

Merri-bek Sportsgrounds Surface Study

Final Report



Ethos Urban acknowledges the Traditional Custodians of Country throughout Australia and recognises their continuing connection to land, waters and culture.

We acknowledge the Wurundjeri Woi Wurrung people, of the Kulin Nation, the Traditional Custodians of the land where this document was prepared, and all peoples and nations from lands affected.

We pay our respects to their Elders past, present and emerging.



'Dagura Buumarri'

Liz Belanjee Cameron

'Dagura Buumarri' – translates to Cold Brown Country. Representing Victoria.

The river system illustrated in this visual image is bound in greens and golds to acknowledge the warmth often felt in a colder climate. The rich earth hues of green, reds and browns reflect the local landscapes of this state while the extensive use of rhythmical patterning captures the unique landscapes of flat and mountainous areas. The use of earth colours imparts a sense of strength and serenity while contrasting greens throughout the image reminds us of the lushness of the natural world, where animals and humans once lived in harmony – it reminds us of the importance to protect the lands, waterways and skies and care for our localised environment. Scattered throughout the image are bold colours of oranges – a source of energy that continues to be felt as a life-giving source. The orange hues also portray the varying sunsets in which many Victorians enjoy seeing.

Executive Summary

Purpose of this report

The aim of this study is to establish a research framework that examines the social, economic, and environmental effects of sportsground surface options in the context of Merri-bek. By analysing the most up-to-date evidence relating to Merri-bek's climate, community, and financial circumstances, this study provides Merri-bek City Council (Council) with valuable insight into the consequences, advantages, and limitations of using natural turf, synthetic turf, and alternative technological solutions and management techniques. Ultimately this research will help inform future decision-making related to sportsground surfaces in Merri-bek.

Council engaged Ethos Urban and Otium Sport and Leisure to prepare this sportsground surface study as a starting point to forming a policy position and decision-making framework.

Methodology

The methodology for this Study was largely desktop-based, relying on a variety of quantitative and qualitative sources to draw conclusions on existing evidence base and the gaps therein. Throughout this study, a distinction has been made between considerations that are well established in academia and the industry, and those which are contested and unsettled.

The following sources constituted the bulk of the analysis:

- Literature review: identifying key existing academic and industry research from an Australian and international context.
- Stakeholder analysis and qualitative dimensions: including an understanding of community sentiment
- Ethos Urban site visit and field observations to understand everyday context of Merri-bek sportsgrounds.
- Stakeholder interviews with key people representing the diverse perspectives and interests across the Merri-bek community.

Recognising the need to identify where the industry has consensus on the evidence and where it is contested, this Study takes a two-stage approach to comparatively assessing the turf options:

- Identifying the established benefits and limitations for each turf typology, natural turf, synthetic turf, and alternative turf technology (**Sections 3.2, 4.2, and 4.3**).
- Outlining the complex topics for which the evidence is not established, across all turf surfaces (**Section 2.5**) and specific for each turf typology (**Sections 3.3, 4.3, and 5.3**).

This Report also outlines:

- The context informing sportsground surface decision-making in Merri-bek (**Section 2.0**)
- Emerging best practice management approaches and an evaluation of options against state sporting association standards (**Section 6.0**)
- Conclusion and key findings (**Section 7.0**)

The following disclaimers to this Report are noted:

- This Report does not go into detail on resolving competing uses between sports and active/passive recreation, beyond noting where the selection of different sportsground surfaces will have impacts on different patterns of use (e.g., formal versus informal use). The Open Space Strategy, currently in development, will go into more detail on this topic.
- The primary focus of this Report is on sportsground surfaces on Council-owned land. This generally gives greater weight to field sport usage, however other uses such as tennis courts, lawn bowls, and the use of synthetics on cricket wickets have been considered. Further detail relating to responding to the use of different sportsground surfaces on privately owned land and non-sportsgrounds will form part of the policy and decision-making framework this Report accompanies.

Key Findings

This table summarises the findings overall findings this report:

Subject	Findings
Merri-bek context	Quality public open spaces make for liveable, sustainable, and healthy neighbourhoods. In the context of growing sporting demand in Merri-bek associated with population growth, increasing urban density, and an increasing diversity of sport participants (including demand for informal use/community recreation) decision-making surrounding the type of surface needed to accommodate growing demand is critical (see Section 2.1 – 2.2). Demand modelling for inner Melbourne has pointed to a clear deficit of fields across all sports that will grow significantly over the next 20 years. This demand, driven by population growth and a deficit in the delivery of new sporting grounds to match, remains challenging to meet because of the spatial constraints in inner Melbourne and the predominance of other growth needs. This comes in the context of divided community sentiment regarding synthetic turf surfaces (see Section 2.3) and complexities in relation to Merri-bek's climatic, geotechnical, and environmental conditions (see Section 2.4). The key issues for Merri-bek arising from this context include (see Section 2.5): • The need to balance the social benefit of increasing community participation in sport and recreation with competing priorities such as the growing impact of climate change on our community, adverse impacts of some sportsground surfaces on water quality and urban heat, and council's commitment of Zero Waste to Landfill by 2030 as well as some community opposition and concern in relation to the social, environmental, and economic impacts of synthetic turf. • Merri-bek has high biodiversity values along Merri Creek, is subject to increased flooding events exacerbated by climate change and is subject to moderate-high levels of urban heat.¹ In this context, the decision around type and location of sportsground surface takes on an increased importance. • Concern over the loss of access to open space and the need to accommodate for diverse users, both formal and informal, is a consideration for both the decision between different turf playing surfaces and the design of fields in a way that allows for multipurpose use. • Modelling capacity can differ substantially from actual demand. When considering which sporting field surface to use, an accurate understanding of actual demand is needed. • Synthetic turf is only more economically efficient from a cost per hour basis over the 15-year lifecycle of a sportsground, when actual demand and usage is optimised, providing for about 54-60 hours per week. • The research on player injury is not settled, although points to differences between playing surface products which must be considered in decision-making.
Literature review	• Most existing analysis on the subject tends to evaluate different surface materials from the perspective of sports users, rather than from the perspective of informal community users. • There are few Australian-specific studies on key issues, including heat, UV, injury, chemical leeching, and comprehensive economic and carbon life cycle analyses.² • There are some Victoria-specific discussion papers and guidelines for decision makers.³ • While environmental and economic analyses of synthetic turf are widely available overseas, research on its social impact remains limited. However, what studies have

¹ See, eg Merri-bek Municipal Emergency Management Plan.

²Football NSW n.d., *Increasing capacity with synthetics: The impact of investing in synthetic pitches on the operation of a club*, GHD for Horticulture Innovation Australia Limited 2020, *Living turf fire benefits study – Literature review*, April 2020 <https://www.horticulture.com.au/globalassets/hort-innovation/resource-assets/tu17008-literature-review-living-turf-fire-benefits-study.pdf>; Lamble, P & Battam, M n.d., "Creating sustainable open spaces – using compost to deliver liveability, sustainability and economic outcomes," and technical paper prepared for OzWater; Smart Connection Consultancy 2017, *The Smart Guide to Synthetic sport Fields Rubber Infill*; Smart Connection Consultancy 2019, *The Smart Guide to Synthetic Sports Surfaces: Volume 3: Environmental and sustainability considerations*, accessed 17 May 2021 <https://www.smartconnection.net.au/wp-content/uploads/2019/11/Vol-3-Environmental-and-Sustainability-Considerations-v1.01.pdf>; WA Department of Local Government, Sport and Cultural Industries nd., *Natural Grass vs Synthetic Turf Study Report*, <https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>.

³ See, Sport and Recreation Victoria 2011, *Artificial Grass for Sports*, Department of Planning and Community Development https://sport.vic.gov.au/_data/assets/pdf_file/0025/55591/download.pdf

Subject	Findings
	shown is that a synthetic turf field can accommodate almost twice as many users as a fully irrigated natural turf field. Long-term studies into the effects of playing on synthetic sportsground surfaces are currently limited, however there are several studies underway in Europe and the United States which reflect growing community concern with the long term health impacts of synthetic turf surfaces.
Natural Turf	Natural turf is multifaceted, providing more than just a playing surface for formal sports teams. However, the benefits of natural fields must be weighed against their established limited capacity compared to synthetic fields, even with the implementation of best practice construction and management. - Natural turf requires specific soil management to create and maintain a quality playing surface - Commonly cited capacity figures suggest natural turf supports around 20-30 hours per week - Vulnerable to drought condition and water restriction - natural turf requires irrigation to maintain a quality playing surface - Natural turf typically offers enhanced social benefit and amenity associated with access to nature, although must be balanced with the social benefit of access to and capacity to accommodate formal sport and recreation - Natural turf mitigates the urban heat island effect - Sportsfields with natural turf are permeable surfaces, allowing water to be absorbed during rain events - Can contribute to positive biodiversity outcomes - Generally supports informal use by the community. - Natural turf has lower up-front costs when compared to synthetic options, yet can often have higher maintenance costs. - Natural turf is highly vulnerable to climate impacts, although may act as a carbon sink (depending on the end of life of grass clippings).⁴
Synthetic Turf	Synthetic turf options have evolved considerably over the past few decades, becoming more amenable to formal sports userbases. Far from being a one-dimensional material, the diverse range of application and evolving sustainability management strategies demonstrates a need for a considered approach to synthetic options in strategic locations. - Synthetic turf is an evolving product that is responsive to the changing needs of a diverse range of sports - Can support 40-70 hours of use a week, depending on a range of factors - Higher upfront cost than natural turf, but with lower maintenance costs over lifecycle - Sporting code preference amongst some winter sports such as Hockey, and acceptance amongst other major codes such as AFL, Cricket and Football - Negative impact on heat island effect: Surface absorbs and radiates heat making use during hot days potentially unsafe - Negative impacts on biodiversity and environmental and human health associated with stormwater runoff and microplastics. - Loss of amenity for local community and informal sports due to synthetic sportsgrounds typically being publicly inaccessible (depending on its design) - Higher CO2 lifecycle emissions and environmental waste - The cost effectiveness of synthetic turf vis a vis natural turf depends on its actual level of use
Alternative Turf Surfaces	It is ultimately concluded that in Merri-bek's context, hybrid turf is not seen as an immediately viable option for Council due to local growing conditions and financial constraints. However, profile reinforcement and the combination of natural and synthetic turf in high-use areas is generally supported as a viable option.

⁴ See Eric Sanjaya, Gustavo Weihs, and Ali Abbas, 'Environmental Impact of Synthetic Turf: A Life Cycle Analysis (LCA) Review and Circular Economy Perspective, in Chief Scientist and Engineer NSW, *Independent review into the design, use and impacts of synthetic turf in public open spaces* (October 2022), 5.

Subject	Findings
	• There are three main types of alternative turf technology and management approaches. These are a hybrid turf profile, natural turf profile reinforcement, and the use of synthetic turf in high wear areas of a natural turf field. • Hybrid turf is commonly touted as an alternative to natural and synthetic turf, as it is seen as being more durable and providing higher usage hours than natural turf without the associated high surface temperatures and environmental impacts of synthetic products • Higher ongoing maintenance cost and capital cost, associated with the complexity of the product and the need for ongoing irrigation • Local growing conditions in Merri-bek substantially limit the potential for hybrid turf to form a suitable alternative, due to its expense and lack of suitability with warm season grasses.
Alignment with best practice	Ultimately, this research found several management methods employed by Councils in Australia to better drive utilisation and cost efficiency, including improved data collection and analysis, methods to manage usage, and strategic siting considerations. Key findings for Merri-bek include: • There are a number of code-specific guidelines and standards which apply to both natural and synthetic turf • Improved data collection and analysis, and the strategic management of use, can improve decision-making and ensure that existing fields are fully utilised • Siting will be critically important for Merri-bek. Positioning any new synthetic turf field, if pursued, away from waterways and sensitive natural areas and prioritising brownfield sites within the centre urban area of the LGA will assist in limiting the potential environmental impacts of synthetic products. • There are a range of natural turf management practices which can improve the performance of natural turf fields. Trialling solutions, and closely monitoring the results, will assist Merri-bek in making informed steps towards improving its natural turf fields. • There are some potential mitigations for synthetic turf fields to improve its environmental and human health accreditations. Merri-bek Council should monitor the development of alternative synthetic turf construction methods and materials. • There are a range of options available to Merri-bek to counteract reactive soils and undulating typologies. The path chosen will depend on the individual requirements of single sites.
Key issues for Merri-bek	Ultimately, this Study has concluded that although research and evidence is limited in some areas, there are clear social, environmental, and economic implications associated with the decision to upgrade a natural turf field to a synthetic playing surface. The unsuitability of hybrid turf as a viable option at present for Council means that a decision needs to be made that weighs the disbenefits of synthetic turf across numerous factors with the significant social value of participation in sport and recreation. There are a number of innovative management and design approaches that can go some way to responding to growing sportsground demand in Merri-bek – however difficult and complex decisions are likely to be required which prioritise synthetic turf in strategically justified locations. The Study has identified clearly both the established evidence on the benefits and limitations of different turf options, as well as areas where research is unsettled and/or entails complexity or nuance in decision-making. Contested areas needing further exploration in partnership with other Councils and state government include: • Monitoring the further development of hybrid turf options that are financially feasible for local councils to install and maintain • Growing evidence of natural turf capacity and best practice grass types and management practices • Responding to concern over the loss of access to open space for informal use • Understanding modelling capacity versus actual demand, and the true operational cost of best practice synthetic turf maintenance (including irrigation to reduce heat) • Weighing social and environmental impact into financial calculations

Subject	Findings
	• Responding to any emerging evidence regarding player injury, and methods to mitigate against pollution and stormwater impacts • Fully appraising and exploring alternative technology, including improved data collection, methods to manage usage through strategic lighting, location shifting and smart scheduling, and strategic approaches to siting and the utilisation of currently private open space for public use. • Recycling/re-use options for synthetic turf products at the end of its lifecycle.
Next Steps	The following steps will be undertaken to form Council's policy position: • Consultation with the community and key stakeholders, and Merri-bek Councillors. • Deliver the Merri-bek Sportsground Turf Policy. This Policy will outline the vision and objectives for sportsground surface management and the principles guiding Council decision-making in alignment with key existing policies and procedures. • Deliver the decision-making framework: clearly outlining the implications of choices for policy decisions based on the evidence in this Study, including a quantitative multi-criteria tool and scenario testing tailored to the Merri-bek context. • Presentation to Merri-bek Councillors.

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Key terms

Demand / User Demand

This is the assessment of the actual hours of use likely to form the demand for a field or sporting space. The actual hours of demand may vary considerably from the modelled capacity and should be considered when comparing the cost benefits of different options.

Engineered Natural Turf

Refers to natural turf fields which have been designed as a high quality and high resilience surface. This includes a complex mix of profiling, growing media, sand, soil, aggregate, sub soil drainage and turf species selection along with sophisticated management regimes.

Field Capacity / Modelled Capacity

Is the theoretical higher limit of use hours a field can tolerate or is likely to sustain. In the case of synthetic surfaces modelled capacity of 60 -70 hours per week is often compared with natural turf fields which can sustain 25-30 hours per week before significant surface degradation.

Hybrid Surface

Is a combination of synthetic fibres and natural grass. This has a higher resilience than natural turf, but does not have the capacity of a synthetic surface and is likely to be more expensive to maintain.

Infill

Is the fine granular material that sits on top of the synthetic carpet but at the base of the fibres. It is a critical part of the functioning of the surface and requires regular maintenance. Infill can be comprised of a range of natural and artificial materials.

Natural Turf and Grass

Refers to those sporting fields and courts that are constructed of natural materials and have a covering of selected grass species.

Grass refers to the plant species, while turf means the whole surface including grass, root mat and soil/sand.

Sporting Spaces, Sportsgrounds, Field of Play

Refers to those areas designed for specific formal sport training and competition and includes line marking, goals and sideline areas needed for the conduct of outdoor sport.

Synthetic Surface / Synthetic Turf

Is the combination of artificial fibres stitched into a carpet that is laid on an engineered constructed base including a “hard” base layer and shock pad. Synthetic fields usually have infill materials which help keep the fibres upright and functioning properly.

Urban Heat / Urban Heat Island

Refers to the increased temperatures retained within the built environment due to higher levels of heat absorption by materials such as asphalt, concrete, brick, etc. The urban heat island refers to the increased temperatures experienced within cities compared to surrounding rural areas due to urban heat.

1.0 Introduction

1.1 Purpose of this Study

The aim of this study is to establish a research framework that examines the social, economic, and environmental effects of sportsground surface options in the context of Merri-bek. By analysing the most up-to-date evidence relating to Merri-bek's climate, community, and financial circumstances, this study provides Merri-bek City Council ('Council') with valuable insight into the consequences, advantages, and limitations of using natural turf, synthetic turf, and alternative technological solutions and management techniques. Ultimately this research will help inform future decision-making related to sportsground surfaces in Merri-bek.

This research base will be accompanied by a policy and decision-making framework, assisting Merri-bek City Council in forming a balanced position on its sportsfield surfaces to ensure they meet the diverse needs of a growing and active community whilst upholding strong social, environmental, and economic credentials.

1.2 Project background

Across Australia, synthetic turf is often selected due to its perceived ability to support higher levels of use than most natural turf surfaces. This is particularly the case for sporting fields. Due to its drought resistance and ability to sustain heavy use during varying weather conditions, it is considered by some stakeholders as a more efficient and effective option. These advantages have been considered to offset higher upfront capital costs and has resulted in an increase in the use of synthetic turf.

However, there are growing concerns about the potential social, environmental, and economic impacts of using synthetic surfaces for recreation and sport uses. These include:

- The perception and tendency for synthetic fields to be exclusively available for organised sports, which often results in decreased access for informal community uses, such as dog walking, socialising, self-organised ball games and community events⁵
- The rubber and microplastic particles in synthetic turfs have been linked to increased air and water pollution⁶
- Adverse effects on thermal comfort as synthetic materials contribute to high ambient surface temperatures during hot weather, impacting user comfort, limiting use for recreational purposes, and contributing towards urban heat island⁷
- Whole of lifecycle costs, including maintenance and end of life disposal⁸
- Amenity impacts of extended use to adjacent residents including increased traffic, lighting and noise⁹
- Reducing the flexibility of the open space to accommodate different sports and local community recreation needs¹⁰
- Potential health impacts on users from infill materials, and synthetic compound¹¹
- Potential injury impacts on users, including abrasions and friction burns¹²
- The replacement of natural surfaces with synthetic materials, which can reduce the amenity of the area and make it less appealing to those who would like to use the open space for a range of recreational uses.¹³

⁵ Eddie R 2020, Coburg North residents blindsided by plans to cover oval in artificial turf, *The Age*, <<https://www.theage.com.au/national/victoria/coburg-north-residents-blindsided-by-plans-to-cover-oval-in-artificial-turf-20201005-p5621q.html>> As will be explored further below, the social dimensions of synthetic turf are under researched compared to the environmental and economic aspects.

⁶ Marsili L et al. 2014. "Release of polycyclic aromatic hydrocarbons and heavy metals from rubber crumb in synthetic turf fields: preliminary hazard assessment for athletes." *Journal of Environmental & Analytical Toxicology* 5:2, 265; *Artificial Grass for Sport*, Victoria Department of Planning and Community Development.

⁷ WA Department of Local Government, Sport and Cultural Industries, Natural Grass vs Synthetic Turf Study Report, <<https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>>

⁸ Ibid.

⁹ Local government stakeholders raised this issue during workshops undertaken to develop this Discussion Paper.

¹⁰ WA Department of Local Government, Sport and Cultural Industries n. d., Natural Grass vs Synthetic Turf Study Report, <<https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>>

¹¹ Synthetic Turf Council 2016, Executive Summary Catalogue of Available Recycled Rubber Research (march 3, 2016) http://cymcdn.com/sites/www.syntheticurfCouncil.org/resource/resmgr/docs/st_c_cri_execsummary2016-0303.pdf

¹² WA Department of Local Government, Sport and Cultural Industries, Natural Grass vs Synthetic Turf Study Report, <<https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>>

¹³ Ibid.

On the 10th of August 2022, Council passed a resolution that requested a report and development of a policy on managing Council's sportsgrounds giving consideration to:

- Council's policy positions articulated in the Climate Risk Strategy, Zero Carbon Merri-bek Climate Emergency Action Plan, Integrated Water Management Strategy 2040, Urban Heat Island Effect Action Plan and our goal of zero waste by 2030 as outlined in our Waste and Litter Strategy.
- The triple bottom line principles of environmental, social and financial sustainability including new and emerging natural turf and soil management, soil organic carbon sequestration or carbon sink potential options, water run-off, microplastics, recyclability and best practice turf management.
- The impact of other synthetic surfaces being used by other land users within the municipality (e.g., schools) on community wellbeing.

It is within this context that Merri-bek City Council have chosen to investigate sportsground surfaces and form a clear policy position for the municipality. Council has engaged Ethos Urban and Otium Sport and Leisure to prepare this sportsground surface study as a starting point to forming a policy position.

1.3 Methodology

The following sections outline the key methods used to inform this study.

1.3.1 Literature Review

A literature review was undertaken to identify key existing academic and industry research from an Australian and international context. This literature review was guided by two primary inquiries:

- What are the established social, economic, and environmental impacts associated with the process of replacing natural turf with synthetic surfaces?
- What is the current best practice of synthetic, natural, and hybrid turf installation and use in Victoria, and why?
- What are the established capacity limits for different sportsground surfaces, and how do these apply in a Merri-bek context?

The review used a two-step process:

1. Ethos Urban conducted key word searches to identify potentially relevant material published in English. The search included any study that referred to the social, environmental, and economic impacts of synthetic turf, with priority given to Australian studies. Ethos Urban also obtained additional relevant studies from the reference lists of identified articles, industry documentation, as well as from the research undertaken by interested Merri-bek residents.

Key search terms were:

- | | | |
|-----------------|--------------------|--------------|
| - Synthetic | - Satisfaction | - Generation |
| - Turf | - Heat | - Multi-use |
| - Sport | - Infill | - Australia |
| - Open space | - Replacement | - Victoria |
| - Recreation | - Redevelopment | - Moreland |
| - Artificial | - Disposal | - Merri-bek |
| - Environment / | - Cost | - Social |
| Environmental | - Fees and charges | - Community. |
| - Life Cycle | - Weather | |
| - Injuries | - Climatic | |

2. Ethos Urban screened all identified references to compile key findings and perspectives, and to identify potential gaps in research and areas for deeper inquiry.

This literature review identified that:

- Most existing analysis on the subject tends to evaluate different surface materials from the perspective of sports users, rather than from the perspective of informal community users.

- There are few Australian-specific studies on key issues, including heat, UV, injury, chemical leeching, and comprehensive economic and carbon life cycle analyses.¹⁴
- There are some Victoria-specific discussion papers and guidelines for decision makers. The latest guidance is provided by *Active Victoria – A strategic framework* for sport and active recreation in Victoria and an “Artificial Grass for Sport Planning Guidelines” prepared in 2011 by Sport and Recreation Victoria for decision makers considering the implementation of synthetic turf.¹⁵
- While environmental and economic analyses of synthetic turf are widely available overseas, research on its social impact remains limited. However, those studies available have shown that a synthetic turf field can accommodate almost twice as many users as a fully irrigated natural turf field. This increased capacity allows for more people to participate in sports, resulting in improved health outcomes for participants (noting that in general, sport participants meet the Australian Physical Activity and Exercise Guidelines). As this report and associated policy continue to be developed, it is important to incorporate stakeholder and community feedback to conduct a more comprehensive and locally-focused assessment of social impacts -including the balance of competing social outcomes.

The key findings from this literature review have been incorporated throughout this study.

1.3.2 Stakeholder analysis and qualitative dimensions

Desktop research was conducted to gauge community perspectives on sports turf change. Examination of community sentiment relied on online sources, where contributors ‘self-select’ to participate in these discussions (and are not necessarily representative of community opinion). Therefore, this feedback is not regarded as a definitive representation of views within Merri-bek. As a qualitative research methodology, desktop research into stakeholder perspectives is useful for identifying potential community concern and hot-button issues through examining online activity (posting comments, starting petitions, writing and sharing opinions pieces). Research included:

- Online community forums and websites
- Community Facebook groups
- Local media coverage.
- Further consultation will be conducted as part of forming the Merri-bek policy position, and will ensure a broad, representative sample of community voices can have their say.

1.3.3 Ethos Urban Merri-bek site visit

At the commencement of the project, Ethos Urban conducted a site visit to a number of sportsgrounds with council officers. Conducting field observations across Merri-bek provided a tangible snapshot of the local social and environmental context. The site visit also underlined specific issues relating to turf quality, maintenance and informal use patterns which are largely unrecorded and ongoing. This provided a qualitative insight into the everyday context of Merri-bek sportsgrounds and their users. The following sites were visited on April 6, 2023:

- Coburg City Oval
- De Chene reserve
- McDonald Reserve
- Parker reserve.

¹⁴ See, however: Football NSW n.d., *Increasing capacity with synthetics: The impact of investing in synthetic pitches on the operation of a club*, GHD for Horticulture Innovation Australia Limited 2020, *Living turf fire benefits study – Literature review*, April 2020 <<https://www.horticulture.com.au/globalassets/hort-innovation/resource-assets/tu17008-literature-review-living-turf-fire-benefits-study.pdf>>; Lamble, P & Battam, M n.d., “Creating sustainable open spaces – using compost to deliver liveability, sustainability and economic outcomes,” and technical paper prepared for OzWater; Smart Connection Consultancy 2017, *The Smart Guide to Synthetic sports Fields Rubber Infill*; Smart Connection Consultancy 2019, *The Smart Guide to Synthetic Sports Surfaces: Volume 3: Environmental and sustainability considerations*, accessed 17 May 2021 <<https://www.smartconnection.net.au/wp-content/uploads/2019/11/Vol-3-Environmental-and-Sustainability-Considerations-v1.01.pdf>>; WA Department of Local Government, Sport and Cultural Industries nd., *Natural Grass vs Synthetic Turf Study Report*, <<https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>>.

¹⁵ See, Sport and Recreation Victoria 2011, *Artificial Grass for Sports*, Department of Planning and Community Development <https://sport.vic.gov.au/_data/assets/pdf_file/0025/55591/download.pdf>

1.4 Content of this Study

Recognising the need to identify where the industry has consensus on the evidence and where it is contested, this Study takes a two-stage approach to comparatively assessing the turf options:

- Identifying the established benefits and limitations for each turf typology, natural turf, synthetic turf, and alternative turf technology (**Sections 3.2, 4.2, and 4.3**).
- Outlining the complex topics for which the evidence is not established, across all turf surfaces (**Section 2.5**) and specific for each turf typology (**Sections 3.3, 4.3, and 5.3**).

This Report also outlines:

- The context informing sportsfield surface decision-making in Merri-bek (**Section 2.0**)
- Emerging best practice management approaches and an evaluation of options against state sporting association standards (**Section 6.0**)
- Conclusion and key findings (**Section 7.0**).

2.0 Context

This section outlines the context relevant to the provision and demand for sportsgrounds in Merri-bek.

2.1 Value of public open spaces

Quality public open spaces make for liveable, sustainable, and healthy neighbourhoods. Public open spaces include parks, gardens, play spaces, public beaches, riverbanks, waterfronts, publicly accessible bushland and outdoor playing fields and courts. They provide us with places to exercise, play, rest, participate in social activities, and contribute to healthy, happy, and resilient communities. The social, environmental, and economic benefits of access to green open space are well established, and include:

- **Encouraging physical activity:** Public open space help people to maintain healthy lifestyles by providing spaces that encourage physical activity, children's play, participation in sport and active transport. Public open space users are more likely to meet recommended levels of physical activity, and park amenities and improvements can increase park use and rates of physical activity.¹⁶ Inactivity is less common among residents of greener neighbourhoods.¹⁷
- **Social connection:** Public open spaces are the living rooms of cities, places where people of all ages, cultures, abilities, and socio-economic backgrounds come together. Sharing these spaces, including through participation in sport and enjoying public open space, promotes social interaction, connection, and cohesion. Socially cohesive communities are more likely to provide support and practical help to each other and provide a sense of belonging to their members.
- **Enabling participation in sport:** Public open spaces also play an important role in supporting participation in sport. In Victoria, many people participate in sport to improve their health and wellbeing, connect with others, including positive role-models, and build their physical and mental resilience.¹⁸ The 2021-22 Ausplay survey identified that 65% of Victorian residents participate in sport-related activities.¹⁹
- **Connection to nature:** Access to the natural environment is good for physical and mental health, but is increasingly difficult to maintain in high density, urbanised environments. Natural landscapes and semi-natural systems such as parks, rivers, bushland, and private gardens, are essential 'green infrastructure' that support quality of life in an urban environment.²⁰
- **Mental health and restoration:** Even brief contact with nature can improve emotional wellbeing and reduce psychological stress.
- **Place identity:** Public open spaces, including sportsgrounds, can strengthen attachment to place and a sense of community, which is strongly associated with improving mental health. Feelings of disconnection, and the experience of loss of place can have significant psychological impacts.
- **Reduced urban heat:** Natural public open spaces and canopy cover reduce urban heat by contributing to shade and evapotranspiration (the process by which the sun's energy is used to transfer water from plants into the atmosphere).²¹ They also provide cooling relief on hot days, enabling people to relax and interact with the public realm.²²
- **Climate change resilience:** Public open space can improve resilience to extreme weather events, such as bushfires, floods and heatwaves, by improving air quality and reducing temperatures and flood risk in urban areas, while sequestering carbon dioxide from the atmosphere.²³

¹⁶ NSW Health 2020, *Healthy Built Environments Checklist*, p.36, <https://www.health.nsw.gov.au/urbanhealth/Publications/healthy-built-enviro-check.pdf>

¹⁷ NSW Health 2020, *Healthy Built Environments Checklist*, p.56, <https://www.health.nsw.gov.au/urbanhealth/Publications/healthy-built-enviro-check.pdf>

¹⁸ May, C 2021, "Physical activity," Clearinghouse for Sport, <https://www.clearinghouseforsport.gov.au/kb/physical-activity>

¹⁹ Australian Sports commission 2022, *AusPlay National Sport and Physical Activity Participation Report November 2022*, p. 95 <https://www.clearinghouseforsport.gov.au/_data/assets/pdf_file/0010/1077544/AusPlay-National-Sport-and-Physical-Activity-Participation-Report-November-2022-V2.pdf>

²⁰ NSW Health 2020, *Healthy Built Environments Checklist*, p.56, <https://www.health.nsw.gov.au/urbanhealth/Publications/healthy-built-enviro-check.pdf>

²¹ Scott, C 2015, *A brief guide to the benefits of urban green spaces*, p.6, https://leaf.leeds.ac.uk/wp-content/uploads/sites/86/2015/10/LEAF_benefits_of_urban_green_space_2015_upd.pdf

²² WSROC 2018, *Turn down the heat: Strategy and action plan*, p.28, p.55, <https://wsroc.com.au/media-a-resources/reports/send/3-reports/286-turn-down-the-heat-strategy-and-action-plan-2018>

²³ GANSW 2017, *Greener Places – draft for discussion*, p.16, <https://www.governmentarchitect.nsw.gov.au/resources/ga/media/files/ga/discussion-papers/greener-places-discussion-draft-2017-11.pdf>

- **Supporting ecosystems:** Public open space can contribute to biodiversity conservation by providing habitats for flora and fauna,²⁴ enhancing micro-climates, as well as other ecosystem benefits such as stormwater management, temperature regulation (e.g., via shade, reduction in wind capacity) and urban heat island mitigation and biodiversity.²⁵
- **Economic benefits:** Well maintained and high amenity public open space may raise the prices of adjacent properties and stimulate economic activities in nearby businesses: *"The creation, maintenance and management of green space also generates employment opportunities and may have indirect benefits to local economies by encouraging further investment and property development in the area."*²⁶

2.2 Growing sporting demand

Through a combination of busy lives and increasingly denser urban areas, access to public open spaces that enable multi-functional recreation (i.e., walking, cycling, dog-walking or formal or informal sport), is increasingly valuable to local communities. An ever-increasing demand for public open space is driven by:

- **Population growth:** The population of Merri-bek City Council is forecast to reach approximately 228,000 residents by 2036, an increase of 23.2% from 2019 levels.²⁷ Population growth is placing pressure on existing open spaces that need to accommodate increased levels of demand and more diverse community aspirations. Ongoing growth will require improvement to the quantity, diversity, quality, and capacity of open space to meet the needs of the Merri-bek population.
- **Increasing urban density:** Access to high quality public open space is becoming increasingly important as Merri-bek become denser, and dwellings become smaller – and increasingly without access to private open space, such as backyards. Increasing urban densities is resulting in more people needing to use open space to maintain their physical and mental health and wellbeing.
- **Increasing diversity of participants in sport and outdoor recreation:** The profile of participants in organised sport is also changing. AFL, soccer, and rugby, once considered male-dominated sports, are seeing an increase in the number of female participants, with more participation from people over the age of 35. Furthermore, the cultural diversity of the Merri-bek community also drives change in community preferences and demand for open space.

Demand for increasing the capacity in existing sportsgrounds is primarily driven by two key factors:

1. The increasing demand for access to sporting fields.

An increasing population increasing pressure on existing sports facilities: Population growth is increasing demand for sport and recreational facilities. According to Vic Health, 866,736 Victorians participated in sports across the state in 2021, a 15.7% increase in total sports participants from 2015 levels, despite a slower return to sports following the COVID-19 pandemic amongst some cohorts.²⁸

2. A decreasing supply and the prohibitive cost to acquire land to develop new sportsgrounds.

Population growth, especially within cities, and the increasing residential densities resulting from infill development in established areas, have resulted in significant pressure on existing open space networks for both formal sporting use and general recreation. However, finding and acquiring land suitable for sporting use (i.e., large flat areas) is an increasingly difficult challenge. In some areas of higher density growth, councils can struggle just to achieve sufficient parkland for recreation.

Other factors driving demand within the sporting community include:

- **A high proportion of 'active years' age group (5-49 years) fuelling demand for organised sports programs and competitions.** Merri-bek is getting younger with the median age falling from 36 to 34 years between 2006 and 2016. Merri-bek has a very high proportion of people aged within the "active years", 5-49 years age group (65.9%) or 112,933 people.

²⁴ GANSW 2017, *Greener Places – draft for discussion*, p.16, <https://www.governmentarchitect.nsw.gov.au/resources/ga/media/files/ga/discussion-papers/greener-places-discussion-draft-2017-11.pdf>

²⁵ Ives et al 2014, *Planning for green open space in urbanising landscapes*, final report prepared for Australian Government Department of Recreation, Natural Environment Research Program, Environmental Decisions Hub, RMIT, p.7, <https://www.environment.gov.au/system/files/pages/25570c73-a276-4efb-82f4-16f802320e62/files/planning-green-open-space-report.pdf>

²⁶ Ives et al 2014, *Planning for green open space in urbanising landscapes*, final report prepared for Australian Government Department of Recreation, Natural Environment Research Program, Environmental Decisions Hub, RMIT, p.82, <https://www.environment.gov.au/system/files/pages/25570c73-a276-4efb-82f4-16f802320e62/files/planning-green-open-space-report.pdf>

²⁷ Moreland City Council 2021, *Estimated population and forecast growth in Moreland*, p. 1, <https://www.merri-bek.vic.gov.au/globalassets/areas/researchlib-6733/revised-population-forecast-brief-january-2021.pdf>

²⁸ Vic Health 2021, *Sports participation in Victoria 2015-2021 The impacts of COVID-19 and the recovery of participations in sport*, Research summary, Vic Health, https://sport.vic.gov.au/_data/assets/pdf_file/0025/55591/download.pdf

- **Need for resiliency in all-weather conditions:** responding to changing climate conditions is another driver to the provision of synthetic sport field surfaces. The loss of playable hours on natural turf playing fields due to wet weather is often cited as a key reason for pursuing synthetic playing fields, ensuring consistent sport participation during the winter season when demand is typically at its highest (especially for football, rugby and AFL).
- **Higher return on investment:** synthetic surfaces are also perceived to have a greater ability to attract a higher return on investment than natural turf playing fields through user chargers. The ability to charge increased hire costs, the number of hours a field can be hired, and the ability to plan and fund refurbishment are attractive to facility owners or operators. However, this is often seen by the community as privatisation of public open space.

The following breakout sections highlight key Victorian sportsground planning studies and their findings.

Inner Melbourne Action Plan – Regional Sports and Recreation Facility Planning Study

The M9 group of councils is unique in bringing local councils and government stakeholders together to develop and deliver regionally based actions. These are based on the goal of making the inner Melbourne region more liveable, setting out a series of outcomes that the partner Councils believe will need to be achieved in order for this goal to be realised. The municipalities of Melbourne, Port Phillip, Stonnington, Yarra, Darebin, Hobson's Bay, Moonee Valley, Merri-bek, and Maribyrnong are the partner Councils that make up the membership of the M9 group.

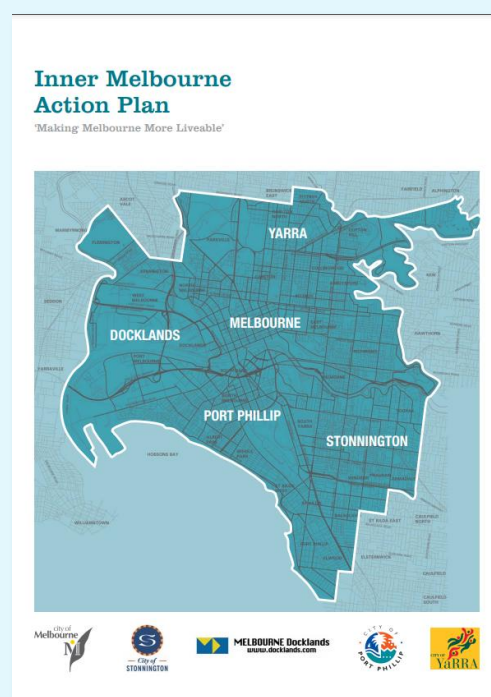
The group of 5 councils which preceded the M9 released The Inner Melbourne Action Plan (IMAP). While not strictly inclusive of Merri-bek council area until the expansion the group to form the M9, this strategy and the findings in relation to sport and recreation is considered relevant given that growth in the inner suburbs will inevitably place additional pressure on fields in Merri-bek.

This report found that the existing sports facilities are at capacity and the participation demand is set to double over the next 20 years. This will require significant investment, innovation and a fundamentally different approach to avoid a critical shortfall.

The study states that without a different approach to investment and delivery (embracing innovation), people will miss out on participation opportunities that will impact community health and well-being.

Key findings include:

- Current supply of aquatic and recreation facilities, indoor sports stadiums, playing fields, outdoor multi-purpose courts and skate facilities **does not meet the needs of the current or projected future population** over the next 30 years.
- Strategies to address this gap include **increasing capacity of existing facilities** and upgrading existing facilities. These actions alone do not provide sufficient capacity to meet future need.
- New facilities will be required in the medium to long term. **The current challenge is to acquire land** for this purpose, and to have a financial plan for the delivery of required facilities in the future.
- The **current funding mechanisms** are not allocating or prioritising funding to community sport and recreation infrastructure. The current focus is precinct funding not addressing municipal or cross municipal facilities.



Inner Melbourne sport and recreation demand statistics

Draft Port Phillip Strategic Sports Network Plan 2023

The Port Phillip City Council are currently preparing a *Strategic Sports Network Plan*. Their analysis found:

- All sportsgrounds were very well used and showing signs of overuse, with many allocated for 25+ hours of use each week.
- The population is forecast to grow by 48%. If using current Ausplay participation rates for field sports (Australian Rules football, football-soccer, cricket and rugby / touch football), the current participation of 15,230 participants will grow to 20,885 participants.
- The demand modelling shows a current shortfall of fields across all field sports that will grow significantly over the next 20 years.
- There is limited capacity in Port Phillip to build new sportsgrounds to address the future shortfall in fields. Introducing synthetic turf fields at strategic locations is considered one solution to meeting this challenge.

Moonee Valley Wider Sportsground Review 2021

The Moonee Valley City Council conducted a review into the supply and demand for field sports. The study found:

- All sportsgrounds were very well used and showing signs of overuse, with many allocated for 25+ hours of use each week. Some fields were often unfit for play in wetter months due to the overuse of fields, however Council had limited options to distribute training activity to alternative fields due to them being at capacity.
- Moonee Valley City Council manage 19 outdoor sporting reserve sites that service 43 sporting clubs and an estimated 9,066 players across Football-soccer, cricket and Australian Rules football and rugby / touch football.
- Football-soccer, cricket and Australian Rules football have recorded significant participation growth in the last 3 years, whilst rugby has maintained 150 participants. If current participation rates are maintained, there will potentially be an additional 3,506 players by 2032 (Total of 12,572 players).
- The demand modelling shows a current shortfall of fields across Football-soccer, cricket and Australian Rules football that will grow significantly over the next 20 years.
- There is limited capacity in Moonee Valley to build new sportsgrounds to address the future shortfall in fields. Introducing synthetic turf fields at strategic locations is considered one solution to meeting this challenge.

Draft Melbourne Recreation Facilities Master Plan 2022

The City of Melbourne conducted a supply and demand assessment for sports facilities. The Study found:

- A significant shortfall in sports facility infrastructure in the next 20 years.
- The population will grow by 43% in the next 20 years that will drive the demand for sports facilities, which is further intensified by 1 million commuters that come in and out of the City daily.
- Current sports facilities are very well used with multiple users. The analysis of sportsgrounds use shows many were allocated for 20+ hours of use each week and that the type of activity, quality of soil profiles, lack of drainage and irrigation and insufficient lighting meant this use could not be increased.
- The plan includes recommendations for upgrading natural turf fields to increase capacity to 25+ hours each week and introduce synthetic turf fields in strategic locations.
- New sportsgrounds are proposed in urban renewal areas, however the provision falls short of what the participation demand requires in the next 20 years.

The plan recognises that even with recommended improvements, Council will still realise a shortfall in sportsground requirements.

Banyule Regional Sport and Recreation Reserves Feasibility Study 2020

The Banyule City Council conducted a supply and demand assessment for sportsgrounds to respond to the impacts of the North East Link project. The Study found:

- A shortfall of sportsgrounds in the next 20 years to meet future participation demand.

- The short-term impact of sportsgrounds used for the North East Link project will require improvements to increase the capacity of other sportsgrounds to meet current participation demand.
- There is an opportunity to increase and improve the capacity of sportsgrounds at reserves impacted by the North East Link to address the shortfall of sports fields projected in the future.
- The plan includes recommendations for upgrading natural turf fields to increase capacity to 25+ hours each week and introduce synthetic turf fields in strategic locations.

2.3 State of our fields

Key Merri-bek sportsgrounds statistics

The following section synthesises existing data provided on Merri-bek sportsgrounds, based on Council's Active Moreland Policy and Open Space Strategy (2012-2022).

Merri-bek currently has:²⁹

- 54 sportsgrounds (52 natural turf and 2 synthetic turf grounds)
- 64 tennis courts
- 28 outdoor netball courts
- 5 indoor sports stadiums
- 576 hectares of open space, which makes up 177 reserves³⁰
- Play spaces such as skate parks and playgrounds
- 50km of off-road bicycle paths and an extensive network of walking paths
- the provision of grants and funding to support clubs and other activity providers

Council's sportsgrounds are very well utilised with multiple user groups allocated access through seasonal tenancy license agreements or hiring (booking). A review of the fields shows:

To be supplemented with additional information from Council, if available.

- *Most natural turf sportsgrounds are allocated for 15+ hours each week.*
- *The Clifton Park synthetic turf soccer field is used 25 hours each week and by multiple clubs and teams.*
- *The Brunswick Secondary College synthetic turf hockey field is used 45 hours each week and is home to the Brunswick Hockey Club.*

2.3.1 Community perspectives

Decisions relating to synthetic turf surfaces generally attract a high level of community and sporting association interest. Often, there is agreement on the need to increase capacity to support community sport and active recreation – however disagreement on the best surface type to meet this growing demand.

For example, there is opposition to synthetic turf amongst some members of the Merri-bek community. Desktop research into local perspectives has shown many community groups are concerned with the environmental and social impacts of synthetic turf. The 2020 proposal for the implementation of a synthetic turf field at Hosken Reserve, Coburg North, led to a sustained community campaign to 'save the reserve'.³¹ Climate Action Morland, a community action group, outlined concerns in a detailed essay submission,³² whilst online groups - 'Save Hosken Reserve' established a series of petitions attracting over 900 signatures,³³ with The Age also highlighting the issue.³⁴

²⁹ Sportsgrounds and facilities, *Active Morland*, <https://activemoreland.com.au/recreation/moreland-group/activemoreland/home/sport-in-merri-bek/sportsgrounds-and-facilities>

³⁰ Open space strategy 2012-2022, *Moreland City Council*, <https://www.merri-bek.vic.gov.au/globalassets/key-docs/policy-strategy-plan/open-space-strategy-2012-22.pdf>

³¹ Save Hosken Reserve 2020, <https://www.facebook.com/savehoskenreserve>

³² Climate Action Morland 2021 < <https://climateactionmoreland.org/2021/04/11/synthetic-turf-and-the-tragedy-of-the-commons-in-moreland/> >

³³ Save Hosken Reserve 2022, *more than 900 have signed our petition* <<https://www.facebook.com/savehoskenreserve>> Stephens T 2022, Keep Moreland's reserves accessible for all, *Get Up by me*, < <https://me.getup.org.au/petitions/keep-moreland-s-reserves-accessible-for-all> >

³⁴ Waters C 2022, Turf war treaty: Council keep some parkland for community use, *The Age*, < <https://www.theage.com.au/national/victoria/turf-war-treaty-council-keeps-some-parkland-for-community-use-20220418-p5ae8f.html> >

Key concerns expressed by community groups and online forums (Facebook groups, petition pages, community action forums) were as follows:

Table 1 **Community sentiment analysis**

Theme	Key concerns
Environmental	• Increased urban heat island effect. • Loss of biodiversity • Loss of surrounding vegetation • Waterway and soil pollution caused by synthetic infill. • Reduction in permeable surfaces in urban fabric, lowering capacity for water absorption • CO2 emission caused across the life cycle (production, transportation, disposal) of synthetic turf. • Pollution caused by turf disposal.
Social	• Overall reduction in community amenity caused by lack of access to sportsground (formal use only) • Lack of transparent community consultation • Community concerns of health issues related to environmental pollution caused by synthetic turf

Source: Ethos Urban, desktop review

Community opposition was successful in changing the overall design and scale of the Hosken Reserve renewal. The compromise – reserving one-third of the park for community green space and implementing a synthetic turf field – highlights the importance of community consultation to find common ground solutions.

From a sporting association perspective, support for synthetic surfaces is relatively common as some clubs struggle to meet growing demand on their sport. Pascoe Vale FC, for example, supported the Hosken Reserve renewal while recognising the need to balance formal and informal community use of sportsgrounds.³⁵ Additionally, The City Vista Sports Precinct, featuring two synthetic soccer pitches in the City of Melton, was widely supported by local clubs and soccer players for the increased opportunities to play the sport that it was seen as providing.³⁶

The following points are some of the key considerations noted by sporting clubs informing their general support for synthetic turf upgrades in Victoria, based on Ethos Urban’s media scan:

- Perceived increase in capacity to program training and games on synthetic turf surfaces, ‘up to 70 hours a week’.
- Enhanced quality and consistency of synthetic surfaces. This was particularly evident when relating to surfaces which were replacing older, badly maintained and poorer quality natural turf fields.
- The availability of substantial grant funding to allow for the installation of new synthetic pitches.
- Ancillary improvements to club facilities, lighting, and fencing.
- The social benefit of increasing access to sport, particularly for younger generations.

The high levels of media attention and community interest in synthetic turf field replacements for natural turf surfaces, such as in the case of Hosken Reserve Renewal, indicates high levels of concern relating to the social, environmental, and economic implications of sportsground surface decisions. This demonstrates the need for nuanced approaches to sportsgrounds renewal and public space management that align with community expectation and values.

2.3.2 Site visit

As discussed in the methodology section, at the commencement of the project, Ethos Urban conducted a site visit to a number of sportsgrounds with council officers. Conducting field observations across Merri-bek provided a tangible snapshot of the local social and environmental context. The site visit also underlined specific issues relating to turf quality, maintenance and informal use patterns which are largely unrecorded and ongoing. This provided a qualitative insight into the everyday context of Merri-bek sportsgrounds. The following sites were visited on April 6, 2023:

- Coburg City Oval
- De Chene reserve

³⁵ Eddie R 2020, Coburg North residents blindsided by plans to cover oval in artificial turf, *The Age*, <<https://www.theage.com.au/national/victoria/coburg-north-residents-blindsided-by-plans-to-cover-oval-in-artificial-turf-20201005-p5621q.html>>

³⁶ *Mirage News* 2019, Four new pitches a win for local soccer fans, <<https://www.miragenews.com/four-new-pitches-a-win-for-local-soccer-fans/>>

- McDonald Reserve
- Parker reserve.

The following factors were assessed:

- Levels of existing community access to sportsgrounds, both formal and informal
- Associated clubs and the type of turf surface
- Quality of turf surface, both natural and synthetic
- Shade
- Sense of inclusivity and accessibility to community, including presence of fencing.

Table 2 *Site visit observations*

Key observations	
Usage and demand	• High levels of informal use on sportsgrounds that are visually open to the public – especially De Chene Reserve, due to proximity and use by adjacent secondary school. • Observed competing use interests between formal sports groups and community members conducting non-sports related activities (principally dog walking). This was primarily observed (though not limited to) Coburg City Oval.
Maintenance	• Prevalence of divots caused by dog scratching and player use. • Grass patched used to infill divots – clubs responsible for small-scale patch maintenance. • Parker Reserve no longer for soccer or hockey due to undulations in the field.
Social	• High levels of informal, non-sports related informal use by community, especially in area adjacent of greenspaces – De Chene Reserve
Environmental	• Porous boundaries between greenspaces with native vegetation and sportfields along the Merri Creek – De Chene Reserve and Parker Reserve.

Source: Ethos Urban

2.4 Merri-bek's climatic, geotechnical and environmental conditions

The following maps show the community health and wellbeing indicators, biodiversity values and climate change effects impacting Merri-bek's open spaces. They have been prepared for the State Government's Open Space for Everyone 30 Year Investment Opportunity Framework project.

2.4.1 Community health and wellbeing indicators

The map below shows Merri-bek population will grow significantly across all areas of the municipality.

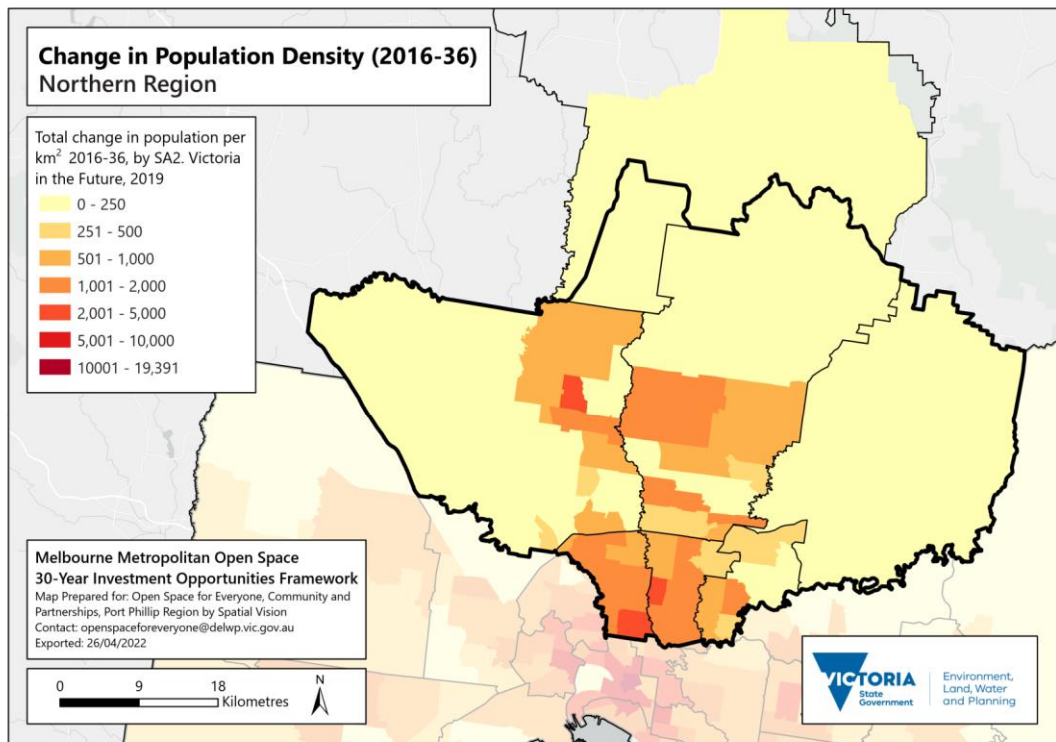


Figure 1 Change in Population Density (2016-36) – Northern Region

Source: *Open Space for Everyone: Open Space Strategy for Metropolitan Melbourne 2021* (Victorian Government, 2021)

The map below shows that Merri-bek has a high proportion of people (41-44%) that exercise four days each week and therefore meet the Australian physical activity guidelines.

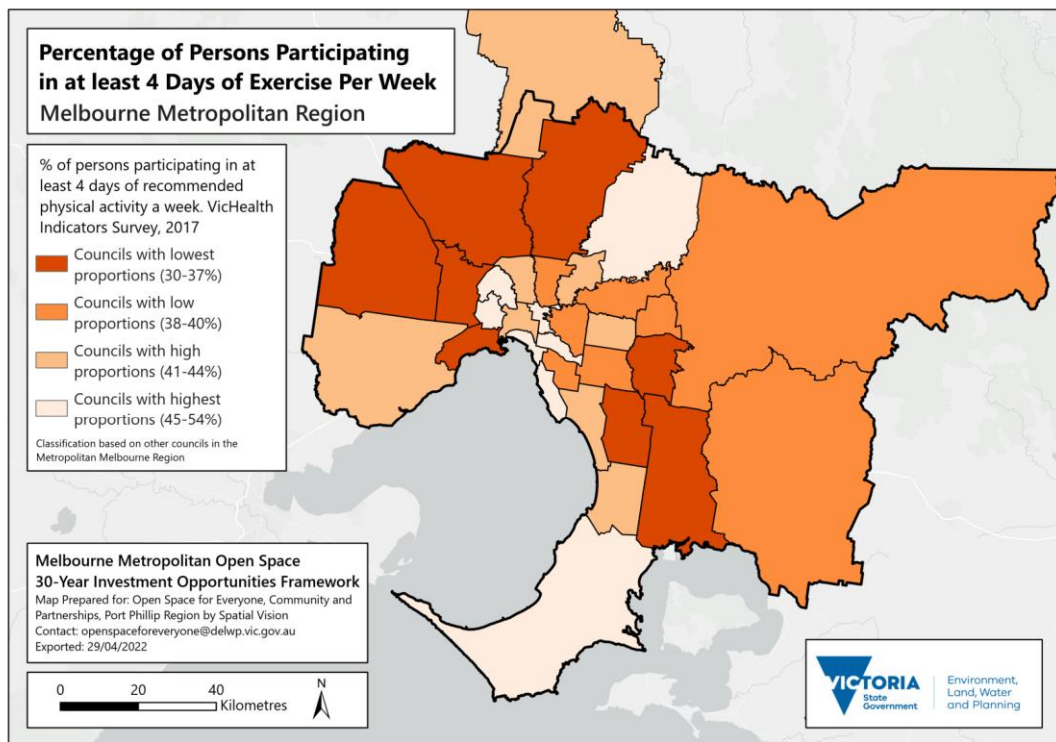


Figure 2 Percentage of Persons Participating in at least 4 Days of Exercise per Week

Source: *Open Space for Everyone: Open space Strategy for Metropolitan Melbourne 2021* (Victorian Government, 2021)

The map below shows that most residents are within 400m and 800m of publicly accessible open space.

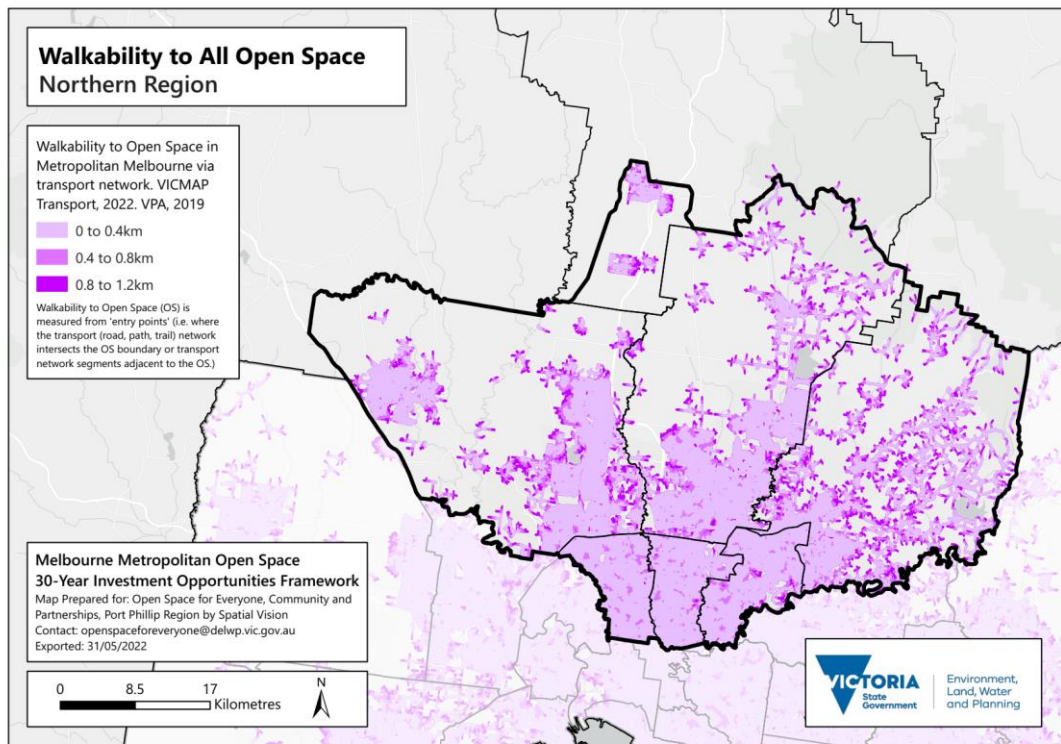


Figure 3 Walkability to All Open Space – Northern Region

Source: *Open Space for Everyone: Open space Strategy for Metropolitan Melbourne 2021* (Victorian Government, 2021)

The map below shows the strategic cycling corridors and principal bicycle network locations. These 'active' transport links connect with public transport and open spaces in Merri-bek.

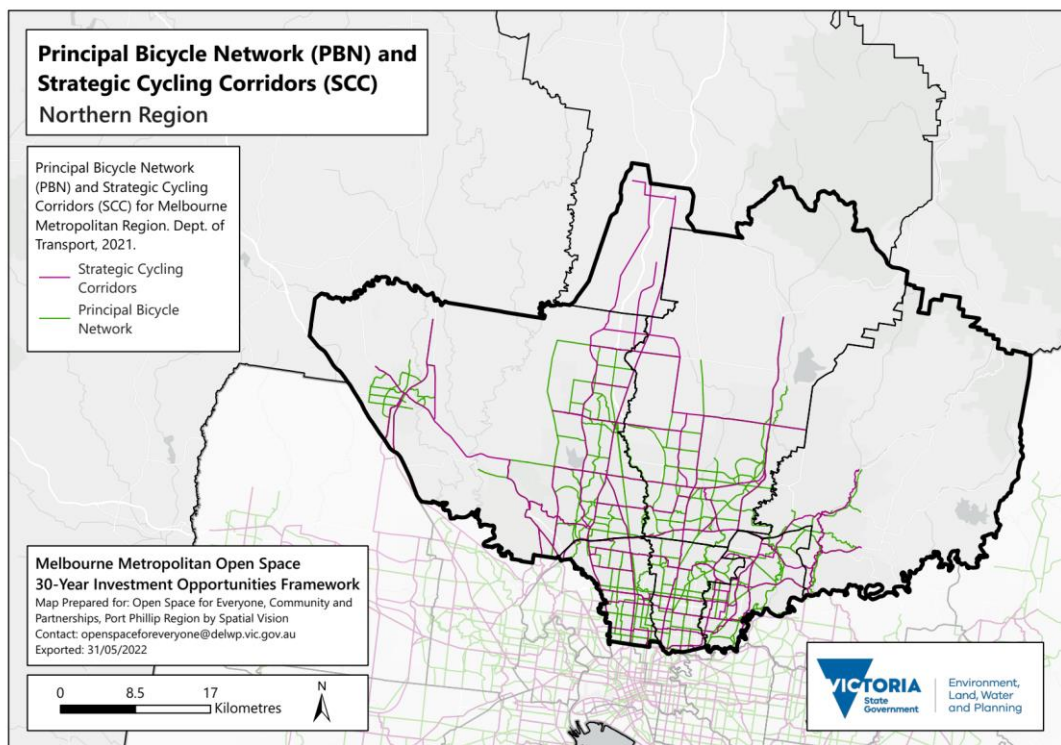


Figure 4 Principal Bicycle Network and Strategic Cycling Corridors – Northern Region

Source: *Open Space for Everyone: Open space Strategy for Metropolitan Melbourne 2021* (Victorian Government, 2021)

Providing access to a diverse mix of fit for purpose sport and recreation facilities within a 20-minute neighbourhood catchment has the capacity to foster the high levels of sport and physical activity participation in Merri-bek. For the significantly growing population, this will be critical to delivering positive health and wellbeing outcomes.

The map below shows the SEIFA (index of social disadvantage) rating in Merri-bek. Access to affordable sports facilities and programs will be important in the northern part of the municipality that has areas that are most disadvantaged in the northern region of metropolitan Melbourne.

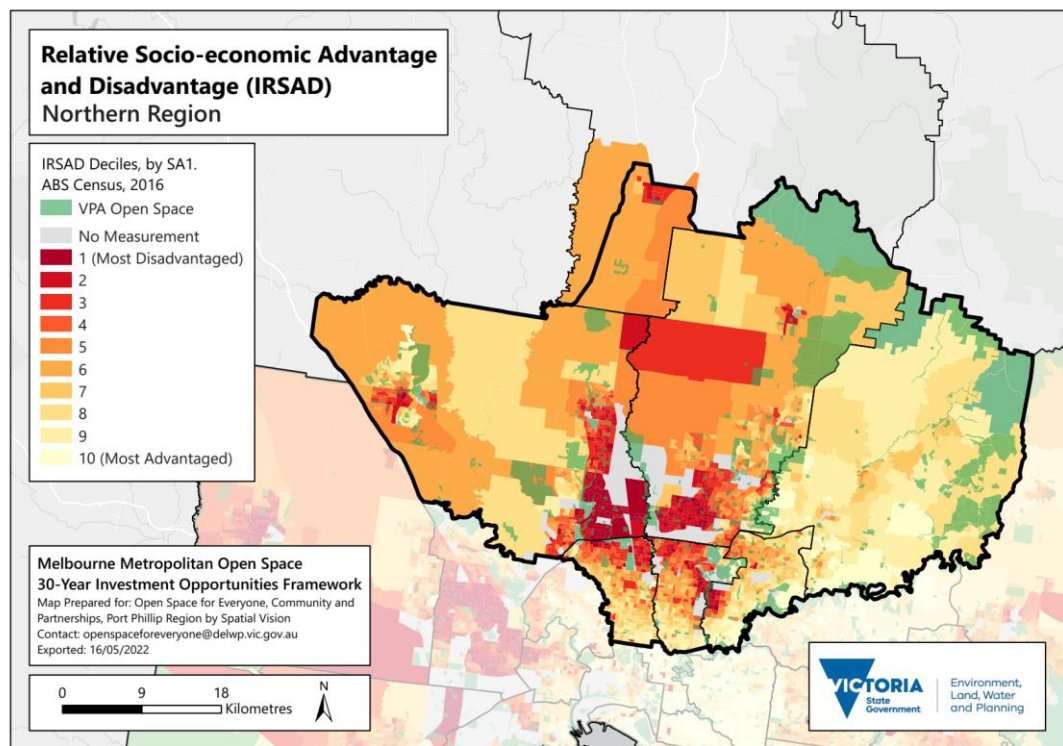


Figure 5 Relative Socio-economic Advantage and Disadvantage – Northern Region

Source: *Open Space for Everyone: Open space Strategy for Metropolitan Melbourne 2021* (Victorian Government, 2021)

2.4.2 Biodiversity Values

The map below shows the strategic biodiversity values in the northern region of metropolitan Melbourne. Merri-bek has low biodiversity values with high values only identified along Merri Creek.

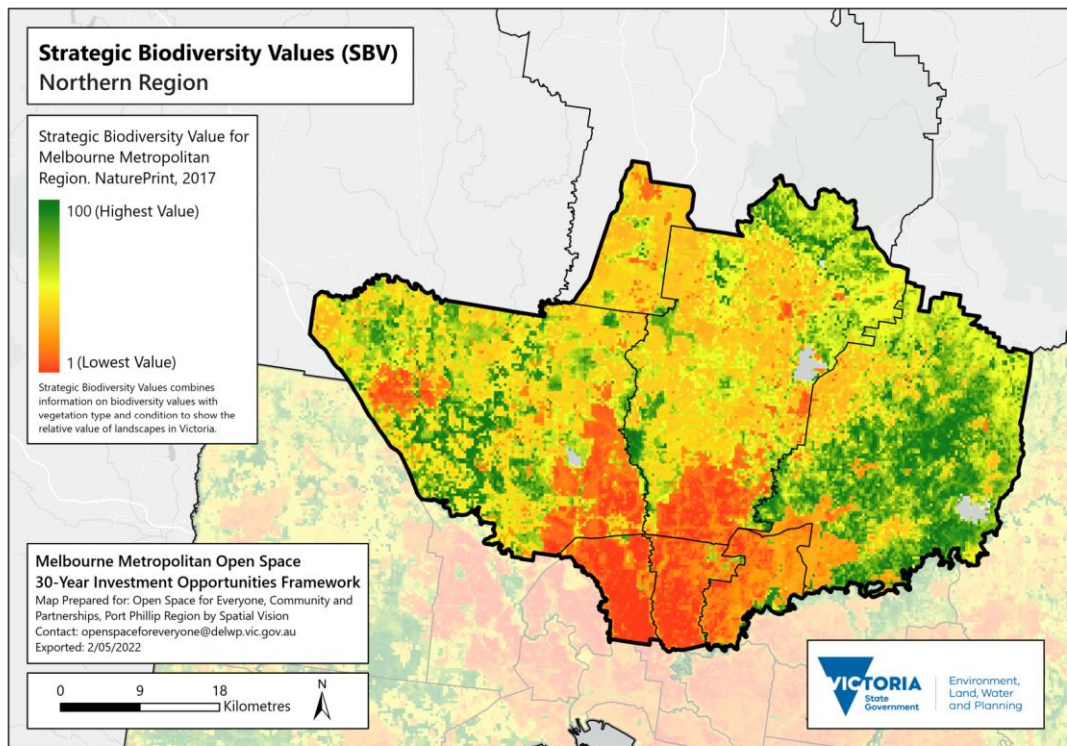


Figure 6 Strategic Biodiversity Values – Northern Region

Source: *Open Space for Everyone: Open space Strategy for Metropolitan Melbourne 2021* (Victorian Government, 2021)

The map below shows the environmental and significant landscape overlays that protect biodiversity values. The overlays protect the high values identified along Merri Creek.

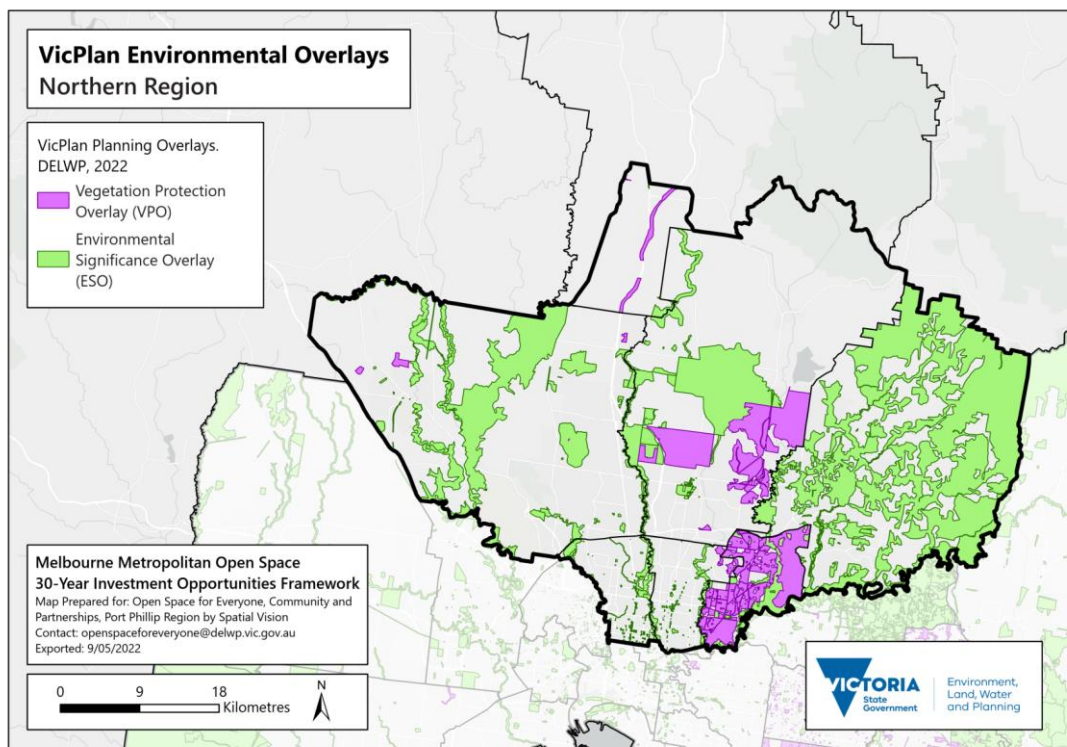


Figure 7 VicPlan Environmental Overlays – Northern Region

Source: *Open Space for Everyone: Open space Strategy for Metropolitan Melbourne 2021* (Victorian Government, 2021)

The map below shows the vegetation coverage of in Merri-bek. Most areas in Merri-bek have low vegetation coverage with pockets of high vegetation coverage including along Merri Creek.

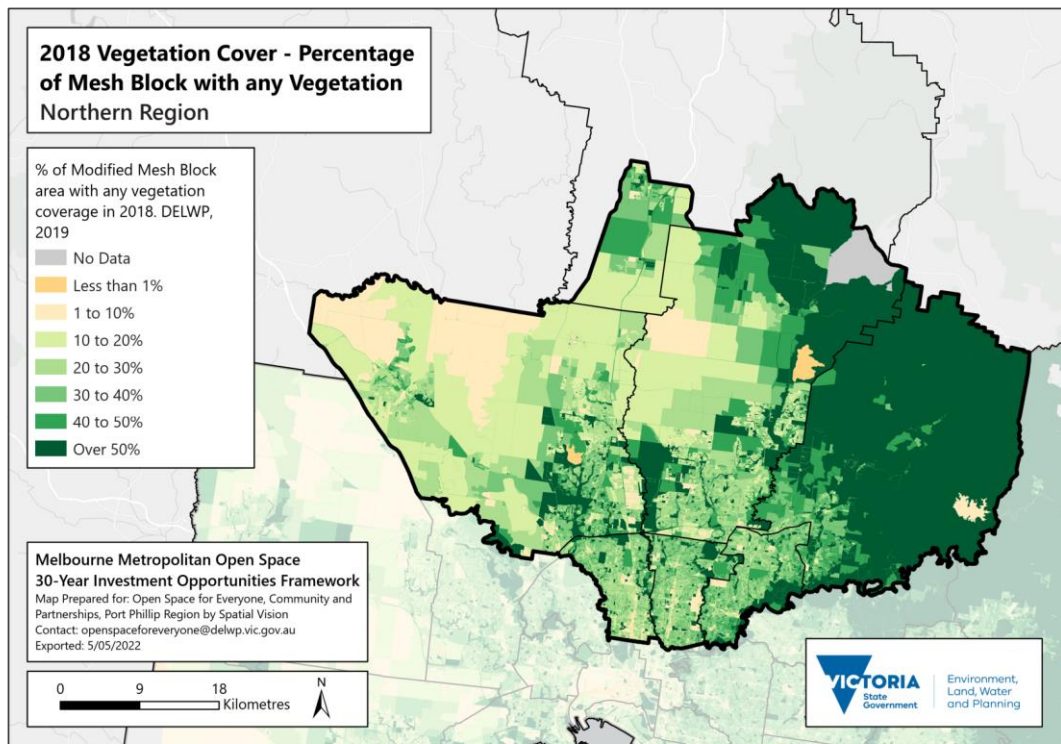


Figure 8 2018 Vegetation Cover – Percentage of Mesh Block with any Vegetation – Northern Region

Source: *Open Space for Everyone: Open space Strategy for Metropolitan Melbourne 2021* (Victorian Government, 2021)

2.4.3 Climate Change Impacts

The map below shows the urban heat island effect. Merri-bek has moderate to high levels of urban heat across the municipality. This shows the importance of open space mitigating the effect of urban heat in Merri-bek and providing people with a cool place to visit on hotter days.

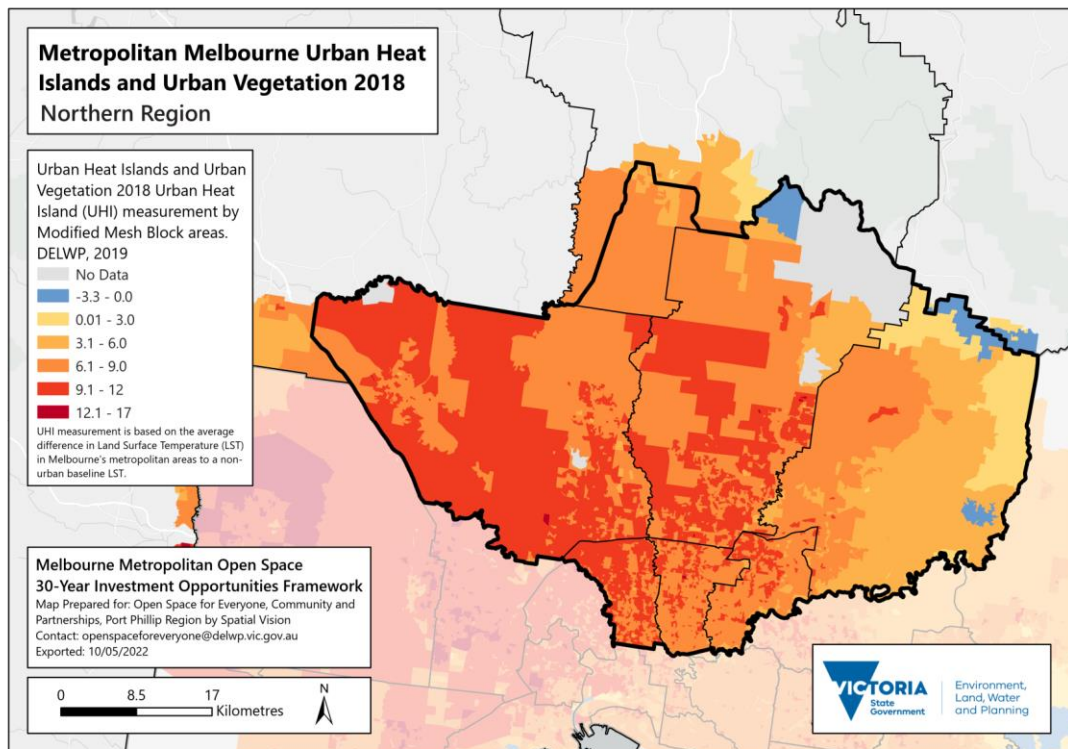


Figure 9 Metropolitan Melbourne Urban Heat Islands and Urban Vegetation 2018 – Northern Region

Source: *Open Space for Everyone: Open space Strategy for Metropolitan Melbourne 2021* (Victorian Government, 2021)

The map below shows the 100-year flood inundation level. Merri-bek is impacted by flood inundation along creek corridors in the east and north. Any modification to sportsgrounds within flood inundation areas need to be designed in a way that maintains storage capacity.

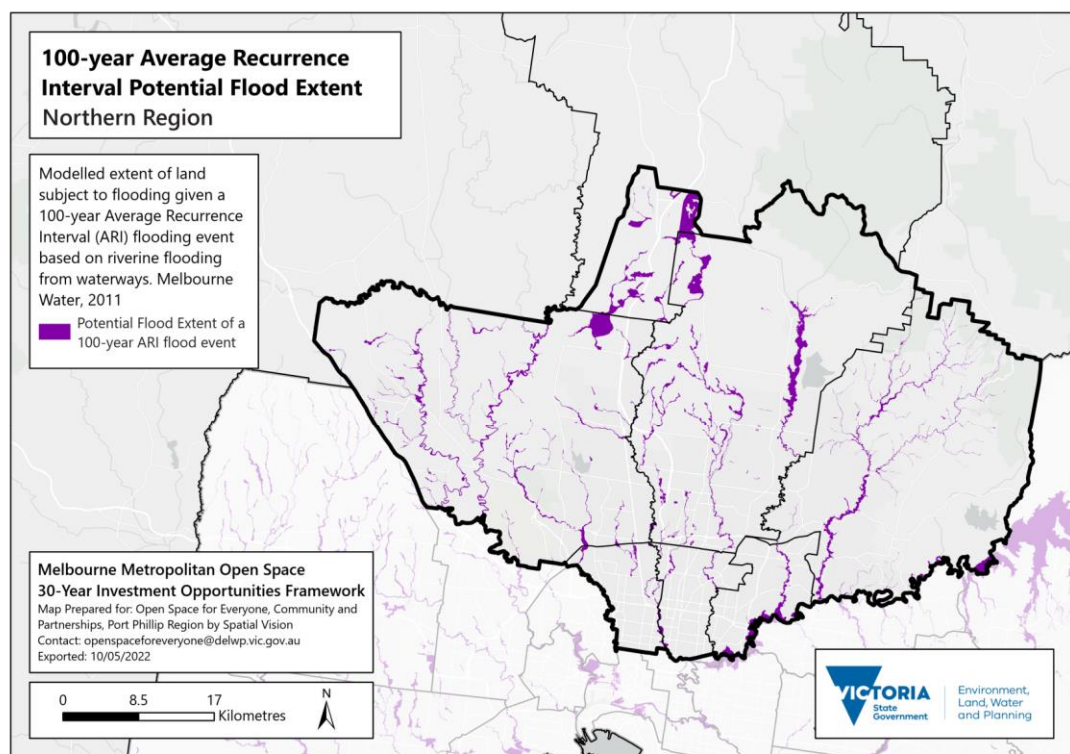


Figure 10 100-year Average recurrence Interval Potential Flood Extent – Northern Region

Source: *Open Space for Everyone: Open space Strategy for Metropolitan Melbourne 2021* (Victorian Government, 2021)

2.5 Contemporary sportsground surface issues

The use of synthetic turf in sportsgrounds has been a topic of discussion and debate for several years, with proponents and opponents of the technology holding strong opinions about its benefits and drawbacks. While synthetic turf has gained popularity in recent years due to its durability and ability to withstand harsh weather conditions, concerns have been raised about its environmental impact, and safety. This section will explore the general issues and discussion surrounding synthetic turf, including the contested aspects of the technology where there is a lack of consensus or clear evidence.

2.5.1 Diverse users and concern over the loss of access to open space

Arguments in favour of synthetic surfaces tend to focus on their ability to increase the capacity of existing open space for sporting activities. However, communities also value the opportunity to participate in a diverse range of recreational activities outside a formal sporting context.

Informal sport has been identified as a key process in generating a sense of belonging in multicultural communities. Access to sports grounds provides sites to gather and perform leisurely sporting activities, helping to form connections between diverse community members within causal contexts.³⁷

Examples of this informal use were identified in Merri-bek during the Ethos Urban site visit at De Chene Reserve, Coburg, wherein informal use of the soccer field and adjoining green spaces by significant numbers of primary school children was observed. Further, the *Melbourne Open Space Strategy (Open Space for Everyone)* aims to create a 'network of public open space that is shared and accessible by everyone'³⁸, reflecting community preferences for spaces

³⁷ Aquino et al 2020, *The right to the city: outdoor informal sport and urban belonging in the multicultural spaces*. Annals of Leisure Research. 25(4) 472-490 DOI: 10.1080/11745398.2020.1859391

³⁸ *Open Space Strategy for Metropolitan Melbourne 2021*, Department of Energy, Environment and Climate Action, 2021 < https://www.environment.vic.gov.au/_data/assets/pdf_file/0025/520594/Metro-Open-Space-Strategy-FA4-book-WEB.pdf >

that enable a range of sport and recreation opportunities including organised sport; and active recreation where you do not require memberships or scheduling for use.³⁹

It was evident during research undertaken for this Study that some community groups consider the installation of synthetic fields as a reduction in access to green open spaces that may be under pressure from densification, or even as a loss of open space (see **Section 2.3.1**). Key voices amongst the community have strongly opposed proposals for the implementation of synthetic turf on social and environmental grounds. In particular, the community organisation *Climate Action Moreland* strongly criticised the proposed synthetic turf in the Hosken Reserve Refresh in 2021 through a detailed discussion paper, indicating the social impact factor as significant in synthetic turf decision making in Merri-bek. While synthetic fields can often accommodate increased usage and greater intensity of formalised sporting use, they can displace informal users of natural turf fields unless carefully mitigated. The following considerations have been identified through a review of community sentiment and feedback surrounding the replacement of natural with synthetic surfaces:

- **Protection of the playing surface:** A synthetic field is a significant capital investment, and as a high value asset there is an increased focus on protecting that asset for its primary purpose. Often there is a need to manage use, preventing dogs from accessing the space and ensuring players clean boots to protect the surface and avoid contamination of the infill.
- **Restrictions on informal access:** As synthetic playing surfaces are generally installed to enable formal sporting use, facility owners may restrict the use of the field outside of organised sporting activities, including by fencing the field. However, there are equally examples of synthetic fields that are not fenced, and informal community use (of synthetic fields) does occur. However, there is clearly a perception within the community that the space is not available for informal or non-sporting use. Furthermore, the high frequency of formal sporting games and training, often results in little downtime for others to use the space.
- **Inappropriate for community events:** Synthetic turf cannot generally be used for community events, as these require marquees and other temporary infrastructure that can damage the underlying carpet of synthetic turf.
- **Reduced amenity:** Synthetic turf has reduced amenity for informal recreation and socialising (due to the touch and feel of the surface type, increased heat load and glare) which may discourage use of the field for alternate purposes even when access is not restricted.
- **Designed for specific codes or groups of codes:** Synthetic fields are usually managed for formal sporting use and therefore have less flexibility to accommodate informal and recreation use as they cannot easily be reconfigured to accommodate different types of use, such as an emerging code or different sport. Line markings on synthetic fields are often more permanent and the pile height and other features are specifically designed for a specific code or group of codes. There are several products of synthetic turf which are more general use and can accommodate a range of large ball sports; however, AFL, football and rugby all have specified performance features to certify synthetic turf as suitable for their sport.

The shared use of public open space and the increasing use of public open space for a diverse recreation offering (not just formalised sport) should be factored into any consideration when choosing surface type. Any conversion of natural turf to a synthetic playing field needs to consider the impact on other users in the community and should be factored into the investigation of the costs and benefits of design options.

Most natural turf fields are for club and community level sport and are open to other users and informal access when not booked for formal sporting use. When these facilities are modified to have a synthetic surface, access limitations can be imposed, such as fencing and restricted access to clubs and fee-paying users. While fencing and other use restrictions may not actually reduce public accessibility of playing surfaces, they can create restricted access. It is important to note that very high-quality natural turf fields designed and managed for sporting use (such as national level sport clubs) can also have restricted use (e.g., fences) to protect the playing surface.

Ultimately, balancing the need to manage adverse use to ensure that community investment is protected with diverse and informal use of public open spaces by the community should be undertaken in close consultation with the community, and considering both the site-specific and broader strategic context of the decision.

2.5.2 Modelling capacity versus actual demand

It is important to understand the actual demand for an open space or by a specific sport that aims to be accommodated, and to consider what might be the most cost-effective response to meeting that demand. When undertaken in the early planning stages of facility upgrade, this assessment should inform the scope of improvements

³⁹ *Open Space Strategy for Metropolitan Melbourne 2021*, Department of Energy, Environment and Climate Action, 2021 < https://www.environment.vic.gov.au/_data/assets/pdf_file/0025/520594/Metro-Open-Space-Strategy-FA4-book-WEB.pdf >

to facilities (surface change, lighting improvements etc.) but also be broadened to consider the impact of meeting this demand on the wider use of the public open space.

A cost-benefit analysis or business case undertaken for a proposed conversion to a synthetic surface compares the capital and operating cost (or life cycle cost) of a playing field against the sporting user hours to be accommodated. As identified above, the impact on non-sporting users and the “disbenefit” or cost of reducing multiple use and community access for other recreation use, is not often considered, or factored into the decision.

The capacity of synthetic fields to accommodate significantly increased sporting use, compared with natural turf, is commonly cited as a key advantage of synthetics over natural turf.

When considering demand, it is important to understand the real, not perceived, level of demand when considering which sporting field surface to use. Additionally, sportsgrounds are not always used solely for formalised sport. They are also places that the community use for dog walking, exercise and fitness, informal sports such as casual sport and many more activities.

Formalised sporting demand for access to sportsgrounds is underpinned by current and projected participation numbers and a club's programming for training and competition needs. Through the literature review it was noted that the peak demand for sporting use is predominantly after school hours and on the weekends. Without lights, field usage would stop at 6:00pm or earlier during winter months. With lights, usage might continue to 8:00pm or later and competition use might also extend further use on Friday evenings. Weekend demand can be across both days and may be as high as 8 hours per day.

The level of wear also depends on:

- Type of sport, e.g., rugby union can have a high impact due to scrums, The goal square areas for soccer and Australian Rules football attract higher use in training and competition, while cricket has a relatively low impact on the sportsground with training activity provided largely in cricket nets and intensity of play isolated to cricket pitch area.
- Age of players, i.e., young children have reduced impact on turf compared to adults due to size and speed of participant.
- Number of players, i.e. Australian Rules football has a higher number of players on a field for training and competition than cricket.
- Programming by clubs, i.e. If limited alternatives to training, fields can attract higher hours of play or number of participants than the field has capacity for.

If a field is supporting daytime use, such as by schools, then there may be additional hours of demand for some days of the week – most likely between 10am and 2pm. In addition, fields in places with high daytime populations may have demand for social sport or organised activity during lunch hours or before or after work.

2.5.3 Whole-of-life and cost per hour costings

The following table, prepared by Sport NZ,⁴⁰ provides a summary of playing field costs across a 30-year period including a breakdown of total lifecycle cost per hour (including consideration of disposal of the old synthetic turf). All costs shown below are in New Zealand Dollars (NZD), apart from the row showing the conversion cost to Australian Dollars (AUD). It is important to note that this table uses a modelled capacity and focuses on winter utilisation in a New Zealand context.

⁴⁰ Adapted from Sports NZ and Jacobs 2019, Guidance document for sports field development, December 2019 <<https://sportnz.org.nz/media/1409/sports-field-development-guide-final-2020-1-22.pdf>>

Table 3 *Lifecycle and cost per hour (typical assumptions)*

		Natural Turf (sand profile)	Hybrid	Synthetic
Utilisation (hours)	Weekly	25	35	60
	25-week season	625	875	1500
	30-year use	18,750	26,250	45,000
Life cycle costs	NZD Construction (incl. earthworks)	\$400,000	\$850,000	\$1,750,000
	NZD 30-year maintenance	\$750,000	\$1,200,000	\$750,000
	NZD Renewal	\$250,000	\$500,000	\$10,000
	NZD 30-year Disposal Costs		\$100,000	\$100,000
	NZD 30-year Life Cycle Costs	\$1,400,000	\$2,650,000	\$2,610,000
	AUD Life Cycle Costs*	\$1,302,000.00	\$2,464,500.00	\$2,427,300.00
Cost per hour	NZD Cost per hour	\$74.67	\$100.95	\$58.00
	AUD cost per hour*	\$69.44	\$93.89	\$53.94

Source: NSW Synthetic Turf Study (NSW DPE 2021), adapted from Sports NZ and Jacobs 2019, Guidance document for sportsground development, December 2019 < <https://sportnz.org.nz/media/1409/sports-field-development-guide-final-2020-1-22.pdf>>

*Note: Conversion rate applied: 1NZD equals 0.93AUD

The main reason that synthetic fields provide a lower cost per hour is the higher modelled use. It is important to consider the actual use hours that are likely to occur when comparing the lifecycle cost of options. It is also important to note that well-constructed and well-maintained natural turf playing fields are often able to provide for more than 25 hours of weekly winter use. This would therefore reduce the cost per hour rate.

In 2021, Otium Planning Group updated the assumptions identified by Sports NZ to compare across use and capacity scenarios to reflect best practice natural turf management and a different picture emerges when considering natural turf to synthetic. (Note that construction costs for natural turf increased by 10% to reflect best practice.)⁴¹

Table 4 shows the updated scenarios produced by Otium and demonstrates that if a natural turf field is able to accommodate 25-30 hours of use a week it competes favourably with synthetics on cost (even with an increased capital costs). Furthermore, if the likely “actual” use of a synthetic is less than 60 hours per week natural turf that accommodates approximately 30 hours per week is preferred over an artificial product.

Table 4 *Cost per hour, revised assumptions*

	Natural turf	Natural turf (10%- increase on capital)	Synthetic	Synthetic	Synthetic
Hours of use / week	25	30	40	50	55
AUD cost per hour	\$69.44	\$59.52	\$75.96	\$64.73	\$58.84

Source: NSW Synthetic Turf Study, Ethos Urban and Otium Planning Group (2021), adapted from: Sports NZ and Jacobs 2019, Guidance document for sportsground development, December 2019 < <https://sportnz.org.nz/media/1409/sports-field-development-guide-final-2020-1-22.pdf>>

⁴¹ See NSW DPE 2021, NSW Synthetic Turf Study, <https://www.planning.nsw.gov.au/-/media/Files/DPE/Reports/Policy-and-legislation/Synthetic-Turf-Study-Final-Report.pdf?la=en>

Research by Battam and Lamble ⁴² compared the lifecycle cost per unit of carrying capacity for a synthetic field, a “well built” natural turf field and a “traditional build” natural turf field. The research indicated that a “well built” natural turf field has a lifecycle cost of approximately \$16,000 per hectare compared to \$48,000 per hectare for a traditional build natural turf field and \$62,000 per hectare for synthetic playing field surfaces (in AUD).⁴³

2.5.4 Stormwater, flooding, and the Merri Creek

Sportsgrounds are frequently adjacent to large impermeable surfaces such as car parks, and therefore experience flooding from run-off. Some open space turf areas are also designed as flood detention basins, meaning they are designed to temporarily store excess stormwater so it can drain into the stormwater system or natural creek.⁴⁴

The location of the open space is important to consider for both natural and synthetic turf fields. Poorly located natural turf fields may become waterlogged and unusable during wet weather, although upgrades to the field (e.g., introduction of sand slit drains, grass swales to divert upstream runoff) can reduce the impact of excess rainfall on turf performance.⁴⁵

For example, if a synthetic turf field floods, the infill on the field (e.g., rubber crumb, cork granules), which is generally lighter than water, can float and be blown around the field, which causes a maintenance issue, or results in infill materials being washed into local waterways and bushland - becoming a source of pollution for local ecosystems.⁴⁶

Many sportsgrounds in Merri-bek are located on constrained sites, such as in close proximity to Merri Creek or landlocked by residential and industrial land uses meaning expansion is not possible. As a result, sportsgrounds in flood inundated areas are often subject to tidal inundation or flooding during periods of heavy rainfall.

Additionally, for Merri-bek's sportfields that are in close proximity to the Merri Creek, there is potential pollution caused by infill run-off and leeching of fungicides and pesticides into adjacent river eco-systems. Therefore, choosing environmentally friendly kinds of in-fill, pest and fungus control, and carefully considering the location of potential synthetic fields will be an important step towards mitigating some of the negative environmental implications caused any potential synthetic field (see case study below for example).

This can be somewhat mitigated by raising the field and developing a retention base under the field⁴⁷ or delivering a “lip” around the perimeter of the field.

2.5.5 Player injury

There is no consensus on whether there is a higher risk of injury on natural turf or synthetic turf. While second generation synthetic fields had a greater risk of abrasiveness on skin and a higher injury rate, there is insufficient evidence on current generation fields to draw such conclusions.

There is, however, strong evidence of a difference in injury patterns between natural and synthetic turf. Natural turf, for example, has been associated with an increase in concussion rates.⁴⁸ Comparatively, Mack et al identify a higher rate of lower extremity injury associated with synthetic surfaces in their recent study.⁴⁹

Ngatuvai et al confirm in a recent 2022 study that there is a higher risk of ACL injuries on synthetic turf compared with natural surfaces in both men and women's soccer, although note that this association was not statistically significant in

⁴² Battam, M & Lamble, P 2021, *Best Practice Natural Turf Fields*, presented at PLA NSW, presentation provided to NSW DPIE.

⁴³ Battam, M & Lamble, P n.d., *Creating Sustainable Open Spaces – Using Compost to Deliver Liveability, Sustainability, Recreation and Economic Outcomes*; provided to NSW DPIE.

⁴⁴ Sydney Water 2011, *Best practice guide for holistic open space turf management in Sydney*, p.60-61

<https://www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mdq1/~edisp/dd_045253.pdf>

⁴⁵ Sydney Water 2011, *Best practice guide for holistic open space turf management in Sydney*, p.62

<https://www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mdq1/~edisp/dd_045253.pdf>

⁴⁶ Smart Connection Consultancy, 2019, *The smart guide to synthetic sports surfaces: Volume 3: Environmental and sustainability considerations*, p.19, accessed 17 May 2021 < <https://www.smartconnection.net.au/wp-content/uploads/2019/11/Vol-3-Environmental-and-Sustainability-Considerations-v1.01.pdf>>

⁴⁷ Smart Connection Consultancy, 2019, *The smart guide to synthetic sports surfaces: Volume 3: Environmental and sustainability considerations*, p.19, accessed 17 May 2021 < <https://www.smartconnection.net.au/wp-content/uploads/2019/11/Vol-3-Environmental-and-Sustainability-Considerations-v1.01.pdf>>

⁴⁸ See Gosnell G et al 2022, *Playing Surface and Injury Risk: artificial Turf Vs. Natural Grass, Injuries and Sports Medicine*, July 2022. DOI: 10.5772/intechopen.106615

⁴⁹ Mack D et al 2018, *Higher rates of lower extremity injury on synthetic turf compared with natural turf among national football league athletes: epidemiologic confirmation of a biomechanical hypothesis*, *The American Journal of Sports Medicine*, 47(1) DOI: 10.1177/0363546518808499.

other sports.⁵⁰ Given that the lower extremity is the anatomic area most commonly injured in sports, which includes injuries to the hip, pelvis, leg, thigh, knee, and ankle, this is a potentially significant finding.⁵¹

While there is a difference in injury patterns between natural and synthetic turf, there is currently no consistent evidence suggesting an overall difference in injury rate. Given the multi-factorial nature of injuries, further studies are needed.

⁵⁰ Ngatuvai MS et al "Epidemiological comparison of ACL injuries on different playing surfaces in high school football and soccer", *The Orthopaedic Journal of Sports Medicine*, 10(5), DOI: 10.1177/23259671221092321

⁵¹ Anderson J 2002, Lower extremity injuries in Youth Sports, *Pediatric Clinics* 49(3) DOI: [https://doi.org/10.1016/S0031-3955\(02\)00010-X](https://doi.org/10.1016/S0031-3955(02)00010-X)

3.0 Natural turf and soil management

3.1 What is natural turf?

3.1.1 Overview

The construction of natural turf varies considerably and has significantly evolved over time to enhance the capacity and durability of natural turf-based playing surfaces. Since the 1920s, research has investigated ways to improve the performance of natural turf playing fields, which has resulted, “almost universally” in the use of coarse-grained, quick-draining materials, such as sand being used to construct natural turf sportsgrounds.⁵²

The siting of natural turf fields can affect performance and resilience, but it is challenging to acquire land to deliver open space due to high land values on sites that are not flood-affected or prone to subsidence. The construction options for natural turf range from a basic soil-based grass field to a high-quality engineered sand-based field with profile reinforcement.

A typical natural turf playing surface profile consists of the chosen natural turf, rootzone sand profile (growing medium) and in-ground supporting infrastructure (drainage and irrigation).

The design of a best practice natural turf playing surface sand profile typically consists of:

- **Natural turf surface layer:** Comprising a layer of soil (e.g., sand, loamy sand, sandy loam, loam and clay) and grass.
 - **Grass/turf:** The species of natural turf has a bearing on its performance.⁵³ Some of the most common types include couch/Bermuda grass, kikuyu and rye. Natural turf experts and social scientists emphasise the importance of selecting appropriate grass species and soil (e.g., compost amended soils have lower water demand while supporting more tolerant turf growth),⁵⁴ as well as the importance of management. Section x below provides further detail in relation to the better performing grass species for Merri-bek.
 - **Soil:** Healthy soil is one of the most important aspects of open space management. The characteristics of soil affect the watering requirements, turf growth and drainage on the surface, and influence the incidence of weeds, pests and diseases.
- **Rootzone sand layer:** Provision of a homogeneous rootzone sand layer provide enough porosity to enable rainfall infiltration and moisture retention to promote strong root growth and reduces risk of compaction.
- **Gravel blanket:** Provision of a gravel drainage layer to convey infiltration to the drainage system.

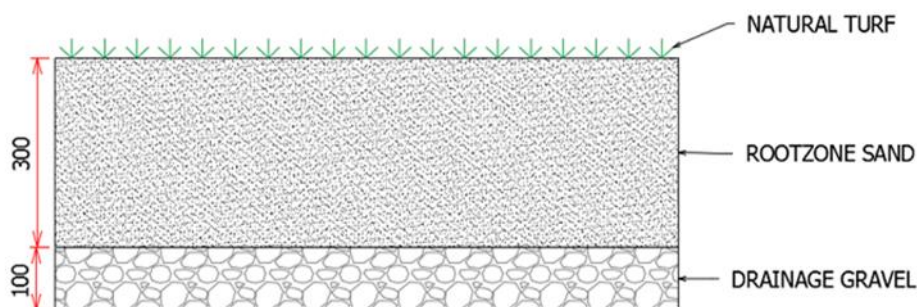


Figure 11 Natural turf profile

Source: SportEng.

SportEng, an engineering firm specialising in “fields of play,” states that natural turf fields are becoming increasingly complex and designed to:

⁵² SportEng 2021, “What is natural turf?” *SportEng*, blog post dated 25 March 2021 <<https://blog.sporteng.com.au/what-is-natural-turf>>

⁵³ Tafe NSW, *Turf Types*, accessed 14th May 2021 from [common turf species \(tafensw.edu.au\)](https://www.tafensw.edu.au/common/turf-species)

⁵⁴ Lamble, P & Battam, M n.d., “Creating sustainable open spaces – using compost to deliver liveability, sustainability and economic outcomes,” technical paper prepared for OzWater.

- Drain more effectively while maintaining sufficient moisture content;
- Reduce reliance on water for irrigation;
- Tolerate more use; and
- Be available during or immediately after bad weather.⁵⁵

To respond to these requirements, the designs of natural turf fields are becoming more complex with highly specified materials and engineering solutions. Natural turf, like other surfaces, has significant maintenance requirements to maintain high levels of performance for all users, such as mowing, “resting” and re-surfacing the field. For example, amending soil with compost to improve its strength and durability.⁵⁶

3.1.2 Grass selection for Merri-bek

The Merri-bek local government area is located in the inner north of Melbourne which geographically places it within the temperate climate zone. This refers to the characteristically warm summers and cold winters in this region. Further classification using data provided by the Bureau of Meteorology identifies this area as having no dry season and therefore a uniform rainfall distribution.

SportENG, in their Technical Note prepared for this Study,⁵⁷ have formed the professional opinion that the turf species which will perform best in this region is couch grass (*Cynodon* sp.), with the preferred cultivar being Santa Ana (*Cynodon dactylon*).

Couch grass varieties are known for having the ability to provide a high-quality sports playing surface with reduced fertiliser and irrigation inputs. Key advantages of using couch grass varieties include:

- Very good performance during periods of both low and high rainfall.
- High wear tolerance – this surface will cope well under high usage hours.
- Very good heat tolerance.
- Good tolerance to salinity
- Shows good recovery following high wear activities
- Has a finer leaf and dense lateral growing habit which provides good surface traction for players.
- Typically requires lower levels of irrigation and fertiliser inputs.⁵⁸

A disadvantage of using couch grass varieties is their low tolerance for growing in heavily shaded areas. It is recommended that in fields which are heavily shaded a ryegrass (*Lolium* sp.) species is oversewn into the field surface. Ryegrasses are cool-season grasses which can survive with reduced sunlight availability and are particularly effective during the winter months.

3.1.3 Demand and capacity

Capacity is often measured in “field hours”. That is, the number of hours a field can be used before it degrades and becomes unsafe or unusable. All fields, regardless of construction, require time for maintenance and most facility managers will “block out” periods to allow for this.⁵⁹

There is significant debate within the existing literature about the “field hours” supported by different surface types. Commonly cited comparisons of capacity suggest natural turf supports around 20-30 hours per week of sporting use. Sports NZ cite high use hours for a 25-week winter period on sand based natural turf fields as around 25 hours per week, and synthetic surfaces at 40-70 hours per week.⁶⁰

⁵⁵ SportEng 2021, “What is natural turf?” *SportEng*, blog post dated 25 March 2021 <<https://blog.sporteng.com.au/what-is-natural-turf>>

⁵⁶ Lamble, P & Battam, M n.d., “Creating sustainable open spaces – using compost to deliver liveability, sustainability and economic outcomes,” technical paper prepared for OzWater.

⁵⁷ SportEng 2023, *Natural Turf Technical Advice* (Technical note, 12/07/2023).

⁵⁸ Ibid.

⁵⁹ Synthetics need to be swept, cleaned and the infill layer needs to be levelled and topped up, whereas natural turf needs mowing, irrigation, management of compaction, remarking and pesticide/herbicide use. See: WA Department of Local Government, Sport and Cultural Industries, *Natural Grass vs Synthetic Turf Study Report*, <<https://www.dlgsc.wa.gov.au/departments/publications/publication/natural-grass-vs-synthetic-turf-study-report>>

⁶⁰ Sports NZ and Jacobs 2019, *Guidance document for sports field development*, December 2019 <<https://sportnz.org.nz/media/1409/sports-field-development-guide-final-2020-1-22.pdf>> These figures are based on use analysis undertaken in 2013, and may not reflect the advances in natural turf field construction that has occurred since then.

A natural turf fields usage (training and competition) and capacity levels are categorised as:

- **Level 1** – A natural turf field (soil based) with no drainage or irrigation, winter grasses = approximately 15 to 20 hours per week.
- **Level 2** – A natural turf field (soil based) with basic drainage, irrigation and winter grasses and lighting = approximately 20 to 25 hours per week.
- **Level 3** – A natural turf field (sand profile) with full drainage, irrigation and warm season grasses and lighting = approximately 25 to 30 hours per week. This is dependent on whether the climate is conducive to sand profile growing.

It is also noted that there are other considerations that impact the level of demand and the capacity of the field and should be considered when investigating options for upgrading the capacity of an existing field. These include:

- **Lighting:** Field lighting is essential to allow extended hours of use. The capital cost of installing a synthetic field or a high-quality natural turf field, should include lights if the benefit of increased capacity for use is to be realised.
- **Scheduling issues versus available capacity:** Clubs or user groups may favour specific time slots, such as Tuesdays and Thursdays for training and Friday night for competition. This can mean that actual demand is concentrated on a few nights only. As such, providing increased capacity via a synthetic field will not necessarily solve a demand issue as it can sometimes be a scheduling challenge.
- **Alternatives to concentrating use:** As sporting demand is more of an LGA-wide issue, the level of investment proposed to install a synthetic field should be compared with alternative strategies. The capital expenditure associated with synthetic turf installation could potentially provide a greater benefit across a number of locations by increasing capacity through lighting and upgrading natural turf surfaces. This can disperse rather than concentrate use and can reduce impacts on local residents through loss of open space, increased traffic and other impacts.
- **Opportunities to “unlock” other potential open spaces:** Patterns of under-utilised open space appropriate for sporting, such as local public or private schools, present alternatives to increasing sportsground capacity using synthetic turf by ‘unlocking’ these spaces for public use by the community.

3.1.4 Benchmarking against best practice natural turf quality

The OzWater *Best practice guidelines and benchmarks for turf open space in the lower hunter* identifies the following characteristics of a healthy soil profile, and can be used to evaluate the relative quality of natural turf soil:

- Adequate soil depth (>200mm topsoil, deeper required on some sites)
- Soil is moderately friable and does not set hard (i.e. is well structured)
- Soil has acceptable nutrient balance and holding capacity
- Topsoil and subsoil have appropriately matched characteristics
- Soil is appropriately amended so that it does not limit the performance of the field or increase the irrigation requirements.

The guideline further identifies the following metrics to achieve suitable water management and drainage:

- No surface water runs onto the field from upslope areas
- Excess water that falls on the surface is removed as run-off by ensuring that the field has sufficient crossfall (1 in 7p to 1 in 100) and slope lengths less than 70m. Alternatively, a slit drainage system can remove this water at a rate of at least 8mm/hr over the entire field area
- Downward movement of water in the rootzone is not impeded by soil layers
- Excess water reaching the base of the rootzone is removed at a rate of at least 2mm/hr by the subsoil and/or a subsoil drainage system.

The G & M Connellan Consultants (2015) Best Practice Guideline for Functional Open Space in Victoria provides additional guidance on natural turf management and quality.

In the following section, the evaluation of natural turf as a product assumes that best practice design, construction and management has occurred in line with the preceding guidelines.

3.2 Established pros and cons of natural turf

Table 5 over the page summarises the pros and cons of natural turf.

Table 5 Pros and cons of natural turf

	Consideration	Established benefit	Established issue	Mitigations/caveats
Social	Social impact	Generally, more amenable to informal community use.	Generally, lower expected usage hours compared to other options at 25-30 hours per week. This can impact on the social benefits of participation in sport.	The level of informal community use depends on a range of factors, such as presence of fencing, level of programming and formal utilisation, and the extent to which a field is perceived as professional.
	Amenity (inc. noise and glare)	Natural turf reduces noise and glare when compared with synthetic turf, which can affect sports participants, other site users and neighbouring land uses⁶¹	N/A	N/A
	Health (inc. pest and disease management, player injury).	- Lower risk of heat stress, biological pathogens, microplastic ingestion and abrasion than other surface types - Lower risk of lower extremity injury	N/A	N/A
Environmental	Heat	- Natural turf is known to mitigate the urban heat island effect – providing a relatively cool and absorbent surface for users.⁶² - Cooler surface temperatures during warm months compared to synthetic turf.	N/A	N/A
	Pollution	Relatively limited pollution compared to synthetic turf. Eliminates environmental risks associated with synthetic grass microplastics.	Natural turf requires the use of toxic plant protection products (i.e., herbicides and pesticides), and these chemicals can leach into the surrounding environment, including waterways where they can encourage algal growth. Additionally, lawn mowing creates air pollution by burning diesel for fuel.	The use of natural pesticides and electric/renewable generated mowers can fully mitigate this limitation.
	Water and flooding	- High infiltration rates - Natural turf retains rainwater, acting as local basins to mitigate against flooding and serving as important pieces in local rainwater management.	High water needs – irrigation annual demand is around 8022kL/year per hectare of natural turf field.	- Creative engineering solutions, such as reusing collected rainwater and stormwater, can significantly reduce the amount of potable water required to irrigate fields.⁶³ - Recent innovation in natural grass species has can be used to create natural turf surfaces that are more durable and with lower water requirements
	Drought resistance and dry conditions	N/A	Drought and water restrictions can make it difficult to provide a safe and suitable natural grass surface for the community. During the Millennium drought, natural turf sportsgrounds across Victoria were unusable due to the prolonged implementation of water restrictions.⁶⁴ Drought are expected to become less predictable and more severe in the coming decades in Victoria due to Climate Change.⁶⁵	N/A
	Waste	Natural grass surfaces have limited end-of-life waste as they are naturally renewing and regenerating.⁶⁶	N/A	N/A
	Climate and carbon footprint	Over the lifecycle, natural turf is more carbon friendly as it actively pulls carbon out of the air through sequestration, requires less overall carbon use to produce and maintain.⁶⁷ While natural grass still contributes CO₂ through mowing and construction/maintenance, overall emissions are considerably less than synthetic turf.	N/A	N/A
	Local microenvironments and biodiversity	- Typical sportsgrounds are a somewhat monocultural environment, however natural turf is still home to local ecosystems and small-scale biodiversity. - Natural turf sportsgrounds can be used as key sites to enrich urban ecologies.⁶⁸ Strategies to improve urban biodiversity emphasise the implementation of native plantings across green spaces adjacent to natural turf sportsgrounds.⁶⁹ - The location of many Merri-bek sportsgrounds within the Merri Creek's tree-covered riparian zone, (such as De Chene Reserve and Parker Reserve) positively contributes to biodiversity outcomes.	N/A	N/A

⁶¹ WA Department of Local Government, Sport and Cultural Industries, *Natural Grass vs Synthetic Turf Study Report*, <https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>

⁶² WA Department of Local Government, Sport and Cultural Industries, *Natural Grass vs Synthetic Turf Study Report*, <https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>

⁶³ SportEng 2021, “How irrigation for Field of Play works,” *SportEng*, published 21 Feb 2021, accessed 17 May 2021, <https://blog.sporteng.com.au/how-irrigation-works>

⁶⁴ *Water for Victorians* Victorian Government Department of Water and Catchments 2016, https://www.water.vic.gov.au/_data/assets/pdf_file/0030/58827/Water-Plan-strategy2.pdf

⁶⁵ Ibid.

⁶⁶ WA Department of Local Government, Sport and Cultural Industries, *Natural Grass vs Synthetic Turf Study Report*, <https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>

⁶⁷ See Sanjaya E, Weihs, G, and Abbas A 2022, Environmental Impact of Snthetic Turf: A Life Cycle Analysis (LCA) Review and Circular Economy Perspective, in Chief Scientist and Engineer NSW, *Independent review into the design, use and impacts of synthetic turf in public open spaces*.

⁶⁸ Wheeler, M., Grossinger, R., Ndayishimiye, E., Spotswood, E., Galt, R. and Carbone, G. (2020). Sports and urban biodiversity. A framework for achieving mutual benefits for nature and sports in cities. Gland, Switzerland: IUCN and San Francisco, USA: SFEI. <https://doi.org/10.2305/IUCN.CH.2020.14.en>

⁶⁹ Wheeler, M., Grossinger, R., Ndayishimiye, E., Spotswood, E., Galt, R. and Carbone, G. (2020). Sports and urban biodiversity. A framework for achieving mutual benefits for nature and sports in cities. Gland, Switzerland: IUCN and San Francisco, USA: SFEI. <https://doi.org/10.2305/IUCN.CH.2020.14.en>

	Consideration	Established benefit	Established issue	Mitigations/caveats
Financial	Capital/construction costs	- Lower capital costs than other options at approximately \$60 + per m2 (grass and sand profile only, no surrounding infrastructure). - A 2019 study⁷⁰ that investigated the use of compost amended soils to enhance playing field outcomes suggested that the indicative cost to construct a "well-built" natural turf field was in the order of \$370,000 per hectare compared to \$1,850,000 per hectare for synthetic fields. This assessment was based on a natural turf field built with a high carrying capacity using compost to amend the soil, irrigation and a turf cultivar (variety) capable of handling high levels of wear.	N/A	N/A
	Operational/maintenance costs	The typical surface life cycle is 10 years.	- Higher performing natural turf fields require more maintenance which needs to be planned for by Council and facility owners. - Maintenance costs are higher than synthetic turf at approximately \$55,000 per year. It includes fertilising, irrigating, weed and mite control, mowing, aeration and repairs. - Irrigation contributes to this ongoing water cost (irrigation Annual Demand is around 8022kL/year per hectare – Minimum weekly irrigation of 25ml of water volume per field) - May require amendments to improve moisture retention.	Improvements to water retention and recycling can irrigate natural fields at a lower cost to facility owners.
	End of life, renewal, and replacement costs	Natural grass is self-renewing and therefore does not produce waste. As waste is biodegradable at the end of life, natural grass surfaces have almost no end of life cost.	N/A	N/A

⁷⁰ Lamble, P & Battam, M n.d, Creating Sustainable Open Spaces – Using Compost to Deliver Liveability, Sustainability, Recreation and Economic Outcomes

3.3 Further discussion

The following section outlines key issues relating to natural turf and soil management, as well as areas requiring further consideration by Merri-bek.

3.3.1 Natural turf offering enhanced social benefit and amenity

Public green space provides a diverse range of value to urban communities. Local parks have been identified as sites where communities form social ties through everyday encounters.⁷¹ Often the distinction between green spaces designed for non-sport related leisure and sports is not firm, with communities using natural turf sportsgrounds for various informal activities – picnicking, dog walking, informal sports, and so on. Further, Ives et al note that the value of urban green space can also include aesthetic/scenic value, access to nature and native plants and animals, health and therapeutic values and social interaction.⁷² Changes to local amenity are a key social consideration.

3.3.2 Atmospheric climate impacts and resilience

The impacts of atmospheric climate on natural turf surfaces have become increasingly apparent in recent years, with extreme weather events such as heat waves, droughts, and heavy rainfall leading to significant damage and decreased resilience of natural turf. As a result, there has been a growing interest in synthetic turf as an alternative that offers increased resilience and durability in the face of these climate challenges.

In their 2021 study, Dingle and Mallen analyse community-level sports clubs in Australia and Canada, through a qualitative methodology of twenty-three organisations managing grass turf sport fields exposed to climactic extremes in temperate regions of both countries (including Melbourne).⁷³

The study found that natural turf fields experience high levels of vulnerability to climate impact, through both direct damage (e.g., from extreme climate events) and indirect impacts (e.g., higher injury risks, interrupted and/or cancelled competitions, insurance risks, and higher operating and capital costs). Ultimately, the study recommended the following outcomes in relation to adaptive management to increase climate resilience:⁷⁴

- The result confirms the climate-dependence of community-level natural grass sportsgrounds in Victoria – rendering them vulnerable to extreme climate impacts.
- Community sport is particularly vulnerable to climate impacts in Australia, making sport management at this level more complex than previously understood.
- Resilience to these climate extremes is achievable through organisational adaptation. These adaptations must focus on:
 - The management of water resources, including through on-site tanks, storm water harvesting, water capture, and best practice guidelines for field irrigation
 - Grass turf resource management, including selection of grass variety (see further **Appendix C**).

3.3.3 Compost use

A recent study from Battam and Lambie has identified the potential for compost to improve natural turf performance. Specifically, the Study identified that:

- Sports fields with compost amended soils have lower water demand and more fertile soils than fields built without any soil amendment
- Natural turf fields with compost and a high wear tolerant turf cultivar offer enhanced liveability outcomes and a lower whole of life cost than synthetic turf alternatives.

⁷¹ Aleksandre K, 2013, The contributions of local parks to neighborhood social ties, *Landscapes and Urban Planning*, 109(1) 31-44. DOI 10.1016/j.landurbplan.2012.05.007

⁷² Ives et al 2014, Planning for green open space in urbanising landscapes, final report prepared for Australian Government Department of Recreation, Natural Environment Research Program, Environmental Decisions Hub, RMIT, p.7 <<https://www.environment.gov.au/system/files/pages/25570c73-a276-4efb-82f4-16f802320e62/files/planning-green-open-space-report.pdf>>

⁷³ Dingle G and Mallen C 2021, "Community sports fields and atmospheric climate impacts: Australian and Canadian perspectives", *Managing Sport and Leisure* 26:4, 301-325, DOI: 10.1080/23750472.2020.1766375

⁷⁴ Dingle G & Mallen C 2021, "Community sports fields and atmospheric climate impacts: Australian and Canadian perspectives", *Managing Sport and Leisure* 26:4, 301-325, DOI: 10.1080/23750472.2020.1766375

In advice received for this Study, SportENG have outlined the following considerations when contemplating the use of compost in a Merri-bek context:⁷⁵

- SportENG have more recently seen compost being proposed for use within sports field construction to amend rootzone sand profiles so that they can increase moisture retention as other products such as coir fibre and peat moss become increasingly harder to source.
- The main concern with compost is the inconsistency of the product and in particular the presence of large particles and non-composted plant materials such as twigs and bark. This type of material can be hard to incorporate into the growing medium during construction and can often create difficulties when levelling the field. It may also clog up the profile reducing water infiltration into the soil. For this reason, compost should only be considered as an organic amendment if the product is composted through the thermophilic stage to the mesophilic maturation stage.
- The compost should be aged for one year to assure that it is fully mature. In addition, a rootzone mixture amended with compost should meet the physical performance parameters outlined in the USGA Guidelines. The USGA Guidelines also highlight the common problem with composts is that they can vary by source and from batch to batch within a source. Extreme caution must be exercised when using compost in rootzone mixtures.
- It is important to be aware that the current Australian Standard for compost is quite broad and there is little or no data to support its use or otherwise.
- SportENG recently undertook laboratory testing on a number of sand samples, which each had varying degrees of compost added. It was found that the capillary porosity (moisture retention) of the samples did increase when a significant amount of compost was added to the rootzone sand and that there was some reduction in the hydraulic conductivity or drainage rate of the soil.
- It should be noted that in poorly performing soils the addition of compost will not overcome the performance issues of the field. Poor quality soils which have an elevated silt and clay content are usually holding excess water in the profile during the winter months and therefore an increase in the moisture retention of the profile and a reduction in the hydraulic conductivity will not be beneficial to these fields.

On this basis there is a potential use for compost in sandier soils to improve the soil, however, this would need to be explored in a case-by-case basis. A trial site in Merri-bek would be a beneficial step for Council to take before investing in the addition of compost to a full field.

3.4 Natural Turf and soil management conclusions

This chapter outlined the strengths and limitations of natural turf and described the basic soil structure and maintenance regimes required to maintain high quality natural turf sportsgrounds. Natural turf's use case is multifaceted, providing more than just a playing surface for formal sports teams. However, the benefits of natural fields must be weighed against their established limited capacity compared to synthetic fields, even with the implementation of best practice construction and management.

Key Points:

- Natural turf requires specific soil management to create and maintain a quality playing surface.
- Commonly cited capacity figures suggest natural turf supports around 20-30 hours per week.
- Vulnerable to drought conditions and water restrictions - natural turf requires irrigation to maintain a quality playing surface.
- Natural turf typically offers enhanced social benefit and amenity associated with access to nature, although must be balanced with the social benefit of access to and capacity to accommodate formal sport and recreation
- Natural turf mitigates the urban heat island effect.
- Sportsfields with natural turf are permeable surfaces, allowing water to be absorbed during rain events.
- Can contribute to positive biodiversity outcomes through integration into urban greenspace networks alongside bio-diverse plantings.
- Generally supports informal use by the community.
- Natural turf has lower up-front costs when compared to synthetic options, yet can often have higher maintenance costs.
- Natural turf can be highly vulnerable to climate impacts, although can contribute to combatting climate change by acting as carbon sinks in urban contexts.

⁷⁵ SportEng 2023, Natural Turf Technical Advice (Technical note), 12/07/2023

4.0 Synthetic turf technology

4.1 What is synthetic turf?

4.1.1 Overview

Enhancing existing open space assets is an important response to the rising demand for open space. Some facility owners are adopting synthetic turf to achieve this, particularly to enable increased use for formalised sport.

Synthetic surfaces have been considered by most major field sporting codes in NSW, with sports such as Football, AFL and Hockey seeing increased use and acceptance for these surfaces. Sporting codes and councils alike have developed “performance criteria” for these surfaces to meet appropriate standards, targeted to the dominant use of a field.

The type of synthetic turf installed will depend on the use it is intended for. For example, hockey specifies a sand-dressed pitch, while football and rugby require infill and a longer pile height. As multi-purpose sportsground use becomes a more prominent demand, further consideration of the optimal construction method that caters for a variety of uses is required.

There are a diverse range of synthetic surfaces and construction methods used for synthetic surfaces across Victoria. Synthetic turf has been through several generations and continues to evolve with new solutions and applications emerging as the industry matures. The history and development of synthetic turf options is summarised in **Table 6**.

Table 6 Summary of evolution of synthetic turf options

	History	Users
First generation (1960s-70s)	- Conceived in the 1960s by the Monsanto company. - Simple artificial short-piled turf, high density knitted nylon; first generation synthetic pitches were coarse, capable of causing friction burns and wounds unless played on wet. - Installed in the indoor Houston Astrodome due to failure of natural grass to grow under the stadium’s translucent ceiling. Other USA stadiums also tried artificial grass but returned to natural turf as synthetics were not popular with baseball players or spectators.	- Baseball - Hockey
Second generation (1980s)	- Versatile and durable pitches based on medium pile height, reduced density of fibres, and filled with sand to provide stability and improved control of ball bounce. - Adopted by English soccer clubs in the 1980s. Initially successful for community and elite level soccer, but were eventually rejected by elite soccer as ball bounced too high on synthetic turf and player footing was not reliable enough on synthetics. - First generation fields continue to be used for hockey.	- Schools - Hockey - Tennis - Soccer – community and professional
Third generation (late 1990s)	- Development of third generation synthetic carpets, which were a very acceptable surface for sports including soccer and rugby union. - Characterised by taller pile height, underlying shock pads and generally dressed with sand or rubber granules to improve stability of fibres. - Most common type of turf installed in Australian community fields	- Community - Football/Soccer - Rugby - AFL/Cricket
Fourth generation (2000s-now)	- Diversified synthetic turf carpet systems, typically used for soccer, rugby, hockey, athletics and tennis. - Alternative construction materials and methods, hybrid sports surface, removal of infill layers	- Professional level codes - Advanced community use

Source: Victoria Department of Planning and Community Development, *Artificial Grass for Sport Guide*, 2011 <https://sport.vic.gov.au/_data/assets/pdf_file/0025/55591/download.pdf>

Generally, reference to synthetic turf refers to third generation turf construction as the most common type of turf installed in Australian community fields.

There is a range of synthetic turf surface systems on the market, and the profile consists of the synthetic grass fibres, infill, backing system and shock-pad. There are variations in the following:

- Synthetic grass fibres (monofilament, fibrillated tape).
- Infill (recycled rubber, virgin rubber, organic).
- Backing systems.
- Shock-pad.

The major components of contemporary synthetic turf construction are:

- **Pavement:** This is the foundation or base and requires engineered design to ensure both appropriate drainage and a stable surface for the playing surface
- **Shock pad:** Different sports require different levels of performance for shock pads, to reduce the risk of injury in sports where players fall, slide or land from a height. Materials are commonly rubber and/or polymer based with examples of recycled natural or synthetic rubbers used by different manufacturers
- **Turf carpet or mat:** This woven mat product has artificial grass blades stitched or tufted through which are normally made of polyethylene or polypropylene. The balance between the thickness and height of the fibre and the softness is key in creating surfaces that are safe and comfortable to play on, and reducing the risk of friction burns and abrasions
- **Infill:** This is the material that helps replicate a more natural surface and keeps the blades upright, provides for grip and give and assists with drainage. The infill is usually chosen carefully to match both the length of the synthetic “blades” and the proposed uses of the surface. Infill can be comprised of many different organic and inorganic materials. different layers and products to achieve particular performance outcomes. The most common types of infill include:
 - **Crumbed/shredded rubber** made from recycled end of life tires are the most widely used and one of the cheapest infills available. Purpose manufactured plastics or “artificial rubber” are also used
 - **Sand**, usually a silica sand which has a rounder grain, is chemically stable and non-toxic, and
 - **Cork** granules are increasingly adopted being explored as a potential infill for artificial turf, as it is a natural, environmentally friendly alternative. However, cork granules are generally more expensive and tend to deteriorate at a faster rate than rubber, requiring more frequent replacement.

Figure 12 is a cross-section of the construction method and materials in a typical third generation synthetic turf.

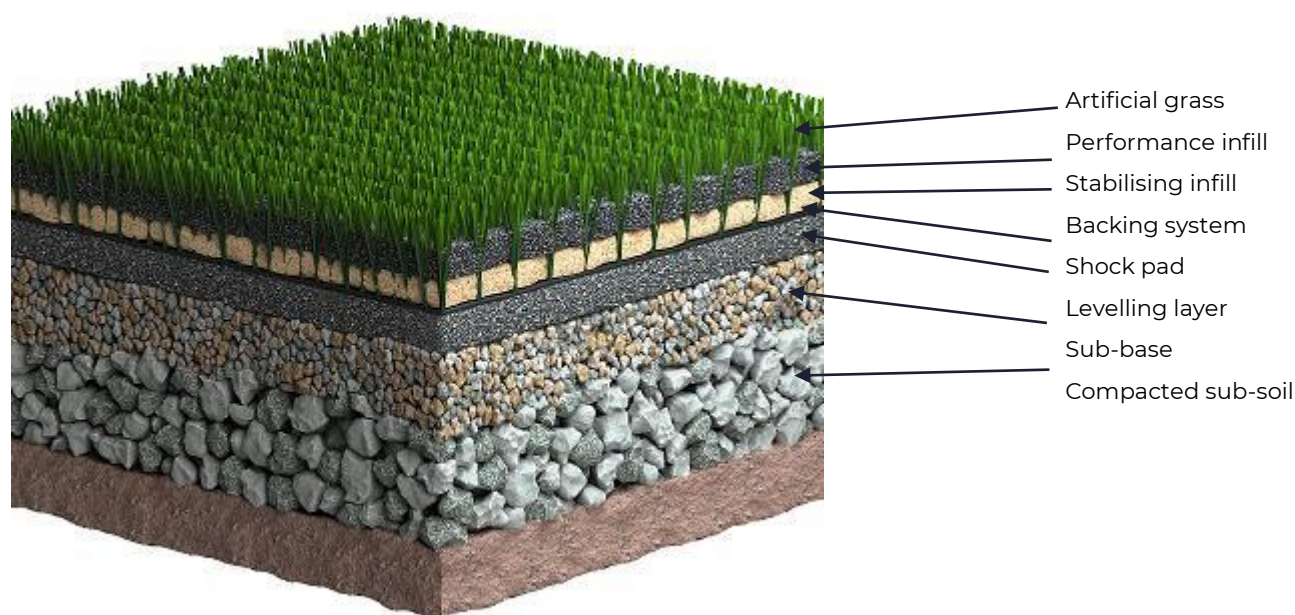


Figure 12 Typical third generation synthetic turf field construction

Source: CCGrass.

4.1.2 Demand and capacity

One of the few available solutions to address unmet demand is to increase the capacity of existing sportsground assets. This increased capacity requires a combination of lights (extending the hours of use) and upgrading the playing surface, either by conversion to synthetic turf or redevelopment as a high grade “engineered” natural turf sportsground.

A synthetic turf fields usage (training and competition) and capacity level is generally considered to support more than 40 hours per week, with some studies suggesting as much as 60+ hours per week.^{76 77}

Some of the key drivers of increased adoption of synthetic turf for sports users include:

- **Hours of use:** Synthetic turf is capable of supporting a high number of hours of use. A higher investment in maintenance costs for natural turf will be required to support higher hours of use on well-designed natural turf fields without displacing other users.
- **Consistency and quality of play:** Synthetic surfaces when maintained correctly, can provide a consistent and usable surface all year round for sport and physical activity. It should be noted that well maintained natural turf fields will also offer a more consistent and usable surface thought the year.
- **All-weather suitability:** The loss of playable hours on natural turf playing fields due to wet weather is often cited as a key reason for pursuing synthetic playing fields, ensuring consistent sport participation during the winter season when demand is typically at its highest. However, as will be discussed below, synthetic fields are significantly hotter during summer.
- **Sporting code preferences:** Some sporting codes (e.g., hockey) have a strong preference for synthetic fields compared to natural turf, as it supports improved performance. Some sporting governing bodies (i.e., International Athletic Associations Federation with Athletics, Federation of International Hockey with Hockey fields etc.) prescribe that if a particular level of game is to be played, there has to be access to an “all weather surface”.

4.2 Established pros and cons

Table 7 summarises the pros and cons of synthetic turf.

⁷⁶ Smart Connection Consultant 2019, *The smart guide to synthetic sports surfaces: Volume 1: Surfaces and standards*, p.8 < <https://www.smartconnection.net.au/wp-content/uploads/2019/11/Vol-1-Surfaces-and-Standards-v1.01.pdf> >
⁷⁷ Football NSW, 2017, *Synthetic fields: A guide to synthetic surfaces for football*, accessed 17 May 2021 < <https://footballfacilities.com.au/wp-content/uploads/sites/11/2018/10/SyntheticFields-v2-2017.pdf> >

Table 7 Pros and cons of synthetic turf

	Consideration	Established benefit	Established issue	Mitigations/caveats
Social	Social impact	• Synthetic turf can be seen as more attractive than natural alternatives due to consistency of green surface. • High quality and consistent surface, supporting higher expected usage hours than other options, has potential to support greater sporting and community use.	• Fenced synthetic fields reduce informal use of open spaces while prioritising sporting use.	• N/A
	Amenity (inc. noise and glare)	• N/A	• The aesthetic of synthetic turf is very different to and perceived as less attractive to natural turf. • Natural turf reduces noise and glare when compared with synthetic turf, which can affect sports participants, other site users and neighbouring land uses.⁷⁸	• N/A
	Health (inc. pest and disease management, player injury).	• Slightly lower risk of concussion rate on Synthetic Turf, associated with a lower -max value⁷⁹	• The higher heat load associated with most types of synthetic grass has the potential to impact on player and user comfort. Heat impacts can be severe on players and informal users,⁸⁰ especially children (heat stress, blisters, burns)⁸¹ • Considerable risk factor associated with synthetic surfaces. Biological pathogens, toxic chemicals, and micro-plastic ingestion are all risks associated with synthetic materials. • Some generations of synthetic turf (typically 1st, 2nd and 3rd) have a greater risk of abrasiveness on skin and higher injury rates. Leads to greater heat stress on players during hotter weather.⁸² • Causes more lower extremity injuries than grass fields.⁸³ • Enhances infection transmission risk.⁸⁴	• The “all weather” nature of synthetics (i.e., durability during wet weather) is frequently used as an argument in favour of synthetics – however, the heat load associated with synthetic grass may make it unusable during very hot weather. • Lower risk of concussion is only associated with well-maintained synthetic surfaces. • The higher heat load can be somewhat mitigated with watering – however this negates some of the benefit associated with water savings for synthetic turf surfaces.
Environmental	Heat	• N/A	• Synthetic turf generally absorbs, rather than reflects sunlight, causing the emission of heat. Further research is needed to evaluate the impact of heat on larger fields and the potential higher UV reflectivity of synthetic turf, generally, studies have concluded that third generation⁸⁵ synthetic turf fields can be between 1.3 -1.81 times hotter than its natural turf equivalent.^{86 8788} • Some synthetic turf, particularly those with non-organic infill (e.g., rubber) contribute to the urban heat island effect. Urban heat is increased when natural grass and trees are replaced by impervious surfaces which absorb heat. Urban heat increases heat-related health problems, particularly for children, older people, and people with chronic health conditions.⁸⁹ Climate change is intensifying this issue,⁹⁰	• Environmental impacts of synthetic fields vary substantially depending on what type they are. Older synthetic fields (generation 2 and 3) are associated with significantly higher radiant heat and environmental pollution. • Hybrid turf/profile reinforcement/combined hybrid and natural turf can reduce the heat load of fully synthetic turf; however, these have not been adequately tested in an Australian context. • Hybrid turf works ideally for use with cool season natural turf (i.e., rye grass). In Australia, we use warm season turf which is a horizontally growing grass which effectively covers the hybrid fibres rendering them useless. It will still aid profile stabilisation, but not durability.

⁷⁸ WA Department of Local Government, Sport and Cultural Industries, *Natural Grass vs Synthetic Turf Study Report*, <https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>

⁷⁹ Gosnell G et al, “Playing Surface and Injury Risk: artificial Turf Vs. Natural Grass”, *Injuries and Sports Medicine*, July 2022. DOI: 10.5772/intechopen.106615

⁸⁰ Center for Sports Surface Research. 2012. Synthetic Turf Heat Evaluation: Progress Report. University Park, PA: Center for Sports Surface Research, Pennsylvania State University.

⁸¹ *Artificial Grass for Sport*, Victoria Department of Planning and Community Development, 53.

⁸² Jim 2017, Intense summer heat fluxes in artificial turf harm people and environment *Landscape and Urban Planning*, 157. 561-576. 10.1016/j.landurbplan.2016.09.012.

⁸³ Mack CD, Hershman EB, Anderson RB, et al. Higher Rates of Lower Extremity Injury on Synthetic Turf Compared With Natural Turf Among National Football League Athletes: Epidemiologic Confirmation of a Biomechanical Hypothesis. *The American Journal of Sports Medicine*. 2019;47(1):189-196. doi:10.1177/0363546518808499

⁸⁴ Valeriani et al 2019, Artificial-turf surfaces for sport and recreational activities: microbiota analysis and 16S sequencing signature of synthetic vs natural soccer fields. *Heliyon*, 5, DOI: e02334. 10.1016/j.heliyon.2019.e02334.

⁸⁵ The most commonly installed fields in Victoria, these are characterised by taller pile heights, shock pad and are generally dressed with sand or rubber granules to improve stability, see Appendix C for more detail.

⁸⁶ *Artificial Grass for Sport*, Victoria Department of Planning and Community Development, 53.

⁸⁷ Pfautsch S, et al 2020, ‘School Microclimates’, Western Sydney University,p.3. <<https://researchdirect.westernsydney.edu.au/islandora/object/uws:57392>>

⁸⁸ Loveday J et al 2019). Seasonal and Diurnal Surface Temperatures of Urban Landscape Elements. *Sustainability*. 11. 10.3390/su11195280.

⁸⁹ See Center for Sports Surface Research 2012. *Synthetic Turf Heat Evaluation: Progress Report*, University Park, PA: Center for Sports Surface Research, Pennsylvania State University.

⁹⁰ See WSROC 2018, Turn down the heat: Strategy and action plan, <https://wsroc.com.au/media-a-resources/reports/send/3-reports/286-turn-down-the-heat-strategy-and-action-plan-2018>

Consideration	Established benefit	Established issue	Mitigations/caveats
Pollution	N/A	- The industrial processes used to manufacture and dispose of synthetic turf are further polluting source in local environments, as is the synthetic turf itself, which needs to be disposed of at the end of its economic life (see Waste section below). - Depending on the material used for the rubber infill, there can also be the potential leeching of toxic materials including Latex, Lead, and Zinc, the latter being problematically high in leachate from crumb rubber fields. While the use of heavy metals is not common, cheaper virgin rubbers used for infill may use them. - Synthetic turf playing surfaces can generate pollution in the form of rubber crumb (i.e., the recycled rubber infill commonly used for the base of synthetic turf fields) and microplastics from synthetic turf fibres. These pollutants can be ingested by players and run off into waterways and soils in the surrounding area.⁹¹ - Many existing sportsgrounds in Victoria have been delivered on flood prone land, and during extreme wet weather, can be flooded. When a synthetic turf field is flooded, microplastics and rubber crumb can leach into the surrounding area in high concentrations. The synthetic field can be rendered unusable from flood impact as well and a major refurbishment may be needed to restore infill to the field	Natural alternatives for infill, including cork, have been implemented successfully to help mitigate against the run-off issues noted for synthetic turf.⁹² At the design stage, the type and source of infill should be carefully considered to ensure safety for players and minimal impact on local environments.
Water	Synthetic turf has been associated with some water savings, as it does not require as much irrigation as natural turf.	Synthetic playing surfaces can have impacts on local stormwater systems. Synthetic turfs generally have a bitumen base, causing rainwater to collect and runoff into surrounding areas, thus changing local environments.	Some solutions have been suggested for synthetic turfs which involve the collection of rainwater in storage tanks for recycling and re-use. For example, the State Netball Hockey Centre in Parkville, Victoria uses 45 kilolitre underground tanks to store and use water, irrigating both surrounding plants and the pitches themselves, reducing water use by 80 per cent. Ivanhoe Grammar School introduced a similar system, delivering on both water and financial savings.⁹³ It should be noted however that these systems can be expensive to implement.
Drought resistance and dry conditions	Drought and water restrictions can make it difficult to provide a safe and suitable natural grass surface for the community. Most synthetics (some surfaces require watering before use) usually require less irrigation than natural turf fields.	N/A	In order to mitigate heat load issues, some watering of synthetic surfaces may be required.
Waste	N/A	The disposal of synthetic turf at the end of its useful life presents an additional environmental (and financial) challenge. Synthetic turf has a life cycle of approximately 8-10 years, requiring a disposal of materials (mostly the carpet) when refurbishment is due. It is purposefully designed to not breakdown quickly, and when it is disposed of it has the potential to stay in landfill for long periods.	- One proposed solution to address the issue of waste is the recycling of synthetic materials. However, this can be expensive, and is not factored into the life cycle costs quoted by many synthetic turf providers. - The Victorian Synthetic Recycling facility is under construction, an Australian first
Climate and carbon footprint	N/A	- There are carbon emissions associated with the production, transportation, disposal of, and maintenance of synthetic turf.⁹⁴ ⁹⁵	N/A
Local microenvironments and biodiversity	N/A	- Implementing synthetic turf sportsgrounds in these contexts may negatively impact biodiversity outcomes. Porous boundaries between natural turf sportsfields and native green spaces with native vegetation will be disrupted by synthetic barriers. - Sterilisation of soil beneath the synthetic turf has an impact on ecosystems. Synthetic surfaces inhibit living systems. - Reduces soil biota, grass seeds, and insects, which can affect biodiversity and birdlife (Bernat Ponce)⁹⁶	N/A

⁹¹ Verschoor, A.J., van Gelderen, A. and Hofstra, U 2021, Fate of recycled tyre granulate used on artificial turf. *Environ Sci Eur* 33, 27 <<https://doi.org/10.1186/s12302-021-00459>-1>

⁹²Smart Connections. The Smart Guide to Synthetic ports Fields Rubber Infill, 2017, Page 15. Available from: <https://www.kennisbanksportenbewegen.nl/?file=7504&m=1484649736&action=file.download>.

⁹³ WA Department of Local Government, Sport and Cultural Industries, Natural Grass vs Synthetic Turf Study Report, <https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>

⁹⁴ 14; citing Sahu R, 2008. 'Technical Assessment of the Carbon Sequestration Potential of Managed Turfgrass in the United States. Research Report, USA.

⁹⁵ Magnusson, Simon & Mácsik, Josef 2017, Analysis of energy use and emissions of greenhouse gases, metals and organic substances from construction materials used for artificial turf. *Resources, Conservation and Recycling*. 122. 10.1016/j.resconrec.2017.03.007.

⁹⁶ Wheeler, M., Grossinger, R., Ndayishimiye, E., Spotswood, E., Galt, R. and Carbone, G. (2020). Sports and urban biodiversity. A framework for achieving mutual benefits for nature and sports in cities. Gland, Switzerland: IUCN and San Francisco, USA: SFEI. <https://doi.org/10.2305/IUCN.CH.2020.14.en>

	Consideration	Established benefit	Established issue	Mitigations/caveats
Financial	Capital/construction costs		- The high initial capital cost of synthetic turf is often seen as a barrier to installation. The difference in capital cost between natural turf fields and synthetic playing fields is typically more than three times higher when compared with natural turf.⁹⁷ - As of 2021, a rubber in-fill synthetic football field of 7,810sqm costs approximately \$1,300,000 or \$166 per sqm. This includes allowances for design, site establishment, base pavement, and the provision of a shock pad. This cost excludes the costs for fencing, lighting, and player dugout areas.⁹⁸	- Capital costs for synthetic playing fields can vary depending on site establishment requirements, facility size, and specifications including the provision of a shock pad and supporting infrastructure such drainage systems, player dugouts, spectator fencing, security fencing and lighting. - The local conditions of a candidate site can have a significant impact on costs or viability, as issues such as flooding, overland flow, past use as landfill and mitigating pollutant runoff, can all increase capital cost significantly. - Partial installation/combined natural and synthetic turf can reduce the cost of delivery of synthetic surfaces.
	Operational/maintenance costs	- Lower ongoing maintenance cost at approximately \$40,000 per year. - Irrigation not always required.	The more that the surface is used, the more maintenance it requires.	N/A
	End of life, renewal, and replacement costs	N/A	- As a general guide, synthetic playing field surfaces will require placement every 8 to 10 years with the shock pad requiring replacement approximately every 20 to 25 years. As of 2021, the cost to remove and dispose of the existing synthetic surface (carpet) and replace with new is approximately \$390,000 for a football (soccer) field or approximately \$52per sqm. Shock pad replacement costs approximately \$180,000.⁹⁹ - High disposal cost at time of asset renewal.	N/A

⁹⁷ WA Department of Local Government, Sport and Cultural Industries, Natural Grass vs Synthetic Turf Study Report, <https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>

⁹⁸ Adapted from the Smart Guide to Synthetic Sports Surfaces, 2019. Smart Connection

⁹⁹ Adapted from the Smart Guide to Synthetic Sports Surfaces, 2019. Smart Connection

4.3 Further discussion

The following section outlines key issues relating to synthetic turf technology, as well as areas requiring further consideration by Merri-bek.

4.3.1 Economic considerations

Other economic considerations that may have an impact on replacing natural turf with synthetic turf include:

- **Valuing lost use hours due to extreme weather:** Intense rainfall can mean that natural turf is not useable for certain periods of time and these lost hours should be considered in any assessment of options. A well-designed natural turf field with good drainage systems will recover quickly from extreme rainfall but will still lose “useable hours”. A synthetic designed properly can be used immediately after a high rainfall event and therefore the cost of “lost hours” would be less. Conversely, in extreme heat events, which are becoming more frequent, a natural turf field will remain playable for longer due to the cooling and heat absorption properties of the grass. Synthetic surfaces are significantly hotter and will have more lost hours from heat load and the need to protect players.
- **Potential improved revenue performance of synthetic fields:** As synthetic fields are perceived to be higher quality, more consistent and more “professional” surface by some sports it is possible that a facility owner can charge a higher hourly rate for use than for grass. This ability to charge more, a willingness from sports to pay more, and the promise of less down times from high rainfall events means that a better revenue projection may be attributable to synthetics. The decision around what level of cost recovery applies to access fees for sporting fields and facilities is subject to policy and strategy settings which are unique to each local government or facility manager. A potential impact to be considered with pricing strategies may be that a higher revenue model is used to support a business case, and this then can act as a cost barrier to sporting use and increase demand for/use of the cheaper natural turf fields.

Although synthetic surfaces have a high construction cost, their increased playing capacity and perceived lower maintenance cost is often the economic basis for the implementation of synthetic fields. The comparison of options is based on assumptions about the user hours that different surfaces can accommodate. As discussed above, a more detailed analysis of actual demand and recent research regarding increased capacity of natural turf may change some of the assumptions which have been used to support the economic rationale for synthetic turf implementation.

Typically cost benefit and business case assessments do not include a consideration or valuation of the disbenefit generated by converting natural grass to synthetic. While there are no currently accepted frameworks for valuing this “cost”, local government stakeholders and recent media articles¹⁰⁰ have raised the following as impacts that should be included in any review of options:

- Loss of locally accessible open space
- Loss of amenity in the local open space network
- Synthetic surfaces acting as a disincentive for informal active and recreation use.

4.3.2 Changes to amenity

It was noted in the literature that the amenity and aesthetics of an open space can be negatively affected by the conversion of natural grass to synthetic turf. Examples noted include:

- **Heat:** Unlike natural turf, which mitigates urban heat island and provides a relatively cool surface for users, particularly in summer, synthetic turf generally absorbs, rather than reflects sunlight, causing the emission of heat. This can reduce the amenity of an open space for all users, including sporting players and informal users of the site. This was a core concern raised by stakeholders and community groups during the planning process of Hosken Reserve, Coburg North.¹⁰¹ Heat is a particular concern in the Victorian context, where summer day often exceed 30 degrees and extreme heat events are expected to become more frequent due to climate change.¹⁰² Although there is limited academic research on heat impacts of synthetic sportsgrounds in an Australian context, researchers from Western Sydney University recently published a report detailing the heat profiles of different materials across

¹⁰⁰ Power, J 2021, “Fake grass may be greener, but much hotter and less friendly to environment,” *The Sydney Morning Herald*, 14 March 2021, accessed 17 May 2021 < <https://www.smh.com.au/national/nsw/fake-grass-may-be-greener-but-much-hotter-and-less-friendly-to-environment-20210312-p57a95.html> >

¹⁰¹ Climate Action Morland 2021 < <https://climateactionmoreland.org/2021/04/11/synthetic-turf-and-the-tragedy-of-the-commons-in-moreland/> >

¹⁰² Department of Environment, Land, Water and Planning, *Victoria's Climate Science Report*, September 2019, < https://www.climatechange.vic.gov.au/_data/assets/pdf_file/0029/442964/Victorias-Climate-Science-Report-2019.pdf >

schools in Western Sydney.¹⁰³ Chief amongst the reports 20 recommendations was to avoid the use of synthetic turf in unshaded areas, with surface temperatures reaching 20+ degrees above the ambient air temperature on 30+ degree days.

- **Aesthetic considerations:** Synthetic turf fields provide a consistent green surface, while natural turf open spaces can be of variable quality depending on their construction and maintenance regime. However, community views expressed on social media have shown preference for the visual appeal of natural turf – citing its natural look and feel compared to synthetic turf, using the hashtag ‘#grassnotplastic’.¹⁰⁴
- **Connection to nature:** Spending time in nature is proven to reduce symptoms of stress, anger, depression, and fatigue, and lead to increases in happiness. Exposure to nature is linked to improved wellbeing by helping to restore attention and break routine in daily life, and by promoting recovery from stress. Emotional responses to aesthetically pleasing stimuli, such as public open spaces, also tend to decrease physiological arousal, thus making us feel relaxed.¹⁰⁵ Replacing natural grass with synthetic materials reduces connection to nature, and the associated feelings of relaxation and restoration.
- **Noise abatement, glare reduction and UV reflectivity:** Natural grass also reduces noise and glare when compared with synthetic turf, which can affect sports participants, other site users and neighbouring uses.¹⁰⁶

4.3.3 Climate credentials of synthetic products

BACF Corporation Eco-Efficiency Analysis in 2010 found that synthetic fields were 15 per cent lower in life cycle energy and raw materials and generation of solid waste over a 20-year average life cycle of natural grass fields.¹⁰⁷ Recent innovations in lifecycle sustainability for synthetic turf are expected to become available in the near-term future. As of January 2023, Sustainability Victoria received funding to build Australia’s first synthetic turf recycling hub with a processing capacity of 7,680 tonnes per annum. The goal is to generate a circular economy that reduces landfill and greenhouse gas emissions associated with synthetic turf.¹⁰⁸

Building circular economies to manage the waste produced by synthetic turf will likely have a positive impact on the climate credentials of synthetic turf. However, the infrastructure and logistics needed to support synthetic turf recycling are still in the early phase of development in Victoria. Ultimately, more complete lifecycle assessments comparing natural turf with the many synthetic options and recycling initiatives is needed before any conclusions on carbon can be drawn.

4.3.4 Perceptions of operational costs

There is a common perception that synthetic playing fields require limited maintenance and hence lower operating costs. However, this is often not the case. Many synthetic playing fields require significant levels of maintenance, and in some cases higher levels of maintenance compared to natural grass alternatives:

*It is often widely believed that synthetic turf fields require less ongoing maintenance than natural grass. Even though they do not require watering and mowing they do have an extensive maintenance protocol, particularly if used regularly for a multitude of sports events or for elite level sport. Such maintenance is critical if the surface is to achieve its optimum performance, and full lifespan. Usually the installer’s guarantee or warranty will usually be conditional on the recommended maintenance requirements being carried out.*¹⁰⁹

Maintenance requirements for synthetic fields can include:

- Cleaning, stain, and debris removal
- Grooming and drag/power brushing

¹⁰³ Pfautsch S, Rouillard S, Wujeska-Klaue A, Bae A, Manea A, Tabassum S, Staas L, Ossola A, Holmes K, Lieshman M 2020, School Microclimates, Western Sydney University, <https://researchdirect.westernsydney.edu.au/islandora/object/uws:57392>

¹⁰⁴ Save Hosken Reserve 2021, <https://www.facebook.com/savehoskenreserve>

¹⁰⁵ Bhullar, N 2019, “We know contact with nature makes you feel better. Can virtual contact do the same?” *The Conversation*, 19 June 2019, < <https://theconversation.com/we-know-contact-with-nature-makes-you-feel-better-can-virtual-contact-do-the-same-111752>

¹⁰⁶ WA Department of Local Government, Sport and Cultural Industries, *Natural Grass vs Synthetic Turf Study Report*, <https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>

¹⁰⁷ Smart Connections. The Smart Guide to Synthetic ports Fields Rubber Infill, 2017. p/16, available from: <https://www.kennisbanksportenbewegen.nl/?file=7504&m=1484649736&action=file.download>.

¹⁰⁸ Sustainability Victoria 2023, “Funded project – Building Australia’s first Synthetic turf Recycling hub” *Sustainability Victoria*, <https://www.sustainability.vic.gov.au/projects/australias-first-synthetic-turf-recycling-hub>

¹⁰⁹ WA Department of Local Government, Sport and Cultural Industries, *Natural Grass vs Synthetic Turf Study Report*, <https://www.dlgsc.wa.gov.au/department/publications/publication/natural-grass-vs-synthetic-turf-study-report>

- Moss and algae prevention and removal
- Weed removal and herbicide application
- Line marking
- Check and top up infill levels (filled surfaces only)
- Joints and seam inspections
- Irrigation – some surfaces still require water to maintain a consistent moisture level in the sub-base material and to prevent movement and to improve playability, and
- Maintenance of drainage and runoff capture systems.
- The cost of the maintenance equipment is also a substantial contributor to the operating cost.

4.3.5 Toxicity and environmental hazard

The NSW Synthetic Turf Review has undertaken a comprehensive review of issues relating to pollution and end of life disposal, based on the latest evidence including from leading Australian researchers and government agencies. Key findings in relation to potential sources of pollution and environmental and/or human health impacts, where applicable to a Merri-bek context, include:

- **PAH and metals:** There is disagreement in the literature regarding the safety of some chemicals commonly found in synthetic turf products, particularly PAHs. The NSW Synthetic Turf Review (Chief Scientist, 2023) identifies that although current literature indicates that leachates from synthetic turf including heavy metals and PAHs are within acceptable limits for human health, the growing awareness of the health risks that these substances present in and of themselves (i.e., whether in a synthetic turf context or otherwise) warrant careful attention and further research. It is noted that the US EPA has listed 16 PAHs as chemicals of concern, with the EU restricting concentrations of eight of these PAHs to under 20mg/kg in crumb rubber used as infill material in synthetic turf products.
- **Microplastics:** The NSW Synthetic Turf Review (Chief Scientist, 2023) has concluded that the preliminary studies suggest that microplastics from synthetic turf fields may contaminate surrounding social and drainage systems, with unknown health impacts.¹¹⁰ This is based on research undertaken by Palanisami. NSW Health further advocate for the application of a precautionary approach to microplastics runoff, due to the existing information gaps.¹¹¹
- **PFAS:** The NSW Synthetic Turf Review (Chief Scientist, 2023) has identified that although the concentrations of PFAS in synthetic turf products are highly variable, generally environmental and health impacts would be minimal as remaining within safe limits. However, the NSW Technical Advisory Group to which the Review relies does express the need to undertake targeted health studies in the context of synthetic turf, through the use of enHealth guidance on risk assessment and the Australia Water Quality Framework.

Overall, the authors of the present Study suggest that an absence of conclusive human and environmental risk should not prevent precautionary measures being taken to minimise the presence of PFAS in synthetic turf products in Merri-bek, given that there is a demonstrated correlation with health effects (notwithstanding a lack of demonstrable associated disease). The United States Environmental Protection Agency is in the process of characterising player exposure to toxins related to synthetic turf products, which is due to be released soon. Council is encouraged to monitor for this report as well as the evolving literature on the human and environmental effects of toxins found in these products.

4.3.6 End-of-life disposal

The most common methods used internationally to recycle or dispose of synthetic turf at its end of life are:

- Separation and mechanical recycling (chemical recycling is currently under research)¹¹²
- Disposal to landfill
- Incineration to produce energy.

¹¹⁰ See further Health Impact of Synthetic Turf (Artificial Grass) in NSW Chief scientist & Engineer 2022, Independent review into the design, use and impacts of synthetic turf in public open spaces Final Report, *NSW Chief Scientist & Engineer*

¹¹¹ NSW Health, Health Impact of Synthetic Turf (Artificial Grass), in NSW Chief scientist & Engineer 2022, Independent review into the design, use and impacts of synthetic turf in public open spaces Final Report, *NSW Chief Scientist & Engineer*

¹¹² Reciturf: turning fake lawn green (2021) <https://circulareconomy.europa.eu/platform/en/news-and-events/all-news/reciturf-turning-fake-lawn-green>

The NSW Synthetic Turf Review (Chief Scientist, 2023) identifies that:

- Australia's first synthetic turf recycling facility is being established in Victoria and is expected to be operational in 2023 with a reported processing capacity of 7,000 tonnes of used turf annually. The company reports an intent to process a mix of sporting fields and domestic surfaces using mechanical recycling techniques.
- Incineration is not a viable option in an Australian context due to regulation.
- Disposal to landfill is a costly option for local Councils, with exporting or recycling the end-of-life waste generally viewed as a more efficient option.

It is important to note that, although recycling of materials used in synthetic turf products may be possible theoretically,¹¹³ this is not always an available option for local Councils due to associated cost and access to suitable recycling facilities.

The first synthetic turf recycling facility is being developed in Victoria by Tuff Group and RE4ORM and is expected to be operational in 2023. The reported processing capacity is 7,680 tonnes of used synthetic turf carpet per year, with a goal of recovering 98 percent of raw materials. The Initiative received a \$500,000 from Sustainability Victoria. Recycling processes seek to recover sand and rubber for reuse. Plastic is intended to be pelletised and sold as a recycled material input for third-party manufacturing processes.¹¹⁴

4.4 Synthetic turf technology conclusions

This chapter examined the strengths, limitations, and key characteristics of synthetic turf. Synthetic turf options have evolved considerably over the past few decades, becoming more amenable to formal sports userbases. Far from being a one-dimensional material, the diverse range of application and evolving sustainability management strategies demonstrates a need for a considered approach to synthetic options.

Key points:

- **Synthetic turf is an evolving product that is responsive to the changing needs of a diverse range of sports.**
- **Can support 40-70 hours of use a week, depending on a range of factors.**
- **Higher upfront cost than natural turf, but with lower maintenance costs over lifecycle.**
- Sporting code preference for this turf amongst some winter sports such as Hockey, and acceptance amongst other major codes such as AFL, Cricket and Football.
- **Negative impact on heat island effect.**
- **Surface absorbs and radiates heat making use during hot days potentially unsafe.**
- **Negative impacts on biodiversity.**
- **Loss of amenity for local community and informal sports due to synthetic sportsgrounds typically being publicly inaccessible (depending on its design).**
- **Higher CO2 lifecycle emissions and environmental waste.**
- **The cost effectiveness of synthetic turf vis a vis natural turf depends on its actual level of use.**

¹¹³ See, eg., Jazbec, M. and Florin, N. (2022) Synthetic Turf in Public Spaces – Chemical composition of materials. A summary report prepared for the Office of the NSW Chief Scientist & Engineer by Institute for Sustainable Futures, 8-10.

¹¹⁴ Sustainability Victoria 2023, Funded project – Building Australia's first Synthetic Turf Recycling Hub, Accessed <<https://www.sustainability.vic.gov.au/projects/australias-first-synthetic-turf-recycling-hub>>

5.0 Alternative turf technology

5.1 What is alternative turf?

In addition to natural and synthetic turf, there are emerging alternative turf technological solutions and management techniques to enhance the capacity of existing open space assets. Some of these technologies include:

- **Hybrid turf profile:** Hybrid turf involves a combination of both natural turf and a synthetic turf fibre product. There are three ways in which a hybrid turf profile can be established:
 - In-situ grown mat laid system.
 - In-situ stitched system.
 - “Ready-to-play” hybrid turf rolls.

This system combines blades of synthetic grass with natural turf to provide a consistent playing surface, improved surface durability and stability.¹¹⁵ The hybrid system is still relatively new to Australia with only a few installations of a system including by Melbourne City Football Club training facility (discussed below). The system has become a popular option for international sporting codes such as the English Premier League and National Football League. This system is more durable than natural turf, due to the presence of synthetic grass fibres that provide traction even if natural grass is worn. However, hybrid turf can impede typical maintenance practices required for natural turf (in particular deep aeration/ decompaction), and further research is required to understand maximum carrying capacity of hybrid playing fields.

Examples of a hybrid turf systems in the Australian context include: Melbourne City Football Club training facility. This is a high usage field, utilised by the Club and international soccer teams requiring a training pitch. The Club required an elite-quality, consistent surface, and originally requested two elite pitches to enable them to rotate high wear usage, but the site constraints meant there was insufficient space available. SportEng designed a large square hybrid turf tablet, consisting of a proprietary product called DESSO Grassmaster.

- **Profile reinforcement:** In addition to hybrid systems, it is possible to incorporate synthetic elements within the soil or rootzone layer to improve the durability and stability of natural turf and reduce divoting (i.e., holes made in grass by sports activities, e.g. rugby scrums). Examples include:¹¹⁶
 - Fibre system, whereby various types of synthetic fibre are mixed into the soil or sand into which natural grass is grown, improving root stability.
 - Mesh-based system, where either a mesh or shredded mesh is mixed into the root zone area to stabilise the natural grass fibres.
- **Combining natural and synthetic turf:** some councils are exploring combining some high use areas of natural turf fields (e.g., the cricket wicket at the centre of an oval, around goal mounts) with synthetic turf (or a blend of both natural and synthetic), to improve durability without needing to convert the entire field. This approach is also used in elite facilities, for example the playing surface at Bankwest Stadium in Parramatta consists of a high-quality natural turf pitch, but synthetic grass is used around the pitch to maximise the extent of vehicular traffic without damaging the natural turf surface.

¹¹⁵ SportEng 2018, *SportEng Field of Play Surface Profiles*.

¹¹⁶ Smart Connection Consultancy 2019, *The Smart Guide to Synthetic Sports Surfaces: Volume 2: Football Turf – Synthetic and Hybrid Technology*, p.

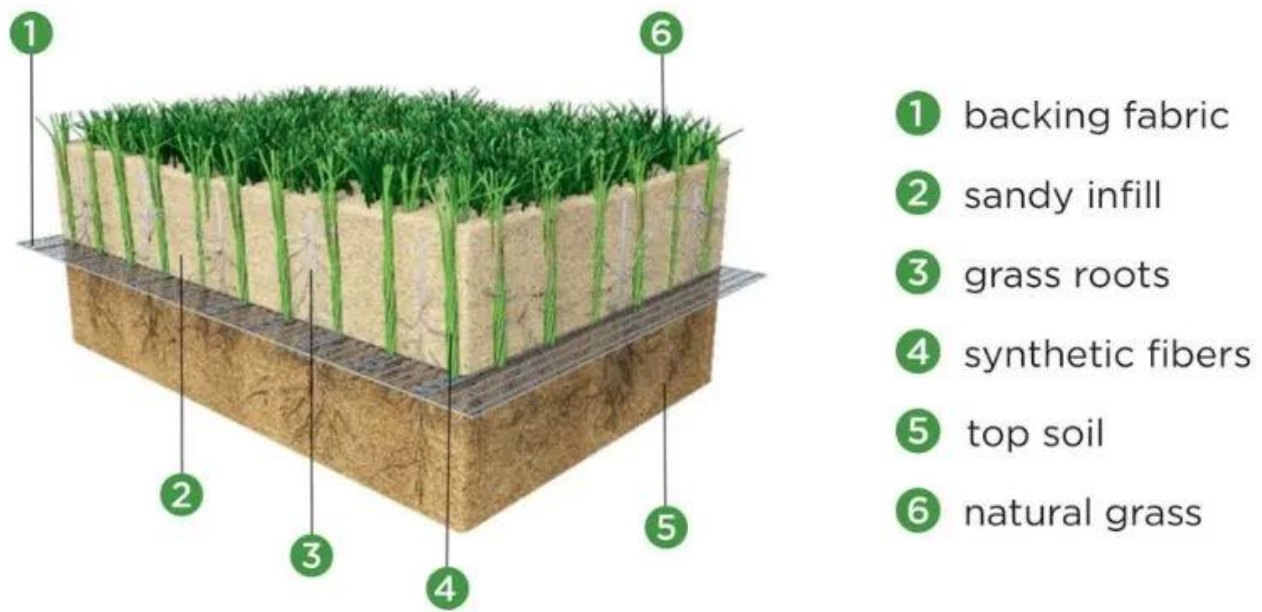


Figure 13 Example hybrid turf field construction

Source: Ekip grass 2023, <https://ekipgrass.net/what-is-hybrid-grass-turf/>

5.2 Established pros and cons

The annual maintenance costs for a single hybrid playing field are approximately 60% higher than a rubber or cork filled synthetic due to the need to maintain both natural turf and synthetic elements.¹¹⁷

Advantages:

- More durable and higher usage hours than natural turf surface. Hybrid turf may be used 30-40 hours a week, depending on the system¹¹⁸
- Improved playing surface stability and load-bearing capacity compared to natural turf
- Increased wear tolerance compared to natural turf
- Can be utilised as a 'ready-to-play' turf product
- Generally unnoticed by the user
- High infiltration rates
- Cooler surface temperatures during warm months compared to synthetic turf.
- Contributes to carbon capture.

Disadvantages:

- Higher ongoing maintenance costs at approximately \$55,000 per year¹¹⁹
- High capital cost at approximately \$160+ per m² (grass, synthetic and sand profile only excluding inground services or surrounding infrastructure)¹²⁰
- Higher ongoing maintenance costs at approximately \$55,000 per year¹²¹. Maintenance is similar to natural grass fields however with an increase in aeration processes such as verti-draining. An annual renovation is also required.

¹¹⁷ Based on comparison costs outlined in the 2019 Sport New Zealand report- *Guidance Document for Sports Field Development*

¹¹⁸ SportEng 2018, *SportEng Field of Play Surface Profiles*.

¹¹⁹ SportENG Technical Note 2023

¹²⁰ Ibid.

Specialised machinery and a 7-day program is developed to remove existing organic layer ready for re-establishing sward over a 7-8 week period.¹²¹

- Requires irrigation (ongoing water cost)
- Mostly used for stadiums and elite facilities
- A potential source of microplastics (e.g., “turf” fibres)
- The profile can feel ‘harder’ than a natural turf surface
- May limit maintenance works options
- Irrigation Annual Demand 9625kL/year per hectare.
- Recycling hybrid turf is generally seen as more complex and costly, where natural turf is combined with synthetic materials due to the need to separate these components out.¹²²

5.3 Local growing conditions and hybrid turf

Local growing conditions, including the type of turf grass utilised, has a pronounced effect on the efficacy and practicality of utilising hybrid turf options. Hybrid turf works ideally for use with cool season natural turf (i.e., rye grass). In Australia, Councils typically use warm season turf which is a horizontally growing grass which effectively covers the hybrid fibres rendering them useless. It will still aid profile stabilisation, but not durability.

It is understood that much of the research on hybrid turf options is at present unsettled. Considerations include:

- Lack of Australian research, including in cooler Victorian growing conditions
- Existing research, largely from the United States, has a focus on cool season turf species.
- The research is inconclusive and contested. Practitioners in the field tend to disagree on the precise extent of capacity and durability benefits associated with hybrid turf, particularly when transferring research in one context to another (for example, from NSW to Victoria).

In this context, hybrid turf is not seen as an immediately viable option for Council, as opposed to synthetic technology or best practice natural turf. The high expense associated with hybrid products, attracting some of the disadvantages of both natural turf (e.g., irrigation) and synthetic turf (e.g., microplastics) without solid research in a Victorian context suggesting that it is a feasible option for local Council. For example, while the Matildas field does utilise hybrid turf on a winter grass, this is noted to be highly expensive and requires extensive management that is likely out of the capability and funding of local council.

¹²¹ SportENG Technical Note 2023

¹²²NSW Chief scientist & Engineer 2022, Independent review into the design, use and impacts of synthetic turf in public open spaces Final Report, *NSW Chief Scientist & Engineer* .

5.4 Alternative turf technology conclusions

This chapter examined the strengths, limitations, and key characteristics of alternative turf technology. Ultimately this section concluded that in Merri-bek's context, hybrid turf is not seen as an immediately viable option for Council.

Key points:

- **There are three main types of alternative turf technology and management approaches. These are a hybrid turf profile, natural turf profile reinforcement, and the use of synthetic turf in high wear areas of a natural turf field.**
- Hybrid turf is commonly touted as an alternative to natural and traditional synthetic surfaces as it is seen as being more durable and providing higher usage hours than natural turf without the associated high surface temperatures and environmental impacts of synthetic products.
- **Higher ongoing maintenance cost and capital cost, associated with the complexity of the product and the need for ongoing irrigation**
- **Complexities in relation to the recycling and sustainable end-of-life disposal of hybrid turf products limit its use in Australia.**
- Local growing conditions in Merri-bek substantially limit the potential for hybrid turf to form a suitable alternative, due to its expense and lack of suitability with warm season grasses.

6.0 Aligning with best practice

6.1 Alignment with State Sporting Association Standards

Over the last ten years, the Victorian Government together with peak bodies of major field sports have developed preferred facility guidelines including for natural turf fields. The following links are provided to facility guidelines for each major field sport.

- AFL <https://www.aflvic.com.au/facilities-funding/afl-preferred-facility-guidelines>
- Football Victoria <https://footballvictoriafacilities.com.au/facility-guides/>
- Cricket Australia <https://www.community.cricket.com.au/clubs/running-your-club/facilities-and-infrastructure/facilities-guidelines>
- Rugby League <https://www.playrugbyleague.com/media/12508/nrl-preferred-facility-guidelines.pdf>

6.1.1 Synthetic turf guidance

Sport and Recreation Victoria have produced the Artificial Grass for Sport Guide¹²³ to assist councils, peak sporting bodies, clubs and schools in the planning, design, project delivery, management and maintenance of an artificial grass project.

The development of guidance for the use of synthetics in cricket and AFL was undertaken in 2007. The AFL, along with Cricket Australia, Sport and Recreation Victoria and JLT Trustees, commissioned the University of Ballarat to determine whether specific criteria could be developed for the use of synthetic grass in football and cricket. The University of Ballarat developed a set of criteria that would enable synthetic turf to mimic the performance characteristics of natural turf.

Since the development of the standards the AFL and Cricket Australia has established a licensing program to that ensures the quality of products being manufactured from a performance and longevity perspective and that the products comply with safety and insurance requirements.

It is important to note that Football-Soccer can use AFL and cricket standard synthetic turf fields, however FIFA synthetic turf standards do not meet the AFL and cricket standards. FIFA has recently introduced new Quality Performance Standards for synthetic turf fields.¹²⁴ These guidelines and standards provide detailed design advice and testing requirements to achieve certification.

6.1.2 Overview

The following table provides an overview of the different state sporting association standards, including specific guidance and level of support for the three main sportsground surface options.

Figure 14 State sporting association standards - overview

Code	Natural turf	Synthetic turf	Alternative turf
AFL	• Supports natural turf, although notes lower capacity • Playing field maintenance to reflect local environmental requirements and the standard of play • Subject to 'fit for play' oval inspection undertaken by both teams and officials prior to any games being played • To incorporate adequate sub-surface drainage and irrigation, and recommended use of drought resistant grasses,	• Supports the use of synthetic turf • Synthetic Turf Product Certification System for AFL/CA	• The capacity of natural turf can also be supported by the use of synthetic or hybrid turf surfaces in high traffic areas, such as goal squares, rather than full investment into synthetic oval installation or oval resurfacing.

¹²³ Sport and Recreation Victoria 2011, *Artificial Grass for Sport Guide*, accessed < https://sport.vic.gov.au/_data/assets/pdf_file/0020/56414/artificial20grass20for20sport20guide2028pdf2c202317kb29.pdf >

¹²⁴ FIFA, 2022, *FIFA Quality Program for Football Turf*, <<https://www.fifa.com/technical/football-technology/standards/football-turf>>

Code	Natural turf	Synthetic turf	Alternative turf
Football Victoria	Supports natural turf, with extensive guidance on construction and management	- Supports the use of synthetic turf, with extensive guidance on construction and management - Notes community concerns and design considerations	Support for hybrid turf, including partial installation in high wear areas such as goal square, centre bounces, soccer boxes, linesman runs, and cricket run-ups
Cricket Victoria	- Supports natural turf, with a preference for warm season grasses. - Some guidance on construction and management	- Supports the use of synthetic surface playing fields - Synthetic Turf Product Certification System for AFL/CA	Generally a consideration for synthetic pitch covering during winter season to protect the cricket pitch and for the safety of winter sport participants.
Rugby League	Supports natural turf, with some guidance on construction and management	Synthetic turf may be used for rugby league games, provided they meet the synthetic turf field standards outlined in the 'National Rugby League's Performance and Construction Standards for Synthetic Turf'	Supports appropriate sports floodlighting and strategic lighting

Source: Ethos Urban

6.2 Innovative management approaches

6.2.1 Improved data collection and analysis for facility owners

New technologies and approaches are offering facility owners improved data on the status and usage of sportsgrounds, enabling councils to better target maintenance, manage peak use and quiet periods, scheduling, and planning for use.

Examples of such technology include:

- Intelligent Play:** Intelligent Play is a system from the UK that uses machine learning and artificial intelligence to monitor sportsground use. The system works by mounting sensors above the perimeter of the sportsground to capture any usage of the field, and provide in-depth data about the status of the field, including the numbers of players using the field, which areas have been used, and how this translates to maintenance requirements.¹²⁵ There is value in this type of system for maximising use of both natural and synthetic turf sportsgrounds, however it is understood to be relatively expensive to implement.
- Telstra usage data:** Some local governments have partnered with Telstra to understand open space use, by installing sensors in open spaces which “ping” when people with mobile phones enter the space. This data can help to provide a more holistic picture of usage on a field, to better target maintenance or plan future upgrades, as well as to understand the diversity of uses on a field – other than organised sport, where clubs maintain registers of users.

6.2.2 Managing usage

Local governments around Australia have been testing innovative approaches to managing usage and reducing pressure on high-wear areas of a natural turf field, including around the goal mouths. Some approaches include:

- Strategically lighting the field at night and in the evening, to draw users away from areas of the field that require rest. For example, lighting the perimeter of a field to enable low-impact activities such as jogging or dog-walking along the edges, while discouraging use of the centre of a field for informal games.
- Shifting the location of the pitch through changing line markings to shift the area of play and help rotate high-wear areas.
- Smart scheduling and hire agreements can also manage usage by effectively balancing diverse users of the field to reduce the intensity of the use of the field.

¹²⁵ Intelligent Play n.d., FAQs, *Intelligent Play*, accessed 16 May 2021 <<https://www.intelligent-play.com/faqs/>>

6.2.3 Utilisation of spaces and siting considerations

There are a number of siting and planning considerations to alleviate pressures on existing fields and improve the quality and availability of open spaces in Merri-bek. These include:

- Sharing of funds to mitigate the anomalies associated with council boundaries impacting best case siting for synthetic fields
- Limiting the over-concentration of synthetic fields in specific areas to ensure that all residents have access to a natural open space close to where they live while also providing sufficient opportunities for formal sport
- Consider the potential for brownfield sites to support the provision of synthetic fields, including on hard surfaces such as rooftops
- Construct synthetic fields away from waterways and sensitive natural areas
- Reconsider private and education uses of open spaces, such as public and private schools, and golf courses, to allow community use and maximise existing natural surface options
- Concentration of synthetics in purpose built, regional scale facilities to maximise usage and ensure adequate supporting infrastructure.

6.3 Managing natural turf

Managing natural turf is a complex field of agronomy, although there are a number of common elements which must be considered. While each site must be treated individually with a tailored management approach, key considerations include:

- Maintaining regular maintenance practices
- Identification of issues limiting field performance at individual sites to develop tailored maintenance activities
- Aeration
- Adequate nutrition and effective control of weeds
- Regular independent soil testing to ensure nutrition requirements are being met.

Additionally, there may be a number of misconceptions regarding the management of natural turf that impact on its continuing use as a viable option for higher-intensity fields. The table below draws on Hunter Water leading practice guidance on some of the more common misconceptions.

Table 8 Common misconceptions impacting natural turf field management practices

Common misconception	Comment from best practice guidance
The best soil for turf is sand or 80:20 mix	It is unsuitable because it is too sandy for community fields
Using new turfgrass variety will give the best performance	Needs to be verified using small scale trials in high wear areas.
All fields require drainage	For drainage at an acceptable rate, waterlogging issues can be overcome using techniques that do not require slit drainage
All fields require automatic irrigation, and the sprinklers need to throw “head-to-head” coverage	May not be efficient or effective if not installed properly

Source: Hunter Water (in press). Best Practice Sporting Fields: A guide for turf surfaces in the Lower Hunter; Lamble, P., Askew, S. and Battam, M. (2022). Best practice guidelines and benchmarks for turf open space in the lower hunter. OzWater22

6.3.1 Organic management practices

While the existing literature on the use of organic fertilisers, insecticides and fungicides on natural turf is relatively limited and predominantly refers to turf species not commonly used in Australia, some potentially relevant findings include in relation to:

- The maintenance of warm season turfgrasses with organic and non-synthetic pesticides and fertilisers¹²⁶

¹²⁶ <https://www.proquest.com/docview/2410817329/8EEDBFDB27764ACCPQ/189>

- Utilising organic amendments for general suppression of dollar spot on creeping Bentgrass turf¹²⁷
- Effect of organic fertilisers on the greening quality, shoot and root growth, and shoot nutrient and alkaloid contents of turf-type endophytic tall fescue, *Festuca arundinacea*.¹²⁸

In advice received for this Study, SportENG have noted the following considerations applying to organic products:¹²⁹

- Often these products can have a lower efficacy and/or strike rate.
- There are some organic products which can overtime create a 'seal' over the field surface which can reduce water and oxygen infiltration into the profile.
- There can be community backlash over the strong smell of some organic products.

6.4 Synthetic turf mitigation

The production of synthetic turf products with the use of more organic materials is being explored by a number of manufacturers as a potential method to avoid the environmental and health impacts of synthetic turf surfaces.

Examples of such products include:

- Biobased synthetic turf (SYNLawn, 2017). Polyethylene can be produced from a sugar cane (SYNLawn) that is sustainably grown under environmental, social and industrial practices. The synthetic turf is combined with soy-based (EnviroLoc) backing technology making it a completely biobased synthetic turf.
- The use of infill to reduce or eliminate SBR. Options include the use of EPDM and TPE, and plant-based materials such as cork, coconut husks, a combination of organic materials or organic-manufactured combinations which can be composted.
- The use of yam blends to eliminate infill microplastics and reduce the heat associated with rubber infill.¹³⁰

However, it is important to fully appraise how the use of such surface types alters the typical cost equation and its impact on intensity of use to ensure that decisions are made on a site-by-site basis.¹³¹

It is recommended that Council continues to monitor the development of alternative synthetic turf construction methods and materials, including but not limited to:

- Monitoring of field performance for the pilot trial of a fully recyclable and compostable synthetic turf system at EHS'85 in Emmen, in collaboration with the Dutch Ministry of Health, Welfare and Sport.¹³²
- The effectiveness of drainage upgrades planned for natural turf fields in the NSW Central Coast.¹³³

6.5 Construction on Reactive Soils

6.5.1 Site investigation and requirements

An important initial step to determine the type of field that is required is to investigate and understand the following three aspects:

- Environmental Conditions - including soil type, water quality and availability and local climate.
- Recreational Needs – what is the current/forecast use of the field over the next 5-10 years? Which sports are to be played and at what levels e.g., junior soccer and senior cricket? What volume of use will these sports require e.g., elite level and 10 hours per week or community level at 25 hours per week?
- Maintenance Provision – The capacity for the field to be maintained to ensure the benefits of the capital expenditure and Client requirements are realised is critical. If the resources for maintenance are lower than required, it is likely that the field won't perform to level required which may result in increased reputational risk or increased cost to rectify poor condition field conditions e.g. turf replacement due to high wear.

¹²⁷ Beckley C and Roberts J 2021, Utilizing organic amendments for general suppression of dollar spot on creeping bentgrass turf, *International turfgrass society research journal*, 14(1). DOI: 10.1002/its2.55

¹²⁸ Cheng Z, Salminen S and Grewal P 2009, Effect of organic fertiliser on the greening quality, shoot and root growth, shoot, nutrient and alkaloid content of turf – type endophytic tall fescue, *Festuca arundinacea*, *Annals of applied biology*, 156(1), DOI: 10.1111/j.1744-7348.2009.00357.x

¹²⁹ SportEng 2023, *Natural Turf Technical Advice* (Technical note, 12/07/2023).

¹³⁰ See, eg., SportENG 2021, Dawn of the 4th Generation synthetic turf systems in Australia

¹³¹ See, eg., Smart Guide 4: Synthetic Sports Surfaces (Challenges, Perceptions and reality) (2021) Smart connections consultancy.

¹³² Sportsfields.info (2021) <https://sportsfields.info/world-first-biodegradable-artificial-turf-field/>

¹³³ Central Coast Football (2022). CCF Invests \$260,000 in field drainage upgrades. <https://ccfootball.com.au/2022/09/28/ccf-invests-in-260000-field-drainage-upgrades/>

A thorough and agreed understanding of the above aspects will better inform the type of field that is required and can be sustained for its expected period of useful life (20-25 years for natural turf fields).¹³⁴ As an example if the field is to accommodate a moderate level of community level junior sport it may be acceptable to provide a field that has surface undulations (+/- 50mm) which can be managed via maintenance practices such as aeration and topdressing however if the field is required to host regional or elite level play it may be unacceptable to have such variances and therefore the design and associated costs of the field will increase to match the demands of the environmental conditions and recreational needs.¹³⁵

6.5.2 Construction

When undertaking construction on reactive soils the use of a capping layer over the poor-quality soils is highly recommended. Reactive soils have a high clay proportion and will shrink when dry and swell when wet which creates movement beneath the surface. A capping layer protects the subgrade from rainfall and weathering and therefore restricts any shrinking and/or swelling from occurring. It is important that in sites where reactive soils are found extra budget is put aside to account for the increased cost of adding a capping layer to a project.¹³⁶

Perched Water Table (PWT) profile designs are also highly recommended for sites where reactive soils are present. A PWT (see Figure 2) consists of a rootzone sand layer over a drainage gravel layer. This profile is often recommended on reactive sites as it does not require any trenching into the reactive subgrade for subsoil drainage pipes. Utilising a flat panel drainage system (e.g., MegaFlo™) the pipes can instead sit on top of the subgrade within the drainage gravel layer. Whenever there is trenching into a reactive subgrade there is an increased risk of surface movement and undulations forming on the field over time.¹³⁷

6.5.3 Maintenance

When attempting to minimise undulations across an existing field surface the most effective maintenance practice is sand topdressing of the low field areas. Depending on the extent of the undulations this may need to be undertaken multiple times, no more than 10mm of topdressing sand should be applied at any one time. When undertaking sand top dressing it is imperative that the sand being used to topdress is a well-draining sand product with minimal fine materials.¹³⁸

6.6 Key findings for application in Merri-bek

Ultimately, this research found several management methods employed by councils in Australia to better drive utilisation and cost efficiency, including improved data collection and analysis, methods to manage usage, and strategic siting considerations.

Key points:

- There are a number of code-specific guidelines and standards which apply to both natural and synthetic turf
- Improved data collection and analysis, and the strategic management of use, can improve decision-making and ensure that existing fields are fully utilised.
- Siting will be critically important for Merri-bek. Positioning any new synthetic turf field, if pursued, away from waterways and sensitive natural areas and prioritising brownfield sites within the centre urban area of the LGA will assist in limiting the potential environmental impacts of synthetic products.
- There are a range of natural turf management practices which can improve the performance of natural turf fields. Trialling solutions, and closely monitoring the results, will assist Merri-bek in making informed steps towards improving its natural turf fields.
- There are some potential mitigations for synthetic turf fields to improve its environmental and human health accreditations. Merri-bek Council should monitor the development of alternative synthetic turf construction methods and materials.
- There are a range of options available to Merri-bek to counteract reactive soils and undulating typologies. The path chosen will depend on the individual requirements of single sites.

¹³⁴ SportEng 2023, *Natural Turf Technical Advice* (Technical note, 12/07/2023).

¹³⁵ Ibid.

¹³⁶ Ibid.

¹³⁷ Ibid.

¹³⁸ Ibid.

7.0 Conclusion

7.1 Key findings

The follow section summarises the key findings from this Study.

7.1.1 Merri-bek context

Quality public open spaces make for liveable, sustainable, and healthy neighbourhoods. In the context of growing sporting demand in Merri-bek associated with population growth, increasing urban density, and an increasing diversity of sport participants (including demand for informal use/community recreation) decision-making surrounding the type of surface needed to accommodate growing demand is critical (see **Section 2.1 – 2.2**).

Demand modelling for inner Melbourne has pointed to a clear deficit of fields across all sports that will grow significantly over the next 20 years. This demand, driven by population growth and a deficit in the delivery of new sporting grounds to match, remains challenging to meet because of the spatial constraints in inner Melbourne and the predominance of other growth needs. This comes in the context of divided community sentiment regarding synthetic turf surfaces (see **Section 2.3**) and complexities in relation to Merri-bek's climatic, geotechnical, and environmental conditions (see **Section 2.4**).

The key issues for Merri-bek arising from this context include (see **Section 2.5**):

- The need to balance the social benefit of increasing community participation in sport and recreation with competing priorities such as the growing impact of climate change on our community, adverse impacts of some sportsground surfaces on water quality and urban heat, and council's commitment of Zero Waste to Landfill by 2030 as well as some community opposition and concern in relation to the social, environmental, and economic impacts of synthetic turf.
- Merri-bek has high biodiversity values along Merri Creek, is subject to increased flooding events exacerbated by climate change and is subject to moderate-high levels of urban heat. In this context, the decision around type and location of sportsground surface takes on an increased importance.
- Concern over the loss of access to open space and the need to accommodate for diverse users, both formal and informal, is a consideration for both the decision to implement synthetic turf playing surfaces and the design of fields in a way that allows for multipurpose use.
- Modelling capacity can differ substantially from actual demand. When considering which sporting field surface to use, an accurate understanding of actual demand is needed.
- Synthetic turf is only more economically efficient from a cost per hour basis over the 15-year lifespan of sportsgrounds when actual demand and usage is optimised, providing for about 54-60 hours per week.
- The research on player injury is not settled, although suggests differences between playing surface products, which must be considered in decision-making.

7.1.2 Natural Turf

Natural turf is multifaceted, providing more than just a playing surface for formal sports teams. However, the benefits of natural fields must be weighed against their established limited capacity compared to synthetic fields, even with the implementation of best practice construction and management.

7.1.3 Synthetic Turf

Synthetic turf options have evolved considerably over the past few decades, becoming more amenable to formal sports userbases. Far from being a one-dimensional material, the diverse range of application and evolving sustainability management strategies demonstrates a need for a considered approach to synthetic options in strategic locations.

7.1.4 Alternative Turf

Ultimately this section concluded that in Merri-bek's context, hybrid turf is not seen as an immediately viable option for Council due to local growing conditions and financial constraints. However, profile reinforcement and the combination of natural and synthetic turf in high-use areas is generally supported as a viable option.

7.1.5 Aligning with best practice

This chapter examines innovative management approaches and alignment with state sporting association guidelines to ensure that guidance for Merri-bek considers the latest guidance. Ultimately this section found several management methods employed by Councils in Australia to better drive utilisation and cost efficiency, including improved data collection and analysis, methods to manage usage, and strategic siting considerations.

7.1.6 Key issues for further discussion

The Study has identified clearly both the established evidence on the benefits and limitations of different turf options, as well as areas where research is unsettled and/or entails complexity or nuance in decision-making.

The following issues are noted to need further discussion with Council and the community to determine relative significance when making policy decisions:

- When and to what extent the established social and environmental disadvantages of synthetic turf are outweighed by the social benefit of participation in sport and recreation. This includes the need to include social risk and impact into calculations of fiscal cost.
- Although synthetic surfaces have a high construction cost, their increased playing capacity is often the economic basis for the implementation of synthetic fields. The comparison of options is based on assumptions about the user hours that different surfaces will accommodate, and the level demand. As discussed above, a more detailed analysis of actual demand may change some of the assumptions which have been used to support the economic rationale for synthetic turf implementation.
- Financial equity and the extent to which the level of investment proposed to install a synthetic field is compared with alternative strategies across the LGA. The capital expenditure associated with synthetic turf installation could potentially provide a greater benefit across a number of locations by increasing capacity through lighting, natural turf surface upgrades, scheduling changes, unlocking existing private open space, and the various innovative management techniques, as outlined in **Section 6.2**.
- Decisions relating to the use of public open space are contested and involve nuanced decision-making for individual contexts. Given the complex social, economic, environmental, and governance considerations attached to synthetic alternatives to natural grass playing surfaces, each site must be treated on its own accord with a thorough understanding of the potential impacts and benefits to the community.
- The decision is not as simple as a dichotomy between a natural turf and synthetic option. There are complex considerations relating to the management and design of natural turf, and the management and type of synthetic product, which makes the decision less obvious. Understanding the full range of options available and the comparative impacts and benefits can enable clearer decision-making.
- Stakeholders have various, often competing, perspectives on the best decision which are sometimes motivated by perceptions of impact and value attached to both natural turf and synthetic turf solutions. Communicating clearly with the community, sporting users, and other stakeholders is vital – emphasising that these decisions do not mean that somebody 'loses', but can be made in a way that benefits all of the community who access the space.

These discussion points will guide conversations with the community and key stakeholders to enable a considered response. The accompanying policy and decision-making framework will navigate the complexities raised by these issues to guide a well-considered approach to holistic ground management that addresses the diverse needs of the Merri-bek community

7.2 Recommendations

Based on the findings of this Study, the following recommendations are made:

- To ensure that Merri-bek City Council fully understands the applicability of natural and emerging synthetic turf technology to its soil and climatic conditions before making substantial investment, conduct temporary trials of shortlisted surface types in selected high-wear areas, accompanied by comprehensive evaluation and open reporting.
- The Policy and decision-making framework should give weight to:
 - The precautionary principle. It is noted that, particularly with respect to the environmental and human health impacts of synthetic turf products, the precautionary principle is being increasingly relied upon by governments across the world to assist in mitigating against unforeseen or uncertain impacts.
 - Site-specific decision-making. The study has identified that, particularly when it comes to the design and construction of sportsgrounds and the maintenance of natural turf, every site comes with its own set of

challenges and limitations. Undertaking site-specific analysis is needed to ensure that the root cause of poor performance for natural turf is explored, to enable informed decision-making for the field.

- Strategic investment that considers financial equity. Value for money in terms of increasing intensity of use should consider strategic opportunities across the sportsground network as a whole to ensure that decisions create a return on investment that justifies the cost of mitigating any associated environmental and health impacts.
- Engage a technical review of the Study on select issues or themes requiring deeper exploration to inform Merri-bek's decision-making. The issues or themes should be identified in close liaison with the community and key stakeholders. This review will ultimately inform a further, regular update to the Policy to ensure that it remains up-to-date with the evolving evidence-base.

7.3 Limitations

Several limitations are noted to provide context to this Study:

- Due to the breadth of material covered by this Study, the inclusion criteria needed to accommodate a diverse range of research methods or standards across different health themes where exposure risks were still being established.
- For some topics, there is a paucity of studies investigating the wider and more indirect implications of synthetic turf use in general. For example, the contribution of synthetic turf to heat island effects and possible heat-related health impacts is limited. As such the authors relied on inferred findings from more tangential studies that considered the negative environmental impacts of impervious surfaces or the positive cooling effects of natural grass.
- This Study does not attempt to provide an exhaustive summary of the literature covering every topic in detail, but rather selected the most relevant, robust evidence available for each critical theme either because of its relevance to Merri-bek or where it was subject to competing views in the industry, academia and amongst the community.
- The analysis conducted is contingent upon the availability and quality of extant literature on sportsground surfaces. Disparities in the recency, comprehensiveness, or rigour of these studies could impinge upon the robustness of the conclusions drawn from this Study.
- The conclusions drawn in this Study are contextually bound to the circumstances under which constituent studies were executed. Variations in geographical, climactic, demographic, or other parameters could curtail the applicability of extant study findings in a Merri-bek context and must be treated with caution.
- This Study's reliance on secondary data, given the lack of primary, locally sourced data, should be supplemented in future with context-specific insights.
- This Study presents a temporal snapshot. The turf space and research on this topic is fast evolving. Any research emerging post-completion of this Study will not be captured, necessitating ongoing update and review.

7.4 Next steps

This stage of the process has been intended to provide the evidentiary scaffolding for the development of a policy, decision-making framework, and to guide engagement with the community and council stakeholders around key issues.

Specifically, the following next steps will be undertaken:

- Consultation with the community and key stakeholders.
- Deliver a draft Merri-bek Sportsground Turf Policy. This Policy will outline the vision and objectives for sportsground surface management and the principles guiding Council decision-making in alignment with key existing policies and procedures. It is based on the principle of ...
- Deliver the decision-making framework: clearly outlining the implications of choices for policy decisions based on the evidence in this Study, including a quantitative multi-criteria tool and scenario testing tailored to the Merri-bek context.
- Presentation to Merri-bek Councillors.

Appendix A Reference list

- Anderson J 2002, Lower extremity injuries in Youth Sports, *Pediatric Clinics* 49(3) DOI: [https://doi.org/10.1016/S0031-3955\(02\)00010-X](https://doi.org/10.1016/S0031-3955(02)00010-X)
- Beckley C and Roberts J 2021, Utilizing organic amendments for general suppression of dollar spot on creeping bentgrass turf, *International turfgrass society research journal*, 14(1) DOI: 10.1002/its2.55
- Aleksandre K, 2013, The contributions of local parks to neighborhood social ties, *Landscapes and Urban Planning*, 109(1) 31-44. DOI 10.1016/j.landurbplan.2012.05.007
- Aquino, K Wise, A Velayutham, S Parry, K Neal, S 2020. The right to the city: outdoor informal sport and urban belonging in multicultural spaces. *Annals of Leisure Research*. 25(4) 472-490. DOI 10.1080/11745398.2020.1859391
- Backman, E Svensson, D, and Danielski, I 2023. The Changing Landscape of Sport Facilities: Consequences for Practitioners and the Environment. In Svensson D, Buckman E, Hedenborg S, and Sorlin S (Eds) *Sports, Performance and Sustainability*. Routledge
- Battam, M & Lamble, P 2021, *Best Practice Natural Turf Fields*, presented at PLA NSW, presentation provided to NSW DPIE.
- Bhullar, N 2019, "We know contact with nature makes you feel better. Can virtual contact do the same?" *The Conversation*, 19 June 2019, accessed 16 May 2021 < <https://theconversation.com/we-know-contact-with-nature-makes-you-feel-better-can-virtual-contact-do-the-same-111752>>
- Center for Sports Surface Research 2012. *Synthetic Turf Heat Evaluation: Progress Report*, University Park, PA: Center for Sports Surface Research, Pennsylvania State University.
- Cessnock City Council 2020, *Weston Bears Park Draft Masterplan*, Cessnock City Council < <https://www.cessnock.nsw.gov.au/Council/Have-your-say/Weston-Bears-Park-Draft-Masterplan>>
- City of Sydney 2016, *Open space, sports and recreation needs study 2016*, November 2016 < <https://www.cityofsydney.nsw.gov.au/surveys-case-studies-reports/open-space-sport-recreation-needs-study-2016>>
- City of Sydney 2021, "More synthetic sports fields for longer playing hours," *City of Sydney News* < <https://news.cityofsydney.nsw.gov.au/articles/more-synthetic-sports-fields-for-longer-playing-hours>>
- Cheng Z, Salminen S and Grewal P 2009, Effect of organic fertiliser on the greening quality, shoot and root growth , shoot, nutrient and alkaloid content of turf – type endophytic tall features, *Festuca arundinacea*, *Annals of applied biology*, 156(1), DOI: 10.1111/j.1744-7348.2009.00357.x
- Clearinghouse for Sport 2022, *Ausplay results, VIC data tables*, released November 2022 < https://www.clearinghouseforsport.gov.au/_data/assets/pdf_file/0010/1077544/AusPlay-National-Sport-and-Physical-Activity-Participation-Report-November-2022-V2.pdf >
- Climate Action Morland 2021 <<https://climateactionmoreland.org/2021/04/11/synthetic-turf-and-the-tragedy-of-the-commons-in-moreland/>>
- Department of Environment, Land, Water and Planning, *Victoria's Climate Science Report*, September 2019, < https://www.climatechange.vic.gov.au/_data/assets/pdf_file/0029/442964/Victorias-Climate-Science-Report-2019.pdf
- Department of Planning and Environment 2019, *Greater Sydney Outdoors Study*, June 2019.
- Dingle G & Mallen C 2021, "Community sports fields and atmospheric climate impacts: Australian and Canadian perspectives", *Managing Sport and Leisure* 26:4, 301-325, DOI: 10.1080/23750472.2020.1766375

Eddie R 2020, Coburg North residents blindsided by plans to cover oval in artificial turf, *The Age*, <<https://www.theage.com.au/national/victoria/coburg-north-residents-blindsided-by-plans-to-cover-oval-in-artificial-turf-20201005-p5621q.html>>

As will be explored further below, the social dimensions of synthetic turf are under researched compared to the environmental and economic aspects.

European Commission 2020, *European Chemicals Agency launches public consultation on the restriction of microplastics intentionally added to products* < https://ec.europa.eu/growth/content/european-chemicals-agency-launches-public-consultation-restriction-microplastics_en>

Football NSW 2017, *Synthetic fields: A guide to synthetic surfaces for football*, accessed 17 May 2021 <<https://footballfacilities.com.au/wp-content/uploads/sites/11/2018/10/SyntheticFields-v2-2017.pdf>>

Football NSW 2021, *Synthetic fields continues to grow across NSW*, <https://footballnsw.com.au/2021/03/24/synthetic-fields-continues-to-grow-across-nsw/>

Football NSW n.d., *Increasing capacity with synthetics: The impact of investing in synthetic pitches on the operation of a club*, provided to NSW DPIE during stakeholder workshops.

Football NSW nd., *Multi-sport facility: A win for football: How working with multiple sports has provided positive outcomes for all involved*, provided to NSW DPIE.

Friends of Gardiner Park 2021, *Questioning the Minister, Rob Stokes, Save Gardiner Park – Banksia NSW 2216*, 9 March 2021, accessed 10 June 2021 <<https://savegardinerpark.wordpress.com/2021/03/19/questioning-the-minister-rob-stokes/>>

Friends of Lane Cove National Park & STEP Inc 2021, *Installation of Synthetic Grass Field at Norman Griffiths Oval, West Pymble*, provided to NSW DPIE.

GANSW 2017, *Greener Places – draft for discussion* <<https://www.governmentarchitect.nsw.gov.au/resources/ga/media/files/ga/discussion-papers/greener-places-discussion-draft-2017-11.pdf>>

GHD for Horticulture Innovation Australia Limited 2020, *Living turf fire benefits study – Literature review, April 2020* <<https://www.horticulture.com.au/globalassets/hort-innovation/resource-assets/tu17008-literature-review-living-turf-fire-benefits-study.pdf>>

Gosnell G, Gerber B, Guyton G, and Gould, P 2022, *Playing Surface and Injury Risk: artificial Turf Vs. Natural Grass, Injuries and Sports Medicine*. DOI: 10.5772/intechopen.106615

Greenwich Community Association Inc 2021, *Submission to Synthetic Turf Study*, provided to NSW DPIE.

Inner West Council 2021, *Henson Park Upgrade, Inner West*, accessed 16 May 2021 <<https://www.innerwest.nsw.gov.au/develop/council-run-works-and-projects/park-building-and-streetscape-projects/upcoming-and-ongoing-projects/henson-park-upgrade>>

Intelligent Play n.d., *FAQs, Intelligent Play*, accessed 16 May 2021 <https://www.intelligent-play.com/faqs/>

Ives et al 2014, *Planning for green open space in urbanising landscapes*, final report prepared for Australian Government Department of Recreation, Natural Environment Research Program, Environmental Decisions Hub, RMIT < <https://www.environment.gov.au/system/files/pages/25570c73-a276-4efb-82f4-16f802320e62/files/planning-green-open-space-report.pdf>>

Jazbec M and Florin N 2022, *Synthetic Turf in Public Spaces – Chemical composition of materials. A summary report prepared for the Office of the NSW Chief Scientist & Engineer by Institute for Sustainable Futures*, 8-10

Jim Y 2017, *Intense summer heat fluxes in artificial turf harm people and environment*, *Landscape and Urban Planning*, 157, pp 561-576. 10.1016/j.landurbplan.2016.09.012.

- Lamble, P & Battam, M n.d., Creating sustainable open spaces – using compost to deliver liveability, sustainability and economic outcomes, technical paper prepared for OzWater.
- Lundstrom, M, Wolfe, E, FairWarning 2019, "The dangerous pileup of artificial turf", *The Atlantic* December 20, 2019 <<https://www.theatlantic.com/science/archive/2019/12/artificial-turf-fields-are-piling-no-recycling-fix/603874/>>
- Mack D, Hershman E, Anderson R, Coughlin M, McNitt A, Sendor R, Kent R 2018, Higher Rates of Lower Extremity Injury on Synthetic Turf Compared With Natural Turf Among National Football League Athletes: Epidemiologic Confirmation of a Biomechanical Hypothesis, *The American Journal of Sports Medicine*, 47(1) DOI: 10.1177/0363546518808499
- Magnusson, Simon & Mácsik, Josef. (2017). Analysis of energy use and emissions of greenhouse gases, metals and organic substances from construction materials used for artificial turf. Resources, Conservation and Recycling. 122. 10.1016/j.resconrec.2017.03.007.
- Marsili L et al. 2014. "Release of polycyclic aromatic hydrocarbons and heavy metals from rubber crumb in synthetic turf fields: preliminary hazard assessment for athletes." *Journal of Environmental & Analytical Toxicology* 5:2, 265; *Artificial Grass for Sport*, Victoria Department of Planning and Community Development.
- Massey, R "Use of Tire Crumb in Recreational Settings: Science and Policy Implications", *University of Massachusetts Lowell*, <<https://www.proquest.com/docview/2409236730/75F43810CAF84D70PQ/2>>
- Massey, R, Pollard, L, Jacobs, M, Onasch, J and Harari, H 2020, "Artificial Turf Infill: A Comparative Assessment of Chemical Contents", *NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy* 30(1) 10–26, <<https://journals.sagepub.com/doi/pdf/10.1177/1048291120906206>>
- May, C 2021, "Physical activity," *Clearinghouse for Sport* <<https://www.clearinghouseforsport.gov.au/kb/physical-activity>>
- Moreland City Council 2021, *Estimated population and forecast growth in Moreland*, p.1 <<https://www.merri-bek.vic.gov.au/globalassets/areas/researchlib-6733/revised-population-forecast-brief-january-2021.pdf>>
- Ngatuvai M, Yang J, Kistamgari S, Collins C, and Smith G 2022 Epidemiological comparison of ACL injuries on different playing surfaces in high school football and soccer, *The Orthopaedic Journal of Sports Medicine*, 10(5), DOI: 10.1177/23259671221092321
- NSW DPE 2021, *NSW Synthetic Turf Study*, <<https://www.planning.nsw.gov.au/-/media/Files/DPE/Reports/Policy-and-legislation/Synthetic-Turf-Study-Final-Report.pdf?la=en>>
- NSW Chief scientist & Engineer 2022, Independent review into the design, use and impacts of synthetic turf in public open spaces Final Report, *NSW Chief Scientist & Engineer*
- Open space strategy 2012-2022, *Moreland City Council*, <<https://www.merri-bek.vic.gov.au/globalassets/key-docs/policy-strategy-plan/open-space-strategy-2012-22.pdf>>
- Open Space Strategy for Metropolitan Melbourne 2021*, Department of Energy, Environment and Climate Action, 2021 <https://www.environment.vic.gov.au/_data/assets/pdf_file/0025/520594/Metro-Open-Space-Strategy-FA4-book-WEB.pdf>
- Pfautsch S, Rouillard S, Wujeska-Klaue A, Bae A, Manea A, Tabassum S, Staas L, Ossola A, Holmes K, Lieshman M 2020, School Microclimates, *Western Sydney University*, <<https://researchdirect.westernsydney.edu.au/islandora/object/uws:57392>>
- Power, J 2021, "Fake grass may be greener, but much hotter and less friendly to environment," *The Sydney Morning Herald*, 14 March 2021, accessed 17 May 2021 <<https://www.smh.com.au/national/nsw/fake-grass-may-be-greener-but-much-hotter-and-less-friendly-to-environment-20210312-p57a95.html>>
- Ramboll 2020, "Comparative Analysis of Major Companies within Artificial Turf Recycling and Treatment", report for Nordic Alpha Partners ApS, April 2020 <https://bekogr.se/wp-content/uploads/2020/09/NAP_comparative-analysis-ATR_30-4-2020-1.pdf>

- Reciturf: turning fake lawn green, 2021 <<https://circulareconomy.europa.eu/platform/en/news-and-events/all-news/reciturf-turning-fake-lawn-green>>
- Sahu R 2008, *Technical Assessment of the Carbon Sequestration Potential of Managed Turfgrass in the United States*. Research Report, USA.
- Sanjaya E, Weihs, G, and Abbas A 2022, Environmental Impact of Synthetic Turf: A Life Cycle Analysis (LCA) Review and Circular Economy Perspective, in Chief Scientist and Engineer NSW, *Independent review into the design, use and impacts of synthetic turf in public open spaces*.
- Save Hosken Reserve 2020 < <https://www.facebook.com/savehoskenreserve> >
- Save Hosken Reserve 2022, *more than 900 have signed our petition* <<https://www.facebook.com/savehoskenreserve>>
- Scott, C 2015, *A brief guide to the benefits of urban green spaces* < https://leaf.leeds.ac.uk/wp-content/uploads/sites/86/2015/10/LEAF_benefits_of_urban_green_space_2015_upd.pdf>
- Shalat S 2017, "Why artificial turf may truly be bad for kids", *The Conversation* March 24, 2017 <<https://theconversation.com/why-artificial-turf-may-truly-be-bad-for-kids-72044>>
- Smart Connection Consultancy 2017, *The Smart Guide to Synthetic sports Fields Rubber Infill* <https://www.kennisbanksportenbewegen.nl/?file=7504&m=1484649736&action=file.download>
- Smart Connection Consultancy 2019, *The Smart Guide to Synthetic Sports Surfaces: Volume 1: Surfaces and standards*, p.8 < <https://www.smartconnection.net.au/wp-content/uploads/2019/11/Vol-1-Surfaces-and-Standards-v1.01.pdf>>
- SportEng 2018, *SportEng Field of Play Surface Profiles*.
- SportEng 2021, "What is natural turf?" *SportEng*, blog post dated 25 March 2021 <https://blog.sporteng.com.au/what-is-natural-turf>
- SportEng 2023, *Natural Turf Technical Advice* (Technical note, 12/07/2023).
- Sportsgrounds and facilities n. d., *Active Morland*, <https://activemoreland.com.au/recreation/moreland-group/activemoreland/home/sport-in-merri-bek/sportsgrounds-and-facilities>
- Sport and Recreation Victoria 2011, *Artificial Grass for Sports*, Department of Planning and Community Development https://sport.vic.gov.au/_data/assets/pdf_file/0025/55591/download.pdf
- Sports NZ and Jacobs 2019, *Guidance document for sports field development*, December 2019 < <https://sportnz.org.nz/media/1409/sports-field-development-guide-final-2020-1-22.pdf>>
- Stephens T 2022, *Keep Moreland's reserves accessible for all, Get Up by me*, < <https://me.getup.org.au/petitions/keep-moreland-s-reserves-accessible-for-all>>
- Sydney Water 2011, *Best practice guide for holistic open space turf management in Sydney* <https://www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mdq1/~edisp/dd_045253.pdf>
- Synthetic Turf Council 2016, *Executive Summary Catalogue of Available Recycled Rubber Research* http://cymcdn.com/sites/www.syntheticurfCouncil.org/resource/resmgr/docs/st_c_cri_execsummary2016-0303.pdf
- Verschoor, A.J., van Gelderen, A. & Hofstra, U 2021, "Fate of recycled tyre granulate used on artificial turf". *Environ Sci Eur* 33, 27, <https://doi.org/10.1186/s12302-021-00459-1>.
- Victoria Department of Planning and Community Development 2011, *Artificial Grass for Sport*, accessed 16 May 2021 < https://sport.vic.gov.au/_data/assets/pdf_file/0025/55591/download.pdf>

Water for Victorians Victorian Government Department of Water and Catchments 2016, <
https://www.water.vic.gov.au/__data/assets/pdf_file/0030/58827/Water-Plan-strategy2.pdf>

WA Department of Local Government, Sport and Cultural Industries n.d., *Natural Grass vs Synthetic Turf Study Report*,
< <https://www.dlgsc.wa.gov.au/departments/publications/publication/natural-grass-vs-synthetic-turf-study-report>>

Waters C 2022, Turf war treaty: Council keep some parkland for community use, *The Age*, <
<https://www.theage.com.au/national/victoria/turf-war-treaty-council-keeps-some-parkland-for-community-use-20220418-p5ae8f.html>>

Wheeler, M, Grossinger, R, Ndayishimiye, E, Spotswood E, Galt R and Carbone G, 2020, Sports and urban biodiversity. A framework for achieving mutual benefits for nature and sports in cities. Gland, Switzerland: IUCN and San Francisco, USA: SFEI DIO:10.2305/IUCN.CH.2020.14.en

WSROC 2018, *Turn down the heat: Strategy and action plan* <<https://wsroc.com.au/media-a-resources/reports/send/3-reports/286-turn-down-the-heat-strategy-and-action-plan-2018>>

Valeriani, Federica & Margarucci, Lory and Gianfranceschi, Gianluca & Ciccarelli, Antonello & Tajani, Filippo & Mucci, Nicolina & Ripani, Maurizio & Romano Spica, Vincenzo. (2019). Artificial-turf surfaces for sport and recreational activities: microbiota analysis and 16S sequencing signature of synthetic vs natural soccer fields. *Heliyon*. 5. e02334. 10.1016/j.heliyon.2019.e02334.

Vic Health 2021, *Sports participation in Victoria 2015-2021 The impacts of COVID-19 and the recovery of participations in sport, Research summary*, Vic Health <https://www.vichealth.vic.gov.au/-/media/VH_Sport-participation-2015-20_Research-Summary.pdf?la=en&hash=2CA4C80925121AA21E800C9D188E57720BF5BA45>

Appendix B Strategic policy review

B.1 Management and Maintenance of Council's Sports Grounds Policy

Summary of key points
Resolved by council: 11 June 2014
Review date: 11 June 2017

Background

Council has 50+ sportsgrounds available for use in the City of Moreland (Merri-bek). These are currently very well utilised by a variety of user groups including sports clubs, Sports Associations, schools, community groups and residence of (Merri-bek). The demand on these facilities is ever increasing. While Council would like to have facilities available to meet all seasonal, annual tenancy and casual bookings requests this is becoming more difficult with the increasing demands on the existing sports grounds and the very limited opportunity for expansion.

Key take aways:

- Recognition of capacity limits
- Maintenance framework to improve field quality (for safety and greater use)
- Encourage diverse range of sports for across the diverse range of people in Merri-bek.

Key policy points

Specific policy goals:	Specific ports ground schedule objectives:
• A programmed approach to sportsground maintenance based on a 3-tiered hierarchy • To have a set specification covering sport field maintenance to appropriate quality standards within the budget allocation by Council. This specification will be reviewed prior to each season. • To have a program of sport field renovations achievable within existing budget allocations. • Sport grounds are closed for the last 2 weeks of March and 4 weeks in September for seasonal changeover and annual restoration works. No forward bookings for use of the playing surfaces will be taken for these periods. • Watering systems to be used at all sport grounds and maintained as appropriate considering any water restrictions enforced by Melbourne Water. • Sub-soil drainage systems are to be used and maintained as appropriate and installed where necessary. • Cricket covers are to be used on turf wickets in winter, as well as summer to minimise damage to the turf wicket tables in wet conditions. • Maintenance needs for sport grounds will be prioritised over requests for access from casual hirers. • Capital works and ground reconstructions to be undertaken as required and according to available budget.	• To identify a sportsground hierarchy to inform the maintenance regime and appropriate works • Facilitate a diversity of sport activities for Merri-bek residents. • Acknowledge that use and activities throughout the year will impact on the quality of the playing surfaces. • Allow adequate time for maintenance activities. • Ensure sport field maintenance works are undertaken at appropriate times during the year to achieve the best results possible which will benefit all users. • Enable the cost of maintenance to be recognised and partially recouped via appropriate fee structures for hire. • Identify Capital Improvements for sport grounds, to be included in the development of Plans of Management and capital works budgets.

The Sports Grounds Maintenance Schedule gives an order of preference of maintenance works that are necessary to be undertaken hence ensuring that sport grounds are managed throughout the year. It also lists	The ability of Council to provide safe playing grounds of a suitable quality for competition levels, and to maintain acceptable quality of playing surfaces is an important factor to consider.
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compatible uses between summer and winter seasons which will.

- Demand management and seasonal use compatibility
- Booking guidelines and requirements
- Quality, maintenance and service description
- Sportsground upgrades and capital improvements
- Demand management and seasonal use compatibility
- Booking guidelines and requirements
- Quality, maintenance and service description
- Sportsground upgrades and capital improvements

- A programmed approach to sportsground maintenance based on a 3-tiered hierarchy
- To have a set specification covering sportsground maintenance to appropriate quality standards within the budget allocation by Council. This specification will be reviewed prior to each season.
- To have a program of sportsground renovations achievable within existing budget allocations.
- Sports grounds are closed for the last 2 weeks of March and 4 weeks in September for seasonal changeover and annual restoration works. No forward bookings for use of the playing surfaces will be taken for these periods.
- Watering systems will be used at all sports grounds and maintained as appropriate considering any water restrictions enforced by Melbourne Water.
- Sub-soil drainage systems are to be used and maintained as appropriate and installed where necessary.
- Cricket covers to be used on turf wickets in winter as well as summer to minimise damage to the turf wicket tables in wet conditions.
- Maintenance needs for sports grounds will be prioritised over requests for access from casual hirers.
- Capital works and ground reconstructions to be undertaken as required and according to available budget

B.2 City of Moreland Hybrid and Synthetic Sports Surface Needs Analysis

Summary of key points

Resolved by council: March 2017

Report issued: April 2018

Background,

The development of a Hybrid and Synthetic Sports Surfaces Study will support Council to achieve various sportsground objectives by embracing synthetic surface technology and encouraging more residents to be more active.

Key take aways:

- Considers implementation of synthetic turf based on formal sporting use analysis.
- Links to overall desire by council to increase formal sport participation rates.

Key take aways	Recommendations
• Needs analysis based on population growth and sportsgrounds use analysis • Advocates strongly for synthetic or hybrid turf solution to increase playable hours. • Detailed study and breakdown of synthetic surface types/ progress overtime • Detailed injury studies – conclusions found no increase in prevalence of injury on synthetic turf. • Acknowledges and discuss detrimental effect of Synthetic on urban head island.	• Council to continue to invest and embrace the use the synthetic and hybrid technology to assist in meeting the growing demands for active recreation and sport as the population continues to grow A Strategic Focus and Intent to be adopted for embracing the technology and used to encourage sports peak bodies and local clubs to develop business cases and funding applications to allow Council to afford the use of the technology in key locations. • Moreland City Council is committed through Active Moreland to encourage participation in active living, play, recreation, and sport. By providing facilities for people to play, recreate and participate in sport the

sports surfaces need to be appropriate, safe and can cope with the intended usage. To this end, the City has developed this strategic intent and commitment.

B.3 City of Moreland Sports and Active Recreation Strategy

Summary of key points

Report issued in 2020

Strategy development drivers:

- Population growth
- Decreasing age profile, meaning more kids in sport
- Desire to improve health and wellbeing across the municipality.

Strategy aims	Target
• Moreland Sport and Active Recreation Strategy provides an evidence-based framework to respond to the needs and aspirations of our community and establishes principles to inform Council decision making, guide partnerships and prioritise the allocation of Council resources for the greatest • The Strategy provides a roadmap for further development and investment in sport and recreation to enable more people to be more active more often. Research and consultation has identified challenges and opportunities and provides direction to enable Council and other stakeholders to respond appropriately to changing community • The Strategy is closely aligned to the Moreland Public Health and Wellbeing Plan and the Moreland Open Space Strategy. Together these Strategies combine to deliver positive impacts for the overall health and wellbeing of the Moreland community. Importantly, the Strategy delivers on Councils commitment in the 2017 to 2021 Council Plan to: - Set a clear vision and strategy for aquatics, leisure and sporting facilities to meet ongoing community needs - Maintain and match our infrastructure to community needs and population growth.	• Increasing participation by Moreland residents in sport and active recreation and fostering strong relationships with local recreation clubs, associations, peak bodies and government agencies. • Ensuring an adequate supply and distribution of good quality sporting infrastructure used in the most effective and efficient manner possible. • Ensuring Moreland City Council's approach to sport and active recreation provision is underpinned and well informed by robust policies, strategies and plans.

B.4 Moreland Sportsground Review, May 2017 (audit)

Background

Moreland (Merri-bek) City Council is a large municipality located in the inner northern suburbs of Melbourne and has over 50 active sporting reserves currently used for activities such as cricket, football, soccer, baseball, lacrosse and for school and informal activities. The aim of the sportsground review is to understand the specific characteristics of the diverse range of sportsgrounds offered within Moreland (Merri-bek), so that future needs analysis can be conducted.

Turf and soil	Drainage and irrigation
• Cricket Wickets: There are 31 sportsgrounds with cricket wickets: 18 synthetic and 14 turf benches. This	• Drainage: Poor drainage will result in the soil remaining saturated for longer than desired. A saturated soil has an unstable surface that is easily

Turf and soil

includes a synthetic and a turf bench at Morris Reserve.

- **Turf Composition:** There are 25 sportsgrounds (51%) which consist predominantly of cool season (ryegrass and *Poa annua*) and 21 sportsgrounds (43%) which consist of a mix of cool season and warm-season grasses (kikuyu and couch). There are only 3 sportsgrounds (6%) that consist predominantly of warm-season grasses.
- Warm-season grasses have a lower water requirement in summer than cool-season however they have a relatively long winter dormancy period (i.e., no or very limited growth). They have no ability to repair or recover from wear or damage during winter and will only repair with the onset of the following spring growth. Hence there is a greater need to overseed ryegrass into any warm-season sportsgrounds that are heavily used to provide a durable winter cover. Only 6 sportsgrounds are overseeded in autumn with winter active turf type perennial ryegrass.
- **Soil Type:** Ninety-two percent of the sportsgrounds (45) are constructed from fine-textured local soils (e.g. high silt & clay content) such as clay loams (43) and clays (2). These soils have poor drainage and are prone to compaction and water-logging which can result in extremely soft surfaces in winter and extremely hard surfaces in summer. The slow draining nature of these local soils can also reduce the playability of these sportsgrounds in wet weather. When play and heavy rainfall events coincide the grass surface can be quickly chopped up with the
- **Topsoil Depth:** Approximately 37% (18) of the sportsgrounds have shallow (50 – 100mm) topsoil depth. There are 24 (49%) sportsgrounds with a moderate depth of topsoil (100 – 150mm) and only 5 sportsgrounds with a good topsoil depth (150 – 200mm) and the 2 and based sportsgrounds have an excellent profile depth (>200mm).

The depth of topsoil determines both the water retention capacity of the soil and rooting depth of the turf plants. The greater the depth of topsoil, the larger the 'reservoir' available to hold water for plant growth. Shallow topsoil (<100mm) also limits the depth of plant root growth. Both of these will in turn, affect the irrigation requirement and frequency of watering.

- **Surface shape:** The preferred shape for a sportsground is a dome or a ridge ('roof-top') design (i.e. sloping two ways from a central ridge), which allows surface water to move off the field in the

Drainage and irrigation

damaged. When a saturated soil is used or even trafficked by vehicles (e.g., mowers), the surface can become quickly 'cut-up' resulting in significant surface damage and consequently expensive repair works.

- Eighty-two percent of sportsgrounds (40 sportsgrounds) have no drainage and there are only 4 sportsgrounds with a complete network of subsurface drains and 5 sportsgrounds with partial drainage (sand slits, spoon drain etc).
- A sportsground without sub-surface drainage may have excellent drainage due to its slope or profile; and conversely the drainage in a sportsground with sub-surface drainage may be poor. There are only 3 sportsgrounds (6%) considered by the Parks Department to have good drainage, 4 sportsgrounds (8%) with okay drainage and 42 sportsgrounds (86%) with poor drainage.
- **Irrigation:** All active sportsgrounds require some supplementary irrigation to be able to sustain a dense sward that is capable of tolerating wear. All sportsgrounds are irrigated from late spring to early autumn with an automatic irrigation system (Maxicom). There are 26 sportsgrounds (53%) considered by the Parks Department to have good irrigation effectiveness, 7 sportsgrounds (14%) with okay effectiveness and 16 sportsgrounds (33%) with poor irrigation.

shortest distance. The least desirable option for surface shape is a 'one-way fall' where the water must move across the whole field before it is off the playing surface. However, site and cost constraints may dictate a less than ideal surface shape.
