides guidance on conforming to their requests

[19] $1.4m capital cost v $0.8m natural turf for 3,000 v 1,000hrs with only 40 people playing per hour the costs are $11.66 (syn) and $20 (natural)

The aim is to use goods – for construction or consumption – that are made from renewable or recycled materials. These goods are produced in a clean[20] and ethical[21] manner. Green Engineering needs to be the basis of a Cradle to Cradle solution for synthetic sports facilities.

- **Local and Sustainable Food** – choosing low impact, local, seasonal and organic diets and reducing food waste

Working with large caterers and small business to provide healthy, ethical, local, seasonal and organic produce which meets dietary and cultural requirements. Transparent purchasing systems need to be established to ensure that food is responsibly sourced and does not contribute to deforestation, over-fishing or pollution.

- **Sustainable Water** – using water more efficiently in buildings and in the products, we buy; tackling local flooding and water course pollution

Water consumption and discharge must respond to regional and local sensitivities on issues such as water stress and flood risk. Opportunities should be sought to enhance aquatic environments. Awareness campaigns can be introduced to engage people in responsible water usage, this includes water harvesting for the facilities (e.g. toilet flushing) and watering local natural fields from water collected off synthetic fields.

- **Land Use and Wildlife** – protecting and expanding old habitats and creating new space for wildlife

Leading ecologists recommend biologically productive land to be left for wildlife. With this in mind leading sporting organisations and events should look to showcase their contribution to this global target by facilitating the establishment or enhancement of valuable wild space and biodiversity value on site or elsewhere.

- **Culture and Community** – reviving local identity and wisdom, support for and participation in, the arts

Striving to develop a thriving sense of place and building connectedness. Through working together with local communities to build networks of shared values and understanding, sustainable sports and events can facilitate cooperation and build social capital. Research has shown that this improves health and educational achievement, increases employment and cuts crime rates. The importance of local 'Places' for people to play and recreate is critical and not always building regional facilities at the cost of the local provision.

- **Equity and Local Economy** – inclusive, empowering workplaces with equitable pay; support for local communities and fair trade

Organisations can demonstrate their commitment to equity and local economy through exemplary procurement and supply chain policies; this includes policies which ensure the workforce of suppliers are treated properly and have their rights respected. Consideration should be given to ensuring equality with respect to gender, ethnic diversity, sexual orientation and disability, in terms of both of physical access, employment and volunteering opportunities. Many of our projects request that local people are used in the project build.

- **Health and Happiness** – encouraging active; sociable, meaningful lives to promote good health and wellbeing

[20] Low embodied carbon, non-polluting and non-toxic

[21] Under fair and safe working practices

Sports organisations and events have a unique opportunity to encourage, inspire and support people in leading more active and healthy lifestyles, in fun and enjoyable ways. Sporting organisations and local government also have the responsibility to support the health and happiness of their employees, volunteers and events participants. The use of synthetic surfaces can provide in excess of 3,000 hours usage per annum, compared to 1,000 hours for an equivalent natural turf field.

5.2 Sustainable Design Considerations

For any organisation, whether that be a Council, education establishment or sport organisation, who is considering embracing the synthetic surface technology there is a need to appreciate how the technology can be integrated into the whole project and not just the field of play. This will ensure that the technology systems are designed and procured to be fit for your project's specific purpose.

To ensure the location, site and design considerations are fit for purpose, five key strategic stages are recommended for the project, namely:

Planning and strategic vision - Review Council's, State Government and SSO's strategies, priorities and Council's Key Principles to ensure alignment to maximise support for opportunity

Design, location and site assessment - Embrace best practice recommendations to inform design, management and replacement for sustainable whole of life considerations. Utilise the self-assessment checklist to review the design, placement and management against Council's Synthetic Sports Surfaces Key Principles and Focus

Gain approval - Submit application when Council advertises

Procurement and construction principles for project delivery - Build or renew the surface in a manner that meets Council's procurement principles ensuring quality and asset sustainability

Monitor sustainability - Continually review and provide feedback to asset owner on the success of the investment

The self-assessment process is designed around these five stages with this section providing guidance to assist the organisation through the process.

5.3 Five Stages to Success

5.3.1 Stage 1: Planning and Strategic Focus

Scope - The purpose of the project needs to be linked to the desired outcomes of installing the surface. Typical outcomes may include:

- ***Encouraging more children to be active*** – fun, play and skill development needs to be considered around learning the basic movement sport skills of running, jumping, throwing and catching;
- ***Providing active recreational opportunities*** **-** for all age cohorts and specific design attributes need to be aligned to the age of the people the facility is attracting. This can include jogging paths, multi-sport activity zones, fitness in park facilities, etc.;
- ***Provision of specific sport's needs*** – compliance against specific sports performance standards and including additional facilities for a sport or multi-sport;
- ***Place activation*** – with specific space being developed as drop-in areas, play or games areas or active recreation spaces joining two areas, etc.
- ***Sustainability and environmental focus*** – to reduce the impact of the development on the land, or CO_2 emissions or the future generations etc

Identification **of needs and analysis of any gaps** - Is there a need for the new surface or a replacement of the current surface and if so, who is the surface targeting – who are the cohorts that will use it from the community?. It is less and less likely that local and state government will automatically approve a standard sports field without it being shown to appeal to more than the normal 5% of the community that are involved in community competitive sports.

Society's Changing Participation Habits

It is understood that specific key cohorts of the community who would be healthier if they participated in some or more physical activity, play, active recreation and community sport are clearly identified by peak bodies in the health, education and sport/active recreation sectors. Both adults' and children's key motivators were based around fun, enjoyment, health benefit as opposed to competitive or developmental sport, which are listed as being less than 5% of the reason why people are active. Key cohorts, their drivers for participation include, and their impact on the design of facilities are:

- **Children** – many guardians/parents believed that they were too young to play sport, so this age group need to be provided with opportunities to 'play' more. During play the play areas can incorporate 'sports' areas that can be fun and enjoyable. Juniors spaces (under 5's, 6-11, 12-15 years) all need slightly different spaces and activation equipment which needs to be designed.
- **Youth** – Significant numbers of young people (teens to early 20's) are looking for opportunities to be challenged more, and 'hang out' with their friends so Multi-use Activity Areas can provide that opportunity.
- **Young Adults** – Many young adults are interested in keeping fit, playing sport (including adapted sports) and socialising. Facilities can be built around this cohort including multi-use sports fields (e.g. 11 and 5-a-side Football fields); Touch/Oz Tag fields; Netball/Tennis facilities).
- **Older Adults** – Time poor and getting older, the appeal of keeping active through walking, jogging, fitness, playing with kids and socially keeping connected is appealing. Facilities include walking tracks, 5-a-side venues, Hockey 5's; Netball; Fitness trails, Jogging tracks, family space (Fitness and active recreation) is important.
- **Retired Adults** – With more time on this cohort's hands, they are still competitive even if only in their minds, so the hard, physical activity of younger people will not appeal. Adapted and slower sports appeal, including Walking Football; Hockey; Touch, Fitness/Jogging facilities, Bowls greens, etc.

Strategic Alignment

It is imperative for long term 'buy in' and for the proposed project to achieve support and resources from local and state government that the purpose and usage can be demonstrated as being aligned with key outcomes, policies and strategies. Failure to do this will impact the ability to be competitive against other projects that are also bidding for support. The Project needs to be able to demonstrate that the opportunity is aligned with key stakeholders' priorities, strategies or funding policy. It is recommended that the project's organisation secures strategic support from key stakeholders (e.g. SSO, University, Department of Education, Council) early in the process in anticipation for the funding rounds. At the bare minimum an organisation needs to be able to demonstrate that the organisation and their Project is aligned to Councils' asset management principles and preferably against a strategic focus of a synthetics sports surface strategy.

5.3.2 Stage 2: Design, Location and Site Assessment

Location guidelines and considerations

The location of the project is critical for the success and sustainability of the build, the funding, community embracement and stakeholder support. Understand the geographical areas that will be providing your organisations users and members for the future, so that investment will be resourcing the right location. Does the site lend itself to meeting the needs of that part of the city, suburb or region, and if so, how? Is the project easily accessible with public transport? Is there adequate car parking so that there is limited impact on the local community? Can the facility be shared with local schools, other sports and accessible for more than just the current membership base? These are some of the questions that will ensure a more positive response from funding agencies.

Site environmental investigation

Many sports fields that Councils have inherited have challenges, some are located on tips, on contaminated land, in close proximity to residential buildings or have a flood overlay plan. All challenges need to start with mandatory investigation before plans are developed if historical challenges are known.

Site specific considerations create both challenges and opportunities for any project and the only way to understand them and their impact on the project design is to collect all of the information first before a clear direction is agreed. This is normally part of a feasibility study or business case prior to a grant submission.

Photo 11: Bicentennial Park (NSW), which was built over a closed tip site with gas capture built into the field

Traditionally closed landfill sites have been perceived as likely to be unsuitable for synthetic fields due to the following:

- geotechnical instability and landfill gas risks and the cost of remediation to ensure site suitability
- presence of existing landfill management infrastructure
- the restriction imposed by the synthetic surface on required future remediation and maintenance works for the closed landfill, such as waste reprofiling, installation of leachate collection and landfill gas
- cost of pre-construction remediation works.

With greater understanding of the engineered solutions available, some sites may be able to overcome these challenging characteristics, albeit with increased investment needed. This additional investment may include:

- addressing gas risks
- installing leachate systems that would most likely preclude synthetic systems being embraced
- stabilisation of a pavement base to address future movement from the decomposing the waste

When considering the design of the site there are a number of aspects to both consider and some aspects that although may not be avoided, could result in a significant increase in the level of investment needed. Some of the considerations, challenges and solutions are addressed in Table 1 below:

Table 1: Considerations, Challenges and Solutions

Challenge /Consideration	Impact on Synthetic Surface	Possible Solution Options
1. Reactive clay soils	Base and sub-base movement and field integrity is compromised	• Design pavement to ensure water table (wet or dry) does not compromise the base pavement
2. Large trees within 20m of field of play	Roots can impact on base movement	• Use of root barriers can assist
3. Sufficient space for run-off zones and paths outside of fence line	• Lack of space on field of play for run-offs will impact on compliance and standards • Lack of pathway will impact on spectator's ability to move around site	• Ensure adequate space to plan field of play, compliance obligations and the movement around the site
4. Underground services	• Underground services may impact safety of build and management	• Preference is to design around the services, not over them, so explore them being moved • Access to pipes under the field could be reduced by "rebuilding" access outside field of play
	• Services, etc. may need access to be upgraded to ensure that there is adequate electricity for the new lights etc.	
5. Increased traffic flows	• Complaints from residents on quality of lifestyle	• Address traffic flow • Address car parking
6. Uncontrolled fill and closed landfill sites	• Moveable sub-base impacts on ability to build firm base	• Compact uncontrolled fill and place layer of clay over and re-compact • Build slab over moveable fill and if necessary, use pylons to secure base
7. Poor drainage creates backlog of water and flood	• Pooling of water on field • Increased maintenance • Backlog of water in drainage and possibly onto field	• Increase storm water exit • Use detention strategy in base (e.g. voids in the aggregate base) or build detention tank
8. Flood plain which is designed to be on a retention	• Impact on synthetic system that could cause	• Allow the level of water to be retained under the surface in

Challenge /Consideration	Impact on Synthetic Surface	Possible Solution Options
basin for short periods	complete failure	the void space of an aggregate base, or in a retention tank
9. Flood plain for overflow path	• Leaves significant damage to surface top which could cause failure of system at worse and significant maintenance damage at best	• Direct the flow of the water under or around the field of play
10. Contaminated infill	• Leaching (chemicals and gases) into environment • Compliance OHS issues	• Capping of contaminated infill • OHS mitigation strategies

Importance of site investigation

The site investigation is a crucial stage of any sports field development. The design solution and project budget will be dictated by the limitations and constraints of the site. It is important to undertake a detailed site investigation during the planning process of any project to understand possible limitations for development on the site. The following minimum investigation is recommended to be undertaken during the planning stage:

- Identify existing in-ground services
- Flood Overlay
- Detailed feature survey
- Geotechnical Investigation
- Contamination Assessment
- Dial Before You Dig

Existing In-Ground Services

Confirm that there are no existing in-ground services that will impact on the proposed development (e.g. local water authority assets, etc). This also includes overhead services (i.e. high voltage power lines), which often require clearance offsets which may impact on the proposed development.

Dial Before You Dig (DBYD) is a free national referral service designed to identify authority assets to prevent damage and disruption to in-ground services for sites within Australia. Dial Before You Dig is a single point of contact for all of Australia's underground asset owners.

A Dial Before You Dig enquiry can be submitted online to provide information regarding the underground and above ground assets and easements in and around the site. Local utility providers assets may pose limitations on the development of the site.

On more serious contaminated sites, the best solution is to work with Council as the field may to the lay person look a normal field but there may be contamination from previous uses and the treatment approaches would preclude such an investment with synthetic surfaces.

It is important to also remember that not all services will be picked up on a Dial Before You Dig enquiry.

Flood Overlay and Drainage Considerations

There needs to be an understanding of the rain and flooding possibilities for a field of play, which will include the annual rain intensity and the ability for the field to take away the rain event. This is linked to the storm water channels to take the water away. This should be the basis of the drainage strategy employed.

The two main drainage strategies are vertical draining over and aggregate base which hold upto 40% of water in the voids which details the water before it leaves the field through the storm water. There is no use of Ag drains anymore for this option.

The alternative option is the use of a drainage cell over an impervious layer to ensure no leakage into the compacted base. This is an excellent method to take the water away quickly, but if the storm water can not cope with it then this option is not good.

Detailed Feature Survey

A qualified surveyor should be engaged to undertake a detailed feature survey of the site. This information allows designers to plan the location of the sports field and associated infrastructure within a site.

3D elements of the detailed feature survey will enable designers to accurately tie into the surrounds of the site and determine the amount of imported fill/material to be taken off-site.

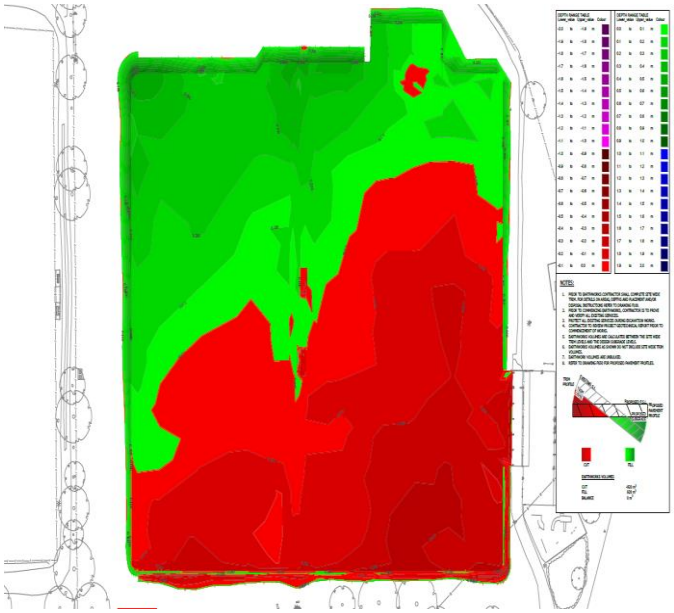


Figure 5; Typical example of cut and fill modelling from a 3D site survey (Source: SportEng)

Geotechnical Investigation

A qualified geotechnical engineer should be engaged to undertake soil testing and provide recommendations for the construction of the proposed sports field. The geotechnical investigation will provide information on the composition of the underlying subgrade material.

If the site consists of poor ground conditions (e.g. reactive clays), the geotechnical report will provide recommendation for the remediation of the subgrade and measures to avoid potential movement and cracking of the proposed field of play pavement.

Geotechnical investigations are crucial to assist in reducing risk of failing pavements by providing an appropriate design solution (e.g. capping layers, subgrade stabilisation).

Contamination Assessment

A contamination assessment will provide important information regarding the presence of contaminates on a site that may pose health and development risks for a project. It contaminates are present on the site, an action plan with appropriate methods of disposal/ management will be provided.

There are typically two options that will be provided if contaminated material is found on site:

- Capping over the contaminated material
- Disposal off-site to an approved Environmental Protection Authority (EPA) disposal site

Disposal of contaminated material can add significant cost to a project, possibly resulting in the project becoming unfeasible.

Management and flexibility design

The importance of flexibility is reflected in the design of the surrounding infrastructure, including:

- Nets – Netting across the width and length of fields so that they can be divided accordingly
- Net cage – Specific cages with manual and motorized mechanisms are being seen more

- Lines – To ensure that lines are subtle for each sport various options have been embraced
- Lights – Lighting design allows for key parts of fields to be sued with the adoption of LED becoming more popular and affordable.
- Technology Cameras – Use of cameras on net posts allow vision in clubhouse and sports analysis to improve performance

Site assessment

The site assessment should identify the challenges from the site investigation and then identify any risk mitigation needed. This should be part of the Business Case being submitted to key stakeholders (Council, State Government, Education Department, etc.) as these stakeholders will want to see how any risks are mitigated, whether they be structural/site issues, technical or community based.

Universal design philosophy

Philosophy

Universal design is the process and philosophy of designing facilities and environments to be used by everyone, to the greatest extent possible. By planning and considering this approach early it should mean that the facility should not need adaptation or specialised design. Universal design is a process, not an outcome. Universal design assists everyone, not just people with a disability. The Victorian Sport and Recreation Department produced an excellent publication 'Design for Everyone Guide' and this should be adopted in any design for improved facilities or indeed planning for new sport and recreation facilities. http://sport.vic.gov.au/publications-and-resources/design-everyone-guide/overview-universal-design

Accessible Design

Universal design is different to accessible design. Accessible design is usually based on minimum legislative requirements or accepted Standards that define how access should be provided to buildings, facilities and products, so they can be used by people with a disability. Often these have a tendency to lead to 'different' or 'separate' facilities, for example, a wheelchair accessible toilet or a ramp installed to the side of a stairway at an entrance to a building.

The aim of universal design is to provide one solution that can accommodate all people, including people with a disability, as well as the rest of the community; universal design incorporates the needs of older adults, children and young people, women and men and people who are left handed or right handed.

Female friendly sports infrastructure guidelines

Historically traditional outdoor sporting facilities have been designed primarily to meet the needs of male participants around the main football codes. To encourage more women and girls to become active and involved in sport and active recreation, user-friendly facilities are required and now is the time to integrate the thinking for updating facilities and the design of new infrastructure. The Victorian Government has produced some excellent guidelines that should be incorporated in all redevelopments and new facilities. http://sport.vic.gov.au/publications-and-resources/female-friendly-sport-infrastructure-guidelines

Facility standards and compliance

Sports performance compliance

All sports fields, tracks and courts that Council invests in shall meet the International Federations (IF's) community sports field /court performance standards and be certified on installation and keep certified where critical to the sport.

Tenderers / suppliers of such sports surfaces must be a licenses or preferred provider if the International Federation or an Agent of such and organisation and can supply a sports system that has been tested and has been certified by them as to meeting the IF's performance standards.

Investment in such facilities should be prioritised to those who can accommodate multi-sport or take significant pressure off natural turf fields so that they can cope the growth in the participation.

Any investment by Council should ensure that a sinking fund is established to accommodate the replacement costs at the end of the expected life. This life expectancy should be reviewed annually, and additional funds raised if the field is being used in a manner that will reduce its life expectancy.

It is the responsibility of the client who commissions the project to ensure that the field of play meets all playing standards for the standards of play. Some sports (e.g. Rugby Union and Australian Rules Football) state that players cannot train or play on the surface unless the field is certified to their appropriate standard. This needs to be confirmed as part of the ongoing management reporting to ensure that the players are insured to use the fields.

These standards should be outlined through the International Federation standard (e.g. FIFA Quality Mark), the National and State Sports Organisation (e.g. Football NSW NPL rule of the game and Football NSW Facility Guide) as well as any legislative requirement (e.g. Football Goalposts with the NSW Office of Fair-Trading Act 1987) and any Australian standards (e.g. AS4866. 1 Playing field equipment – Soccer goals). All of this can be sourced from the governing body of the sport and through a good specialist consultant.

The dimensions and run-offs need to be explored in detail and there is normally a range that a client can choose. Liaison with the State Sports Organisation and working with a consultant to sign these off will ensure all compliance obligations are met.

Civil engineering considerations

It is critical to ensure that the civil engineering sub-base and pavement is designed by a civil engineering specialist so that it can support the synthetic surface system. The design should be based against data from the locations/field inspections including topographical survey, geotechnical report, drainage study, etc. which needs to be completed by a qualified geotechnical engineer.

The focus of the sub-base and pavement base design must be able to achieve the following:

- Support the vehicle load during the construction, maintenance and replacement phases,
- Integrate with the synthetic surface to ensure that the sports' performance criteria are achieved,
- Support the load on the pitch once in use, including players and maintenance machinery to ensure no negative deformation of the surface, and
- Protect the surface from other sub-grade movement or water
- The base pavement standard shall be designed to meet a twenty (20) year life expectancy and the specific suite requitement as identified by a Geotech and environmental assessment prior to tender.

The construction standards must meet all legislative obligations which are accessible from the planning department of Council. The construction design should also be built around Universal Design principles and sport specific approaches can be seen in the Victorian Government Guides http://sport.vic.gov.au/publications-and-resources/design-everyone-guide

Management and flexibility design

The importance of flexibility is reflected in the design of the surrounding infrastructure, including:

- Nets – Netting across the width and length of fields so that they can be divided accordingly
- Net cage – Specific cages with manual and motorized mechanisms are being seen more
- Lines – To ensure that lines are subtle for each sport various options have been embraced
- Lights – Lighting design allows for key parts of fields to be sued with the adoption of LED becoming more popular and affordable.
- Technology Cameras – Use of cameras on net posts allow vision in clubhouse and sports analysis to improve performance

Field of Play Compliance

It is important that the sports field is designed and constructed to meet the standards that are appropriate for how the field is to be used, so if it is to be used as a community playing field then there is no benefit of requesting a stadium standard field. Indeed, in many instances this would work against the performance requirements and would not be fit for purpose.

The various sports in each state have their performance design and surface standards linked on their website and should be included in the Assessment Process to ensure that the right standards are being complied with. This will ensure that the field dimensions, lighting levels, surface standards and ancillary designs will be fit for purpose.

The best site for sports field sizes and measurements is the WA Department of Sport and Recreation who have a summary of all sports dimensions: https://www.dsr.wa.gov.au/support-and-advice/facility-management/developing-facilities/dimensions-guide

Field of Play Orientation

If site constraints allow, the orientation of the field should take into account the sun, wind and other natural aspects that may impact on a fair game of sport. The aim should be to ensure that during the game that both teams benefit or are disadvantaged equally. The time of day (early morning or late afternoon) as well as the time of year (winter or summer) has a bearing on optimum orientation. The WA Department of Sport and Recreation[22] state in their guide on field orientation that:

> *The aim however is to share between opposing participants the advantages and/or disadvantages of the sun's direction and other natural factors such as breezes. It is generally recommended that playing areas are orientated approximately in a north-south direction to minimise the effect of a setting sun on players. The best common orientation is 15° east of north.*
>
> *However, with more sports being played under lights, this may be less of a concern. Limits of good orientation where a uniform direction for all facilities can be arranged:*
>
> - athletics, basketball, bowls, croquet, handball, lacrosse, netball, tennis – between 20° west of north and 35° east of north
> - football: soccer, five-a-side, Australian rules, Gaelic, rugby league, rugby union – between 20° west of north and 45° east of north
> - hockey, polo, polocrosse – between 45° west of north and 45° east of north
> - baseball, cricket, softball – between 45° west of north and 35° east of north
>
> *Prevailing winds also have to be taken into account. In athletics, the potential problems caused by strong winds are worse than the inconvenience caused by the setting sun. Athletes approaching the finish line should not have to contend with strong winds. Pole vaulters should not be*

[22] https://www.dsr.wa.gov.au/support-and-advice/facility-management/developing-facilities/dimensions-guide/orientation-of-outdoor-playing-areas

exposed to crosswinds or strong opposing headwinds. The discus is best thrown into a headwind.

In outdoor diving pools, springboards and platforms should face south. In shooting sports and archery, outdoor ranges should be constructed so that the sun is behind the shooter as much as possible.

Lawn bowling greens must be located away from tall buildings and trees that may cast shadows over the bowling surface, thereby affecting turf performance. This is not relevant for synthetic surfaces.

Cricket pitches must run approximately north/south to minimise the risk of batsmen or bowlers facing a low sun. The pitch axis must point in a direction between 55° and 325° on the compass.

Tennis courts must be oriented with play along an approximate north/south axis.

The WA Departments (Figure 6) Guide on Field Orientation illustrates the optimum orientation for Australia for various sporting activities. Local conditions may override these recommendations.

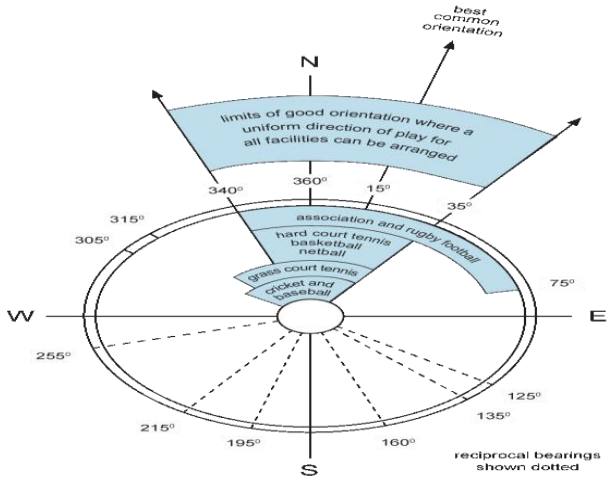


Figure 6: WA Department of Sport and Recreation, Guidance on Field Orientation

Lighting

There are Australian Standards and guidance documentation that are used to guide the design, construction and installation of lights for sports fields. These need to be adhered to and considered in terms of the planning for new facilities. Also, the cost implication of the investment from one level to another is substantial, and may not be needed. For instance, if a 200lux field is determined for semi-professional sport then the cost difference could be as high as $200,000 from the training lights needed at 50 lux. So, determine how often the lights are going to be used and for what standard, as it may be better to move an evening game that would need 200lux to an afternoon and re-invest those savings in a better quality surface, etc.

The Victorian Government published the Community Sporting Facility Lighting Guide for Australian Rules Football. Football (soccer) and Netball in 2012 which provides guidance on key topics that councils and clubs will need to consider when planning a sports lighting project. http://sport.vic.gov.au/publications-and-resources/community-sport-resources/community-facility-lighting-guide

These include:

- Planning process
- Planning the power supply
- Maintenance and operation
- Environmentally sustainable design
- Types of lighting
- Pole height and location
- Design standards for training and competition
- Where to get further assistance

Photo 12: Chatswood High School, LED lights installed in 2017 show the reduced light spill (source: Willoughby City Council)

The key Australian Standards for the lighting outdoors include:

- AS 2560.1 – 2002 Sports lighting Part 1: General Principles
- AS 2560.2.3 – 2007 Specific Applications – Lighting for football (all codes)
- AS 4282 – 1997 Control of the obtrusive effects of outdoor lighting

In the past 12-18 months, the investment in LED lights has become close to the traditional metal halide lamps and so with a longer life expectancy and reduced maintenance their benefits are being embraced as the way forward.

Fencing

Fencing of the field of play provides a double benefit as it can act as both a method of keeping the ball in the area close to the field of play and secondly keep people off the field, while also providing a defined area for maintenance and security.

The normal fencing would be in accordance with the Australian Standard AS 1725 Part 5 (2010) which is a chain link heavy duty commercial grade.

Spectator Experience – seating, paths, movement across site

It is important that when designing the field of play that the movement and spectator needs are explored in the design and planning stage. In general, the following aspects should be considered:

- Path width – allow at least 2.4m, as this will allow to buggies/wheelchairs to pass. Where the path is aligned to a fence that people will be stationary and will watch the sport, then allow an extra metre for the path to still allow to wheelchairs/prams to pass, so a path around 3m is needed where practical.
- Seating – there is often soil that needs to be moved if a synthetic surface is to be constructed, and many organisations would embrace this across the site as topsoil for other fields or for the development of viewing mounds. This reduces the cost of movement off site and also enhances the spectator viewing areas. Some have planted trees and use shade cloths to provide shade for the spectators.

Storage

When using sports fields, it is important to have space to store the goals, posts and flags so that they are in good use. These can be aligned along the fence, incorporated into the pavilion or fenced storage areas at one end of the field of play.

Concept design

The concept plans should embrace the design standards and principles from within this Study (Part 2), Section 6.3 for ideas. The concept plans should embrace the technical standards and be aligned with the State Sports Organisations Facilities Guides (see your sports development staff for information).

A typical concept design may include the following:

- Pictorial representation of the site
- Details of 'Field of Play'
- How the field of play, associated infrastructure and access around the site is integrated with the rest of the site
- Orientation against the sports compliance/standards

A typical Concept Plan may look like this:

Figure 7: Concept plan (source: 106 Architects www.106architects.com)

Project Budget

It is important that the organisation appreciate the cost of this project. Within this Study Part 2, the estimated unit rate for each surface type is identified.

In developing the budget cost an organisation should identify the Whole of Life costs, which includes the capital costs, operational and replacement costs. An example for a typical Budget Costing can be seen in each sports area.

This budget should be developed by either:

- A qualified Quality Surveyor who has experience in similar sports infrastructure projects;
- A technical consultant who can benchmark costs against similar recent projects; or
- Quote form installers and suppliers of synthetic sports fields.

To ascertain true costs, the project needs to identify the quantity and quality or standards of each of the project components. Complete the template in the Assessment Process

The additional revenue that a synthetic surface can generate, should be structured to allow for an organisation's annual operational costs and also the replacement costs. The replacement costs should be based on a minimum life expectance of the surface (based on number of hours used and maintenance resourced) and then amortised over the year to gain an annual replacement or 'sinking fund'. This sinking fund should be increased by inflation annually.

The costs of use of the facility should include:

- Membership fees
- Hire facilities (for 3rd party usage)
- Academies (add unit rate for each person)
- Competitions (integrate on hourly 'rental cost' for usage)

5.3.3 Stage 3: Application Process

Apply to your local Council or State Government once the advert has been issued for funding, following their instructions to seek funding and design development approval

5.3.4 Stage 4: Procurement and Construction Principles for Project Delivery

Procurement and construction of the fields and surfaces are best value for the community

It is unlikely that a Council would not endorse specific contractors or service providers but depending on the value of the investment would make the following recommendations:

- ***Define the scope for the works*** – what standards for the sports performance surface and the civil engineering solution are needed to be fit for purpose, ensuring that this standard is signed off by the State Sport Organisation
- ***Develop a budget*** - that is realistic and ensure that the project can be procured for this price
- ***Obtain technical advice*** – both from the State Sports Organisation and most likely from a synthetic sports surface and sport's engineering consultant. Specialise advice from Geotech

engineers to ensure that the surface can accommodate the design is critical.

- ***Prepare a technical specification and design package –*** it is recommended that the organisation engages a technical expert to assist them in the process as many times it may seem logical that a specific product or solution is procured, but the specialist can ensure that the best standards are chosen with the organisation and where needed additional quality and performance standards are specified. A good design and specification package will ensure that the tenderers area all bidding on the same rules and conditions, that the detailed drawings ensure that the site constraints are considered by the tenderers and that the Bill of Quantities ensures that the correct price is submitted.
- ***Scope the procurement approach*** – depending on the size it may be as simple as obtaining a quote or defining a full procurement process. It is important for a Council that the procurement of the field and associated equipment follows good practice to ensure best value for its rate payers.

Key considerations that should be addressed in the procurement process include:

- Probity
- Value for money evidence
- Audit trail for public funds

Council oversight of selection process for contractor:

- Guidance for quality delivery
- Council involvement in the procurement process
- Evaluation team member
- Approval to proceed with recommended contractor.
- Approval to proceed with works on quotation provided.
- Ability to inspect site.

Typical procurement expectations for a synthetic surface on Council Land:

- At least three written quotes
- Evaluation plan with criteria and including a Council officer as part of evaluation team (must use schedule following this table to be included as a schedule to the funding agreement)
- Evaluation documenting selection and recommendation required
- Provide the quotes and evaluation note to Council prior to work being awarded
- Obtain written authorisation from Council to proceed with work
- Expectations of successful contractor
- Specification of works recommended

Schedule provided to complete for evaluation of the quotes and recommendation of contractor:

- Provision of works program
- Obligation re workmanship, quality and delivery
- Defects liability
- Appropriate insurances
- WH&S and quality documentation
- Access for Council staff to inspect
- Documentary evidence supplied to Council
- Copy of all quotes

Evaluation plan, selection criteria and recommendation supporting the suitability of the Contractor:

- Executed contract.
- Contractor's insurances.
- Construction program.

Project management achieves outcomes on time and within budget

It is critical that an experienced project manager is identified to manage the contract to ensure that the outcomes are achieved. At key points of the project delivery there should be some Critical Hold Points that ensure that the civil engineering work components have been delivered and are appropriate.

A typical Project Manager would ensure that key critical stages of the project are reviewed with the contractor and would normally ensure that these hold and witness points are assessed by a qualified person in that area of the construction process. These points may include:

Witness Points

- Earthworks – Subgrade affected by moisture
- Earthworks – Placing fill
- Earthworks – Compaction
- Earthworks – Proof roll
- Earthworks – Excavating service trenches
- Earthworks – Backfilling services trenches
- Stormwater – Testing and inspections
- Stormwater – Testing and inspections
- Flexible Pavements – Compaction tests
- Flexible Pavements – Placing base and subbase
- Flexible Pavements – Proof roll

Hold Points

- Design Documentation
- Earthworks – Bad ground
- Earthworks – Compaction Tests
- Earthworks – CBR Tests
- Earthworks – Sediment and Erosion Control Plan
- Stormwater – Backfill density testing
- Stormwater – Pipe bedding material
- In-Situ Concrete – Concrete tests
- In-Situ Concrete – Contractors Submissions
- In-Situ Concrete – Materials
- Flexible Pavements – Execution
- Flexible Pavements – Compaction tests
- Flexible Pavement – Crushed rock material
- Flexible Pavement – Subbase and base compaction
- Synthetic Surface Field of Play – Acceptance of Base
- Synthetic Surface Field of Play – Survey Verification

It is important that at handover the key standards are tested against to ensure that the quality control and quality assurance is achieved. All defects should be listed and an agreed timeline in place for correction.

At handover it is critical that there are a number of aspects that is needed prior to acceptance of the field/surface from the supplier/builder. It is important that a handover the supplier provides the following:

- All warrantees and guarantees;
- All finished drawings;
- Equipment handbooks;
- Field of play/surface manual;
- Certification by the International Federation;
- Synthetic System details/ delivery forms; and
- Any 3rd party assessments.

5.3.5 Stage 5: Monitor Sustainability

Monitoring sustainability is critical to measure the success of the investment. This is often called measuring Return on Investment (RoI). This can be measured through various perspectives, including:

- **Community sustainability** – measuring usage and embracement by the community, throughout the year. Key measures may include:
  - Number of hours usage (day, week, month, season, year)
  - Number of people (day, week, month, season, year)
  - Range of usage (by sport, training, competition, schools etc.)
  - User types (juniors, seniors, casual, organised etc.)
- **Asset sustainability** – measuring the performance of the field key measures may include:
  - Number of hours usage versus number of hours maintenance
  - Monthly report form cleaning contractor

- Cost of maintenance per 1,000 hours usage
- Annual assessment (quality, life expectancy etc.)
- Key maintenance areas focussed on

- **Economic sustainability** – measuring the economic revenue generated, compared to the Whole of Life/maintain and replace scenario. Key measures may include:
  - Revenue generated versus budget (casual, programmed, Council etc.)
  - Sinking fund achievement (quarterly/annual % achieved etc)
  - Cost management (costs versus income ratio)
  - Utilization Optimisation of field (by hours and revenue)

All of these sustainability perspectives can be monitored by investing in smart machine intelligent software such as from Intelligent Play. This global software is now available in Australia[23].

How it works?

Two sensors are mounted to the facility lights or stadium press box and automatically process and convert the recordings into anonymous data for analysis. Through advanced computer vision and deep learning algorithms, live field participation is translated into tangible data.

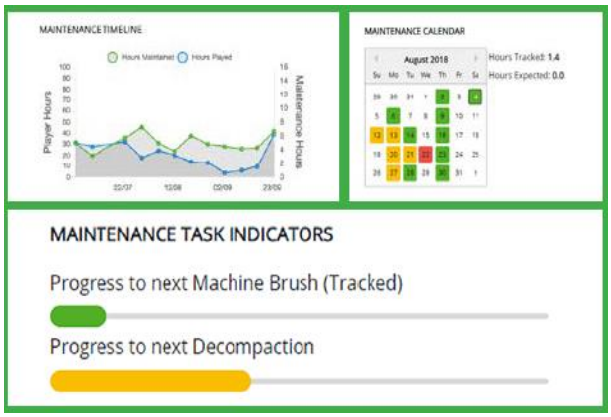
What does it monitor?

The system monitor all on-field activity and translated it into Equivalent Usage Hours (EUH).

- 22 Players playing for 1 hour = 1 EUH
- 11 Players playing for 1 hour = 0.5 EUH

By determining a quantifiable usage amount, proper maintenance and usage recommendations can be made. Live monitoring allows for accurate recommendations.

Easy access to information using the online dashboard



Using the online dashboard, advanced facility reporting is at your fingertips. Easily access field usage history, trends, planned and executed maintenance sessions and detailed heatmaps. Manage and compare multiple facilities using one platform from any device, from any location.

Maintenance and usage hub

Using the live heatmap, you can easily identify areas of high use to help properly maintain and care for your

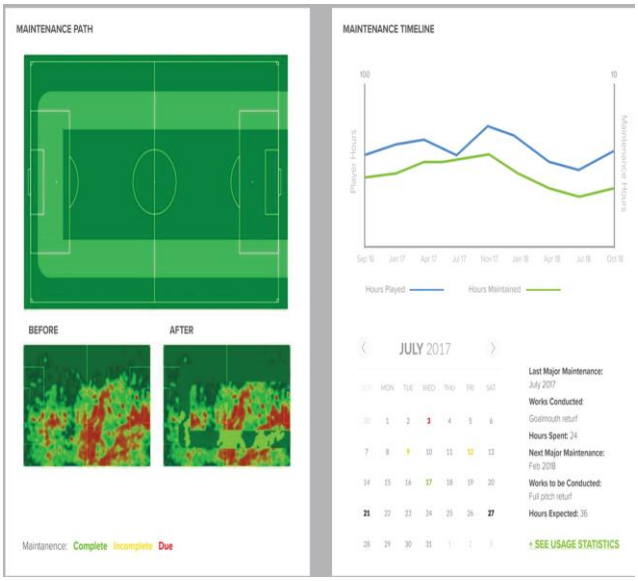
[23] Available from FieldTurf Australia (info@fieldturfaust.com.au) and can be used on any synthetic sports surface from any manufacturer

surface. Quickly access and sort field usage by quarters, thirds or halves to help balance utilization.

Maintenance Alerts

When your field reaches certain milestones, a maintenance alert is issued indicating the needed service: brushing, aerating, raking or sweeping. After the maintenance is completed, an updated heatmap allows you to track the efficiency of the session. A calendar and tracker help your team plan and ensure your field receives the proper care based on its true usage.

Advanced Facility Reports



Generate advanced reports integrating weekly or monthly averages and custom date ranges to gain in-depth knowledge on your facility. The tool can help identify areas for additional rental and aid justify investment.

Smart Connection Consultancy believes that this is a gamechanger for managing sorts facilities and ascertaining real information from the fields in terms of their sustainability. Due to this, we have established access to all the reporting cycles so that for a small investment we can on behalf of our clients monitor the reporting and produce a monthly detailed report against a Triple Bottom Line Sustainability Framework together with an Annual Smart Health Check of the field.

6. Sustainable Facility Design Considerations

6.1 Introduction

When embracing synthetic sports surfaces in designs aimed at encouraging more people to be more active, the technology lends itself to the imagination of the designer. It is important to appreciate the drivers and accelerators that will encourage more people to be active. Each grouping may have a slightly different design implication and use. To assist in the design thinking the following groups of facility types are identified:

6.2 Playgrounds

Encouraging children to be active is critical for them to have a health gain. Cognisant that traditional playgrounds have embraced colour surfaces to “energise” these spaces, building into the floors and rubber fills aspects that are a little more challenging both excites the children, develops their skills, increases cardiovascular endurance (as they want to play for longer) and strength.

In addition to the “play equipment” the design should integrate some sports skills that continues with the fun element but includes games around throwing, catching, kicking, jumping, etc.

Photo 13: Children play area inside and outside of school

These designs can be built into one part of the playground and does not have to be independent. The surfaces could be cushioned acrylic or rubber. These designs can be targeted to specific age cohorts; very young (under 5's; 5-10 years, youth, etc.).

6.3 Design Options and Activation of Community Environments

To encourage more people to recreate and be active, it is important to provide them with safe environments to walk, jog and keep fit. There is an increase in these around schools, universities, gated communities and in local suburbs.

Photo 14: A'Beckett Urban Square, Melbourne (source: Peter Elliot ltd Architecture)

Where there is significant building development we are seeing 'pop-up' parks for people, which may only be for 3-4 years until a new building is planned and built. RMIT (university) and Melbourne City Council has developed one in the CBD area which is very appealing to students and young people.

Normally they are paths, with subtle lighting to provide the users with a degree of safety. Many times, they are linking fitness trails and should have good signage both on the surface and on the stand-a-lone signs that encourage people to move from one space to another.

Photo 15: Monash Uni Caulfield Campus Green (source: Taylor Cullity Lethlean Landscape Architect)

The Fitness Trail Designs that are being installed more and more, unfortunately do not help or motivate the users and Council needs to be cognisant of this. The following guidelines should be built into the design:

i.) The equipment should be part of a walking, jogging trail, that encourages the users to walk, jog and run between stations around a park, lake, river, etc.

ii.) The trail should be promoted at each station to encourage greater movement and exercise.

iii.) The trail pathway should be coloured (rubber, acrylic) to entice and encourage more movement

iv.) The flooring around the equipment should be rubber to provide safe but firm footing etc.

v.) Where possible the fitness trail should be situated next to play or Multi-use Activity Zones to encourage family participation

6.4 Building Developments

As Australia follows Asia, Europe and America by embracing vertical cities, the active recreation space needs to be built around and within these apartment and commercial developments. As the buildings continue to grow small neighbourhood parks are struggling to survive with lack of light for natural grass. The enhancement of Multi-use Games Zones should be adopted. These could include:

- Multi-use Activity Zones at the base of groups of apartment blocks
- Rooftop Sports Facilities – on top of car parks to allow greater participation

Linear Parkways – where the exact size of the space isn't as important, but the young people will make the sport/recreation work. You're can find these spaces under roadways, train tracks or next to them.

6.5 Multi-use Activity Areas

Many councils are starting to build Multi-use Activity Zones in local parks and sports are also integrating them into their facility design so that the families can come and watch a game, or adults train while the children are busy playing sport and being active. These designs are varied but the ones that encourage the greatest participation include the following components.

- Fenced to control Activity Zone, stop dogs and provide protected spaces;
- Multi-sport design on the inside (e.g. Soccer, Basketball, Netball etc.);
- Hard and cushioned surface (Acrylic cushioned surface is the most durable);
- Outside of Activity Zone more activity can happen, e.g. jogging track, Basketball 3 on 3 etc.

Design for specific cohorts and areas may include:

I. Sports Play Area

Allowing and encouraging participants of all ages to take part with a durable surface, originally using a sand filled grass surface but more are now adopting acrylic surfaces.

II. Youth Activity Areas

Youth Activity Zones are designed for places where older children are looking to be active and this would include activities such as parkour obstacles, fitness facilities and older sports zones. Photo 16 shows an Activity one next to a play area, which has been designed for older children/youth that want greater challenges around balance/strength and gymnastics.

Photo 16: Youth activity area

III. Family Fitness / Activity Areas

Combining the best of the Children's Activity Zones with activities for youth, adults and older people provides opportunities for generations to be active together. Examples in the simplest form would include a playground or Children's Activity Zone next to a Fitness trail/equipment.

More sophisticated strategies include designing areas that encourage younger people to try some of the fitness exercises that adults are using. The above picture shows older playground integrated with fitness activities that adults, children and young people can all participate in. Ideally the design should have three zones:

- The Multi-use children's zones
- An integrated zone – used by all
- Fitness space – using body weight resistance equipment for ideas for this type

IV. *Multi-sports areas*

Many local governments are considering the colocation of sport so that there will be a greater usage of the facilities. There are several design considerations when exploring multi-sport facilities, including:

- Purpose – what are you using the facilities for? For instance, a school site may embrace Hockey and Tennis, so that they have winter and summer sport. Other designs may be structures for income generation to recoup capital cost quicker.
- Standards – what standards are going to be embraced? Some multi-sports facilities maybe a compromise for a second or third sport, which should be agreed firstly. For instance, although Hockey can be played on a 3G or long-pile surface, traditional hockey players do not like this as the long-pile surface slows down the run of the ball. Ironically this slowness is good for youngsters when learning the sport's ball skills.
- Level of Play – similar to the standards, many sports will determine the associated equipment and ancillary facility needs linked to the level of play

V. Sport and active recreation facilities

Many governments, sport and education sites are being designing to combine both traditional sports facilities with active recreational needs and in a manner that allows both the formal and casual usage of a facility.

This Athletics track has included many aspects that will encourage active recreationists to use the facility due to

the creative active recreation, fitness and parkour trails as well as integrating the facility with external park paths. This allows the athletes who are keen to train to continue to do so, while others are only looking for a fitness benefit and others the social side of active recreation. Truly an Active Recreation site.

VI. Multi-code sports fields

Combining sports codes is difficult at times and so a general rule is that large ball football codes and small ball codes work together well (e.g. tennis and hockey). The long grass codes of Football (Soccer, Union, League and Australian Rules) have long shared venues and two within Sydney (NSW) show the flexibility for greater usage by integrating them into their field design. Blackman Park, Lane Cove NSW, below also integrates a movable cricket wicket allowing the summer game to be played.

Moore Park, Centennial Parklands (below): Integrating the sports of Football (Soccer), Rugby Union and League with the recreational interests of 5-a-side by designing for netting to be used to delineate the various codes and users.

St Kevin's College (below), Toorak: embracing long pile (AFL and Soccer) with Hockey fields/Tennis and rubber athletics bend and straight. All surfaces have need successfully certified.

VII. Sport – traditional and adapted combination

Understanding the need for casual and adapted use of the facility for adapted league competitions (e.g. 5-a-side football) can be built into the design of a single sport field so that it can be used for both adults/children's sports as well as the adapted games such as with this design for a Football (Soccer) field.

VIII. Seasonal sport site

Integrating summer and winter sports works well and can ensure community engagement and usage all year round.

With cricket and five-a-side, rugby 7's and AFL X being the typical sports that are being embraced outside of the traditional winter games. In addition, athletics at the Little Athletics level for children are now also using the synthetic grass technology for summer carnivals around running. Many are using temporary paint to mark the running track.

6.6 Single sport sites

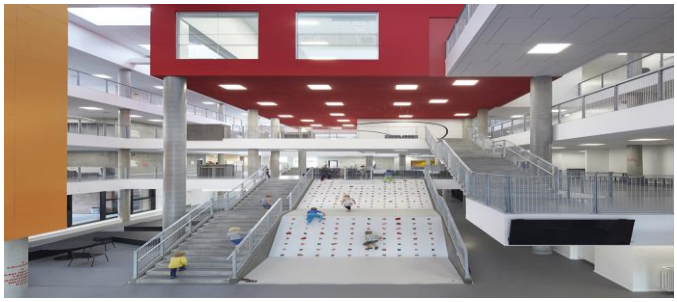
There are still some sites that are only used for specific sports, such as hockey, but depending on the level of use we as a community we are seeing examples where hockey and tennis are working together at a recreational level in schools and with community clubs.

6.7 School Activity Zones

Schools are cognisant of the increase in sedentary lifestyles and over the past decade we have seen asphalt being replaced with colourful play and games areas. This encourages children outdoors and to be active.

Some schools are now exploring how they can build in 'Activity Zones' throughout the school precinct, these would include the following examples (see photos below):

Utilising space, which in many schools that are becoming vertical in inner cities, so playgrounds are at a premium.



Indoor spaces used for climbing and preferably with rubber underneath in case the child slips etc.

7. Site Management Considerations

7.1 Understanding your Management Objectives will Impact Design

The management of the sports facility will impact the design of the site and the type of surface requested. These management considerations may include:

- **Use of facility** – if the facility will be used as a significant income generator, the ability to divide the field of play into defined areas (e.g. half, quarter fields, or futsal areas etc.). These may need to have specific nets or fences designed to allow flexibility. For instance, a typical football (soccer field) could in summer be divided into eight 5-a-side areas, which over the summer (12 weeks) could realistically raise $60,000 net for an organisation.
- **Management of facility** – the organisation needs to ensure that they have adequate resources to be able to manage this sophisticated sports system. The specific skills and knowledge is needed around maintenance programming to optimise revenues to invest in the operational cost and the sinking fund to replace the field.

7.2 Ongoing Compliance Obligations

Some sports have important compliance standards that need to be addressed, including:

- **Insurance** – the field of play needs to be certified and recertified to meet insurance obligations (e.g. AFL, Rugby Union)
- **Performance standards** – the surface must be certified for a certain level of competition (e.g. Athletics, Hockey etc.)

7.3 Conclusion

7.3.1 Sustainable Growth

Recreational growth is expected to be significantly higher and the facilities need to be designed to accommodate these growth trends. The considerations should include:

- Multi-sport Active Zones – aimed at the recreational participation around the key football codes; basketball, netball and football. Positioning these in the main growth areas will assist in the continued growing populations.
- Traditional sports fields (e.g. Soccer, and AFL) should also be designed with the modified games lines integrated, which may include 5-a-side/futsal (Soccer); and AFL 9's (AFL)

Many organisations have commitment to sustainability which should then be reflected in the approach they take to embracing synthetic sports fields exploring the following considerations:

7.3.2 Planning

- Placement of fields should be more positively embraced when they reduce need for vehicle transport to access them
- Positioning of fields close to public transport should be encouraged
- Siting of new fields and surfaces should be linked to new developments to ensure that Active Communities are encouraged
- Any reduction in natural turf should be replaced by the planting of trees and shrubs

7.3.3 Design and Construction Considerations

- Ensure design uses Green Engineering Principles
- Reduce carbon intensity during the manufacturer, construction and ongoing maintenance of the surfaces

- Embrace recycled system components where possible
- Favour procurement choices with lower carbon intensity
- Procure components that have a longer life expectancy and can be reused numerous times (e.g. shockpads)
- Ensure that all end of life components can be either reused or recycled
- Design to 'contain' microplastics, thus reducing impact on the environment

7.3.4 WaterSmart and Environmental Prudency

- Explore water harvesting on all installations to use on natural surfaces in close proximity
- Fields and surfaces need to reduce the need for watering of the surfaces and Hockey fields should be designed for a National Standard Hybrid surface so that the dependency on water should be paramount. (This approach is encouraged by the International Federation for Hockey – FIH)
- Ensure that all components of the system are environmentally friendly and safe
- Explore integration of the synthetic field into the local landscape
- Any impacts on local biodiversity should be considered and alterations used to add value elsewhere on the site
- Explore planting of trees to provide natural shelter, enhancing Councils commitment to urban forests and can offset the carbon sequation loss
- If recycled car tyres are used, ensure they meet the European REACH standards for PAH's

7.3.5 Accessibility

- The management of the facilities should encourage openness and use the local community
- Growing network of Active Games Zones are placed in communities and are designed to be accessible by all
- Ensure Universal Design principles are embraced in each design and installation
- Program the facilities/fields of play to maximise community usage by being as multi-sport as possible

8. Key Australian Contacts

8.1 Independent Advisory Services

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w: www.smartconnection.net.au

Consultant to all Football Codes in Australia

8.2 Key Sports

Football

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National Rugby League Limited (NRL)

Martin Meredith

Participation Manager

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Rugby Union

Rugby Australia (RA)

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Australian Football League Victoria (AFL)

Shayne Ward, Executive Officer, AFL/Cricket Australia

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Australian Oztag

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8.3 Suppliers and Agents

ABS Sport Surfaces

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Mitcham VIC 3132

p: (03) 9873 0101

e: daarons@berrysportsurfaces.com.au

w: www.abs-sportsurfaces.com.au

FieldTurf Australia

Unit 8A Port Air Industrial Estate

1A Hale Street, BOTANY NSW 2019

p: +61 2 9316 7244

e: info@fieldturfaust.com.au

w: www.fieldturf.com

Grassports Australia

1/38 Green St

Doveton VIC 3177

p: (03) 9792 0622

e: info@grassports.com.au

w: www.grassports.com.au

Grassports Australia & ABS Sports Surfaces are an agent for Polytan, who are:

- FIFA Licensee
- World Rugby Preferred Provider
- AFL Approved Manufacturer

Greenplay Australia

3/550 Churchill Rd

Kilburn SA 5084

p: 1300 769 499

e: as@greenplay.com.au

w: www.greenplay.com.au

Greenplay Australia is an agent for the Limonta products. Limonta are:

- FIFA Licensee
- World Rugby Preferred Provider

HG Sports Turf Australia

Suite 2, Level 1

526 Whitehorse Road

Mitcham VIC 3031

p: (03) 9329 8154

e: info@hgsportsturf.com.au

w: hgsportsturf.com.au

HG Sports Turf is an agent for Desso, who are recognised as:

- FIFA Preferred Provider
- World Rugby Preferred Provider

They also provide a range of Hybrid solutions for local government, sport and stadia

Polytan

Factory 3, Dunlopillo Dr

Dandenong South VIC 3175

p: (03) 8792 8000

e: enquiry@polytan.com.au

w: www.polytan.com.au

- FIFA Licensee
- World Rugby Preferred Provider
- AFL Approved Manufacturer

TigerTurf Australia

14 Latitude Boulevard

Thomastown VIC 3074

p: 1800 802 570

e: auinfo@tigerturf.com

w: www.tigerturf.com

TigerTurf is a FIFA Licensee

Tuff Turf

58-60 Sunmore Close

Heatherton VIC 3202

p: 1800 887 326

e: enquiries@tuffturf.com.au

w: www.tuffturf.com.au

Tuff Turf is an agent for the Co-Creation grass (CCG)

products. CCG is:

- FIFA Licensee
- World Rugby Preferred Provider

Turf One

330 Towts Rd

Whittlesea VIC 3658

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w: www.turfone.com.au

- FIFA Preferred Producer
- World Rugby Preferred Provider
- AFL Approved Manufacturer

Turf One is an agent for the FieldTurf products. FieldTurf

is a:

- FIFA Preferred Producer
- World Rugby Preferred Provider

8.4 Independent Testing Institutes

Acousto-Scan

44/59-69 Halstead Street

South Hurstville NSW 2221

p: (02) 8385 4872

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w: www.acoustoscan.com.au

Labosport Australasia

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Ormiston QLD 4160

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e: keith.mcauliffe@labosport.com

w: www.labosport.com

About Smart Connection Consultancy

Smart Connection Consultancy offers an innovative approach that delivers outcomes to enhance the experience of participation in physical activity, recreation and sport in local communities.

We specialise in the planning, development, management and procurement of synthetic sports surface technology. We see this technology as complementing natural grass and encouraging more people to be active, play and achieve success in sport because of its extended durability.

By embracing the skills sets and knowledge of our collaborative consultants, we can provide an integrated and holistic approach to our client's projects.

SCC is the Technical Consultants for FFA, the NRL, and the Australian Rugby Union for Synthetic Surfaces.

- **Field of Expertise**

In collaboration with industry experts, we provide our clients with high level quality service that is offered for a very affordable investment.

- **Commitment to Knowledge Building**

We are committed to providing leading edge advice and knowledge so that the industry and our clients can appreciate how synthetic sports turf can complement their natural turf options.

Our Services Include:

- **Feasibility and Funding Advice and Solutions**

Completing a Business Case to justify the need of a synthetic surface can be streamlined by using our *Smart Whole of Life Costing Model.* We support clients in developing financial strategies, funding applications and where applicable offer funding packages with major financial institutes.

- **Masterplanning and Design Solutions**

We will work with you in exploring the site parameters and constraints together with the opportunities to ascertain the best design and management options for your park or venue.

- **Procurement and Project Management Support**

Over 30 years' experience in procurement and in collaboration with SportEng, we provide civil engineering hold points to ensure that every step of the installation meets the appropriate civil and performance standards.

- **Our Clients**

We have successfully completed a significant number of sports performance standards reviews, sports strategies, master plans, feasibility studies, business cases and procurement projects. Our client base includes:

- International Federations (FIH, FIFA, World Rugby)
- National and State Sports Organisations (FFA, NRL, ARU, AFL (NSW/ACT), Golf Australia, ASC, Hockey ACT etc.)
- Local Governments – More than 100 local

"Over the last four years the relationship the City has built with Smart Connection Consultancy has become integral to the development of our public open space planning, most notably the Ellenbrook District Open Space, which includes four synthetic playing fields.

Smart Connection Consultancy has contributed in many ways including various studies, reports and research tours that we continue to use today. The work has been outstanding: on time, on budget and most importantly of a very high quality.

Martin has been very accommodating in its approach to our requirements and continues to go out of their way to help us where necessary – always going that extra mile."

Wayne Stuart, Facilities Planning Coordinator, Asset Management – City of Swan

SYNTHETIC SPORTS FIELD HEALTH CHECK

Review your field, understand risks and extend life expectancy

Australia's leading synthetic sports surface consultancy is now offering the **Smart Sports Field Health Check**, for clients who wish to find out what condition their synthetic fields are in and what is the probable life expectancy.

Smart Connection Consultancy has been involved in over 70% of all the synthetic sports fields developed and installed in Australia in the past five years. We work closely with our clients to maximise their usage and life expectancy of their fields.

The **Smart Sports Field Health Check** consists of:

- ✓ Conducting a site analysis and field review to ascertain its current status;
- ✓ Assessing current maintenance practices to explore if this can extend the life of the field;
- ✓ Reporting on findings with improvement strategies;
- ✓ Risk assessment with mitigation strategies; and
- ✓ Predicting life expectancy.

Assessment Report provided within 48 hours of field assessment.

"The Smart Sports Field Health Check allowed us to appreciate the challenges we had, reduce our risks by adopting the risk mitigation strategies identified and we believe that we have extended the expected life by two years by adopting the recommendations for remediation and maintenance." (Mick Roberts, Sports Grounds Manager, ACT Government)

Call 03 9421 0133 and talk to Martin Sheppard or email martins@smartconnection.net.au to find out how the **Smart Sports Field Health Check** can extend the life of your synthetic sports field.

SPORT INSPIRES A NATION

Synthetic & Hybrid Sport Surfaces Create Opportunities for The Next Generation

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