Memo

RE: *Planning, Development, and Operation of Rectangular Fields at Athletic Parks* study — cost estimates

Building on the *Sport Field Strategy* completed in 2016, The *Planning, Development, and Operation of Rectangular Fields at Athletic Parks* study provides a summary of research, emerging trends and best practices related to athletic park planning.

As Calgary Recreation plans future amenities, this information will be used to determine site-specific needs and considerations. It is important to note, the cost estimates in the study can only be used as a planning reference; they do not represent actual costs.

PLANNING, DEVELOPMENT, AND OPERATION OF RECTANGULAR FIELDS AT ATHLETIC PARKS

VERSION 1 - DEC. 1, 2020

2020

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The purpose of this study is to provide the City of Calgary with a summary of research and case studies on best practices for athletic parks including the management, operation, and development of natural and artificial turf sports fields, as well as guidance for artificial turf surfaces at community sites.

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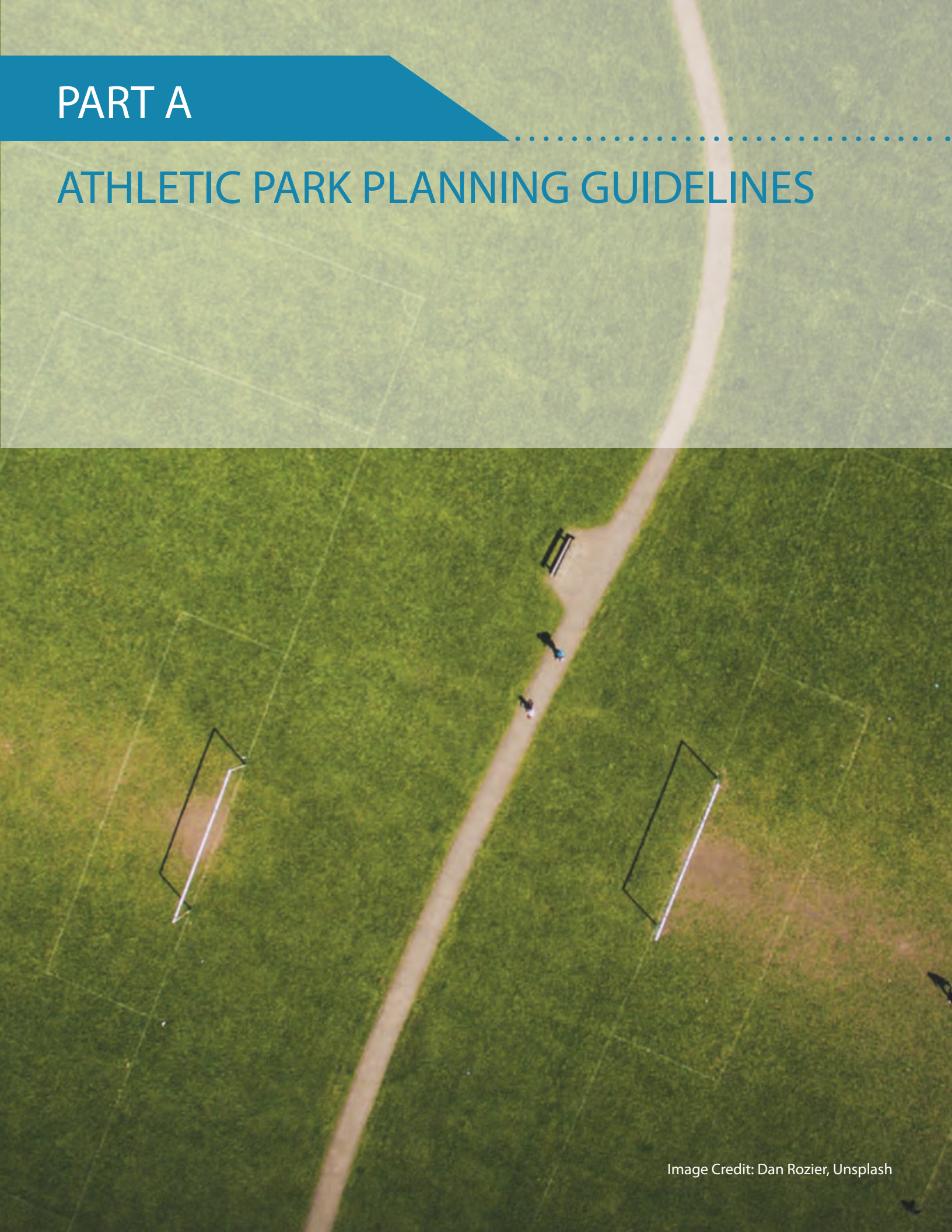
PART A

ATHLETIC PARK PLANNING GUIDELINES



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1.0 ATHLETIC PARK PLANNING GUIDELINES

1.1 Introduction and Overview

1.1.1 | Objectives

The objectives of the athletic park and facility planning guidelines include:

- Review athletic park planning principles and guiding documents for the case study municipalities, similar in size and climate to Calgary for the purposes of providing recommendations for Calgary
- Review key decision-making criteria for determining the typology and location of new athletic parks
- Provide an overview of emerging trends impacting athletic park planning
- Review allocation practices for the case study municipalities for the purposes of providing recommendations for Calgary
- Identify opportunities to optimize athletic park facility utilization
- Identify triggers for market saturation with respect to number of type of athletic parks

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1.1 Introduction and Overview

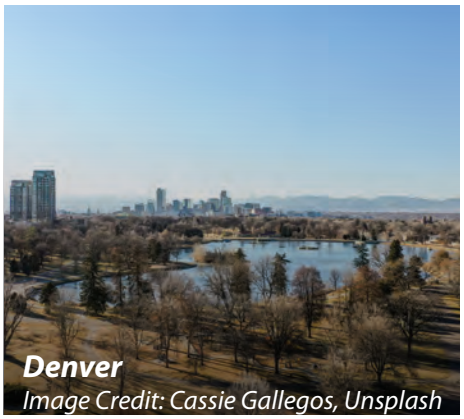
1.1.2 | Comparable Case Study Cities

Case study cities were chosen for comparison to the City of Calgary based on the use of both artificial and natural grass sports fields in their athletic parks, proximity to Calgary, as well as similarities in population, field programming, cold winter weather and total winter field closures.

The case study cities selected included:

- Brampton, Ontario
- Denver, Colorado
- Edmonton, Alberta
- Mississauga, Ontario
- Ottawa, Ontario
- Toronto, Ontario
- Toronto District School Board


Brampton
Image Credit: www.Brampton.ca


Denver
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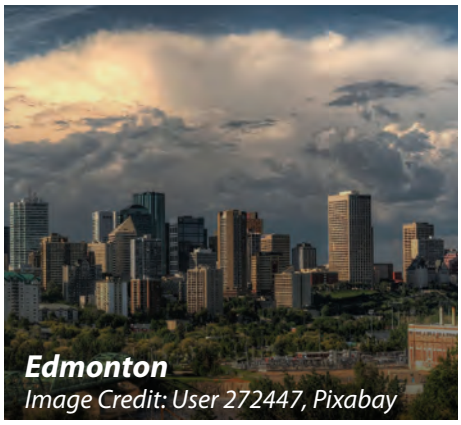
Edmonton
Image Credit: User 272447, Pixabay


Mississauga
Image Credit: Wikipedia


Ottawa
Image Credit: Christopher Austin, Unsplash


Toronto
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Many of these cities were also included in the review carried out as part of the City's 2016 Sport Field Strategy. All of the case study cities exhibit cold winter weather and total winter field closures. Refer to the **Part G: Case Studies** section of this report for addition information.

Image Credit: Jonathan Hanna, Unsplash

1.2 Planning Decision Making Models of Other Municipalities

1.2.1 | Overview

A review was completed on the decision-making processes used by the case study cities when planning new athletic parks. This included the classification and type of fields (artificial vs. natural grass), location in the city, as well as the influences on multi-field vs. standalone field park development. Although there were variations specific to the cities reviewed, and in some cases no information, there were several common themes and similarities with the parameters set to help guide the planning and design of athletic parks.

Where we were unable to obtain meaningful information (such as very vague or absent planning guidelines), no information was provided for that case study city.

Information on site selection for artificial turf fields has been included separately.

1.2.2 | General Athletic Park Planning

All cities had some form of a guiding planning document, either a recreation master plan, sports field strategy, or series of neighborhood development plans for the general planning of athletic parks.

These documents typically contained recommendations on upgrades to existing facilities, construction of new facilities, or methods proposed to increase utilization (e.g. refurbishment, conversion to artificial turf). In many cases the detailed rationale behind the context of how specific sites and fields were selected was absent. However, typical field planning factors generally included a needs and demands analysis reflecting the following:

- Identification of existing stresses on existing athletic parks driving the need for additional inventory (over-booked fields, excess wear on surfaces). These stresses were identified through monitoring of existing field utilization/bookings, field surface quality, and stakeholder consultation
- User demand for higher quality facilities (better surfaces, amenities, tournament sites)
- Predicted rate of growth of outdoor field sports
- Demographics and trends in outdoor recreation including field sports
- New residential development areas driving the need for athletic parks
- Locality of existing and new athletic parks to ensure reasonable and convenient access to users

1.2 Planning Decision Making Models of Other Municipalities

While the definition of an athletic park was not always clear, for the purposes of this review, an athletic park is considered to be a facility comprised of two or more natural grass fields with supporting amenities, or alternatively one or more artificial turf fields with amenities. Most municipalities classify athletic parks as either district athletic parks (e.g. city-wide) or community athletic parks. The following table highlights some commonalities with respect to athletic park planning considerations among the case study cities. Sections 1.6-1.10 of this document elaborate on the recommended amenities.

Table 1.1 - Athletic Park General Planning Commonalities - District Park
The following table outlines the general commonalities each Municipality adopts when planning a district athletic park (e.g. City-wide). This would be equivalent to Calgary's Class A facilities.

Item	Ottawa	Toronto	Brampton	Edmonton
Location	Fronting arterial road On transit route Linked to public green space	Fronting arterial road On or near transit route Trail connections	Fronting arterial road On or near transit route City Gateways	Fronting major road On or near transit route
Constructed by City	Yes	Yes	Yes	Yes
Parking	Onsite	Onsite	Onsite	Onsite
Sport Field Uses	Tournaments Programmed field sports (various)	Tournaments Programmed field sports (various)	Tournaments Programmed field sports (various)	Tournaments Programmed field sports (various)
Other Uses / Events	Passive area Ad-hoc sports Community events Natural treed areas Play areas Picnic areas	Passive area Ad-hoc sports Community events Natural treed areas Gardening for locals Play areas Picnic areas	Passive uses Community events Natural treed areas Pathways	Passive uses Community events Natural treed areas Pathways
Adjacent to Other Community Facilities (Rec Centres, Stadiums, Arenas)	Yes	Yes	Yes	Yes
Natural Areas	20% naturalized 30% canopy cover	Buffer and natural area plantings Residential area screening in high use areas	Buffer and natural area plantings	Buffer and natural area plantings
Suggested Minimum Size	10 hectares[1]/ 24.7 acres	15 hectares[2] / 37 acres	40.5 hectares (*)/ 100 acres	33 hectares (*)/ 81.5 acres

(*) Size includes provision for community buildings
[1] Minimum size for District Park within Ottawa. The park size is based on the particular focus and facilities for each district park facility.
[2] This facility would accommodate two sports field facilities plus community building space. The next size in facility would be 40 hectares (City-Wide Focus) with passive and active recreation activities for community members.

1.2 Planning Decision Making Models of Other Municipalities

Table 1.2 - Athletic Park General Planning Commonalities - Community Park
The following table outlines the general commonalities each Municipality adopts when planning a community athletic park (e.g. City-wide/Regional/Local/Community). This would be equivalent to Calgary's Class B and C facilities.

Item	Ottawa	Toronto	Brampton	Edmonton
Location	Fronting collector road On or near transit route Public Greenspace linked	Fronting arterial road On or near transit route Trail connections	Fronting major road On or near transit route	Fronting major road On or near transit route
Constructed by City	Yes	Yes	Mix – City/Partners	Yes
Parking	Onsite	Onsite	Onsite	Onsite
Sport Field Uses	Tournaments Programmed sports	Tournaments Programmed sports	Tournaments Programmed sports	Tournaments Programmed sports
Other Uses	Passive area Ad-hoc sports Community events Natural treed areas Play areas Picnic areas	Passive area Ad-hoc sports Community events Natural treed areas Gardening for locals Play areas Picnic areas	Passive uses Community events Natural treed areas Pathways	Passive uses Community events Natural treed areas Pathways
Adjacent to Other Community Facilities	Yes	Yes	Optional	Optional
Natural Areas	20% naturalized 30% canopy cover	Buffer and natural area plantings Residential area screening in high use areas	Buffer and natural area plantings	Buffer and natural area plantings
Suggested Minimum Size	3.2 hectares/ 7.9 acres	5 hectares/ 12.3 acres	10 to 12 hectares (*) 24.7 – 29.7 acres	10 hectares (*)/ 24.7acres

(*) Size includes provision for community buildings

Image Credit: Gellinger, Pixabay

1.2 Planning Decision Making Models of Other Municipalities

1.2.3 | Planning for Artificial Turf

For the case study cities, our research revealed a less formalized system to guide the planning and design of artificial turf fields. The following is an overview of artificial field planning guidelines:

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City of Toronto
The City of Toronto plans new sports fields based on population targets of one field per 10,000 residents. Their Parks and Recreation Facilities Master Plan 2019-2038 Guidelines indicate that City should be looking for other options to increase field utilization including adding lights and artificial turf to existing fields in strategic locations. No other guidance is provided.

City of Edmonton
Planning new artificial turf facility development at the City of Edmonton begins with evidence of growing demand and an evaluation of existing artificial turf facilities to assess if target utilization is being achieved. Generally, the city locates artificial turf fields targeted to the population which they serve and in high-demand areas of the city. Development of artificial turf facilities are considered for the following Edmonton park types:

- District level parks: Major recreation facilities (arenas, pools, soccer centres, etc.) and high schools
- City level parks: Unique, "one-of-a-kind" parks that attract people from across the city. Parks may provide active or passive recreation opportunities
- River valley & ravine parks: Major outdoor gathering places

1.2 Planning Decision Making Models of Other Municipalities

The following criteria and considerations are based on Edmonton's standards, and are used to select sites for artificial turf field development:

- Equitable/balanced distribution across the city
- Integration of facilities/proximity to other recreation facilities or sports fields
- Proposed sites currently equipped with amenities that can support artificial turf facility development (lights, change rooms, parking, bleachers, etc.)
- Availability to have on-site staff presence to support to the maintenance and operation
- Community support, including school districts and educational institutions
- Sites-specific accommodation including, topography (flat vs. steep site), geotechnical (suitable soil conditions), and adequate area for supporting amenities such as lighting, change rooms, parking, and bleachers
- Existing Use / Demand – whether the current level of use warrants the intensity of an artificial turf facility development
- Transportation linkages (LRT, bus, vehicle, bike, pedestrian)
- Partnerships - are there interested partners to assist in capital investment
- Ability to host cultural and sporting events
- Emerging Opportunities – can the project merge with other capital development opportunities to maximize operational effectiveness and reduce cost
- Asset Management - artificial turf replaced typically 8-10 years
- Increased Demand/Growth Areas - An optimum level of service for artificial turf field is to achieve the target usage of 1,000 booked hours / year / field. In comparison to a premier rectangular natural grass field, categorized as 'heavy use', that is booked 250 hours annually
- The recommendation of 1,000 hours of booked use recognizes the additional spontaneous and drop-in use of open access facilities. It is reasonable to expect that drop-in use of an open access artificial turf facility would be in the range of 200-300 hours per year

Image Credit: Max Hermansson, Unsplash

1.2 Planning Decision Making Models of Other Municipalities

City of Mississauga

The City of Mississauga has no formal artificial turf site selection information. Excerpts from their 2019 Park & Forestry Master Plan outline that planning with additional artificial turf fields begins with business case planning that also considers common criteria including:

- Balanced geographic distribution for equal access to facilities for residents city-wide
- A goal to attain program/scheduling consistencies and efficiencies throughout the season by having a field capable of accommodating heavy use without needing to rest it, and to minimize disruptions due to inclement weather
- Locate facilities in areas of densification and attracting high levels of usage
- Participation growth in field sports other than soccer (e.g. football, field hockey, and field lacrosse) is such that a multi-use field configuration is required to address these needs in the peak summer months
- The formation of partnerships and new opportunities. A cost-sharing and/or joint-use agreement is negotiated with a third party, such as school districts and educational institutions (Secondary or post-secondary institution)

Image Credit: Wikipedia

1.3 Athletic Park Planning and Design Framework – Artificial Turf

From the review of comparable cities, there are many common criteria addressing placement, programming, technical requirements, and desired sites and conditions for artificial turf field development. These are included in a baseline framework for the City of Calgary:

Table 1.3 - Artificial Turf Field Site Decision Criteria

Criteria	Description
Park Typology	Athletic park - regional park (city-wide) or community park
Service Area	City and district-wide
Uses	Multi-use, passive, and active recreation, major sports facilities and / or tournament level fields
Location	Arterial street
Transit	Major transit route
Size (Hectares)	3 hectares (7.4 acres) minimum (single field site) 10 hectares (24.7 acres) minimum (site with three fields)
Street Frontage	Preferred minimum 75% of continuous frontage on abutting streets
Parking	Access to parking; preferably on-site with a minimum of 30 to 40 parking stalls per field
Integration of facilities	• Proximity to other recreation facilities or sports fields to increase opportunities for integration of complimentary services and amenities (e.g. sports teams can do indoor strength training) • Is the site near a school or other education institutional site?
Neighbourhood Support	Is the project supported by the neighbourhood?
Topography	Is the site flat? Are there steep slopes?
Geotechnical	Does the site have limited geotechnical issues (organics, dry landfills, etc.)?
Specific Sites	• Do the natural features of the site support the development of an artificial turf facility? • Can supporting amenities be accommodated? • Can proposed site can accommodate the addition of artificial turf field amenities such as: lighting, change rooms, parking, bleachers, sound system, etc.?
Event Hosting	Ability to host cultural and sporting events from local weekend tournaments to major international sport competitions for training and/or play
Demand Threshold	• Has the demand threshold been met? • Does the service area demand exceed current capacity or is there a large increase in demand expected in near future (e.g. new development), capacity for field utilization and user groups support for additional field?

1.3 Athletic Park Planning and Design Framework – Artificial Turf

The following matrix presents an approach that could be used to assess the suitability of sports field sites for conversion to artificial turf. The scoring matrix could be used in two ways; a) to evaluate a specific site independently of others (e.g. a site needs to achieve a minimum score in order to be validated as a candidate for an artificial turf retrofit) or b) to rank multiple sites that are under consideration. Before applying the matrix the City should confirm the weighting of each criteria (the weighting provided in the matrix below is for example purposes only) and review / refine the scoring metric based on current conditions and situational factors (e.g. considerations that are requiring the City to review or possibly contrast sites).

Table 1.4 - Artificial Turf Weighted Planning Matrix

Criteria	Scoring	Weighting
Utilization & Capacity	**3 pts:** Natural grass fields on the site are being used over 75% 'prime time' capacity and/or the need for significant shoulder season capacity is required. **2 pts:** Natural grass fields on the site are being used to between 50 – 75% 'prime time' capacity and some need for shoulder season capacity is required. **1 pt:** Natural grass fields on the site are being used to between 25 – 50% 'prime time' capacity and minimal need for shoulder season capacity exists. **0 pts:** Natural grass fields on the site currently receive less than 25% utilization.	3
User Ability to Pay	**3 pts:** Existing and/or new user groups have agreed to consume more than 75% of the prime-time capacity at existing city artificial turf rates. **2 pts**: Existing and/or new user groups have agreed to consume between 50 and 75% of the prime-time capacity at existing city artificial turf rates. **1 pt:** Existing and/or new user groups have agreed to consume between 25% and 49% of the prime-time capacity at existing city artificial turf rates. **0 pts:** Existing and/or new user groups have not agreed to consume at least 25% of prime time capacity at existing artificial turf rates.	3
Multi-Use	**3 pts:** The artificial turf field development will support four (4) or more activity types on a regular basis. **2 pts:** The artificial turf field development will support three (3) or more activity types on a regular basis. **1 pt:** The artificial turf field development will support two (2) or more activity types on a regular basis. **0 pts:** The artificial turf field development will be focused on a single user type.	2
Site Synergies	**3 pts:** The site has sufficient existing support amenities that will have synergies with a new artificial turf field (e.g. no new support amenity development is required). **2 pts:** Some minimal support amenity development will be required to capitalize on the benefits of developing an artificial turf field on the site. **1 pt:** A moderate investment into support amenities will be required to capitalize on the benefits of developing an artificial turf field on the site. **0 pts:** A significant investment into support amenities will be required to capitalize on the benefits of developing an artificial turf field on the site.	2
Operational Costs Considerations	**3 pts:** The operational costs are shared by a partner and are less than a similar facility. **2 pts:** The operational costs are typical compared to other fields. **1 pt:** There are moderate levels of additional operational costs arising from the site conditions (e.g. extra security, maintenance due to poor soils, flood risks, etc.) **0 pts:** There are significant additional operational costs arising from the site conditions (e.g. extra security, maintenance due to poor soils, flood risks, etc.)	2

1.3 Athletic Park Planning and Design Framework – Artificial Turf

Table 1.4 - Artificial Turf Weighted Planning Matrix (Continued)

Criteria	Scoring	Weighting
Event and Tournament Hosting	**3 pts:** There is reasonable evidence that the development of an artificial turf field on the site can significantly enhance its event and tournament hosting capability. **2 pts:** There is reasonable evidence that the development of an artificial turf field on the site can moderately enhance its event and tournament hosting capability. **1 pt:** The development of an artificial turf field on the site is likely to have a minimal impact on the sites event and tournament hosting capability. **0 pts:** The development of an artificial turf field on the site is likely to have an adverse impact on the sites event and tournament hosting capability (e.g. it is necessary to remove a key natural grass field or other amenity that supports event hosting for the site).	2
Geographic Distribution	**3 pts:** There is not another publicly accessible artificial turf field within ~7 km **2 pts:** There is not another publicly accessible artificial turf field within ~5 - 7 km **1 pt:** There is not another publicly accessible artificial turf field within ~3 - 5 km **0 pts:** Another publicly accessible artificial turf field exists within ~0 - 3 km	1

Table 1.4 is designed with specific criteria to evaluate the need for an artificial turf field in a District park site. If development of an artificial turf field is being considered to serve as a neighborhood-based asset (e.g. in a park space, infill opportunity) a different set of criteria is recommended to evaluate the programming needs, and whether a standalone or multi-field investment is required. These considerations include:

- The opportunity to provide low or no cost recreational space that can be used for 'pick up' games and spontaneous use (is the site likely to be well-used for these purposes?)
- The impact on adjacent or nearby passive recreation and leisure spaces
- Site suitability and appropriateness (the intended service level needs to match: City-wide, community, and neighborhood)
- The opportunity to address issues of public access barriers through the development of smaller scale and/or community based artificial turf (e.g., pick-up games occurring at nearby, bookable artificial turf or premium surface fields)
- Projected growth areas and future recreational needs
- Service gaps and areas that are underserved

1.4 Recognizing the Need for Natural Grass and Artificial Turf

While artificial turf offers a number of benefits over natural grass, particularly for high intensity athletic parks, it is important to recognize that a well maintained, optimally utilized natural grass field provides the best surface for soccer, field lacrosse, rugby, football and the majority of other sports and uses. Field hockey is the only sport where an artificial turf surface is required for higher level play.

Costs

High performance natural grass fields are typically operated by professional organizations, with funding for full time field managers, a single field user group, and restricted public access. Under these conditions, a natural grass field would be superior to artificial turf. From a practical perspective, municipalities do not have adequate resources to construct and maintain high performance natural grass fields. As such, natural grass fields are at risk of damage due to overuse (or improper use) and are typically not in an ideal condition throughout the sports season.

The need for artificial turf should therefore be driven by the following factors:

- Provide an opportunity to relieve natural grass fields from overuse, by transferring bookable hours to artificial surfaces where possible. This is particularly important for popular natural grass fields that show signs of excess wear
- Allow for extension of use into the shoulder seasons (Spring and Fall) when grass fields may be saturated or frozen or are at risk of adverse surface conditions. Increased pressure to keep grass fields open can result in extensive field damage arising from just a single day of sports such as football, rugby or adult soccer. Artificial turf allows for grass fields to be closed and play moved onto artificial turf
- On tournament sites, inclusion of one or more artificial turf fields can allow for maximum utilization of the facility even during poor weather conditions. Tournament delays and cancellations are minimized, the playing surface is reliable, and concerns over potential field damage due to overuse are greatly reduced

Image Credit: Ben Hershey, Unsplash

The primary goal for an artificial turf surface should therefore not be to replace natural grass wherever possible, but rather to supplement and support natural grass fields within the City's overall field inventory.

1.5 Economic & Other Benefits of Artificial Turf

1.5.1 | Economic Benefits

A 2016 study conducted by Sport Calgary, Calgary Sport Tourism Authority, Calgary Economic Development, and the City of Calgary found that:

- The "Gross Municipal Amateur Sport Product" in Calgary was over $1.2 billion, which represents the sum of expenditures such as private household consumption (over $715 million), various levels of government spending (nearly $150 million), balance of trade (over $350 million), and other private capital investments
- The overall GDP (value added) impact on the Calgary economy of these expenditures was approximately $1.1 billion; amateur sport supported almost 1.0% of Calgary's GDP
- The overall impact on wages and salaries on the Calgary economy of these expenditures was approximately $750 million; amateur sport supported almost 2.3% of Calgary's employment
- Amateur sport spending had an effect on employment in Calgary of almost 17,000 full-time jobs
- The installation of artificial turf can enhance the competition and event hosting capability of a community or city by meeting the hosting requirements of some sport bodies, allowing for additional flexibility, and mitigating the risk of inclement weather

1.5.2 | Investment Return (Social, Economic, Environmental)

The rationale for determining whether an investment in artificial turf fields is warranted requires a number of different considerations to be taken into account. The following chart outlines a number of the Return on Investment (ROI) considerations related to increased artificial turf provision as observed in other urban municipalities. These considerations are often used as a basis or rationale for developing new artificial surfaces or retrofitting existing natural grass fields to artificial turf.

Image Credit: Catia Climovich, Unsplash

1.5 Economic & Other Benefits of Artificial Turf

Table 1.5 - Investment Return Summary

Consideration	Potential Benefits
Sport / Recreation experience	■ Increased quality and consistency of turf can enhance the overall sport experience ■ Ability to expand seasons of play (enhanced athlete development opportunities)
Optimization of available spaces and sites	■ The expanded season afforded by artificial turf can maximize the use of, and benefits provided by major sport field sites. Given the increasing scarcity of land in many urban centres, these considerations are becoming more important.
Economic benefits	■ For context: In some instances, artificial turf fields (and their associated support amenities) are required to host certain events. Examples include: high school football and shoulder season soccer tournaments. In other instances, tournaments and competitions prefer artificial turf venues due to field quality certainty and the ability to mitigate potential disruptions that could occur because of inclement weather. ■ Artificial turf fields can enhance the capacity of region to host tournaments and competitions, which research demonstrates has provided significant benefit to Calgary.[1]

Image Credit: Jonathan Petersson, Unsplash

1.5 Economic & Other Benefits of Artificial Turf

Capacity Benefits Analysis

Further to the optimization of available spaces and sport / recreation experience benefits outlined in the previous sub-section, a common rationale for the installation of artificial turf in winter climates is the ability to extend seasons of play and provide a greater degree of utilization certainty during shoulder seasons (e.g. April / May and October / November). The following parameters were used to conduct a high-level capacity benefits comparison of an artificial vs. natural grass field:

- Prime time use of sports fields occurs between the hours of 5 p.m. and 9 p.m. on weekdays and 11 a.m. to 9 p.m. on weekends. These hours shift during certain periods of time within a season but are generally valid as parameters for this exercise based on available data
- Artificial turf fields are generally 'playable' in similar climates from, at minimum, early April to late October (7 months). Natural grass fields are generally 'playable' at full capacity from early May to late Sept (5 months). These seasons of play are fluid and fluctuate depending on weather patterns, but have been set as parameters based on a review of available weather data
- A 15% maintenance and weather downtime adjustment has also been added to the natural grass field capacity

The following chart summarizes the impact of the capacity analysis using the above parameters. As reflected in the chart, an artificial turf field provides 462 hours of incremental time in comparison to a natural grass field.

Table 1.6 – Prime Time Capacity: Artificial Turf vs. Natural Grass

	Months of Use	Prime Time Hours Available
Artificial Turf	7	1,176
Natural Grass	5	714
Additional Capacity Provided by an Artificial Turf Field	+2 Months	462 Hours

Image Credit: Jannes Glas, Unsplash

1.5 Economic & Other Benefits of Artificial Turf

1.5.3 | Visitation Characteristics & Potential Benefit

One of the primary benefits of artificial turf is the ability to expand availability capacity into the shoulder months of the spring and fall seasons (e.g. April and October/November). This additional capacity provides some opportunity to attract incremental events (championship games and tournaments) which can bring non-local spending and associated economic benefits to a city. The following chart extrapolates the average Alberta resident spend of $205 per day [2] when visiting other communities in the province for tourism (and related) purposes to a potential scenario that reflects increased competition / tournament capacity provided by artificial turf in comparison to a natural grass. It is important to note that these assumptions are simply intending to reflect how increased capacity provided by artificial turf could be utilized to accrue economic benefit. Engagement with user groups and sport tourism stakeholders is required to validate or adjust these assumptions.

Table 1.7 - Potential Benefit (Artificial Turf Field)

Assumptions	
Non-local teams per competition / tournament	8
Players per team	12
Parents / family / guardians per player	0.75
Parents / family / guardians per team of 12 players	0.75 x 12 = 9
Total visitors per team (players as well as parents / family / guardians)	12 + 9 =21
Total visitors per incremental event day (players and parents / guardians)	21 x 8 = 168
Spending per person, per day	**$205**
Total incremental spending per tournament	**$205 x 168 = $34,440**

1.5 Economic & Other Benefits of Artificial Turf

1.5.4 | Sport Development, Performance and Injury Considerations

Sport for Life – Version 2.0
Sport for Life exists to build physical literacy and improve the quality of sport based on Long-Term Development in Sport and Physical Activity. The Long-Term Development (LTD) framework is a nationally accepted, eight-stage framework for developing physical literacy among individuals of all ages and athletic goals. National and Provincial Sport Organizations in Canada are mandated to demonstrate alignment with LTD principles.


Image Credit: Jeffrey Lin, Unsplash

Identified as follows is an overview of the first stages of LTD.

Awareness and First Involvement: To engage in sport and physical activity, individuals must be aware of what opportunities exist for them, and when they try an activity for the first time, it is critical that the experience is positive. That is why Sport for Life emphasizes the two stages of Awareness and First Involvement.


Image Credit: Chris Thornton, Pixabay

Active Start: From 0-6 years, boys and girls need to be engaged in daily active play. Through play and movement, they develop the fundamental movement skills and learn how to link them together. At this stage developmentally appropriate activities will help participants feel competent and comfortable participating in a variety of fun and challenging activities and games.

FUNdamentals: In the FUNdamentals stage, participants develop fundamental movement skills in structured and unstructured environments for play. The focus is on providing fun, inclusive, multi-sport, and developmentally appropriate sport and physical activity. These experiences will result in the participant developing a wide range of movement skill along with the confidence and desire to participate.


Image Credit: Treddy Chen, Unsplash

1.5 Economic & Other Benefits of Artificial Turf

Sport for Life's Long Term Athlete Development framework encompasses eight stages that articulate and provide a basis for understanding physical literacy across the lifespan.

The following chart identifies the seven 'active' stages and the potential level of benefit that artificial turf fields can provide.

AT Benefit Legend*

High - The provision of artificial turf aligns strongly with the nature of activities that occur during this stage LTAD and may be a necessity for some specific types of activities.

Moderate - The provision of artificial turf is not a necessity to support this stage of LTAD but can help optimize certain activities.

Low - The provision of artificial turf is not required to support this stage of LTAD.

Table 1.8 - Long Term Athlete Development Framework

LTAD Stage and Description	Key Concepts	Level of Benefit Provided by AT*	Rationale
Active Start From 0-6 years, boys and girls need to be engaged in daily active play. Through play and movement, they develop the fundamental movement skills and learn how to link them together. At this stage developmentally appropriate activities will help participants feel competent and comfortable participating in a variety of fun and challenging activities and games.	• Physical activity should be a fun part of a child's life everyday and is essential for healthy child development. • Active play is key at this stage as it builds important connections within the brain, and between the brain and children's muscles. • Opportunities for exploration of risk and limits in safe environments. • Unstructured access to a wide variety of colourful toys and equipment. • Activities should help children feel competent and comfortable participating in a variety of fun and challenging activities and non-competitive games. • For children with a disability, access to age and disability-appropriate adapted equipment is an important contributor to success been physically active. • Daily physical activity with an emphasis on fun.	Low	Children at this age (Boys approximately six to nine years, and girls approximately six to eight years) are not engaged in competitive or structured activities that require premium surfacing.

Table 1.8 - Long Term Athlete Development Framework (Continued)

LTAD Stage and Description	Key Concepts	Level of Benefit Provided by AT*	Rationale
FUNdamentals In the FUNdamentals stage, participants develop fundamental movement skills in structured and unstructured environments for play. The focus is on providing fun, inclusive, multisport, and developmentally appropriate sport and physical activity. These experiences will result in the participant developing a wide range of movement skill along with the confidence and desire to participate.	• Target 180 minutes of activity per day, with 60 of those minutes spent in vigorous physical activity. • Activities should include significant time for repetition, require minimal correction allowing children to safely test their own limits, and improve their abilities through experience. Activities should be helping children build confidence and competence as they engage in physical activity. • Emphasize the overall development of the child's physical capacities, fundamental movement skills, and the ABCs of athleticism: agility, balance, coordination and speed. • Develop skills by exposing participants to a variety of environments - indoors and outdoors, on land, ice and snow, in the air, and in or on water. • A mixture of structured and unstructured play, with some instruction.	Low	Children at this age are not engaged in competitive or structured activities that require premium surfacing.

Table 1.8 - Long Term Athlete Development Framework (Continued)

LTAD Stage and Description	Key Concepts	Level of Benefit Provided by AT*	Rationale
Learn to Train Once a wide range of fundamental movement skills have been acquired, participants progress into the Learn to Train stage leading to understanding basic rules, tactics, and strategy in games and refinement of sport specific skills. There are opportunities to participate in multiple sports with competitions focused on skill development and retention. Games and activities are inclusive, fun, and skill based. At the end of the Learn to Train stage, participants grow (or progress) towards sport excellence in the Train to Train stage or being Active for Life, either by being Competitive for Life or Fit for Life.	• Develop foundational sport skills in a range of sports, physical activities, positions, and environments. • Children should continue to be active and engage in a minimum of 60 minutes of moderate to vigorous physical activity every day. • Develop strength, endurance, and flexibility through games and fun activities. • This is a period of accelerated development of coordination and fine motor control. It is also a time when children enjoy practicing skills they learn and seeing their own improvement. • Use physical literacy movement preparation as part of warm-ups to support overall development of physical literacy. • Balance training (70% of the time) with competition (30% of the time) and avoid specialization in late specialization sports. • Provide opportunities for every child to learn and play. Children are less likely to be included in peer activities if they do not have the same skill level and will have fewer opportunities for practice in the future. • Continue to encourage unstructured free play. • Ensure sport and physical activity remains FUN.	Moderate	While not a necessity, artificial turf can support some shoulder season use and mitigate weather related disturbances.

Table 1.8 - Long Term Athlete Development Framework (Continued)

LTAD Stage and Description	Key Concepts	Level of Benefit Provided by AT*	Rationale
Train to Train Athletes enter the Train to Train stage when they have developed proficiency in the athlete development performance components (e.g. physical, technical-tactical, mental, and emotional). Rapid physical growth, the development of sporting capability, and commitment occurs in this stage. Athletes will generally specialize in one sport towards the end of the stage. A progression from local to provincial competition occurs over the course of the stage.	• The Train to Train stage provides the gateway for both the Podium Pathway and Active for Life stage. • The start of the growth-spurt, Peak-Height Velocity (PHV), and menarche are important markers to identify sensitive periods of accelerated adaption to training and inform what is developmentally appropriate. The physical, mental, and emotional maturity of individuals will develop at different rates. • During this phase there is a tremendous influence on behaviour from peer groups and possibly tension between adults and adolescents. • This is a critical stage for participants to learn and understand the rules of sport, values, and consequences of one's actions. • Implement a regular, periodized training, and competition plan using single or double periodization. Careful monitoring of athlete growth and response to training will enhance the development of a plan. Use physical literacy movement preparation as part of warm-ups. • Assess and remediate gaps in physical literacy or muscular imbalances. • Introduce athletes with a disability to specialized sport-specific equipment such as racing wheelchairs and athletic prostheses. • Offer programs specifically targeted at participants not engaged in sport/ physical activity by providing a safe, developmentally appropriate, and welcoming environments.	Moderate - High	Athletes at this stage are beginning to develop technical proficiency and identify sport(s) that they have a keen interest in. Artificial turf can mitigate weather issues, enable shoulder season use, and maximize safety for some types of sports.

Table 1.8 - Long Term Athlete Development Framework (Continued)

LTAD Stage and Description	Key Concepts	Level of Benefit Provided by AT*	Rationale
Train to Compete Athletes enter the Train to Compete stage when they are proficient in sport-specific Train to Train athlete development components (e.g. physical, technical-tactical, mental, and emotional). Athletes are training nearly full-time and competing at the national level while being introduced to international competition.	• Participants enter this stage based on individual commitment, volume and intensity of training, and performance results as well as having achieved all the objectives of the Train to Train stage. • Participate in year-round, high-intensity, individual- event- and position-specific training within a high quality training environment. • Specialize in one sport or at most two complementary sports (e.g. cycling and speed skating), though discipline/event specialization may not occur until late in the stage. • Learn to perform skills under a variety of competitive conditions. • Compete at a national level and develop international competition skills and abilities. • Optimize recovery and regeneration with scheduled (periodized) time for regular recovery and developing mental fitness. • Athletes may transfer from one sport to another sport during this stage. Transferring athletes may require remedial technical/tactical development to compete, while being capable of meeting the training demands of the stage, physical, and mental.	High	Artificial turf is a game requirement for some sports at this stage (e.g. football) and can optimize training.

1.5 Economic & Other Benefits of Artificial Turf

Table 1.8 - Long Term Athlete Development Framework (Continued)

LTAD Stage and Description	Key Concepts	Level of Benefit Provided by AT*	Rationale
Train to Win Athletes in the Train to Win stage are world class competitors who are competing at the highest level of competition in the world (e.g. Olympics, Paralympics, World Championships, World Cups or top professional leagues). These athletes have highly personalized training and competition plans and have an Integrated Support Team of physical therapists, athletic therapists, and sport psychologists providing ongoing support.	• Athletes are competing with the best in the world in a high quality daily training environment supported by an Integrated Support Team preparing for specific competitive events. • All physical, technical, tactical, mental, personal and lifestyle skills are established and the focus is on maximizing performance. • Have a year-round, training and competition plan scheduled to peak for major competitions using multiple periodization. • Recovery, regeneration and mental fitness is maximized by scheduling preventative breaks to avoid injury and burnout.	High	Artificial turf is a game requirement for some sports at this stage (e.g. football) and can optimize training.
Active for Life Individuals who have a desire to be physically active are in the Active for Life stage. A participant may choose to be Competitive for Life or Fit for Life and, if inclined, give back as a sport or physical activity leader. Competitive for Life includes those who compete in any organized sport recreation leagues to Master Games. Fit for Life includes active people who participate in non-competitive physical activity.	• Competitive for Life embodies all sport that functions under a set of rules, with the exception of the Podium Pathway. • Fit for Life includes all physical activity such as hiking, gardening, yoga, aerobics, skiing and walking, as well as non-organized sport (self-determined rules) including pick-up games at a park. • Participate in a minimum of 150 minutes of moderate and vigorous physical activity a week. • Help as a coach, instructor, official, volunteer, or sport/activity leader.	Moderate	While not a requirement for many activities, artificial turf provides a benefit to outdoor Active for Life focused athletes as many of their activities occur in shoulder seasons and in non-prime time hours. Artificial turf can also maximize safety.

1.5 Economic & Other Benefits of Artificial Turf

User costs and historical allocations processes and procedures in many urban centres generally results in artificial turf hours being consumed by athletes in the Train to Train, Train to Compete, and Train to Win stages. However, in the Calgary context, this historical practice may warrant further discussion and consultation with user groups around the following issues:

- Shoulder season needs of recreational users
- Ability of recreational users to pay for access to artificial turf
- Specific benefits of having increased access to artificial turf (e.g. reduced cancellations, increased participation, etc.)

The degree to which expanded provision of artificial turf can benefit sport performance and the overall availability of sport and recreational activities is dependent on a number of factors, including:

- **The provision of indoor facilities -** The degree to which artificial turf is needed during shoulder seasons is highly dependent on the supply of suitable indoor facilities that can be used for early or late season training
- **Physical Time Allotment Access -** Municipalities take a number of different approaches to providing access to higher quality venues with artificial turf
- **Cost -** The fees associated with artificial turf will significantly impact the extent to which users will access the space during non-primary seasons of play

In recent years significant research has been conducted on the impacts of artificial turf on athletic injuries and physical wellbeing. Generally speaking, the majority of recent studies have found no difference in the rates of injury between natural and artificial surfaces.

Research Study Examples

- A recently published study that tracked injury incidences in Major League Soccer from 2013-2016 and found no discernible difference between natural and artificial turf surfaces.[3]
- 3,009,205 National Collegiate Athletic Association (NCAA) athlete exposures and 2,460 knee injuries that occurred from 2004 to 2014 were analyzed to identify turf-related attributes. The study found no difference in the mechanisms of knee injuries between natural grass and artificial turf.[4]

Image Credit: Mabel Amber, Pixabay

1.5 Economic & Other Benefits of Artificial Turf

In contrast to the research examples provided, some Canadian municipalities have issued warnings on the potential for increased injuries resulting from play on artificial turf. The City of Toronto, in partnership with Toronto Public Health, conducted a Health Impact Assessment of the Use of Artificial Turf in Toronto in 2015 which concluded with the following statement:

> *In certain cases, artificial turf can sustain higher levels of use than natural surfaces and could be appropriate in areas which would otherwise not be available as an active space for a community. The use of third generation artificial turf is not expected to result in exposure to contaminants at levels that pose a significant risk to human health provided it is properly installed and maintained and users follow good hygienic practices. Under such conditions, and in the cases where use of natural grass is not possible or practical, the benefits from increased physical activity on fields are expected to outweigh the risks. In addition, available evidence indicates that, while playing on artificial fields results in a different pattern of injuries, it does not result in an overall increase in injuries when compared to natural grass surfaces. However, outdoor artificial turf surfaces can become hot during the summer months so it is important to take steps to prevent heat stress and surface burns to skin.*

Image Credit: Jeffrey Lin, Unsplash

1.6 Emerging Trends in Sports Field Infrastructure and Use

Some key trends in the public sector provision of sports fields, suggest potential approaches or broader user attitudes towards surface types, and reflect emerging activity preferences. These are sourced from observations from planning work undertaken across Western Canada, knowledge of public sector recreation and sport as well as research of available data.

Increasing Demand for Artificial Turf

Once seen as solely for high performance sport, artificial turf is increasingly in demand for recreational and participatory levels of sport. The ability of artificial turf to handle a higher volume of use and mitigate loss of play due to weather is highly desirable among all levels of users. Driving this trend (as further explained in the *Increasing Provision in Medium Sized Municipalities* section) is provision of artificial turf outside of major urban centres.

Increasing Provision in Mid-Sized Municipalities

Historically, artificial turf had typically only been provided in large urban centres. However, over the past decade several smaller and mid-sized communities across Alberta have undertaken artificial turf projects. The rationale for many of these projects includes the ability to expand seasons of play, minimize maintenance costs, and provide a better user experience. Small to mid-sized communities in Alberta that provide artificial turf include Okotoks, Cochrane, Lacombe, Bonnyville, Cold Lake, Fort Saskatchewan, and Spruce Grove. Mid-sized Alberta cities such as Red Deer, Grande Prairie, Lethbridge, and Medicine Hat have also studied the validity of increasing provision from one to multiple artificial fields based on user demand. To date, none of these municipalities have proceeded with the development of a second artificial turf field. It is also important to note that artificial turf feasibility analysis is ongoing in Airdrie and Chestermere which could impact overall supply and demand in the Calgary region.

Increasing User Expectations and the Demand for Convenience Amenities

In general, expectations for recreation and sport facilities continue to increase. Active participants and spectators alike have higher expectations for the experience provided at facilities that they use and visit than in decades past. This trend is largely fueled by the significant investment made in recreation and sport infrastructure by municipalities of all sizes. This increased provision has raised expectations across the board and resulted in a highly competitive landscape. Convenience and comfort amenities expected by many users at recreation facilities (including multi-sport field sites) now include Wi-Fi, comfortable seating areas, washroom facilities, change areas, and child play areas. Investment in athletic field infrastructure in many municipalities has become driven by the demand for sites that can accommodate special events and tournaments. Findings from the public and stakeholder engagement undertaken during the City of Calgary's 2016 Sport Field Study re-affirmed the importance of support amenities at sport field sites.

Image Credit: Alberto Frias, Unsplash

1.6 Emerging Trends in Sports Field Infrastructure and Use

Providing Infrastructure for Emerging Sports
Municipalities in Canada have traditionally provided rectangular athletic fields designed for soccer and football. Emerging sport organizations such as cricket are increasingly looking for dedicated field sites for their specific sports. The ongoing social and cultural diversification of many urban cities (small, mid, and large) has additionally led many municipalities to think more broadly about outdoor recreation and sport infrastructure priorities and space allocation practices. Increasing societal conversations regarding historical privilege have further influenced these conversations and led many public sector providers of recreation space (including sports fields) to focus on providing spaces that are inclusive and able to foster the growth of emerging activities.


Image Credit: Jose Pablo Dominguez, Unsplash

Spontaneous Play and Physical Literacy
There is an increasing societal demand for spontaneous or unstructured recreation. Residents are increasingly demanding spaces that can support these activities. There is ample research that supports the community value of providing high quality and accessible spaces for pick-up games.

National movements and initiatives such as Sport for Life (S4L) have also gained traction in their advocacy of the importance of physical literacy across ones' lifespan. As municipalities play a key role in providing recreation / sport spaces and places, the relationship between movements such as S4L and public sector demand for recreation has strengthened in recent years.

1.6 Emerging Trends in Sports Field Infrastructure and Use

Notable Participation Indicators

Participation in organized soccer remains significant, especially for children and youth. Currently soccer is the top outdoor sport in Canada. Table 1.9, sourced from the *Canadian Youth Sport Report, 2014** summarizes the top 10 sports and activities among youth. Note this is only the top 10, not a comprehensive list.

**http://www.srgnet.com/2014/06/10/massive-competition-in-pursuit-of-the-5-7-billion-canadian-youth-sports-market/*

Baseball, softball, and fastball did not rank within the top 10, however some data suggests growth in these activities. Between 2015 and 2016, participation in all Baseball Canada sanctioned levels increased by 14% to over 120,000 participants. From 2014 to 2015, participation increased by 8%.

Source: https://www.baseball.ca/baseball-participation-on-the-rise-across-canada.

Table 1.9 - Sports & Activities Participation Statistics

Top Ten Sports & Activities in Canada
Among Youth 8 to 17
By Current Organized Participation

Activity	Participants
Swimming	1,120,000
Soccer	767,000
Dance	625,500
Hockey	531,000
Skating	436,000
Basketball	354,000
Gymnastics	336,000
Track and Field : Running	330,000
Ballet	277,300
Karate	230,000

Alberta Recreation Survey

The 2017 version of the Alberta Recreation Survey found that 20% of Albertans participated in soccer in the previous year.

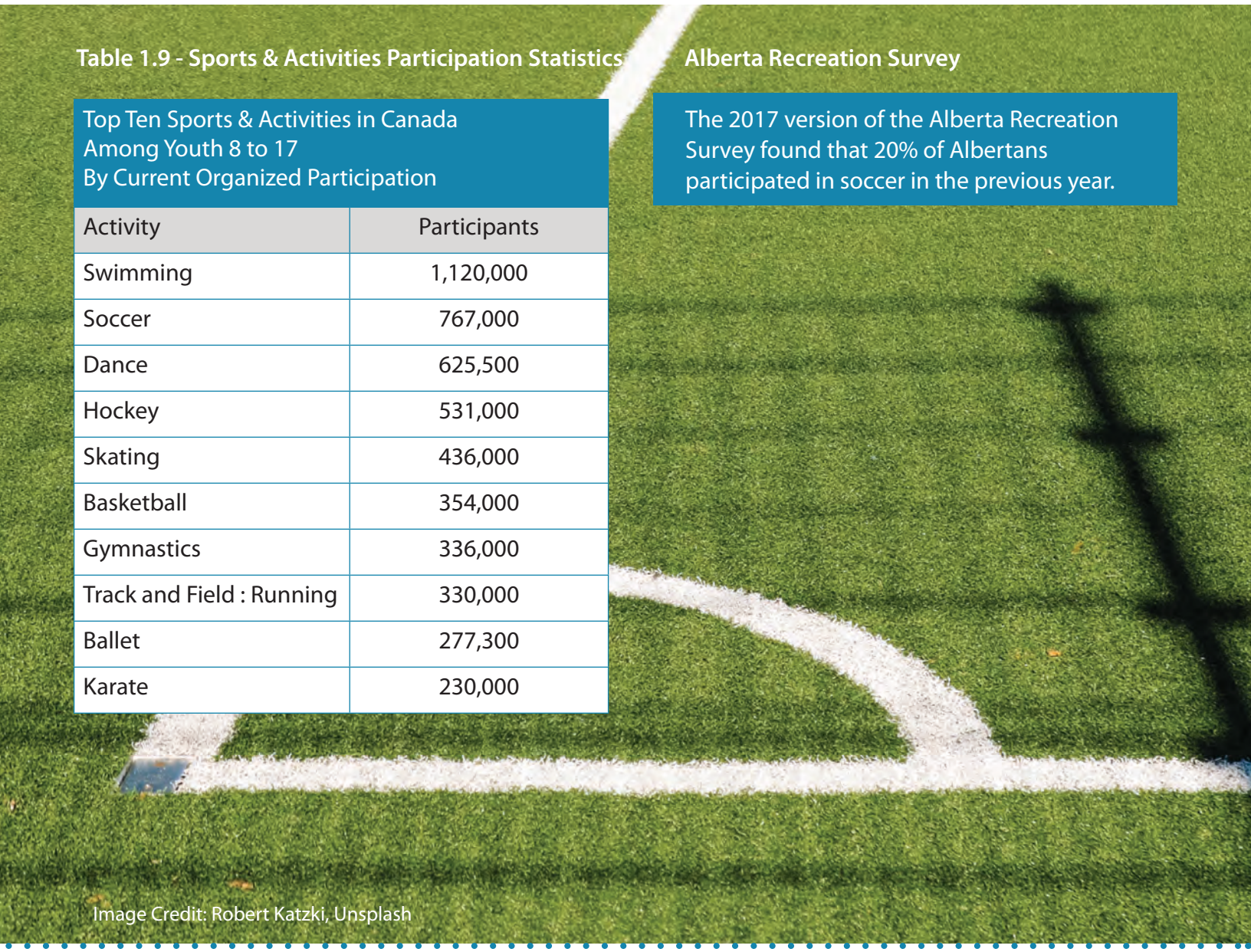


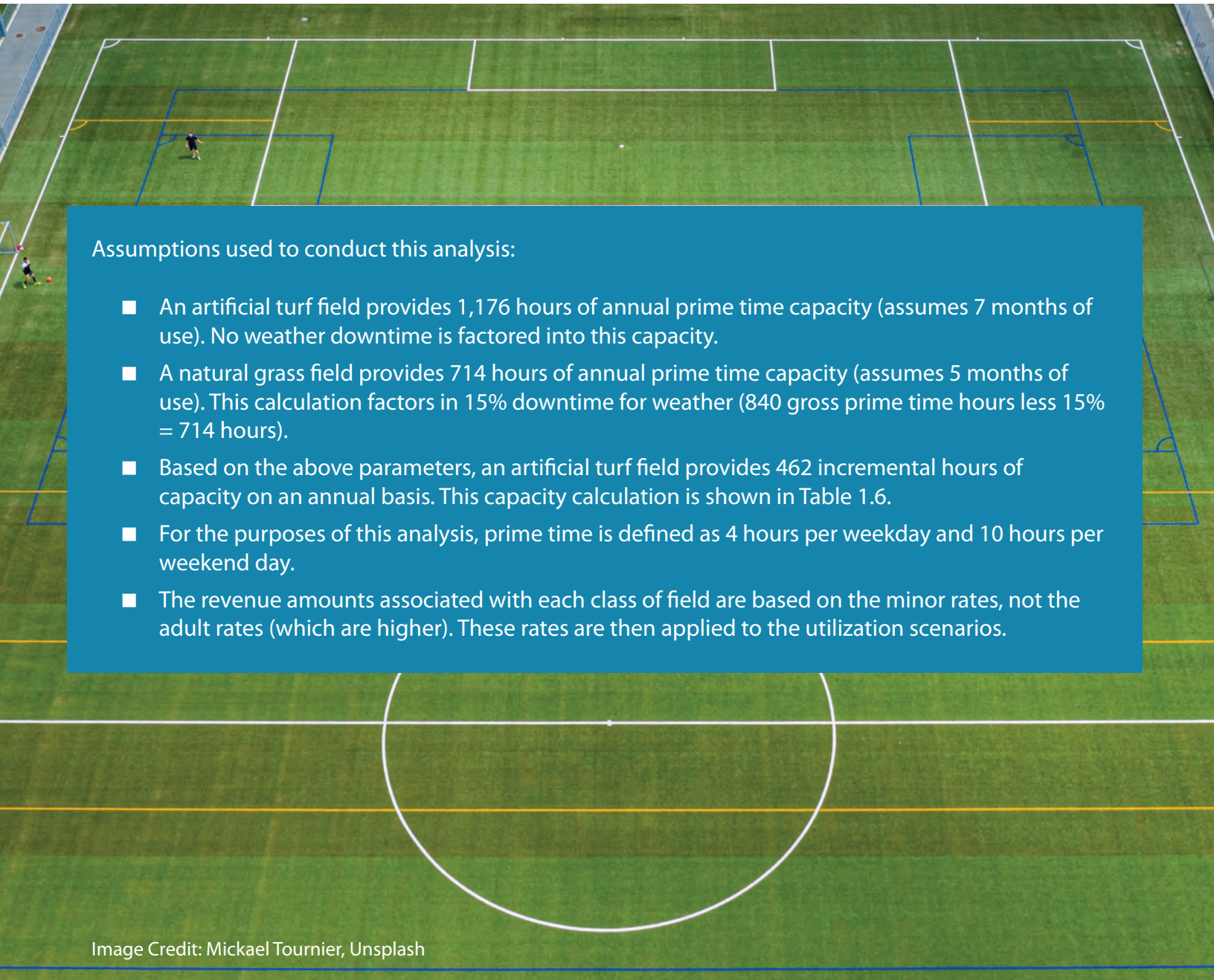
Image Credit: Robert Katzki, Unsplash

1.7 Revenue Increase from Converting Grass to Artificial Turf

Tables 1.10 and 1.11 provide a high level overview of the gross revenue impact of artificial turf vs. natural grass fields that can be accrued based on the following two factors:

1) Incremental capacity as a result of a lower season of use and reduced weather downtime
2) The rate variance between natural grass fields and artificial turf

The intent of this analysis is to outline the gross revenue benefit that could be accrued by shifting users from natural grass to artificial turf fields as well as providing more desirable and functional capacity during shoulder seasons.



Assumptions used to conduct this analysis:

- An artificial turf field provides 1,176 hours of annual prime time capacity (assumes 7 months of use). No weather downtime is factored into this capacity.
- A natural grass field provides 714 hours of annual prime time capacity (assumes 5 months of use). This calculation factors in 15% downtime for weather (840 gross prime time hours less 15% = 714 hours).
- Based on the above parameters, an artificial turf field provides 462 incremental hours of capacity on an annual basis. This capacity calculation is shown in Table 1.6.
- For the purposes of this analysis, prime time is defined as 4 hours per weekday and 10 hours per weekend day.
- The revenue amounts associated with each class of field are based on the minor rates, not the adult rates (which are higher). These rates are then applied to the utilization scenarios.

Image Credit: Mickael Tournier, Unsplash

1.7 Revenue Increase from Converting Grass to Artificial Turf

Table 1.10 - Artificial Turf Comparison to Class A Natural Grass Fields

Class A				
% of Capacity Utilized	Natural Grass Field Hours Used	Natural Grass Field Revenues	Artificial Turf Field Hours Used	Artificial Turf Field Revenues
100%	714	$38,855.88	1176	$131,088.72
75%	536	$29,141.91	882	$98,316.54
50%	357	$19,427.94	588	$65,544.36
25%	179	$9,713.97	294	$32,722.18

Table 1.11 - Artificial Turf Comparison to Class B Natural Grass Fields

Class B				
% of Capacity Utilized	Natural Grass Field Hours Used	Natural Grass Field Revenues	Artificial Turf Field Hours Used	Artificial Turf Field Revenues
100%	714	$28,731.36	1176	$131,088.72
75%	536	$21,548.52	882	$98,316.54
50%	357	$14,365.68	588	$65,544.36
25%	179	$7,182.84	294	$32,722.18

As reflected in the above tables, the incremental capacity and rate differential (based on 2020 adult rates) provides the opportunity to generate significantly more revenue from artificial turf fields in comparison to natural grass fields. However, it is important to note that this analysis reflects two assumptions; that user groups would have capacity / willingness to pay more for access to artificial turf and that the increased capacity would be consumed (25% utilization of a Class A or B field is different than 25% utilization of an artificial turf field). These assumptions require further exploration with user groups.

Image Credit: Kakudmi, Unsplash

1.7 Revenue Increase from Converting Grass to Artificial Turf

Another way to look at the potential gross revenue benefit of artificial turf is to factor how much incremental revenue potential exists within shoulder seasons by providing artificial turf. As reflected in Table 1.12, an artificial turf field can provide significantly more gross revenue potential. However, as previously noted, further engagement with user groups is required to validate shoulder season demand.

Table 1.12 - Gross Revenue Potential

	Artificial Turf	Class A	Class B
Hours available during shoulder seasons	462	92*	92*
Total possible gross revenue (if 100% of available time is booked)	$51,499.14	$5,028.41	$3,718.18
Total gross revenue if 25% of available capacity is booked	$12,874.79	$1,257.10	$929.54

**Based on the general assumption that a natural grass field would be playable for 20% of the time on average during shoulder seasons.*

Other factors that should be considered in converting grass to artificial turf include operational costs such as:

- The length and amount of shoulder season use (e.g. costs associated with snow clearing)
- Lifecycle budget allocations (e.g. if lifecycle replacement costs are funded from revenues or through other means)
- Costs associated with amenity uses and requirements (e.g. level of night time use that requires lighting, spectators and associated janitorial costs)

Conceptually, the greatest revenue benefit would be achieved by targeting retrofits towards lower use Class B fields that already have sufficient support amenities, or for which these amenities can be easily added. However, a further case by case review and analysis will be required to determine those fields that have the highest degree of operational cost benefit.

1.8 Part A Key Recommendations and Takeaways

Recommendations and key takeaways from Part A – Planning include the following:

1. The City of Calgary can improve its athletic park planning procedures by incorporating planning procedures utilized by the comparable cities. The following planning considerations are presented as a baseline framework:

   - **Table 1.3 Artificial Turf Field Site Decision Criteria**, which provides guidance on artificial turf field placement, programming, technical requirements and desirable conditions
   - **Table 1.4 Artificial Turf Weighted Planning Matrix**, which can be used to identify the need for artificial turf within a District site, and to compare the compare the relative desirability of potential sites for artificial turf

2. With the exception of field hockey, a well-maintained natural grass field provides the best surface for soccer, football and the majority of other sports and uses. The goal should not be to replace natural grass wherever possible, but rather to supplement and support natural grass fields within the City's overall field inventory.

3. Artificial turf provides a safe, uniform and reliable playing surface with sport development, economic, social and environmental benefits. An optimally utilized artificial turf field provides for a longer playing season, higher intensity of play (3 times higher than natural grass), better tournament opportunities and higher return on investment.

4. The expanded season and higher utilization afforded by artificial turf can maximize the use of, and benefits provided by, major sport field sites. Given the increasing scarcity of land in many urban centres, these considerations are becoming more important with artificial turf.

5. Some emerging trends impacting athletic park planning include:

   - Increasing demand for artificial turf for recreational and participatory use
   - Increased user expectations for high quality amenities and overall user athletic park experience
   - Provision for infrastructure for emerging sport
   - Provision for opportunity for spontaneous, non-programmed play
   - Joint use municipal and school district artificial turf fields, which allow for peak utilization of artificial turf as the hours of use are largely complimentary (e.g. schools use the field during weekdays prior to 6 pm, with municipalities using the field evenings and weekends)

6. Where conversion of an existing natural grass field to artificial turf is being considered, the greatest economic and utilization benefit is achieved by retrofitting an under utilized field with existing support amenities, or where amenities can be easily added.

PART B

DEVELOPMENT OF ATHLETIC PARKS

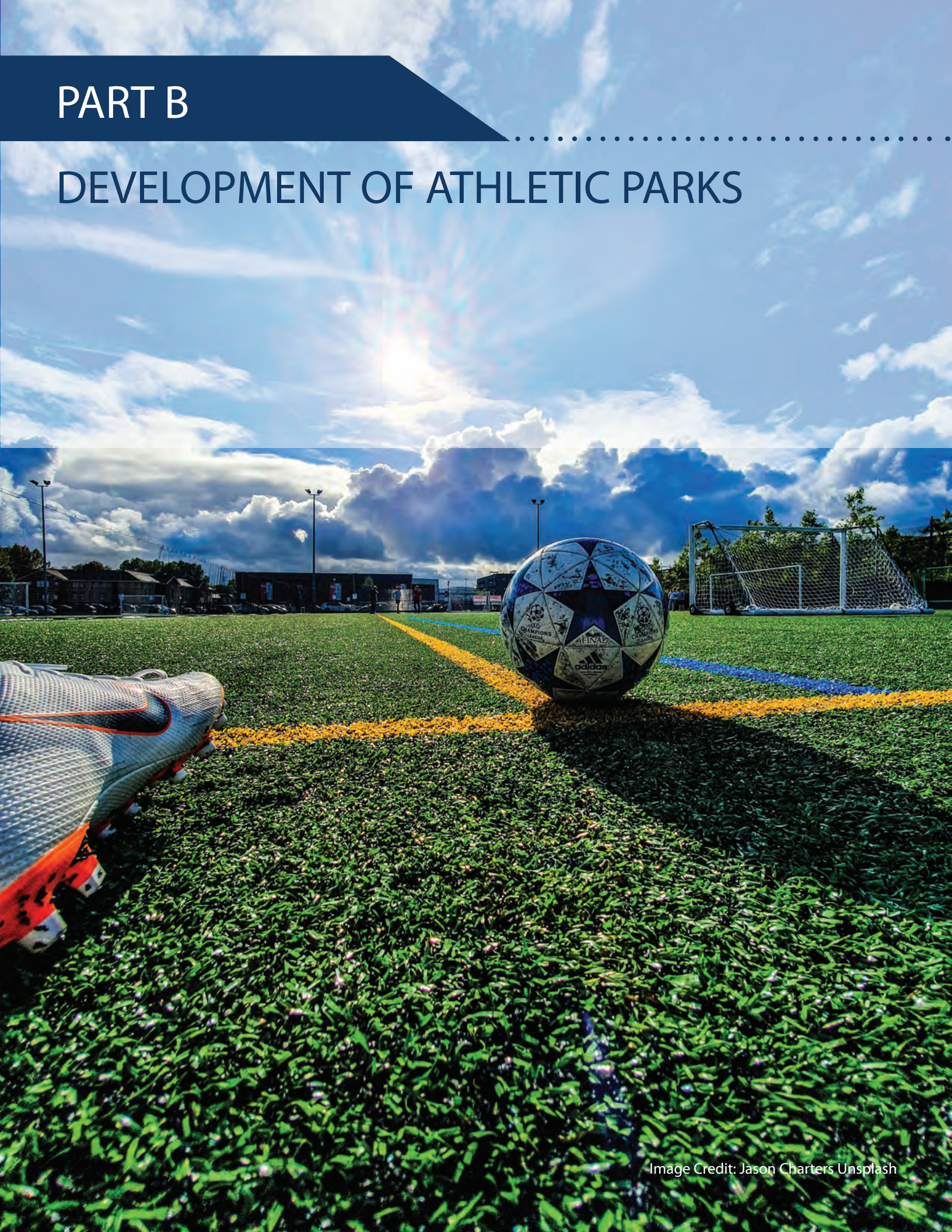


Image Credit: Jason Charters Unsplash

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2.0 DEVELOPMENT OF ATHLETIC PARKS

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SUMMARY OF TABLES

2.0 DEVELOPMENT OF ATHLETIC PARKS

Image Credit: William Smith, Unsplash

2.1 Introduction and Overview

2.1.1 | Introduction

This section summarizes the key considerations and best practices in the development of athletic parks. This includes factors common to athletic parks containing natural grass fields, artificial turf fields, or a mix of both artificial turf and natural grass fields.

Refer to other sections of this report for related information including Part A Planning and Part D Artificial Turf.

2.1.2 | Overview

This section contains the following information:

- A summary of proposed field amenities for the City's athletic park classifications (A, B and C)
- Field surface construction guidelines
- Guidelines for field configuration, offsets and functional park layout
- Typical athletic park area requirements
- Best practices for field illumination and parking requirements
- Comparison of natural grass and artificial field typology

2.2 Amenities Requirements

2.2.1 | Classification System

The City's athletic parks have been categorized into the following three classifications:

- Class A - Purpose built for Organized Multi-Sport Play and High-Level Tournaments
- Class B - Purpose built for Organized Multi-Sport Play and League Tournaments
- Class C - Purpose built for Organized Single or Multi-Sport Play for Leagues

Image Credit: Vlad Vasnetsov, Pixabay

2.2 Amenities Requirements

2.2.2 | Proposed Field Classification System - Rationale

Class A: Highest Level Multi Field Complex

- Unique City-wide high-level facilities
- Typically, only one or two in the City (e.g. Shouldice Athletic Park)
- Ability to compete for and host National and International events
- Staffed during operating hours
- High level of amenities which could include stadium seating, artificial turf, change rooms, concession, etc. or unique features (e.g. # fields, co-location with Parks amenities)
- User rates may be higher
- Access given to permit holders only
- Examples: Glenmore Athletic Park, Foothills Athletic Park

Class B: Multi Field Complex

- Athletic parks serving the City-wide population
- Ability to compete and host District and potentially Provincial events
- Many similar amenities as 'Class A' athletic parks
- Often Staffed
- Access given to permit holders only
- Examples: Optimist A Athletic Park, New Brighton Athletic Park

Class C: Multi Field Complex

- Athletic parks serving local areas in the City
- Not typically staffed
- Site fencing may be limited, and public may utilize more readily
- Examples: Frank Mc Cool Athletic Park, Woodbine Athletic Park

Artificial Turf Field

- City-Wide Asset. May be a stand-alone artificial turf field or within a Class A, B or C Complex
- Always has lighting, seating or certain other unique features (e.g. co-location with parks amenities such as washrooms)
- Has high intensity use (e.g. back to back to back bookings)
- Has unique maintenance requirements
- Has different user rates
- Typically only available by permit

2.3 Programming & Amenities Based on Classification System

Table 2.1 - Proposed Planning, Programming & Amenity Table

Amenity Criteria		Athletic Park Classification		
		A	B	C
Planning Criteria	Capital Planning Service Area	City-wide /regional	Regional	Local area and/ or community
	Maintenance facility (460 square meters)	Yes	Optional	No
	Servicing	Electrical Water Storm Sanitary WIFI (optional)	Electrical outlets Water Storm Sanitary	Water Storm
	Parking (25-30 stalls on average in Canadian Cities)	Yes	Yes	Yes
	Parking amenities	Bus turnaround Food truck parking	Bus drop off Food truck parking	No
	Lights	Yes, for Artificial Turf and Natural Grass	Yes, for Artificial Turf Optional for Natural Grass	No
	Minimum number of fields	3 of same type/use	2 of same type/use	1 or more
	Supporting facilities	Adjacent to stadium or sport club house	Ideally adjacent to recreation center, arena, clubhouse	Optional adjacent to recreation facility
	Outdoor storage (~1215 square meters)	Yes	Preferred	Optional
	Training/warm up space	Yes	Optional	No
	Change rooms	Yes	Optional	No
	Washrooms	Yes (permanent structure)	Yes (permanent structure or portable)	Portable
	Onsite passive recreation	Yes	Preferred	Optional
Programming	Public access	No	By permit only	By permit only
	Tournament capable	Up to national level	Up to a regional/ league level	No
	Staffed	Yes	Optional but preferred	No
	Site fencing	Controlled perimeter fencing- restricted access	Perimeter fencing	Perimeter fencing

2.3 Programming & Amenities Based on Classification System

Table 2.1 (Continued) - Proposed Planning, Programming & Amenity Table

Amenity Criteria		Athletic Park Classification		
		A	B	C
Amenities	Ball control fencing	Yes	Yes	Optional
	Artificial Turf field(s)	Yes	Optional	No
	Score boards	Yes	Optional	No
	Sound/ Public Address system	Optional	Optional	No
	Field lines	Yes	Yes	Optional
	Players benches	Yes	Optional	Optional
	Seating per field (minimum)	500 main field 200 secondary fields. Concrete pad for additional temporary seating on all fields	100 with concrete pad for additional temporary seating	100 preferred with concrete pad for additional temporary seating
	Nets/goals/uprights	Yes	Yes	Yes

Image Credit: Sean Musil, Unsplash

2.3 Programming & Amenities Based on Classification System

2.3.1 | Field Development Category Level

The field development standards are separated by artificial turf and natural grass, and are applicable to all classifications (A, B, C).

2.3.2 | Artificial Turf Field Development Category

Table 2.2 - Artificial Turf Development Categories

	Artificial Turf Categories				
Design Requirement	Soccer	Rugby	Football	Field Hockey	Lacrosse
Sport Governing Body	International Federation of Association Football (FIFA)	International Rugby Football Board (IRB)	Canadian Football League (CFL)/ National Football League (NFL) (High School)	International Hockey Federation (FIH)	World Lacrosse (WL)
Certification Type	FIFA Quality (Community Play) FIFA Pro Quality (Stadium)	World Rugby Regulation 22 / One Turf Concept	FIFA Quality / One Turf Concept	Global Elite Global National	FIFA Quality / One Turf Concept
Shock Pad	Yes	Yes	Yes	Yes	Yes
Infill	Yes	Yes	Yes	No – Global/ Global Elite Permitted - National	Yes
Wetdown Sprinklers	Optional	Optional	Optional	Required – Global/Global Elite Not Required – National Not Required – Multi-Sport	Optional

The decision on whether a field will be certified, and to what level (e.g. FIFA Quality vs. Quality Pro) should be made in consideration of the level of play, the value of certification in terms of tournament play, and the needs of the sport user groups. There is an ongoing cost to maintain the field rating which is different than an inspection for safety/lifecycle.

For safety reasons, all artificial turf fields should incorporate a shock pad.

2.3 Programming & Amenities Based on Classification System

2.3.3 | Natural Grass Fields

Natural grass fields have been the standard for most athletic parks in many communities in Alberta, including Calgary. Depending upon level of use and program needs, fields are developed according to one of five horticultural standards. **The development of natural grass fields should be based on expected hours of usage.**

Detailed information on how Calgary's existing natural grass fields have been constructed is not available. Based on observations by staff at R.F. Binnie & Associates, it appears they have been built to a Category Four standard. The current Calgary Parks 2020 Development Guidelines and Standard Specifications : Landscape Guidelines do not currently call out for specific Soil Classification for sports fields. **The development of new sports field soil classification and specifications should be developed by the Recreation Department for future sports field projects. This could include standards for include irrigation, topsoil, sodding, seeding, fencing, electrical, and overall field dimensions.**

Image Credit: Roy Harryman, Pixabay

2.3 Programming & Amenities Based on Classification System

Table 2.3 - Recommended Natural Grass Development Categories

	Horticultural Practices Categories				
Horticulture Design Requirement	One	Two	Three	Four	Five
Current City of Calgary Amenities Context *	Not used	Not Used	Class A Class B	Class C	Class D Refer Parks Development Guidelines
Soil % (Silt, Clay)	<8.0	<25	25-35	36-45	All Soils
Sand %	<92	<75	65-75	55-64	
Sand to Soil (Ratio)	11.5:1	3:1	2.6:1	1.2:1	
Sub-Surface Drainage	Yes	Yes	Yes	Yes	No
Irrigation	Yes [1]	Yes [1]	Yes [1]	Yes [1]	Site by Site Basis
Lights	Yes	Yes	Optional	Optional	No
Context compared to Best Management Practices	Not used	Not Used	Irrigated & Lit	Irrigated & Unlit	Irrigated & Unlit
Hours of Usage	450	550	700	450	

(Sports Turf Canada, 2012)

[1] Within the City of Calgary context, all horticultural practices for all-natural grass fields include irrigation from Class A to Class D

** Within field categories, facilities are further sorted according to accompanying site amenities with a designation of Class A, B, C. Currently field categories 3 and 4 are standard for fields with more intense programming and as such, are better equipped with support amenities.*

- *Category 3 Fields – are generally high-use and performance fields intended for formal programs, sport hosting, allocated to and used by organized sports groups and leagues for practices and tournaments. The base composition of Category 3 Fields has more sand*
- *Category 4 Fields – are intended for formal and informal training and practice activities and school activities. The base composition is closer to an even ratio of sand and soil*
- *Category 5 Fields – are generally fields intended primarily for informal and spontaneous community and neighbourhood use. The fields are developed with a variety of soil types*

2.3 Programming & Amenities Based on Classification System

2.3.4 | Geotechnical Investigation

A geotechnical investigation should be conducted with a grid-style onsite drilling program for all outdoor athletic facilities. Unconfirmed geotechnical conditions can impact construction costs. Existing soil conditions may be unsuitable, consisting of organic material, dry land fill, or unsettled material. For natural grass fields, topsoil testing should be completed as part of the geotechnical investigation in order to determine whether the existing soils can be incorporated into the new sports field. For example, a deep layer of organic material at a potential site would be an unsuitable base for many aspects of the athletic park development. The material would need to be excavated, removed off the site, and replaced with suitable base material. If this is not feasible, alternate design solutions may be explored; however, these could also be quite costly.

Key Recommendations: A geotechnical investigation should be conducted to test the suitability of topsoil for athletic park development. Modifications or removal of the soil may be the recommended outcome.

Image Credit: Andres Simon, Unsplash

2.3 Programming & Amenities Based on Classification System

2.3.5 | Lighting

Lighting is an important component of an athletic park, however, if the system is not effectively designed, lighting can impose negative impacts on the surrounding area due to glare, spill light and other forms of light pollution. Lighting increases the number of playable hours in a day at the beginning and ends of the outdoor season. At a minimum, appropriate lighting levels are specified for the programmed activities and use, but if a venue is potentially to be used for national and international sport hosting with televised events, enhanced lighting levels may be required. The particular lighting requirements will need to be reviewed as it can affect the spacing and quantity of poles, types of fixtures and accessories needed to achieve the required lighting levels.

According to the Community Standards Bylaw 43: *"No owner or occupier of a Premises shall allow an outdoor light to shine directly into the living or sleeping areas of an adjacent dwelling house unless the outdoor light is permitted or required pursuant to the Land Use Bylaw 1P2007, a development permit or a similar approval."*[1]

Field lighting glare affects the neighbouring properties, players and spectators: *"Glare control is important for neighbors, player safety, and spectator enjoyment. Fixture glare will make it difficult for players to follow the ball, creating the possibility for injury. Players competing on multi-field complexes can also be affected by glare from adjacent fields."*[2] Refer to Section 2.8 of this report for information on lighting pollution mitigation.

The use of appropriate lighting controls (lenses and covers) can significantly help to minimize offset glare, spillage, or a halo effect around field lighting fixtures. Another method of reducing light pollution is to increase the number of sport field lighting poles from four to six. The increase of the number of poles reduces the amount of the area to be covered by one single pole and allows for increased control of the light fixtures. However, if the existing electrical servicing is not sufficient to accommodate the increased demand, upgrading services would be required by pulling additional power from off-site sources, which will add costs to the project.

Image Credit: Free-Photos, Pixabay

"Fixtures with poor light control waste light by allowing it to go off the field into neighborhood spill and sky glow. Proper light control redirects wasted spill light back onto the playing surface. No matter which light source is used, LED* or metal halide, efficient fixture and system design, along with application expertise, impacts the quantity and quality of lighting results. With better control, you reduce the number of fixtures needed to get useful light on the field. This also reduces operating and maintenance expenses."[3] (*The use of energy-efficient LEDs would require increased controls due to the intensity of this lighting type).

Key Recommendations: Light pollution is an important factor to consider when developing fields. Strategies to reduce spillage include installing lenses and covers and increasing the number of poles.

2.3 Programming & Amenities Based on Classification System

2.3.6 | Irrigation / Water Source

Both natural and artificial turf fields require access to water. Artificial turf fields require water for surface conditioning and maintenance, and natural grass fields require water mainly for irrigation and as well as maintenance. In the case of natural grass fields where sites have no water source and/or low water pressure, the City would need to consider solutions such as installing an on-site water storage tank for irrigation, and/or adding an irrigation booster pump to increase pressure. These solutions would add to project capital costs.
Key Recommendations: Access to water is needed for both natural and artificial turf fields, and this should be considered during design.

2.3.7 | Spectator Seating

Spectator seating for 200 people per field (as a minimum) along with associated amenities is anticipated with a typical athletic field development, regardless of field surface type. In addition, additional concrete pads should be provided to accommodate temporary seating of up to 500 per field for Class A and Class B athletic parks. **Sport field venues that may be used to host larger-scale events, regional, national or international competitions and should be planned and designed to accommodate between 500 to 5000 spectators with a combination of permanent and temporary seating.** Increased spectator seating capacity for larger events is costly and results in a need for more parking, washrooms, and potentially site lighting. Some of these costs may be recovered from increased revenue from onsite parking and potentially expanded services such as food vendors.
Key Recommendations: Spectator seating is necessary for all fields at athletic parks. It is an added expense, but some costs can be recovered through revenue that this generated from events.

2.3.8 | Supporting Infrastructure and Services

Program modifications or expansion to an existing athletic or community park will likely require improved or additional support infrastructure including on-site washrooms, change rooms, community spaces, site servicing, and other amenities.
Key Recommendations: For the development of an artificial turf facility, the minimum amenities should include lighting, bleachers, waste/recycling bins and portable washrooms.

2.3.9 | Site Servicing

Site servicing must be considered as reasonable access to services is required for facility development. If a site does not have reasonable proximity to services, it will need to be self-sufficient and functioning. While not ideal, alternate site servicing infrastructure could include wells, septic fields, fire ponds, ditches, retention areas, rain gardens and other stormwater management features.

The following are key site servicing requirements for either natural or artificial turf field developments:

- Water service, if the field will be irrigated or has a water source
- Electrical service, if the field will be lit and / or requires irrigation
- Sanitary service, if buildings are part of overall development
- Stormwater service is to be provided for all field types
- Shallow utilities (telephone, natural gas, etc.) if buildings are part of overall development

Key Recommendations: Servicing requirements that should be considered when developing athletic parks include water, electrical, sanitary, stormwater and shallow utilities.

2.3 Programming & Amenities Based on Classification System

Table 2.4 - Site Servicing – Typical Athletic Park

Items	Requirement	Example Use
Sanitary Servicing	Sanitary service at one location.	Required for washrooms and any buildings.
Water Servicing	Water service at one location.	Required for washrooms, irrigation, maintenance, amenity buildings, showers, drinking fountains.
Stormwater Servicing	Stormwater service at one location.	Stormwater service connection would be required to allow for stormwater release off site.
Shallow Utilities (Gas, Telephone)	Shallow utilities, only required for amenity buildings, if to be built on the site	Concession, change room, washroom building.
Electrical	Electrical service, Phase III power would be required for sport lighting and buildings. Electrical connection would be required to operate irrigation system	Power for field lighting, washrooms, amenity buildings and irrigation (with potential booster pumps)

2.3.10 | Field Typology

The development requirements and associated costs of a new or redeveloped artificial turf or natural grass field is determined by the field size and field program (sports to be played). Some sports and combination of sports such as soccer and football, require a larger layout to accommodate the areas of play compared to others.

The City should consider the possible program of sports that will be played on a multi-use natural grass or artificial field. Many typical sports include:

- Rugby
- Soccer
- Football (touch or tackle)
- Ultimate Frisbee
- Field Lacrosse
- Cricket
- Field Hockey – Multi-use
- Field Hockey – Primary Use (Wet Field)

Image Credit: Sheri Hoole, Unsplash

2.3 Programming & Amenities Based on Classification System

2.3.11 | Multi-Use Fields

In general, unless a field is being built to accommodate a single sport, fields should be designed to accommodate soccer and other sports that will fit within a soccer field footprint. This includes field hockey, field lacrosse, as well as practices and drills for most other sports.

Football and rugby would not fit within a standard soccer field footprint and would require a longer field (about 140 m in length vs. 110 m for soccer). In order to minimize construction costs and optimize site utilization, it is recommended the City constructs multi-use fields that can accommodate football and rugby only where there is a need for additional football/rugby fields. Consultation would occur with stakeholders before a new artificial turf field is constructed, to determine needs and preferences.

To accommodate a cricket oval, a larger area than a single soccer or football field is required.
A cricket pitch or portable mat could potentially be situated between two rectangular fields to create a cricket oval.

Natural grass fields require a larger footprint than artificial turf fields in order to accommodate the need to shift the goal mouth and upright posts to counter excessive surface wear, and aid turf repair and recovery.

Table 2.5 - Facility Area Requirements – Typical Artificial Field

Field Type	Field Size (w x l) in meters	Safety Zone Endline/Sideline per side (m)	Pathway per side (m)	Total Width (m)	Total Length (m)	Area (m^2)
Soccer	64 x 100	5	3	80	116	9,280
Football	60 x 140	5	3	76	156	11,856
Rugby*	70 x 122	5	3	86	138	11,868
Field Hockey	55 x 91.4	5	3	71	107.4	7,626
Lacrosse*	60 x 110	5	3	76	126	9,576
Multi-use Field (no football)	64 x 100	5	3	80	116	9,280
Multi-use Field (including football)	64 x 140	5	3	80	156	12,480

Note: 'Area' requirements include safety zone, players area, and other associated amenitie. Spectator seating areas are not included. Field size reflects the game line boundaries, not considering safety zone allowances.

** Both lacrosse and rugby allow for adjustment of field size to fit within standard soccer (lacrosse) or football (rugby) fields*

2.3 Programming & Amenities Based on Classification System

Table 2.6 – Facility Area Requirements - Natural Grass Fields

Field Type	Field Size (w x l) (m)	Field Shifting[1] (m)	Safety Zone[2] Endline/ Sideline per side (m)	Total Width (m) Field Width + Shift +Safety Zones	Total Length (m) Field Length + Shift + Safety Zones	Total Area (m^2)
Soccer	64 x 100	20	10	104	140	14,560
Football	60 x 140	20	10	100	180	18,000
Rugby	70 x 122	20	10	110	162	17,820
Field Hockey	55 x 91.4	20	10	95	131.4	12,483
Lacrosse	60 x 110	20	10	100	150	15,000
Multi-use Field (no football or Rugby)	64 x 110	20	10	104	150	15,600
Multi-use Field (including football)	70 x140	20	10	110	180	19,800

Note: 'Area' requirements include offset space to shift/adjust goal mouths or uprights, safety zone, seating area, players area, and other associated amenities.

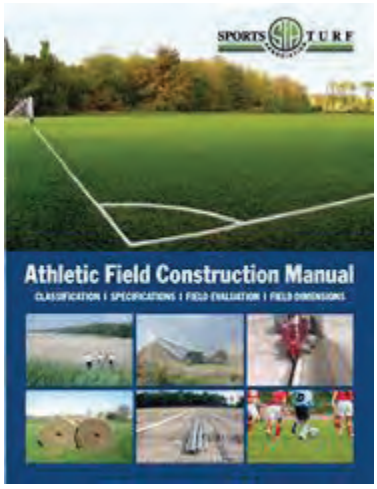
[1]Field shifting is a technique that reduces field damage on natural grass fields. Areas such as the goal mouths and sidelines get more wear than other parts of the field. Periodically shifting the field (by repainting lines 4-7m away from the previous location) and moving the portable goals accordingly will allow the damaged areas to re-grow and spread the higher use to new areas.

[2]Safety zone setbacks are described in section 2.4 of this report

Image Credit: Studio Orange

2.3 Programming & Amenities Based on Classification System

2.3.12 | Field Design Guidelines and Standards



Natural Grass Fields

The design and associated costs of natural grass field development can vary considerably depending on site location, access to servicing, topography, geotechnical conditions, desired field type and design specifications. Based on current best practices in Canada, three construction design specifications (Category 3, 4 & 5) are commonly followed for natural grass field design and construction. The Sports Turf Canada's Athletic Field Construction Manual, 2012 (AFCM), outlines five categories of field development, but Category 3 and Category 4 field development standards (based on agronomist and horticulture specifications) are recommended for City of Calgary fields. The categories are differentiated by the specific ratios of sand, silt and clay in the soil mix. For example, Category 3 will be more expensive than Category 4 due to the higher ratio of sand in the soil mix.


Image Credit: Studio Orange

New Construction and Redevelopment of Existing Play Field

New construction and redevelopment of play fields should follow the Athletic Field Construction Manual, 2012 (AFCM, Sports Turf Canada), an industry standard guide for natural grass field development. The field classes are listed in Table 2.7.

The field classes prescribed in the AFCM specifications are based on the soil classification system. The specifications include requirements for irrigation, sub-surface drainage, and best management practices for sports field maintenance / horticultural practices.

2.3 Programming & Amenities Based on Classification System

Natural Grass Fields – AFCM Design Standards (Sport Turf Canada, 2012)

Table 2.7 – Horticulture Design Requirements - Natural Grass

	Horticultural Practices Categories				
Design Requirement	One	Two	Three	Four	Five
Current City of Calgary Amenities Context *	Not used	Not Used	Class A Class B	Class C	Class D Refer to Parks Development Guidelines
Soil (% silt plus clay)	<8.0	<25	25-35	36-45	All Soils
Sand %	<92	<75	65-75	55-64	
Sub-Surface Drainage	Yes	Yes	Yes	Yes	No
Irrigation	Yes [1]	Yes [1]	Yes [1]	Yes [1]	Site by Site Basis
Lights	Yes	Yes	Optional	Optional	No
Context compared to Best Management Practices	Not used	Not Used	Irrigated & Lit	Irrigated & Unlit	Irrigated & Unlit
Hours of Usage	450	550	700	450	

[1] Within the City of Calgary context, horticultural practices for all-natural grass fields include irrigation from Class A to Class D

** Within the field categories (1-5), facilities are further sorted according to accompanying site amenities with a designation of Class A, B and C. For Class D, refer to the Parks Development Guidelines. Currently, field categories 3 and 4 are standard for fields with more intense programming and are therefore better equipped with support amenities.*

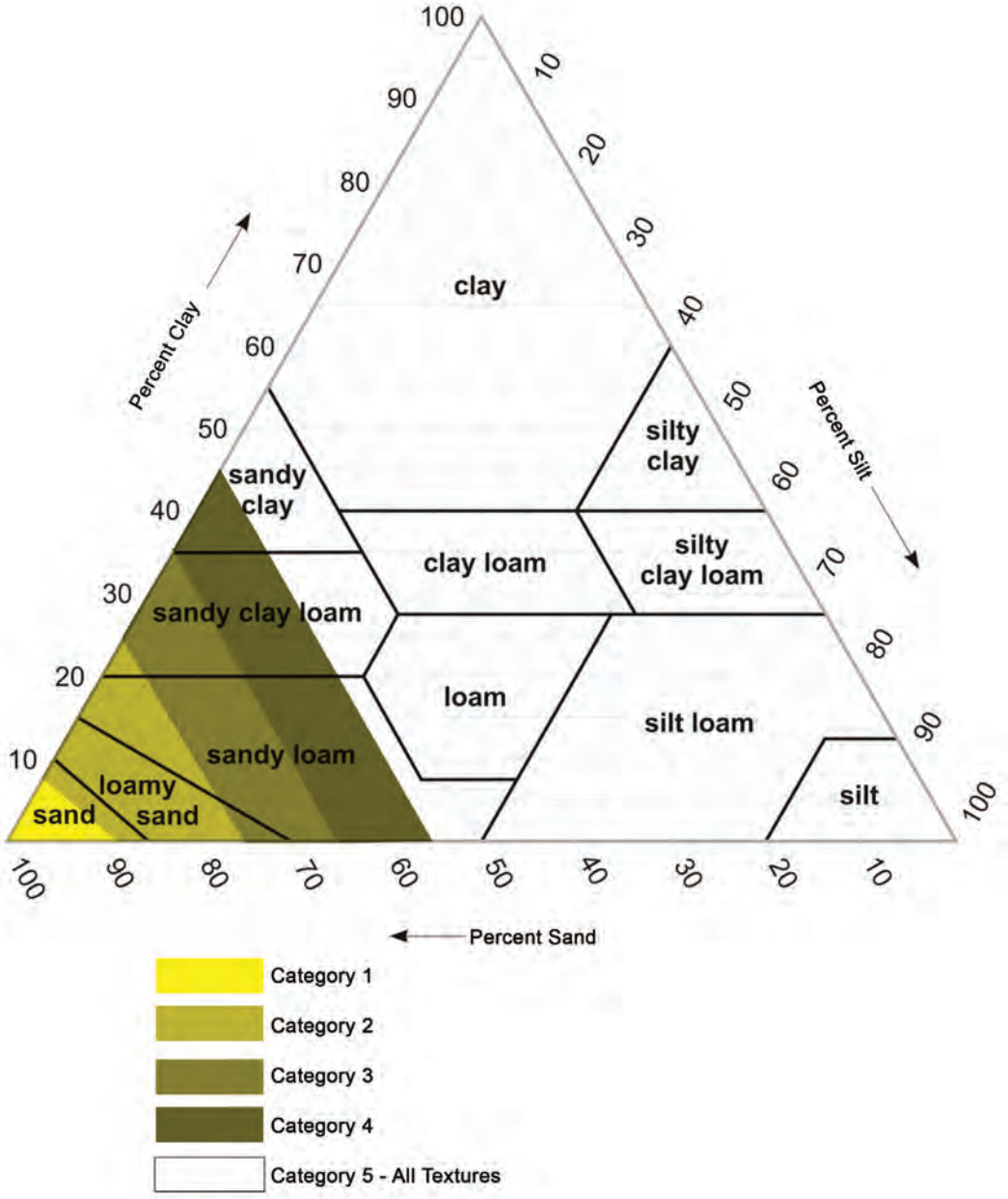
- *Category 3 Fields – are generally high-use and performance fields intended for formal programs, sport hosting, allocated to and used by organized sports groups and leagues for practices and tournaments. The base composition of Category 3 Fields has more sand.*
- *Category 4 Fields – are intended for formal and informal training and practice activities and school activities. The base composition is closer to an even ratio of sand and soil*
- *Category 5 Fields – are generally fields intended primarily for informal and spontaneous community and neighbourhood use. The fields are developed with a variety of soils*

**The current system uses a variation of Field Category Three, or Four for all current classes of A, B, C fields, as the soil composition of these fields is unknown.*

2.3 Programming & Amenities Based on Classification System

Soil Classification

Figure 2.1 – Field Categories based on Soil Composition – AFCM, Sports Turf Canada



(Sports Turf Canada, 2012)

Natural grass fields with a higher percentage of sand content (based on the above soil classification triangle), have better characteristics for drainage, typically have less compaction issues, and provide increased playability and usage hours. Soils with higher silt and clay content typically have drainage and compaction issues. One consideration for using a higher percentage of sand is that the field will dry out faster in Calgary's climate and will require more irrigation than a field with higher silt and clay.

2.4 Facility Layout Principles - Setbacks

Property Line & Safety Zone Setbacks

Setbacks protect the safety of the athletes and the public and prevent injury. They should be wide enough so that a participant would not come into contact with obstructions during play.

Recommended minimum setbacks are:

- 30 m minimum from the property line and/or building from safety zone around any recreational sport field
- 30 m minimum from the property line and/or building from safety zone around any lit recreational sport field
- 10 m minimum safety zone around the field play area

These typical setbacks are based on the following examples:

- City of Mississauga uses a 15 m setback for all rectangular fields
- City of Brampton uses a 20 m setback from the property line, and 30 m from the property line if the rectangular field is being illuminated
- City of Ottawa uses at least 20 m from the property line, and 10 m from any plantings

Table 2.8 – Property Line & Safety Zone Setbacks

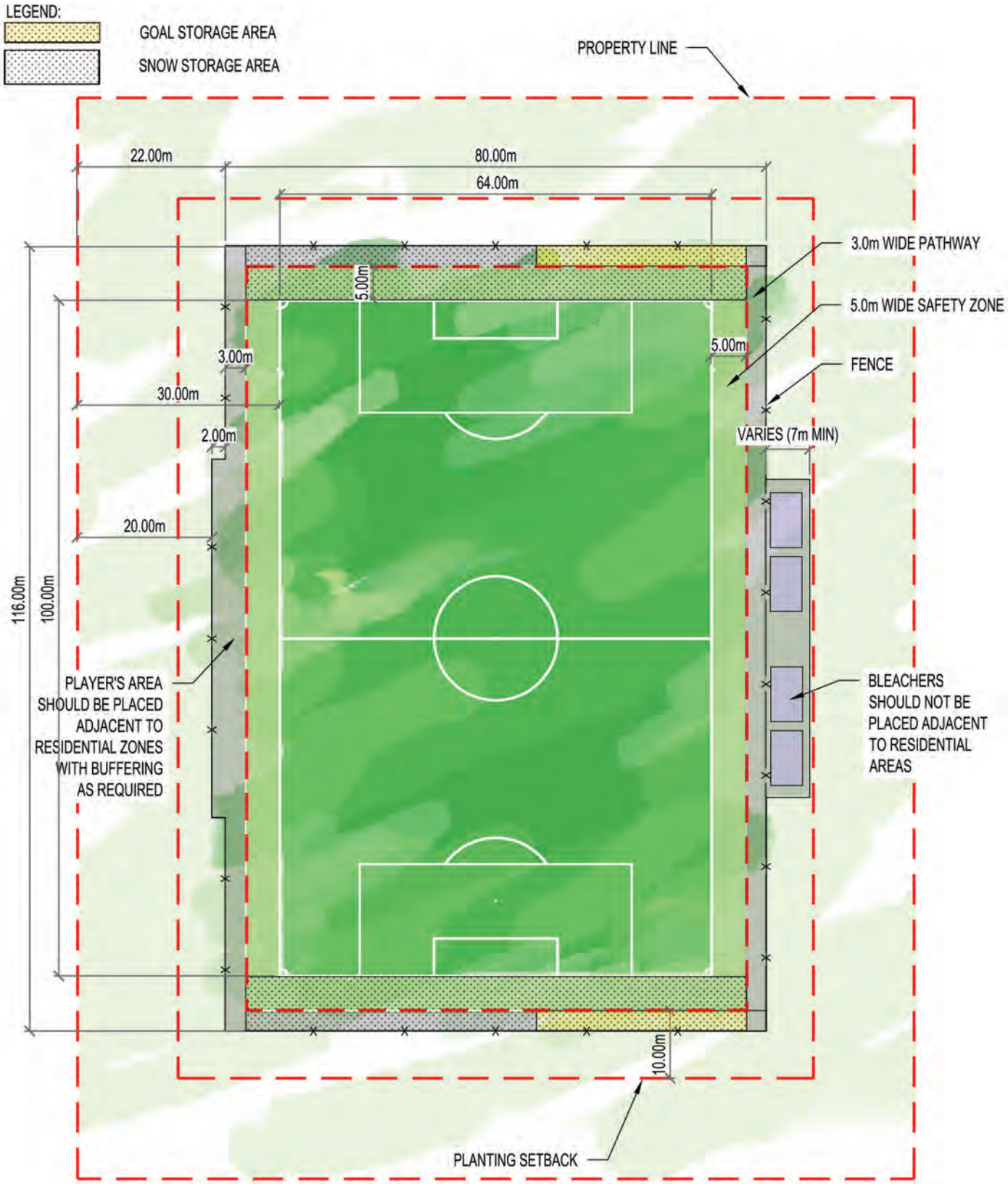
Field Type	Safety Zone	Property Line[1]	Planting
Artificial Turf	5 m	30 m	10 m
Lit Field	10 m	30 m	10 m
Unlit Field	10 m	30 m*	10 m

[1]Surrounding land use is discussed in Part G - Case Studies under 7.9 - Recreation Facility Adjacencies, Trends and Commonalities.
** Field Shifting Requirement*

- The Safety Zone surface extends from the limit of play and is clear of any fixed elements (such as sport field lighting, bleachers, players benches) and sloped consistently with the playing field
- The setback between the property line and play field reflects the dimension to the field game lines plus safety zone (or field fencing)
- Planting setback represents the area where no planting of any kind should occur (e.g. trees) Furthermore, limiting tree types near artificial turf fields and natural grass fields is recommended, when the tree species have aggressive root systems (e.g. trembling aspen, poplar). In addition to this, it is wise to limit the amount of trees near artificial turf fields, which can create leaf litter, needles and seed pods that blow onto the field and build up within the infill surface
- Refer to the drawings on the following pages showing the setbacks for artificial turf fields, lit natural grass fields and unlit natural grass fields reflecting typical setbacks

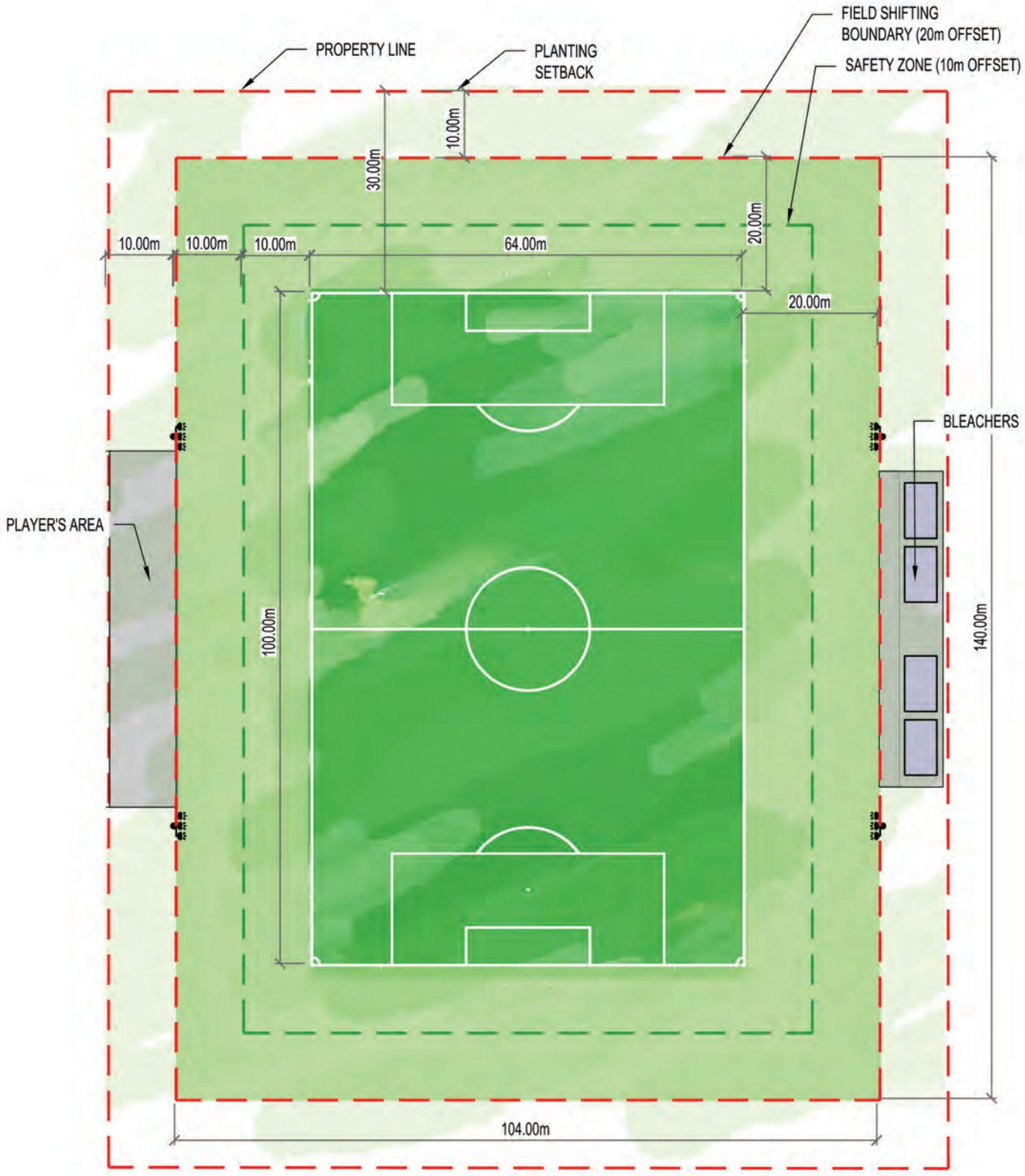
2.4 Facility Layout Principles - Setbacks

Figure 2.2 – Artificial Turf Field Setbacks



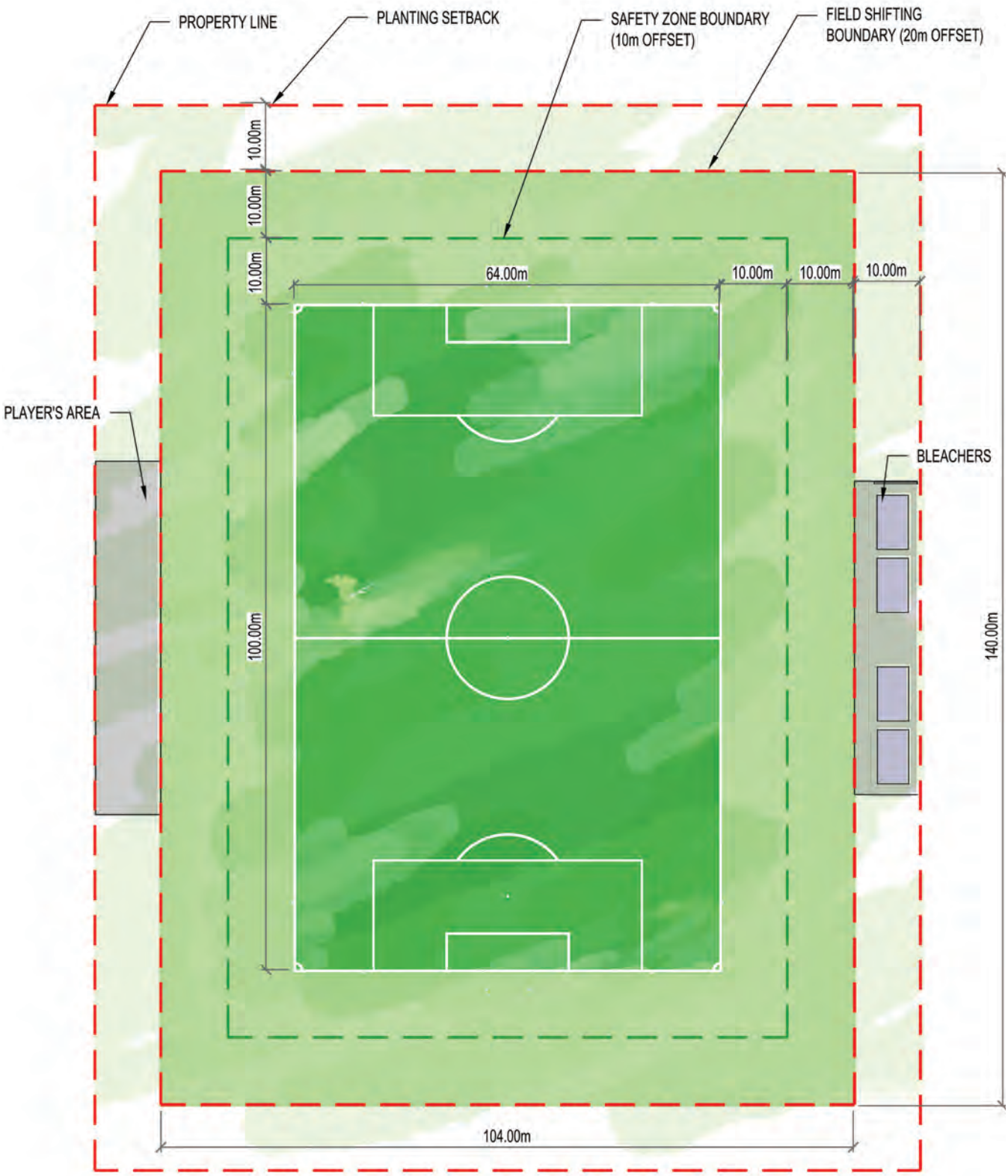
2.4 Facility Layout Principles - Setbacks

Figure 2.3 – Natural Grass Field Offsets – Lit & Irrigated



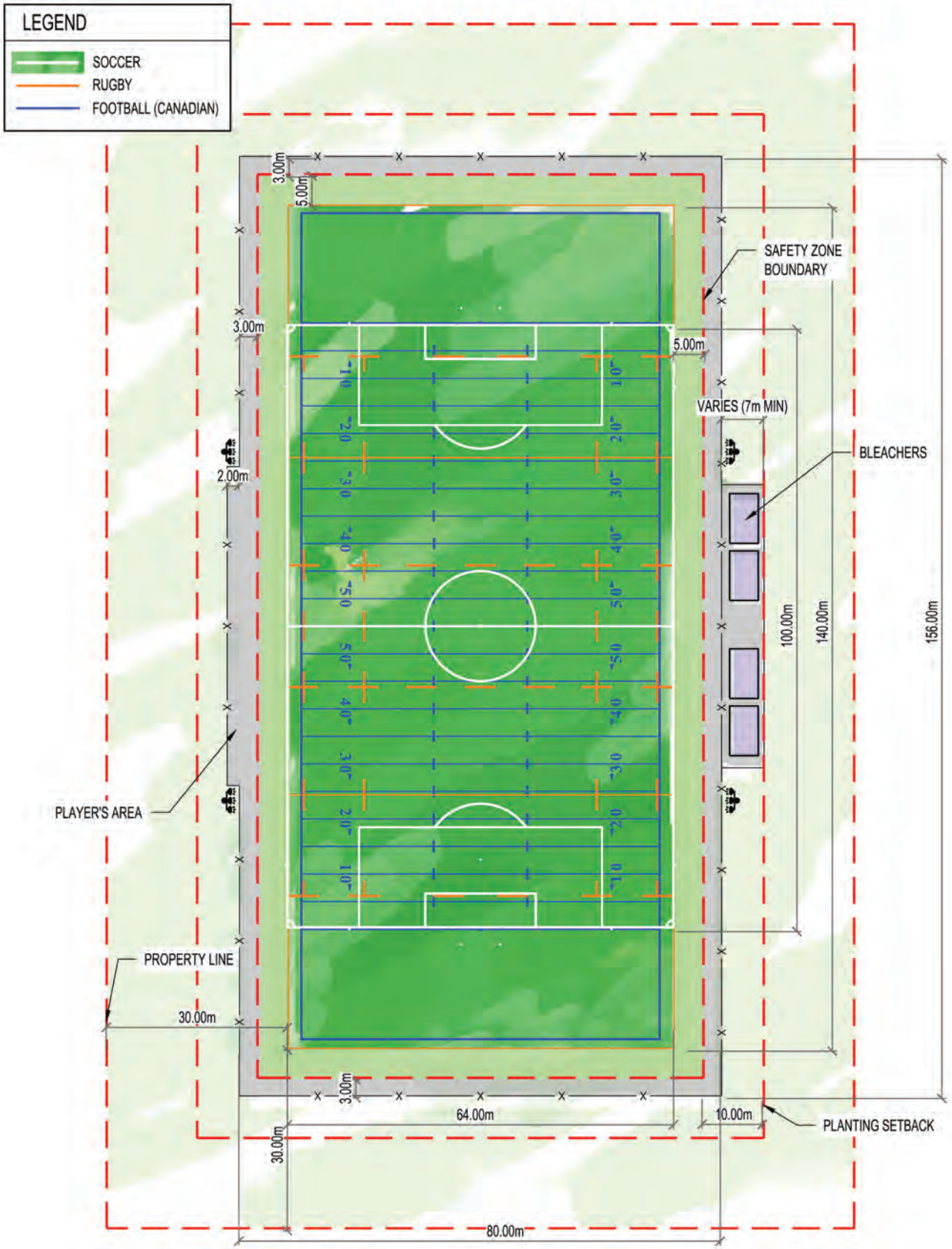
2.4 Facility Layout Principles - Setbacks

Figure 2.4 – Unlit and Irrigated



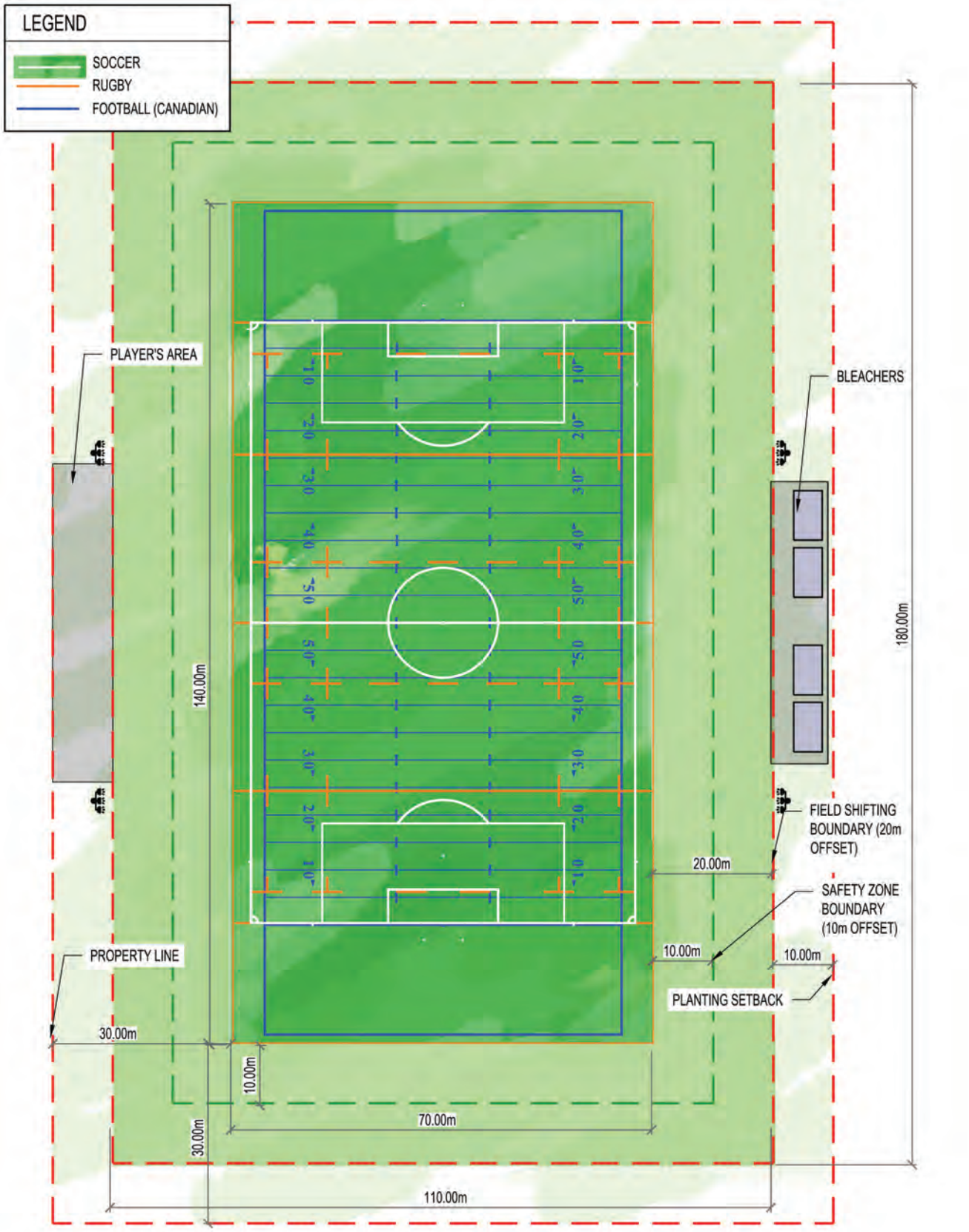
2.4 Facility Layout Principles - Setbacks

Figure 2.5– Artificial Turf Field - Multi-Use - Lit



2.4 Facility Layout Principles - Setbacks

Figure 2.6– Natural Grass Field - Multi-Use - Lit and Irrigated



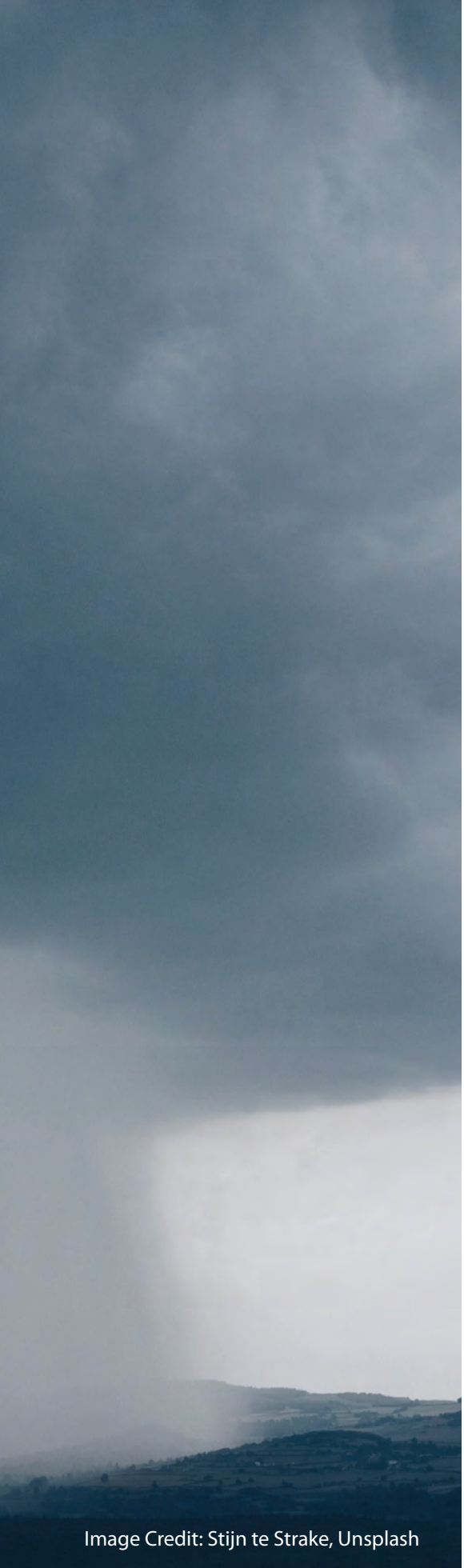


Image Credit: Stijn te Strake, Unsplash

2.5 Environmental Considerations

Annual Rainfall

The most critical element in field design and function is drainage. This applies to both artificial turf and natural grass. The movement of annual rainfall, prevention of standing water and slow percolation is key so the playability and availability of playing surfaces is not affected. Calgary's rainy period lasts for 6.1 months from April 10 to October 13, with a sliding 31-day rainfall of at least 0.5 inches. The most rain falls during these 31 days (around June 14) with an average total accumulation of 2.9 inches. Since 2000, the maximum monthly rainfall recorded for Calgary was 247 mm or 9.7 inches. In 2019, Calgary recorded a rainfall record of 53.9 mm (2.1 inches) in 24 hours. Over an estimated 10-year period where the maximum monthly rainfalls applied to drainage coefficient is 118 mm (4.6 inches), the maximum daily rainfall is 2.1 inches in 24 hours. Drainage recommendations and hydraulic conductivity specifications should consider peak 1 in 10 year design storms, maximum daily rainfall, as well as the impact of multiple sustained rainfall events. This will require careful analysis of field aggregate storage volumes, perforated pipe size and spacing, as well as the infiltration rate and thickness of the permeable aggregates under the field. If these recommendations are incorporated, fields should be rarely closed due to flooding.

Stormwater Management

The development of the natural or artificial turf field should follow the process prescribed in the Development Site Servicing Plan (DSSP) as do all other developments (*City of Calgary, 2018)*. The stormwater management system should be designed to meet a 1:5-year storm with overland flow accommodating the 1:100 year storm. The overall stormwater management plan for any natural grass or artificial turf field should take into consideration the best management practices for the drainage design which could include a perimeter collector along the edge of a natural grass field and artificial turf field and internal field drainage within the natural grass field.

2.5 Environmental Considerations

Flooding Hazards

If natural or artificial turf fields are developed within a 1:100 to 1:1,000 year flood zone, the drainage design should accommodate such flood events based on good engineering practice for the expected storms. This will ensure the system is not saturated during the flood event, causing sub-surface surcharge in the municipal storm system, or uncontrolled overland flooding *(City of Calgary, 2019)*. The stormwater management system must also have either back-flow preventors or check valves within the system to help protect against contamination to municipal systems.

Fields should not be built immediately adjacent to storm ponds, as this results in poor turf (e.g. Seton Field).

Wetlands/Environmentally Sensitive Areas

A preliminary desktop review of potential properties should be completed to confirm any existing wetlands, endangered species, or other environmental issues to be considered. All sites with wetland or environmentally sensitive areas present should be assessed according to the Biophysical Impact Assessment Framework *(City of Calgary Parks and Urban Development Institute – Calgary, 2010)*.

Additional setbacks may be required to preserve wetlands/environmentally sensitive areas.

Image Credit: Schwoaze, Pixabay

Image Credit:
Tadeusz Lakota,
Unsplash

2.5 Environmental Considerations

Environmental Reserve Setbacks

The City of Calgary developed environmental reserve setback guidelines to help prevent any potential pollution of water bodies from land development. The development of any new natural or artificial turf fields must adhere to the guidelines prescribed in the Community Services and Utilities & Environmental Protection Report:

Water body Type (As identified in the Municipal Government Act):
A site-specific variable setback width shall be applied to water bodies qualifying as Environmental Reserve based on the following water body types:

"Stream Order

- 1st order: 6m setback typically a vegetated 'draw' that conveys flow primarily during periods of moderate to heavy rainfall and may not convey flow during other periods
- 2nd order: 30m setback - Formed when two first order streams meet, e.g. West Nose Creek
- 3rd order: 50m setback - tributary of two 2nd order streams (e.g. Nose Creek)
- 4th order: 50m setback - tributary of two 3rd order streams (e.g. Bow River, Elbow River)"

"Wetland Class
Stewart and Kantrud Class 3-6 wetlands, considered to be Environmental Reserve (ER) Wetlands under the Wetland Conservation Plan will have a 30m base setback applied to them.

Wetlands that are engineered to serve as stormwater management facilities ('stormwater wetlands'), may, at the discretion of the Administration have an ER setback width of less than 30m applied to them if the primary function of the wetland is for the provision of stormwater treatment rather than functioning as a natural wetland. Appropriate design elements (such as buffer strips, treatment swales or site grading) would be required to demonstrate that the water body would not be subject to surface or subsurface pollutant loading."[4]

2.5 Environmental Considerations

Table 2.9 – Environmental Reserve Setbacks

Setback Type	Base Setback	Adjustment Factors		
		Slope Adjustment	Hydraulic connectivity to groundwater	Cover Type
1st Order	6 m	+1.5% slope over 5m	N/A	N/A
2nd Order	30 m	+1.5% slope over 5m	Areas of land adjacent to water bodies that have shallow groundwater connectivity to surface water are taken as ER.	Double base setback width to provide for better buffering of water body or restoration of riparian lands to provide for proper riparian function
3rd – 4th Order Stream	50 m	+1.5% slope over 5m	Areas of land adjacent to water bodies that have shallow groundwater connectivity to surface water are taken as ER.	Double base setback width to provide for better buffering of water body or restoration of riparian lands to provide for proper riparian function
Class 3-6 Wetlands	30 m	+1.5% slope over 5m	Areas of land adjacent to water bodies that have shallow groundwater connectivity to surface water are taken as ER.	Double base setback width to provide for better buffering of water body or restoration of riparian lands to provide for proper riparian function

(City of Calgary Land Use Bylaw IP2007; Environmental Reserve Setbacks, City of Calgary[5])

Image Credit: Pixabay Free Photos

2.6 Parking


Image Credit: Brett Ryan Studios

A Traffic Impact Assessment (TIA) should be completed as part of the planning and design of any new athletic park to confirm parking space requirements and any associated improvements to park entrances or roadways.

The quantity and configuration of onsite parking should be guided by review of current City standards, precedents from other municipalities, as well as source guides including the latest *Parking Generation Manual* from the Institute of Transportation Engineers (ITE), Transportation Association of Canada (TAC), and parking estimates from previous studies and surveys. The parking lot design should include drop-off zones for both buses and cars, but the provision of parking for buses should be reviewed on a site-by-site basis.

The City of Mississauga and several other municipalities typically provide a range of 16-32 parking spots for their rectangular fields (unlit or lit) facilities. *(City of Mississauga, 2003)*. Typically, parking along with amenity facilities and buildings are centrally located among multiple fields for easy access and operations. The table below shows standard parking provisions that are used per athletic field (artificial turf field, lit or unlit natural grass field). The parking standards are based on the sports fields being lit or un-lit. The overall parking requirements do not consider its surface (artificial or natural grass) or field lighting.

Table 2.10 - Parking Requirements

Field Type	City of Calgary (Parks)	Recommended amount of parking per field
Artificial Turf Field (Lit)	20*	32
Natural Grass Field (Lit)	20*	32
Natural Grass Field (Unlit)	20*	16

(City of Calgary, 2019)
** 20 parking stalls per major/minor soccer-based Calgary Parks 2020, Development Guidelines And Standard Specifications Landscape Construction*

The City of Calgary Zoning By-laws do not require parking for park spaces but it is applicable for buildings under Special Purpose – Recreation District , where provision of 1.5m motor vehicle parking stalls are required per 100 square metres of gross usable floor area.[6] *(City of Calgary, 2007)*

2.6 Parking

Transit and Active Transportation Networks

The planning and development of the natural grass or artificial turf field should consider connectivity to the existing active transportation networks. This will provide options for alternative transportation methods, reducing the number of vehicles and required parking, and increase community activity where access is possible through walking and cycling.

If the parking is near Transportation, Transit and Active Transportation Networks, the number of parking spaces could be reduced or modified based on City of Calgary – Land Use Bylaw IP2007 and designated land use regulations. *(City of Calgary, 2007)*

2.7 Complimentary Facilities

Typical complimentary public facilities and land uses adjacent to artificial turf or natural grass fields include:

- Community Centre (pool, arenas, community hub, Library)
- Institutional (high school, college, university)
- Community Association Building
- Open Space (regional parks, district parks)
- Land use (Residential, Multi-Residential, Commercial, Industrial, Special Purpose, Direct Control)

Stormwater management ponds (except dry ponds), are not typically associated with athletic parks due to the potential for losing balls and equipment, and overland flooding adjacent to stormwater management ponds. However, they are often adjacent to schools. If athletic parks are constructed near stormwater management ponds, fencing and signage should be placed on site to ensure users are aware of any potential hazards. Based on the cases studies, the majority of the natural grass or artificial turf fields were not located near stormwater management ponds. It is recommended that stormwater management ponds are not located in an athletic park.

Image Credit: Brett Ryan Studios

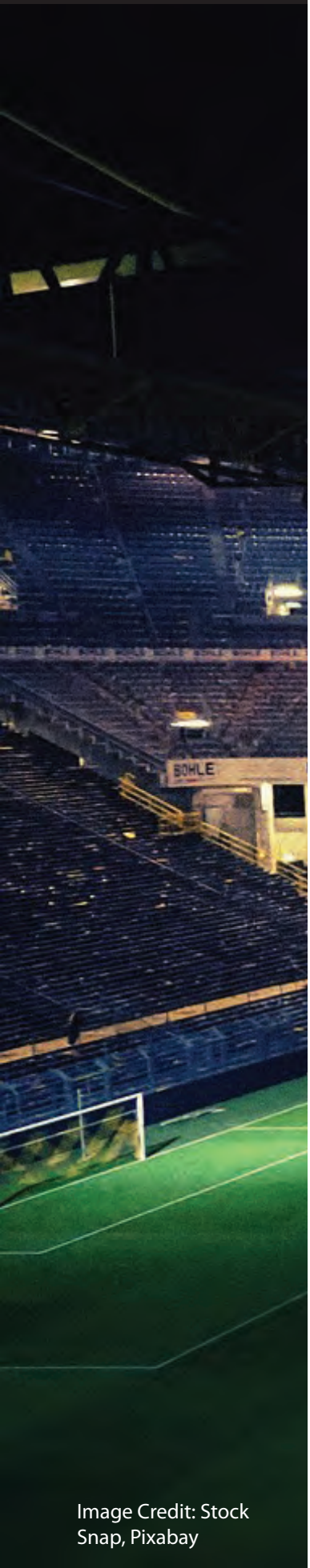


Image Credit: Stock Snap, Pixabay

2.8 Lighting Pollution Mitigation

Many municipalities are conscious of shining light only where it is needed and minimizing light pollution into the night sky. Designing dark sky-friendly sports lighting (or 'dark sky compliant' with an industry authority) could minimize wasted light, reduce neighbourhood light impact and improve interaction with the natural world, as compared to conventional lighting.

Many municipalities adopt overarching policies, by-laws, or development standards to govern their commitment as a Dark Sky Compliant community. Calgary Parks developed their own Lighting Plan in 2017. Such policies are recommended for the City of Calgary to consider in future planning initiatives. In this strategy, the following design elements align with typical Dark Sky principles:

Minimize or eliminate light trespassing on nearby people, wildlife, and the natural world. This should be done by choosing:

- The beam-spread or distribution pattern of a luminaire
- The aiming angle of the luminaire
- The type of light fixture
- The uplight, backlight, and glare ratings of the luminaire
- Allow reasonable use of lighting for night time safety and enjoyment, while preserving the ambiance of the night, by:
  - Using photocells and motion sensors whenever possible to turn off or dim un-used lighting
  - Assessing safety requirements in conjunction with other crime prevention through environmental design (CPTED) elements
  - Minimize or eliminate glare and obtrusive light by limiting misdirected, excessive, or unnecessary outdoor lighting
  - Consider screening through use of landscaping and trees

Sports field lighting technologies which mitigate light pollution, namely glare and spill light (both vertical and lateral spill), include high efficiency LED systems. The lighting systems provide excellent illumination on the field for sport, with maximum reduction of light impact elsewhere. While LED systems are presently more expensive than traditional lighting systems, they should be considered for athletic parks.

2.8 Lighting Pollution Mitigation

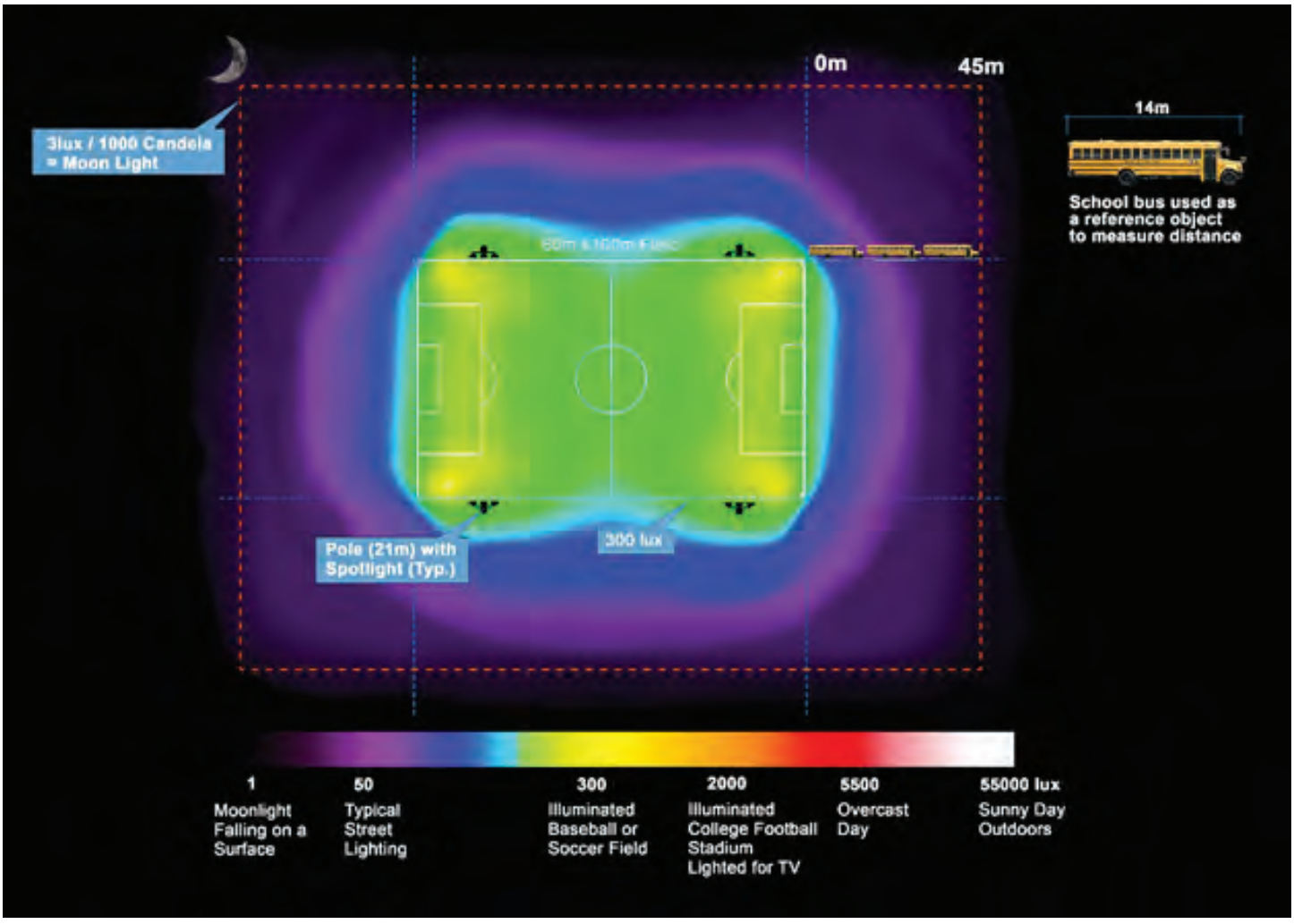
During design, the following lighting parameters should be considered:

- Intended level of competition
- Other specific requirements for the facilities
- Operating and maintenance procedures and issues
- Site constraints

The lighting design should be in accordance with Illuminating Engineers Society of North America (IESNA) recommended practices and guidelines as well as FIFA Associate Section 9 from Football Stadium Design.

The pole height is determined by the setback of the sports field lighting pole from the field. The typical design criteria angle for fixtures at sports fields is between 20 to 30 degrees, which determines the pole height required. Pole heights can range from 18.2 m (60 feet) to 27.4 m (90 feet) based on the setback from the field.

Figure 2.7 – Sport Field Illumination Illustration – Typical Light Spillage



2.8 Lighting Pollution Mitigation

The sport field lighting industry in general is starting to shift from using metal halide to LED lights for illuminating sport surfaces. Reasons for doing so include reducing environmental impacts, potentially decreasing operating costs, and warranty incentives from manufacturers to encourage operators to move to LED.

Some manufacturers are shifting from providing a 25-year warranty to 10-year warranty for metal halide while increasing the LED warranty to 25 years. Going forward, an LED light system is preferred because of the lower energy cost, superior quality of light, reduced glare and increased warranty length. LED is currently more expensive, but the cost difference is expected to equalize as the technology becomes standard and widely used. The decision on whether to utilize LED or metal halide lighting at an athletic park should be made considering capital cost, operating cost and the impact of light pollution on the surrounding neighborhood. The following design parameters for athletic field lighting are recommended:

Table 2.11 - Lighting Design Parameters - Comparisons

City of Calgary (Current Standards)	Level of Play (Activity Level)	Lighting Level (lux)	Pole Layout	Lighting Type
McMahon Stadium	High Performance Class III National Games	650 to 700 (2000 – TV)	8	LED
Not applicable **	Leagues and Clubs Class II Leagues and Clubs	350 to 500	4 or 6	LED
Class A & B	Training and Recreation Play Class II Leagues and Clubs*	500	4 or 6	LED

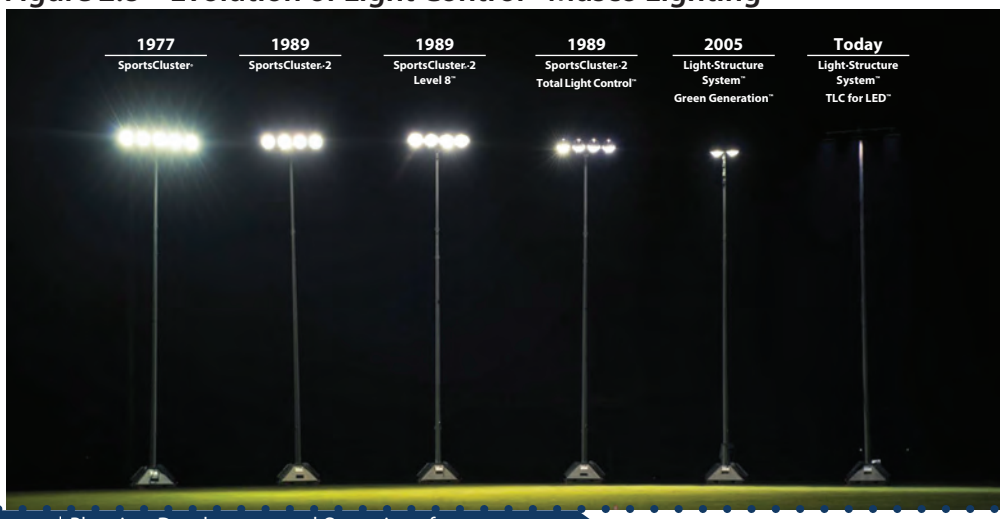
(Fédération Internationale de Football Association, n.d.)

**Use of Class II Leagues and Clubs (Activity Level) for the lighting design, since it will reduce overall light pollution to neighbouring site*

***This would be option if light pollution and light spillage is concern with the site.*

Figure 2.5 - Sport Field Illumination Illustration – Typical Light Spillage would be typical of the current lighting levels for majority of the sports field in Calgary.

Figure 2.8 – Evolution of Light Control - Musco Lighting



2.9 Spectator Seating

Spectator seating is based on the development plan for the site, and if the site is to be used for high-level competition or community events, such as the following:

- Mini-Stadium or Stadium Complexes (which typically have a stand-alone artificial turf field) contain 1,000 – 5,000+ seats. A similar development is Hellard Field at Shouldice Athletic Park. The space for these types of bleachers would be 80m by 25m plus a 5.0m buffer around for a pathway and 5,000-person bleachers
- Community use or educational use fields (which are typically located near community centres or educational facilities) would contain 0 – 1,000 seats or have an assigned area for spectator seating, but potentially no bleachers on-site. The space for these types of bleachers would be 6.4m by 3.0m plus a 2.0m buffer around for a pathway and 70-person bleachers.
- Temporary onsite bleachers – Site Development (rental facilities). If the temporary bleachers will be needed in future accommodations, they should be taken into account during the design phase to allow for ease of access for equipment and set up of bleacher systems. The space for these types of bleachers would be 80m by 20m for temporary bleachers with a maximum of 5 to 10 rows. The City of Calgary's preferred bleachers are 21' long, 5 rows deep, aluminum with guard, central aisle and handrail. These specifications are similar to the bleachers installed at New Brighton Park.
- If a field is located beside or near residential properties, bleachers should be located on the opposite side of the field and not directly adjacent.

2.10 Development Considerations - Impact Mitigation

2.10.1 | Noise Mitigation Considerations


Image Credit: Sean Benesh, Unsplash

Noise mitigation measures should be considered. For example, locating artificial turf fields away from residential areas and positioning site entrances/exits away from local roads. Adding natural or built sound barriers where appropriate is also recommended. These may include planting berms, trees/ landscaping buffers, sound fencing and physical sound barriers.

The impact of high noise emitting games (e.g. where PA and frequent whistles are common) can be managed through scheduling. They will be less disruptive to neighbours if they are scheduled to occur in early evenings (rather than late at night) and during the daytime on weekends. Locate spectator seating areas away from residential areas to reduce noise impacts.

For fields located directly adjacent to residential areas, it is recommended to consider a noise impact assessment to better identify the extent of noise at the property line, and to identify effective methods of managing it.

2.10 Development Considerations - Impact Mitigation

2.10.2 | Traffic Mitigation Considerations

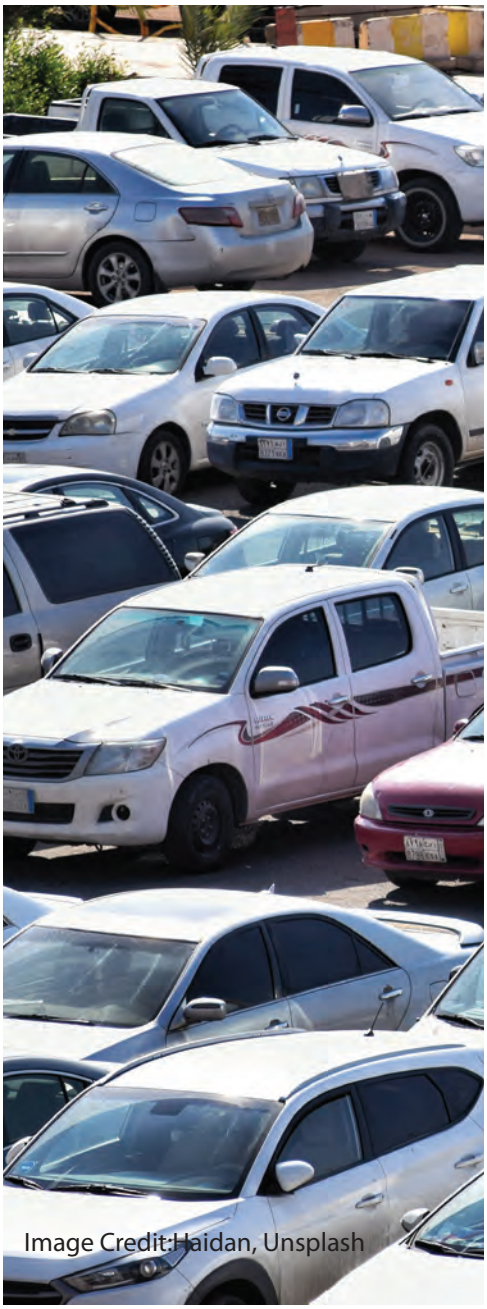


Image Credit:Haidan, Unsplash

Major roadways are classified in the City as follows:

- Skeletal Road (e.g. Crowchild Trail, Glenmore Trail)
- Arterial Street (e.g. Bow Trail)
- Industrial Arterial (e.g. 14 Avenue S.E.)
- Urban Boulevard (e.g. 16 Avenue N.W.)
- Parkway (e.g. Memorial Drive)
- Neighbourhood Boulevard (e.g. Kensington Road N.W.)

Artificial turf fields should be adjacent to higher volume roads such as those classified within Calgary as Arterial Street, Urban Boulevard, Parkway and Neighbourhood Boulevard. The advantages of locating artificial turf fields adjacent to these higher volume roads include:

- Higher ambient traffic volumes on the adjacent roads that allow for greater visibility of the site from citizens and law enforcement, allowing for increased personal security and reduced vandalism
- Easier access to the athletic field for vehicles
- Better access to transit and major pedestrian corridors
- Reduced impact in terms of relative increase in traffic over pre-development traffic conditions

For all sites incorporating artificial turf fields, a traffic impact and parking assessment is recommended. This will ensure safe access to and from the site, and determine parking requirements (without over-building on-site parking). This would include opportunities to accommodate peak overflow parking on adjacent public roads or coexisting land uses (such as a recreation centre, high school, etc.).

2.11 Site Design Layout Examples

For costing purposes, two alternative layouts for a three-field athletic park have been developed, with associated parking and amenities to confirm the minimum site size that would be required. The two site development options below are based on the following assumptions:

Concept Plan Option #1

- 23-acre (9.3 ha) parcel of land
- Site Configuration
  - Three Artificial Turf Fields (Soccer)
  - Associated parking
  - Facility building
  - Plaza (gathering space)
  - Additional space on the site for other amenities

Concept Plan Option #2

- 23-acre (9.3 ha) parcel of land
- Site Configuration
  - One Artificial Turf Field (Soccer)
  - Multi-Use Field (natural grass) for Soccer and Football
  - Soccer Field (natural grass)
  - Associated parking
  - Facility building
  - Plaza (gathering space)
  - Additional space on the site for other amenities

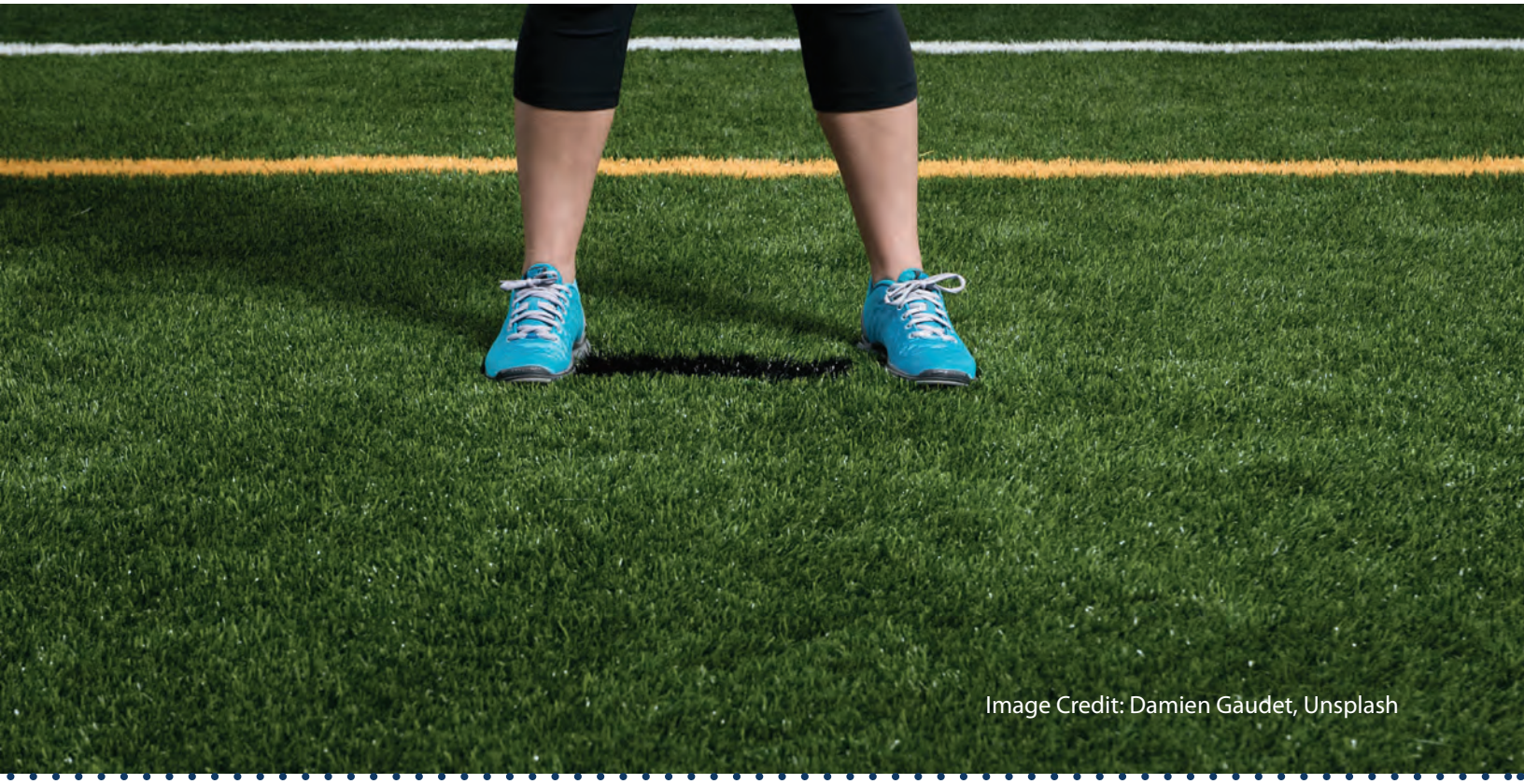
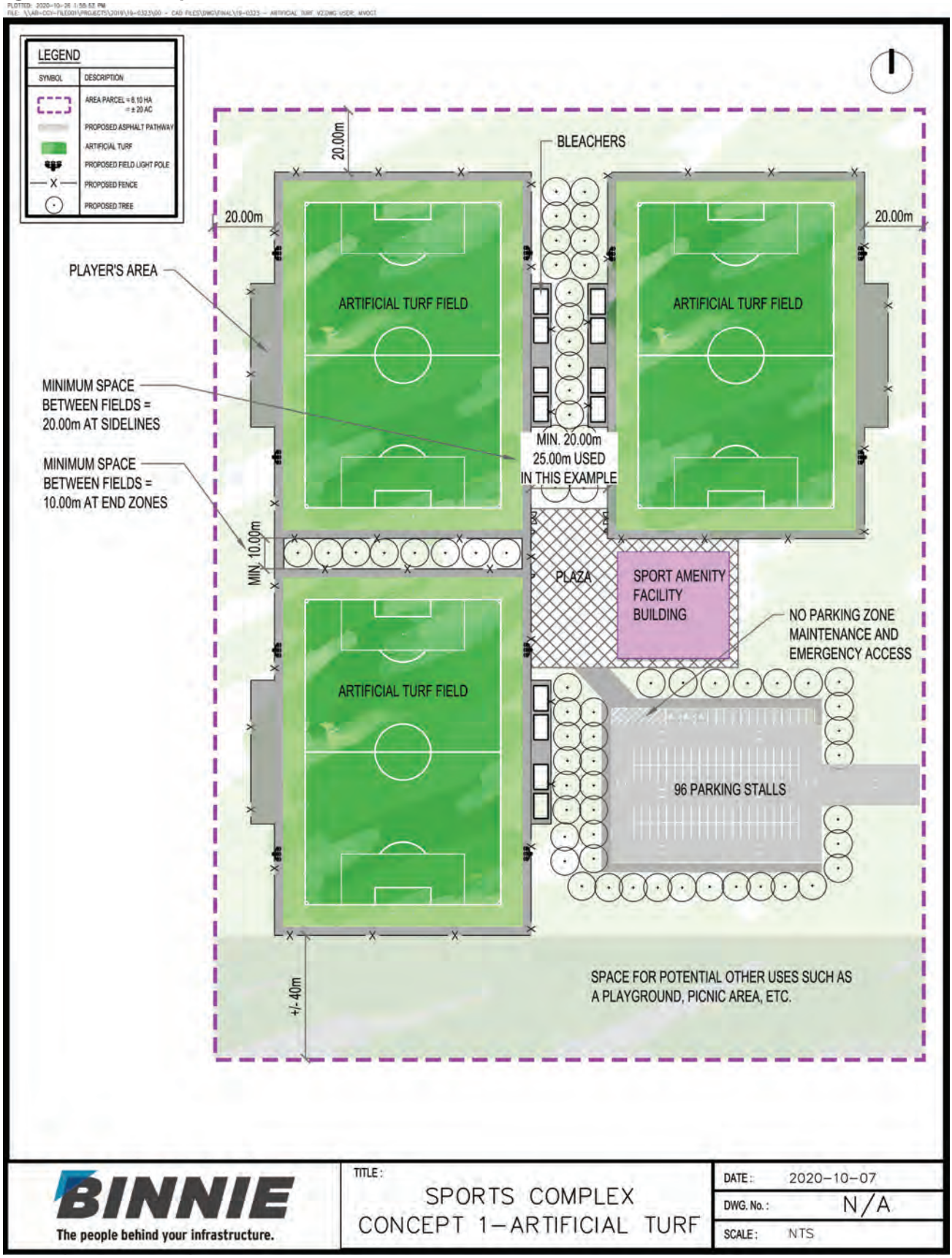


Image Credit: Damien Gaudet, Unsplash

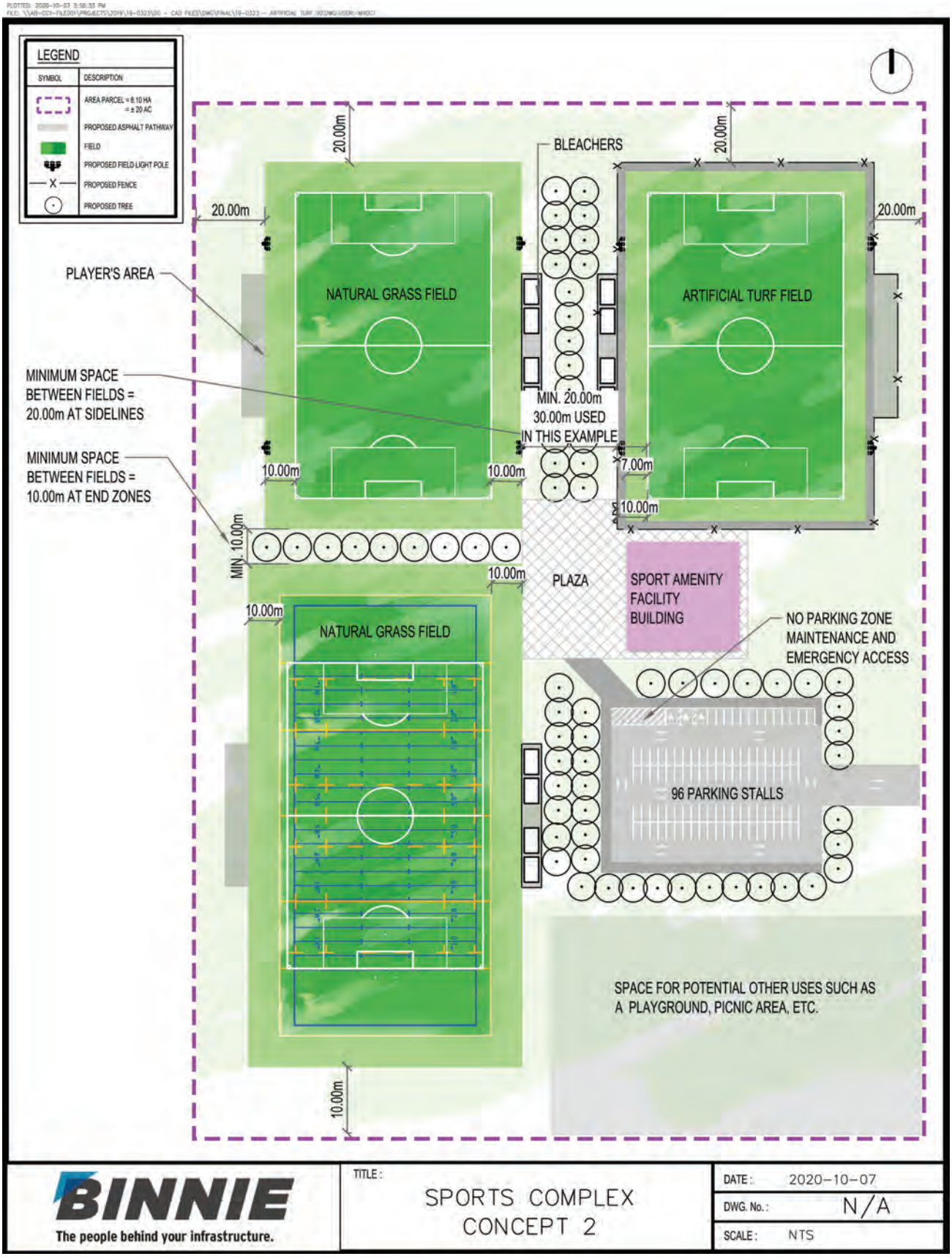
2.11 Site Design Layout Examples

Figure 2.9 – Concept #1 : Three Multi-Use Fields (No Football)



2.11 Site Design Layout Examples

Figure 2.10 – Concept #2 : Three Multi-Use Fields (Incl. Football)



2.11 Site Design Layout Examples

Optimization Layout

The overall layout of multiple sports fields should be towards the outside of the site with the community hub (concessions, washroom, etc.) being at the center. The overall location of the parking lot should be centrally located on the site with sports fields on either side of the parking and amenities building. This is to improve accessibility to the community hub, and helps with visibility, maintenance and minimizes desire lines across the fields.

Figure 2.11 - Functional Layout

The design of the building will need to consult the Alberta Building Code and Land Use-Bylaws for supporting washroom facilities. The overall building program will need to be developed for each site or a generic building program developed that could suit multiple sites. The overall number of change rooms, storage space, meeting rooms, and non-commercial kitchens will need to be developed for each site.

2.12 Optimizing Athletic Parks

Identified as follows are additional considerations related to optimizing the functionality and revenue potential of athletic park sites:

- Athletic field sites need to balance having a mix of field dimensions with having multiples of the same field typology that can support tournaments and competitions (example: a primary tournament site could be targeted for having multiple artificial turf or premium natural grass fields to support tournaments that require multiple fields of a similar typology on the same site)
- Support amenities should be based on:
  - The nature of use (e.g. sites that accommodate football may require more storage and locker room capacity than soccer)
  - The anticipated spectator load of the site or specific fields (e.g. sites that are likely to host tournament, major competitions, or considered "game" sites for higher level amateur sports should provide a higher level of amenity than sites which are designed for recreational use)

2.13 Field Use Compatibility - Artificial Turf Field and Natural Grass

Multiple sport field layouts are compatibile with each other on a rectangular field, and most can be played on either natural grass or natural grass.

Standard Rectangular Field Sports
Based on the standard playing field layouts noted in Table 2.12, the following sports can be played on natural or artificial turf fields:

- Soccer
- Football (Tackle and Flag)
- Rugby
- Field Lacrosse
- Ultimate Frisbee

Specialized Field or Configurations

- Field Hockey – High Level competition (Club Level or Higher)
- Cricket – two combined rectangular field or purpose-built cricket oval

Community Activities

- Pick-up games, kite flying, Frisbee, informal play, etc.
- Festival, other community events with protective cover on Artificial Turf Fields

2.13 Field Use Compatibility - Artificial Turf Field and Natural Grass

Table 2.12 - Sport Field Compatibility on Surfaces

Sport Type	Artificial Turf	Natural Grass
Soccer	X	X
Football	X	X
Rugby	X	X
Field Hockey	Global/Global Elite/League Play	League Play Only
Lacrosse	X	X
Multi-use Field	X	X
Cricket		X
Pick-up Games	X	X
Community Activities	Limited Usage (Protective Cover)	Limited Usage (Extended rehabilitation after event)
Festival	Limited Usage (Protective Cover)	Limited Usage (Extended rehabilitation after event)

Image Credit: David Clarke, Unsplash

2.14 Typology Analysis - Natural Grass

Stormwater Management and/or Other Climate Change Challenges

Considerations in field construction and the increasing demand for potable water can impact design considerations. Stormwater and treated effluent water is a common irrigation source for many golf course and commercial applications. When considering the application and use of non-potable water for irrigation, the inevitable contaminants can risk field quality. If the infrastructure is possible, irrigating sports fields with less than ideal water quality can be managed - which represents significant long-term savings in water costs, and/or disposal costs. If available, playing fields employing storm or treated water should be constructed of sand-based medium which possess the ability to flush contaminants (primarily sodium and chlorine) out of their rootzone. Native soil models do not possess the drainage qualities to adequately filter treated water, so a build-up of contaminants is inevitable. In our province of limited annual rainfall, utilizing stormwater or treated effluent as an irrigation source will be most effective in sand-based systems.

Water Consumption

Water consumption should be addressed by the facility manager. Routine assessment of infiltration and percolation will be unique to each facility. The rate of hydraulic conductivity will differ where soils and traffic vary. Fluent understanding of the irrigation system(s) will ensure adequate cycle/soak of irrigation to minimize usage and eliminate run-off. Average water compensation rate on a natural grass field is 37.5mm (1.5") per week *(Gil Landry, 2010)*, but given evapotranspiration during the growing season, the water usage can increase or decrease based on multiple factors (wind, heat, soil type, humidity). *(Fry, 2000)*. During the growing season, a natural grass field (70x140m – Multi-Use Field) could use 367.5 cubic metres per week, but this volume could range based on multiple factors (wind, heat, soil type, humidity).

Water consumption of a natural grass field can be managed and potentially reduced through an irrigation system which is connected to a central control system, wind sensor, rain sensor, moisture sensors and ET (evapotranspiration) monitoring system.

Herbicides / Pesticides

The current practice within City of Calgary "applies some herbicides to control dandelions and other broad leaf weeds. We apply herbicides regularly to sport fields, as they have a high use and too many broad leaf weeds can cause safety issues and threaten the health of the turf."[7] Based on the research study paper "Municipal Weed Control: Lessons from Ground Zero – October 2018", the local residents where the study was conducted were "supportive of weed control methods that do not expose people to toxic pesticides and that residents are satisfied with the groomed (but not manicured) appearance of public green spaces."[8] *(Randall McQuaker, 2018)*

2.14 Typology Analysis - Natural Grass

Community Development and Public Health

Recreation provides many societal benefits. When parks and sports fields offer residents a place to exercise and relax, there is a reciprocal savings in provincial health care costs in both mental health and by physical activity and exercise*. The availability of youth activities offers alternatives to loitering and promotes positive social interactions. Sports fields and recreational areas/green spaces attract young families to play there, and make communties desirable to live in. As these communities grow, the city gains additional property tax revenue, which can potentially be used for re-investing into recreational facilities.

User Safety (including sport injuries and other liabilities)

As noted in Part E: Maintenance-5.2.2 Compaction Management (Aeration), there is a need to de-compact the playing surface for horticultural and agronomic reasons. There is also a need to ensure the playing surface is able to absorb the impact of a player's body without creating an injury. Traumatic injuries such as concussions carry a high risk on fields which are not managed appropriately. On professional fields and Class A venues, impact testing (e.g. G-Max testing) may be performed which measures the shock-attenuation performance of the surface. Most commonly used standards are those established in the ASTM international. Clegg hammer is a similar tool which can provide a quantifiable benchmark for field hardness. To minimize injury to patrons, it is advisable that the field conforms to ASTM standard F355-Procedure A (F355-A).

References:

- **http://www.cfah.org/hbns/2014/mental-health-wins-when-teens-play-school-sports*
- *https://www.turftest.com/gmax-overview.html*
- *STP1073, Natural and Artificial Playing Fields: Characteristics and Safety Features, Schmidt RC, Hoerner EF, Milner EM, Morehouse CA, Published: 1990*
- *https://www.astm.org/Standards/F355.htm*

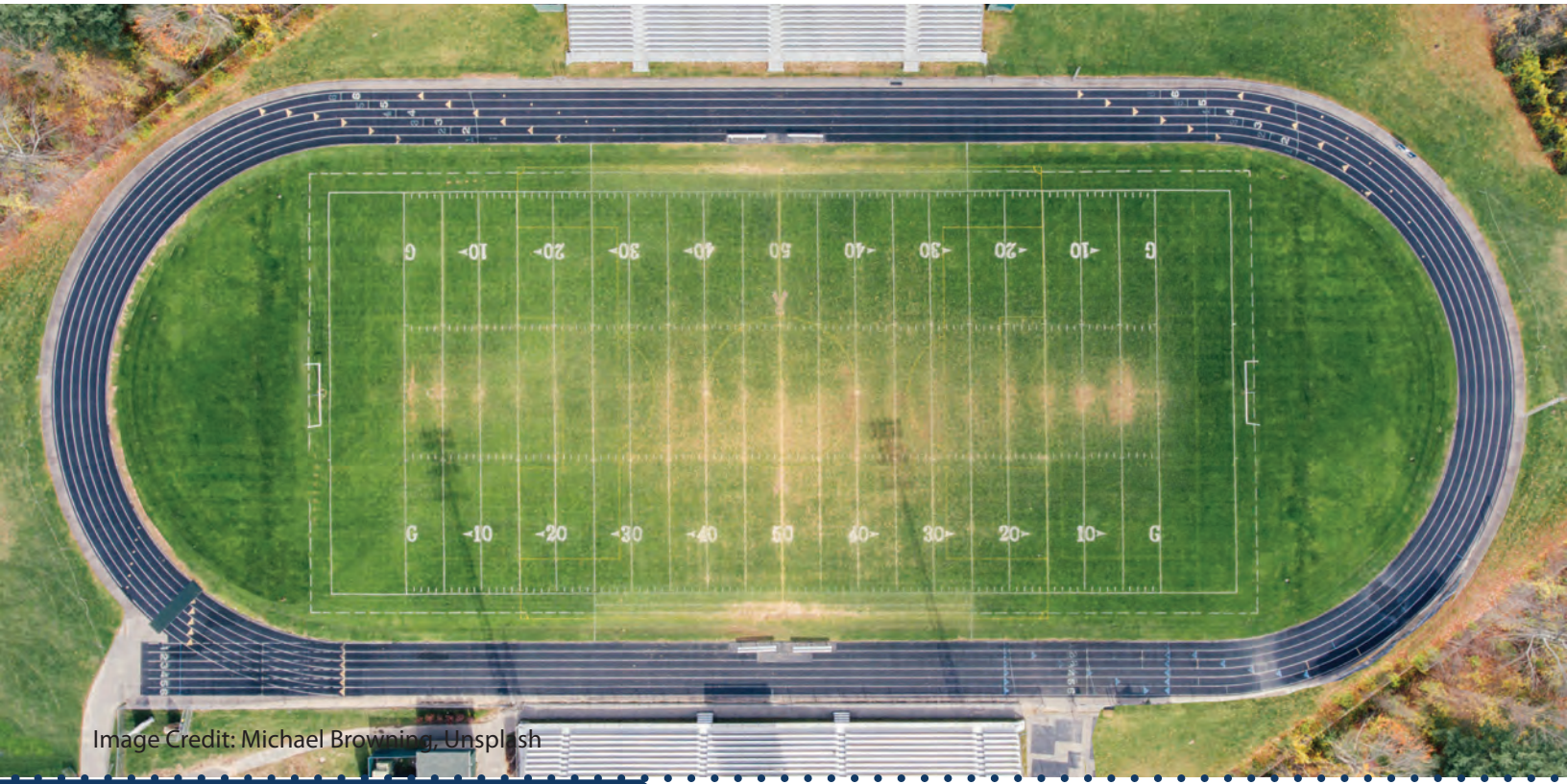


Image Credit: Michael Browning, Unsplash

2.15 Typology Analysis - Artificial Turf

Environmental Considerations

The current practices for the end of lifecycle for artificial turf are:

- Artificial turf shipped to overseas markets for recycling
- Reclaim infill material, re-use in new artificial turf field. Typically 50% to 75% can be recovered and reused. The 25% to 50% is trapped within the turf fibres and is diverted along with the turf to a landfill or recycling facility.
- Landfill (artificial turf, infill [crumb rubber, sand] and shock pad)
- Re-use in secondary markets in Canada (paintball facilities, equestrian facilities indoor rings)

Recycling (Artificial Turf Field)

Recycling of the artificial turf and infill materials has been an ongoing question within the artificial turf industry in North America. At the end of its useful lifespan, current industry practice is to remove the infill and ship the turf to a recycling facility in Asia. The facility is certified by the Geneva, Switzerland-based International Organization for Standardization (ISO), and meets the US Environmental Protection Act's Resource Conservation and Recovery Act with regard to waste. At the facility, the turf fibres are separated from the backing materials and are processed into small pellets or beads and incorporated into other manufactured products including plastic lumber, irrigation pipe, various household products, and other materials. A third-party certification is provided at the conclusion of this process.

FIFA – Environmental Recycling Research Document

Environmental Impact Study of Artificial Football Turf - *https://football-technology.fifa.com/media/1230/artificial_turf_recycling.pdf*

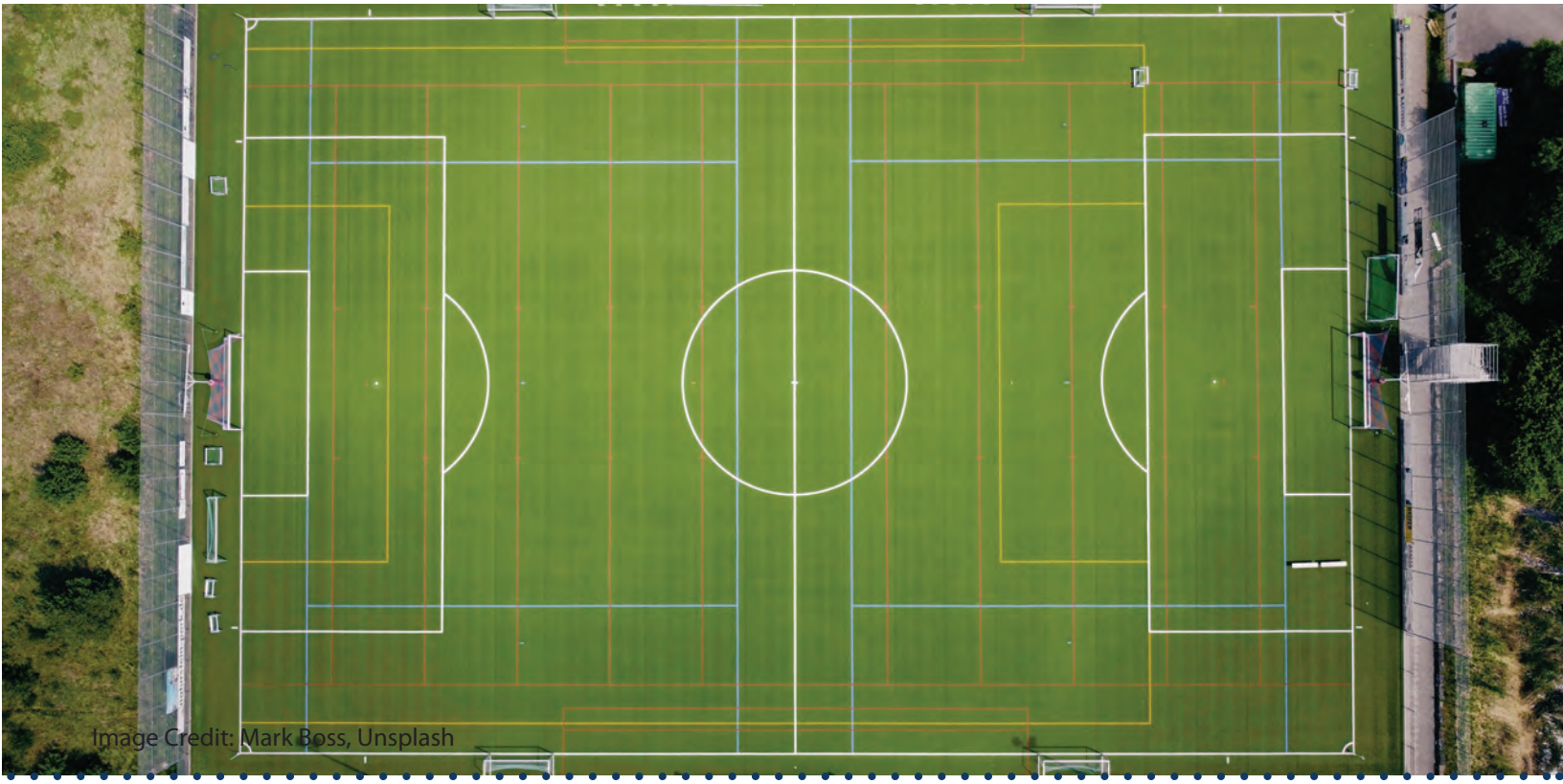


Image Credit: Mark Boss, Unsplash

2.15 Typology Analysis - Artificial Turf

2.14.1 | Infill Risk Migration

Members of the Artificial Turf Industry and the public in several regions have raised concerns regarding the migration of infill product. Specifically, these groups are concerned that the migration of infill product and broken turf fibre off the field and into watercourses will further contribute to pollution. The following possible options can be used for any artificial turf field development:

- Different infill products have different migration rates. Infill product migration is partially managed at the source through the choice of infill product.
- Turf fibres migrate significantly less than infill. The turf fibres are stitched rather than glued to the backing material, providing a durable mechanical means of anchorage. Fibre migration increases when the turf has been severely damaged and not repaired or over worn. Turf wear is monitored by the extent of splitting of the fibre ends. Once splitting reaches a certain point, the turf loses its playable characteristics and is replaced, before it is overworn.
- To contain infill and turf fibre migration for any future proposed field:
  - Select an infill product with a low migration characteristic and stitched turf fibre system
  - Implement a raised perimeter edge to contain migration
  - Install boot brushes and educational signage at all access and egress gates
  - Implement a site overland drainage system that directs all drainage to sump style catch basins possessing an inverted weir and filter
  - Additional water quality measures can be included within the overall stormwater management plan by adding a stormceptor (Oil Grit Separator) to outlet of catchment area for the artificial turf field area
- Collectively, these efforts will prevent migratory elements from entering the municipal storm water system and ultimately the natural environment, and allow for recovery and reuse of migrated infill products

Images: Monica Vogt, R.F. Binnie & Associates

2.15 Typology Analysis - Artificial Turf

Image Credit: Daniel Norin, Unsplash

Image Credit: Santa 3, Pixabay

Heat

Heat strategies should be engaged by all parties who play on, maintain, or operate artificial turf fields. Since Artificial Turf gets significantly hotter than natural grass during the summer months, the users and operators of the field need to take proper precautions to prevent heat exhaustion, heat stroke, or other heat-related health complications.

Research has found that the surface temperatures of Artificial Turf playing surfaces are significantly higher than Natural Grass; as much as 35 – 60°C higher. Where temperatures are conducive to turfgrass growth, the natural system will cool rather than heat. *(A.S. McNitt) (Synthetic Turf Council, 2013)*

Limited Usage

Demand for artificial turf facilities typically increases during the shoulder season, and scheduling preference would be given to user groups who have booked the field in years past compared to new user groups.

Stormwater

The City has requirements for stormwater runoff volumes which need to be adhered to. Artificial turf has similar properties to asphalt, concrete or other hard surfaces, in that it cannot absorb rainwater. Any rainwater will simply drain through the artificial turf surface or along the ground into storm sewers. There is the potential to harvest rainwater for re-use on site or adjacent to the artificial turf field. The overall idea is environmentally responsible. However, the practicalities of setting up the infrastructure and ongoing management requires significant capital investment, which is costly. The harvested rainwater standards would need to be reviewed by the City of Calgary and Alberta Public Health to see if this is a viable option, and additional filtration or UV cleaning of the water may be required.

2.15 Typology Analysis - Artificial Turf

Compaction

"Surface hardness or the surface's ability to absorb shock is linked to the level of impact on players during a collision with the field. Increased hardness may therefore translate to higher injuries such as concussions, fractures and dislocations. Shock absorbance is measured by using the G-max value where one "G" represents one unit of gravity. Currently, fields with a G-max of greater than 200 are considered unsafe for athletic play, based on standards set by the U.S. Consumer Products Safety Commission *(USCPSC)* and the American Society for Testing and Materials International *(ASTM) (McNitt & Petrunak, 2007)*.

Several studies have examined the impact attenuation properties of artificial turf. Factors such as infill type, amount of infill, infill compaction, and the presence of a shock pad are thought to determine hardness levels. One study found that artificial fields with shock pads had lower surface hardness values compared to no-pad systems *(McNitt et al., 2004)*. The same study found that infill depth did not affect surface hardness, but that mixtures of sand and crumb rubber infill resulted in lower surface hardness (*McNitt et al., 2004)*."[9]

Mitigation Strategies

"Strategies to prevent sports-related injuries on artificial turf generally relate to footwear and surface hardness levels. Footwear plays a major role in the amount of traction a player experiences. Turf-style cleats (shorter cleats) have been noted to reduce torque in comparison to soccer or rounded cleat patterns intended for play on natural grass *(Livesay et al., 2006; McGhie & Ettema, 2013; Villwock et al., 2009)*. With respect to surface hardness, several reports recommend that routine surface impact testing be performed to ensure that accepted G-max standards (lower than 200) for playing surface hardness are met *(Drakos et al., 2013; McNitt & Petrunak, 2007)*. Performing regular grooming and brushing of artificial fields has also been noted to minimize the potential of infill compaction which can increase hardness levels *(State Government of Victoria, 2011)*."[10]

Image Credit: Emilio Garcia, Unsplash

2.15 Typology Analysis - Artificial Turf

Table 2.13 - Typology Comparison Summary

Considerations	Artificial Turf	Natural Grass
Environmental	Urban Heat Source Can be hot for players Stormwater Runoff End of Lifecycle Disposal Manufactured Product	High Water Consumption Not a heat source Cool for players Herbicide / Pesticides required Natural product
User Safety	Safe surface if well constructed and maintained Infill migration	Safe surface if well constructed and maintained
Stormwater Management	Runoff management required	Reduced runoff (soil absorption)
Maintenance	Low maintenance	High maintenance
Cost	High capital cost Lower Maintenance Cost Replacement 10 – 12 years	Low/Medium capital cost Higher Maintenance Cost Major refurbishment ~ 30 years
Utilization	High utilization (4 X natural grass) More effective of use of land	Low utilization Requires larger land space for same annual use as artificial turf field
Public Perception	Concerns about human health impacts Considered 'fake' grass	Well received by public
Community Use	Limited Usage (booked)	Available to community

2.16 Athletic Park Standard Specifications

The City of Calgary's **Development Guidelines and Standard Specifications for Landscape Construction** has park guidelines for the development of natural grass sports fields operated by Parks & Recreation. For the purposes of City athletic parks, the existing park development guidelines and specifications are either incomplete or not applicable. We therefore recommend that the City update the park development guidelines and specifications to incorporate athletic parks and artificial turf fields. This will require a significant amount of effort and is considered beyond the scope of this report.

2.17 Part B Key Recommendations and Takeaways

Recommendations and key takeaways from Part B – Development of Athletic Parks include the following:

1. Categorization of the City of Calgary's athletic parks allows for standardization and consistency in development, programming maintenance and operation. It is recommended that the City's athletic parks be categorized as follows:

   - Class A: Highest Level Multi Field Complex – typically only one or two in the City
   - Class B: Multi Field Complex - City-wide service area
   - Class C: Multi Field Complex - Local service area
   - Artificial Turf - City-wide service area. May be a stand-alone artificial turf field or within a Class A, B or C Complex

2. **Table 2.1 - Proposed Planning, Programming & Amenity Table** provides guidance for the planning, programming and composition (ie. types of amenities included) for Class A, B and C athletic parks.

3. **Table 2.2 - Artificial Turf Development Categories** supplements Table 2.1 and provides further guidance for the development of artificial fields based on the type of sports accommodated.

4. **Table 2.3 - Recommended Natural Grass Development Categories** provides recommendations on the horticultural composition, irrigation, lighting and drainage for natural grass fields, as well as target utilization.

5. A thorough geotechnical investigation should be conducted to confirm the suitability of underlying soils for the proposed athletic park, and in particular for artificial turf fields. In addition, existing topsoil should be tested for suitability for incorporation into the growing medium layer for natural grass fields.

6. Light pollution is an important factor to consider when developing fields. Strategies to reduce spillage include installing lenses and covers and increasing the number of poles. As LED lighting is more energy efficient and has better spill light control, its use should be strongly considered.

7. Servicing requirements for natural grass and artificial athletic parks include water, electrical, sanitary, stormwater and shallow utilities.

8. Supplying spectator seating is an expense for the City, but some costs can be recovered through revenue that is generated from events.

9. For the development of an artificial turf facility, the minimum amenities should include lighting, bleachers, waste/recycling bins and portable washrooms.

2.17 Part B Key Recommendations and Takeaways

10. Field sizes are largely regulated by the sport governing bodies, however, some sports such as soccer and rugby allow for a range of sizes. In addition, player runout zones, snow clearing/storage and seasonal shifting of goals (natural grass) must be considered. For consistency of play, tournaments and player experience, recommended field sizes are provided in **Table 2.5 Facility Area Requirements – Typical Artificial Field**, and **2.6 Facility Area Requirements - Natural Grass Fields**.

11. Cricket ovals could potentially be located in the middle of two soccer fields, with the pitch situated between the two rectangular fields.

12. New construction and redevelopment of natural grass fields should follow the **Athletic Field Construction Manual, 2012 (AFCM, Sports Turf Canada)**, an industry standard guide for natural grass field development.

13. Storm water management is critical to the effective operation, maintenance, and longevity of a sports field. Careful analysis of existing and proposed drainage conditions is essential. Design should accommodate the impact of peak single event and multiple consecutive storm events, snow melt, and major floods to ensure drainage is effectively managed. Fields should also not be built directly adjacent to storm ponds.

14. For artificial turf fields, infill migration and turf fibre loss collection systems should be incorporated into the field development.

15. Calgary's **Development Guidelines and Standard Specifications for Landscape Construction** require a significant update to incorporate development guidelines and specifications for athletic parks and artificial turf.

PART C

LIFECYCLE & CAPITAL COST CONSIDERATIONS

Image Credit: Chris Knight, Unsplash

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3.0 LIFECYCLE & CAPITAL COST CONSIDERATIONS

3.1 Introduction and Overview

3.1.1 | Introduction

This section summarizes the capital cost and lifecycle cost considerations in the development and operations of athletic parks. This includes factors common to athletic parks containing natural grass fields, artificial fields or a mix of both artificial turf and natural grass fields.

3.1.2 | Overview

The section contains the following information:

Capital Cost Considerations:

- Capital costs considerations including land acquisition and facility construction
- Best management practices for life cycle/capital reserve budgeting
- Best management practices for replacement scheduling

Operational Cost Considerations:

- Annual operating cost impacts
- Impact of investment in turf maintenance expertise and equipment

Several factors can influence the development and capital costs of athletic parks. Overall, the budgeting factors for athletic parks should take into consideration the following major categories of work:

- Land Acquisition
- Off-site Levies (Greenfield Development)
- Site Servicing
- Lighting
- Irrigation
- Spectator Seating
- Supporting Infrastructure and Services
- Field Typology
- Site Preparation/Soil Conditions

3.1 Introduction and Overview

3.1.3 | Parameters and Assumptions

The quantity estimates, unit prices, and other costing information has been completed based on the following parameters and assumptions:

- Unit prices and cost estimates are based on 2019 dollars using information derived from 5 projects completed by R.F. Binnie & Associates between 2017-2019, as well as information obtained for Calgary-based sports field construction work
- Quantity takeoffs (detailed measurements of materials and labor) have been completed for typical field types and other components of work, and where noted, for suggested representative multi-field athletic parks. The quantities are 'order of magnitude' and would be subject to variation based on actual design details
- Construction quantities and units of measure are based on typical methods of athletic park construction
- Unit prices are based on average construction prices for the various typical components of work included in typical athletic park construction. The unit prices would be subject to variation based on market conditions at the time the work is issued for construction
- Land values were derived from R.F. Binnie & Associates' discussions with the City and typical land values. The actual land costs may vary considerably depending on location, size of parcel and market conditions at the time the land is purchased
- Contingency factors are applied in accordance with standard industry practice and R.F. Binnie & Associates' experience with athletic park pricing. As these cost estimates are considered 'Class D' (Class 5) a contingency factor or 20% has been applied (per good engineering practice)

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Image Credit: Sides Imagery Pixabay

3.2 Developable Land Costs

3.2.1 | Overview

Under the Municipal Government Act, developers are required to dedicate 10% of their land to a municipal land reserve dedicated for provision of local municipal parks and open space. The Act states:

"The City acquires open space lands primarily through the 10% Municipal Reserve dedication as part of the subdivision process, and through direct purchase on an opportunity basis. The majority of the 10% dedication is used in supplying local and community park needs and, therefore, land for district, regional and city-wide parks is generally purchased out of the Joint-Use Reserve Fund. Furthermore, the acquisition of land through the Joint-Use Reserve Fund or other sources is necessary to ensure the protection of environmentally significant areas since Environmental Reserve dedication does not protect all environmentally significant lands."* [1] *(*In some cases, institutional, recreational lands (district park, athletic park, or community park), or community lease sites in part are drawn from the 10% reserve dedication)*

There are multiple pressures on the Joint-Use Reserve Fund and it cannot be relied upon for every project. Some regional projects are funded separately.

Typically, land required for senior high schools, major regional recreation centres, and athletic parks is therefore purchased on the open market by the City. Where possible, the City should look for opportunities to purchase greenfield land prior to development activities as it is generally less expensive. Land purchases from developers are at a much higher cost. However, the cost does not factor in the negative effects of sprawl and the benefits that come from centrally located facilities.

For the purposes of this research, it has been estimated that the purchase of developed land will be at an approximate cost of $988,000 per hectare ($400,000 per acre). The estimated land costs will vary depending on the location within the City of Calgary, the associated land use zone or districts and whether or not the land is serviced. The development of a greenfield site would also trigger development fees and levies as prescribed in the City of Calgary Off-Site Levy By-law. Process charges and off-site development construction costs could add an estimated $450,000 - $700,000 per hectare.

It is anticipated the City will require a minimum of 9.3 ha. (23 acres) for the three-field athletic park development site options included in this report.

3.2 Developable Land Costs

The joint use agreement (1985) explains the priority of use for the joint use reserve fund.

Priority of Use

4.7.1 The following priorities of use shall apply with respect to all Reserve Lands;

- Priority #1: Neighbourhood needs, which include School Board operated Elementary Schools, or the equivalent thereof, and associated Municipal and School Reserve (M.S.R.) sites, and neighbourhood parks
- Priority #2: Community needs, which include School Board operated Junior High Schools, or the equivalent thereof, and associated Municipal and School Reserve (M.S.R.) sites; community parks where no Junior High and associated Municipal and School Reserve (M.S.R.) sites exist; community leases; park land required for open space linkages and to provide setbacks beyond environmental reserve limits at the tops of escarpments and adjacent to water courses in accordance with the Calgary Municipal General Plan
- Priority #3: Regional needs, which includes School Board operated Senior and Vocational High Schools or the equivalent thereof, and associated Municipal and School Reserve (M.S.R.) sites, pools, arenas, athletic parks and other recreational facilities

Image Credit: R.F. Binnie & Associates Ltd.

3.2 Developable Land Costs

3.2.2 | Land Costs – Comparison of Artificial Turf/Natural Grass

The land cost on a greenfield site for an artificial turf vs. natural grass field facility has been reviewed, and a comparison based on total hours of use the two types of sport surfaces offer has been made. This comparison may be of value when considering property acquisition in premium locations of the city or in areas where a certain level of utilization is required using a minimal amount of available land.

The cost comparison below reflects the following:

- Capital costs for a single natural grass and artificial turf field are based on the estimates summarized in Table 3.3. The values reflect the high range estimates indicated
- Capital costs for natural grass include irrigation and no lighting. This composition has been selected as very few of the natural grass fields are lit, consistent with other comparable cities
- Capital costs for artificial turf include lighting as this is standard practice
- Comparative utilization of amenities has not been included and no allowance is based for additional property acquisition for these supporting services. **For example, parking lots, access roads, bleachers, washrooms, etc. will be more heavily utilized with artificial turf (at about 3 to 1).** These other amenities require their own land space. A simplification of this principal would be that if three artificial turf fields provide the same hours of use as nine natural grass fields then proportionally more land would be required for supporting amenities such as additional parking, washrooms, etc. As the ratio is not straightforward in terms of facility construction, consideration for amenities in the comparison analysis has been omitted
- The City's current field utilization rates are based on one artificial field being approximately equivalent to three natural grass fields. This ratio of hours of use is not unlike the utilization experienced in other municipalities. This information was obtained from the athletic park booking hour summaries provided by the City. While numbers vary greatly on each field, and facility, the City's natural grass fields experience about 225 hours and artificial turf about 650 hours of annual use (based on 2019 bookings)
- A new rectangular natural grass playing field requires approximately 1.22 hectares (3.1 acres) of land whereas an artificial turf field requires 1.08 hectares (2.67 acres). This excludes land required for parking and supporting amenity areas. Natural grass fields require more land for field shifting due to wear

3.2 Developable Land Costs

Table 3.1 – Artificial Turf/Natural Grass Land and Development Cost Comparison

Field Surface Type	Field Use Equivalency (No. of Fields)	Land Per Field	Total Land Cost ($988K/ha)	Construction Cost per Field	Total Construction Cost	Total Capital Cost
Natural Grass	3	1.22 ha	$3,616,080	$1,280,000	$3,840,000	$6,240,820
Artificial Turf	1	1.08 ha	$1,067,040	$4,500,000	$4,500,000	$5,567,040
Differences (Natural Grass vs. Artificial Turf)			+$2,549,040		($610,000)	+$1,939,040

As indicated above, when considering the purchase of greenfield land, and the field surface utilization equivalencies, the cost savings to develop a single artificial turf field at a greenfield site (vs. three natural grass fields) could be in the order of $2,000,000.

Note that the above costs do not include overall lifecycle replacement or maintenance costs for either surface. Development levies and off-site servicing (if required) are also not included in the table.

Image Credit: R.F. Binnie & Associates Ltd.

Image Credit: Pexels Stock Image

3.3 Construction Costs

3.3.1 | Off-Site Servicing

For greenfield sites, adequate provision for road access and servicing must be reviewed and included in capital cost considerations, as these costs could impact the viability of a project. If a site is not in reasonable proximity to services, it will still need to be self-sufficient and functioning. While not ideal, alternate site servicing infrastructure could include wells, septic fields, fire ponds, ditches, retention areas, rain gardens and other stormwater management features.

Off-site servicing estimates have not been provided, as these costs are site specific.

3.3.2 | Existing Infrastructure Utilities

For existing sites, it is assumed that adequate provision for road access and servicing are already existing onsite or near the property line to reduce the capital cost of a project. Part B Section 2.2.4 discusses the recommended road classifications that an artificial turf field would be suitable beside. There may be existing infrastructure utilities that need to be removed to accommodate the project. Off-site servicing estimates have not been provided, as these costs are site specific.

3.3.3 | Geotechnical Conditions

A geotechnical investigation should be conducted with a grid-style onsite drilling program. Unconfirmed geotechnical conditions can impact construction costs. Existing soil conditions may be unsuitable, consisting of organic material, dry land fill, or unsettled material. For example, a deep layer of organic material at a potential site would be unsuitable base for many aspects of the athletic park development. The material would need to be excavated, removed off site and replaced with suitable base material. If this is not feasible, alternate design solutions may be explored. However, these could also be quite costly. As part of the planning guidelines for athletic parks, a field's location should be away from storm ponds, adjacent to a suitable road and not on a borrow pit.

3.3 Construction Costs

3.3.4 | Environmental

The following are environmental factors that could impact a project's cost:

- Wetlands - Potential disturbance, removal or reconstruction of wetlands areas that are classified under the *Wetland Policy Guidelines*[1] would require application of a Water Permit and likely involve requirements for compensation to mitigate disturbance related to specific wetland classification types. There would be additional costs associated with the compensation work. An environmental consultant would be required to assist with reports and studies required through the Bio-Physical Impact Assessment Reporting, and construction monitoring. Calgary Parks follows the Biophysical Impact Assessment Framework[2]
- Woodlots (A tract of land of any shape or size that supports naturally occurring or planted trees) or treed areas - Requirements for tree clearing during certain times of the year and any Restricted Activity Period would require assessment and monitoring according to the *Migratory Bird Convention Act*.[3] Tree removal is ideally done outside the general bird nesting period between September to March, otherwise expect additional costs for environmental assessments and monitoring during this general nesting period
- Endangered Species or Species at Risk - A natural features assessment report will confirm the plant and wildlife communities prominent at the proposed site that may be impacted by the proposed development. The findings may greatly impact the development potential. Bald Eagles, Sharp-Tailed Grouse, etc.[4] are examples of the species at risk within the Calgary Region. Disturbance of these species would require mitigation measure as part of the development plans for a potential subject parcel. Initial screening based on City of Calgary Parks Biophysical Impact Assessment Framework (City of Calgary Parks and Urban Development Institute – Calgary, 2010) would help reduce the risk of this issue with completions of a "Level 1: Initial Project Review: Preliminary Natural Site Assessment (PNSA)". The additional cost of the report would be minimal relative to the overall project costs
- Environmental Hazards - These may include site contamination from release of hydrocarbons, hazardous materials and other toxic chemicals or contaminations. Affected sites would require capping or complete removal of toxic chemicals and contaminants incurring added costs to the capital budget to rectify. Site assessments should be completed per Canadian Environmental Assessment Act[5]

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3.3 Construction Costs

3.3.5 | Lighting

Artificial fields are typically lit in order to optimize utilization by accommodating play during non-daylight hours. Use of LED systems and lighting mitigation measures to control glare and spill light are common and should be allowed for in costing.

At a minimum, appropriate lighting levels are specified for the programmed activities and use but if a venue is potentially to be used for national and international sport hosting with televised events, enhanced lighting levels may be required. The particular lighting requirements will need to be reviewed as it can affect the spacing and quantity of poles, types of fixtures and accessories needed to achieve the require lighting levels.

3.3.6 | Irrigation / Water Source

Both natural and artificial turf fields require access to a water source. Artificial turf fields require water for surface conditioning and maintenance, and natural grass fields require water mainly for irrigation and as well as maintenance. In the case of natural grass fields where sites have no water source and/or low water pressure, the City would need to consider solutions such as installing an on-site water storage tank for irrigation, and/or adding an irrigation booster pump to increase pressure. These solutions would add to project capital costs.

3.3.7 | Turf Protection System

Turf protection covering is recommended to maximize field facilities programming for multi-use as a venue not only for sport but large-scale community events. The temporary event flooring helps to protects and preserve the sensitive field surfaces and capital investment. The initial capital cost of a protective covering (9,800 m2) ranges from $1,200,000 – $1,600,000 (per local sourcing in the Calgary Region).

3.3.8 | Field Hockey

Field programming to accommodate high level Field Hockey will require specialized artificial turf and higher levels of play need to have pitches irrigated or wet down to be added to the design. Additional costs (over and above the standard cost for an artificial turf field) can range from $500,000 – $2,000,000/per field according to the design and overall requirements for the fields (e.g.- irrigation system, elastic layer, bleacher seating, lighting, and fencing).

3.3.9 | Spectator Seating

Spectator seating for 200 people minimum (up to 500) per field and associated amenities is anticipated with a typical athletic field development. Sport field venues used to host larger-scale events, regional, national or international competitions should be planned and designed to accommodate from 500 to 5000 spectators with a combination of permanent and temporary seating. The capacity of required spectator seating will impact costs for the seating structure.

3.3 Construction Costs

3.3.10 | Supporting Infrastructure and Services

Any program modifications or expansion to existing athletic or community park will likely require improved or additional support infrastructure including on-site washrooms, change rooms, community spaces, site servicing, and other amenities.

3.3.11 | Field Typology

As stated in the Part B - Development Section of this report, the field program (e.g. sports to be played) and size for a new or redeveloped artificial turf/natural grass field will determine development requirements and their associated costs. Some sports and combination of sports such as soccer and football require a larger layout to accommodate the areas of play compared to others. In general, unless the field is to be built to accommodate a single sport (which would be uncommon), fields should be designed to accommodate soccer and other sports that will fit within a soccer field footprint. This includes field hockey, field lacrosse, as well as practices and drills for most other sports.

Football and rugby would not fit within a standard soccer field footprint and require a longer field (about 140 m in length vs. 110 m for soccer). In order to minimize construction costs, and optimize site utilization, it is recommended to construct multi-use fields that can accommodate football and rugby only where there is a need for additional football/rugby fields.

A cricket pitch is an oval playing surface and requires a larger area than soccer and football. Cricket pitches could potentially be located in the middle of two soccer fields, with the wicket situated between the two rectangular fields.

The City should consider the possible program of sports that will be played on a multi-use natural grass (94m by 130m) or artificial field (84m by 120m) to determine field sizing and costs. These field sizes exclude full football field as part of the multi-use field.

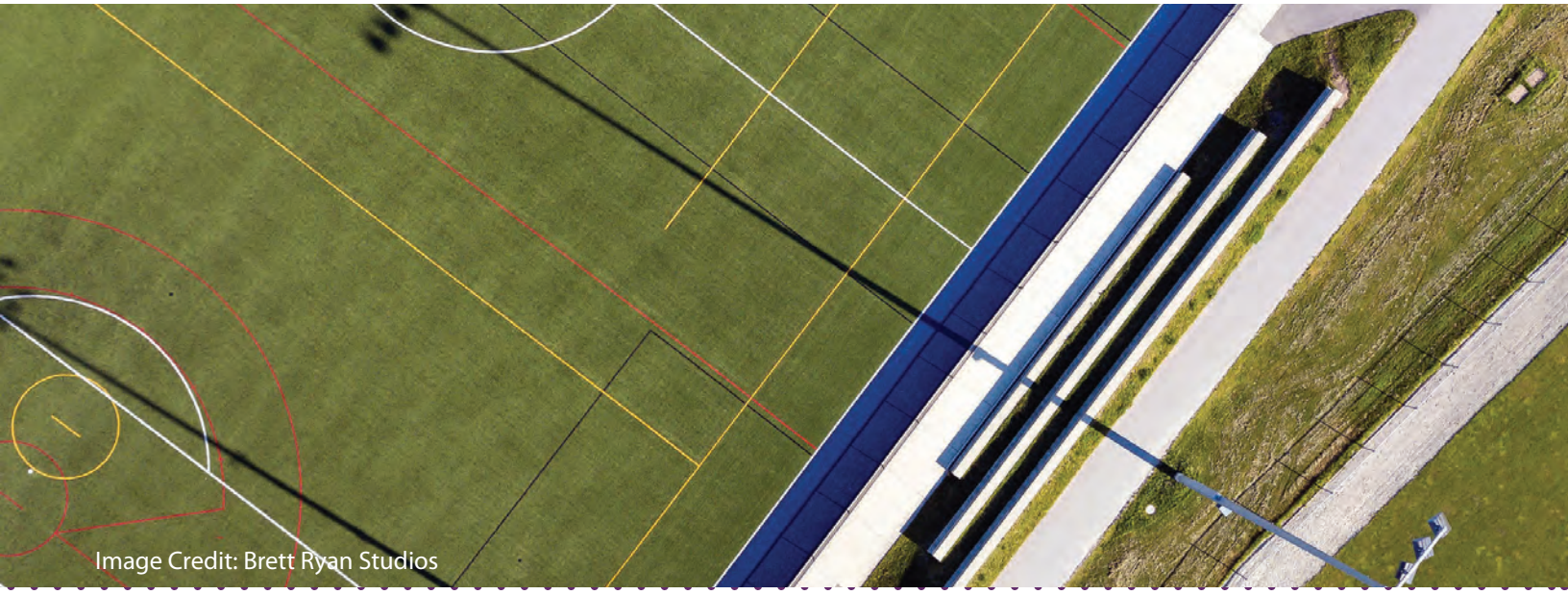


Image Credit: Brett Ryan Studios

Image Credit: Daniel Norin, Unsplash

3.4 Field Development Costs

Rectangular Field Types

Most rectangular fields can be classified and developed according to the following categories:

- Artificial Turf Fields – are developed to include lighting, bleachers/ seating, subsurface drainage, water source, base preparation, and associated amenities (goals, fencing, etc.)
- Natural Grass Fields – Lit/Unlit with Irrigation, are developed to include a Category 3 Field Horticulture Standard soil profile (25-35% of silt & clay, and 65-75% sand), lighting, irrigation, subsurface drainage, and associated amenities
- Natural Grass Fields – Unlit with Irrigation, are developed to include a Category 4 Field Horticulture Standard soil profile (36-45% of silt & clay, and 55-65% sand), perimeter subsurface drainage and associated amenities

Artificial Turf Fields

Development costing for Artificial Turf fields is based on the following assumptions:

- The typical field dimension is 84 m by 120 m. This is comprised of a standard soccer play area of 64 m x 105 m, with 3 m sideline and 5 m end line safety zones. Additional area is comprised of snow storage area, players benches and goal storage pads. If a future cover (e.g. air inflated structure) over the field is desired, min. 10 800 square meters of space is desired. More information can be found in Part D - Section 4.3
- Installation of typical components and support facilities include infilled artificial turf surfacing over a shock pad, new field lighting, new subsurface drainage system, fencing, covered players' seating, bleachers, portable goals, pathway connections, and boot brushes.
- Installation of new storm drainage connections
- Site excavation to include stripping depths corresponding to the thickness of the proposed field structure (infill turf, shock pad, and permeable aggregates)
- Over-excavation and replacement of unsuitable subgrade materials if discovered during construction is not included

Note: It is important to recognize that most of the artificial turf surfacing is manufactured and sourced from the US and Europe. Therefore, prices are heavily impacted by Canadian and US dollar exchange rate, and any currency fluctuation will affect development costs.

3.4 Field Development Costs

Natural Grass Fields

Development costing for natural grass fields is based on the following assumptions:

- The typical field dimensions are 94 m x 130 m. This is comprised of a standard soccer field play area of 64 m x 105 m, but with 10m safety zones. The overall size allows for shifting and adjusting the goal mouth and uprights
- Site excavation to include stripping depths corresponds to the thickness of the proposed field structure (engineered topsoil or imported topsoil)
- Installation of new storm drainage connections
- Installation of irrigation (according to type), subsurface drainage system, and associated amenities with each field type
- Over-excavation and replacement of unsuitable subgrade materials if discovered during construction is not included

Capital Cost Analysis – New Field Development

Table 3.2 - Capital Cost Summary per Field Type

Field Type	Lower Range	Medium Range	High Range
Artificial Turf - Lit	$4,000,000	$4,500,000	$5,200,000
Natural Grass – Irrigated & Lit	$1,521,650	$1,694,550	$1,952,600
Natural Grass – Irrigated & Non-Lit	$1,010,000	$1,120,000	$1,280,000
Natural Grass – Non-Irrigated & Non-Lit	$670,000	$740,000	$840,000

Note: Refer to Tables 3.3, 3.4 and 3.5 for supporting information.

3.4 Field Development Costs

Table 3.3 - Capital Cost Breakdown for Artificial Turf base 84m by 120m Field Footprint

Cost Breakdown	Artificial Turf		
	Lower Range	Medium Range	High Range
Site Demolition, Mobilization, and Demobilization	$67,500	$75,000	$86,250
Site Earthwork	$498,370	$553,800	$636,870
Artificial Turf (Turf, Infill, Shock pad, Concrete Curb, Granular Base)	$1,309,194	$1,454,660	$1,672,859
Site furniture (Seating, shelters etc.)	$36,900	$41,000	$47,150
Field perimeter hard surfacing (Asphalt, Concrete Paving)	$36,900	$41,000	$47,150
Field perimeter fencing	$165,000	$185,000	$210,000
Landscaping	$91,800	$102,000	$117,300
Site Servicing (Stormwater, Water)	$394,200	$438,000	$503,700
Sport Field Lighting	$468,450	$520,500	$ 598,575
Subtotal	$3,143,149	$3,494,110	$4,015,477
Contingency Allowance (20%)	$628,630	$698,822	$803,095
Soft Costs (Design, Investigation, Studies) (5% of Construction)	$314,315	$349,411	$401,548
Estimated Total Project Cost	**$4,086,094**	**$4,542,343**	**$5,220,120**

3.4 Field Development Costs

3.4.1 | Artificial Turf Cost Assumptions (Line Items)

Site Earthwork

- Supply and install construction fencing, 1.8m high by " Fast Fence Inc" or approved equal
- Mud mat per detail and associated restoration works after construction
- Removal and Disposal of Existing topsoil and unsuitable fill material onsite with assumption of 0.75m unsuitable to be dispose off site
- Supply and install suitable fill material of 0.25m depth
- All excavation, rough and fine grading
- Erosion Control which includes Silt fence

Artificial Turf

- Supply and install perimeter concrete barrier curb (150mm Width, 300mm Height)
- Artificial Turf (60mm Height) without infill but including soccer lines per specifications
- Infill - Artificial Turf Field (Rubber Crumb Infill)
- Supply and install pre-engineered shock pad
- Artificial Turf Field Granular Base including but not limited to 500mm Granular with 100mm high density Styrofoam insulation and all associated items

Site Furniture

- Supply and install Movable Soccer Goals (KWIK GOALS-2B9006SW)
- Supply and install Bleachers per detail and specifications (5 - Tier with 80 persons capacity)
- Supply and install Player's Benches per detail and specifications

Field Perimeter Hard Surfacing

- Supply and install Concrete Pad (100mm depth) per detail and specifications
- Supply and install new granular per detail (300mm Granular Depth) - Concrete Pad
- Supply and install Asphalt Pathway (75mm Depth)
- Supply and install new granular per detail (300mm Granular Depth) Asphalt Pathway

Field Perimeter Fencing

- Supply and install 1800mm (6') tall galvanized chain link fencing
- Supply and install 1500mm (16') tall galvanized chain link fencing for soccer field backstop
- Supply and install 1.2m wide galvanized chain link fence gate
- Supply and install 3.0m wide galvanized chain link fence gate
- Supply and install 6.0m wide galvanized chain link fence gate

Landscaping

- Supply and install Sod and 150mm of Topsoil including fine grading

Site Servicing

- Underground SWM Water storage tanks
- Supply and install 1200mm maintenance hole per City of Calgary Standards
- Supply and install 900mm catch basin per City of Calgary Standards
- Supply and install Slotted or Perforated PVC pipe 300mm diameter include all connections to manholes and sewers per City of Calgary Standards
- Supply and install Slotted or Perforated PVC pipe 450mm diameter include all connections to manholes and sewers per City of Calgary Standards
- Ads-Drain Inlet with 150mm Light Duty Grate per detail

Sport Field Lighting

- Supply and install Sport Field Lighting as Musco Lighting with four pole system

3.4 Field Development Costs

Table 3.4 - Capital Cost Breakdown for Natural Grass – Lit & Irrigated

Cost Breakdown	Natural Grass – Lit & Irrigated		
	Lower Range	Medium Range	High Range
Site Preparation	$40,000.00	$45,000.00	$50,000.00
Bulk excavation and backfill	$100,000.00	$110,000.00	$125,000.00
Site Drainage (Perimeter drainage)	$50,000.00	$55,000.00	$ 63,000.00
Site infrastructure (Electrical, Storm water)	$67,500.00	$75,000.00	$85,000.00
Paving, pathways, & retaining walls	$80,000.00	$90,000.00	$100,000.00
Soft landscaping	$3,000.00	$3,500.00	$4,000.00
Fencing	N/A	N/A	N/A
Natural Grass rectangular field (94m X 130m) (Sod, Topsoil, soil amendments, Irrigation, sub-surface drainage, goal nets)	$450,000.00	$500,000.00	$575,000.00
Sport Field Lighting	$380,000.00	$425,000.00	$500,000.00
Subtotal	$1,170,500.00	$1,303,500.00	$1,502,000.00
Contingency Allowance (20%)	$234,100.00	$260,700.00	$300,400.00
Soft Costs (Design, Investigation, Studies) (10% of Construction)	$117,050.00	$130,350.00	$150,200.00
Estimated Total Project Cost (Fencing not Included)	**$1,521,650.00**	**$1,694,550.00**	**$1,952,600.00**

3.4 Field Development Costs

3.4.2 | Natural Grass Cost Assumptions (Line Items)

Site Preparation

- Mobilization, Demobilization
- Mud Mat (10m x 6m)
- Construction Sediment Control
- Construction Fencing

Bulk Excavation and Backfill

- Clearing and Grubbing of the site
- Topsoil Stripping and Stockpiling (150mm)
- Common Excavation (Cut/Fill) including Compaction
- Fine grading of site to depths indicated on details and drawings. Find grading of profile by Laser Grading/automated unit
- Misc. Items

Site Drainage

- 100mm Diameter Perforated Lateral Pipe c/w 16mm clear rock, wrapped with non-woven geotextile
- Storm Connection to Existing Stormwater Sewer/Into SWM Pond

Site Infrastructure

- Electrical Service to Site
- Stormwater Management Misc. Items onsite

Paving, Pathways, & Retaining Walls

- Asphalt Surfacing (walkways) (100mm Asphalt, 200mm Base)
- Concrete Paving (100mm and 150mm aggregate base)
- Misc. Paving, Pathways & Retaining Walls

Soft Landscaping

- Seeding and 150mm topsoil – outside sport field and hardscaping area

Fencing

- Chain Link Fence 1.5m tall
- 1.5m wide Gate
- 3.6m wide Maintenance Gate
- Misc. Fencing Items

Natural Grass Field

- Sport Field Sod
- Topsoil (Sandy Loam or Sandy Clay Loam) - 300mm Depth
- Soil Amendments (Blended with existing topsoil)
- Sport Field Drainage
- Irrigation System
- Goal Nets
- Miscellaneous Items

Sport Field Lighting

- Rectangular Field (LED) – Four Pole System
- Miscellaneous Lighting Items

3.4 Field Development Costs

Table 3.5 - Capital Cost Breakdown for Natural Grass – Unlit & Irrigated

Cost Breakdown	Natural Grass – Unlit & Irrigated		
	Lower Range	Medium Range	High Range
Site Preparation	$40,000.00	$45,000.00	$50,000.00
Bulk excavation and backfill	$100,000.00	$110,000.00	$125,000.00
Site Drainage (Perimeter drainage)	$50,000.00	$55,000.00	$ 63,000.00
Site infrastructure (Electrical, Storm water)	$67,500.00	$75,000.00	$85,000.00
Paving, pathways, & retaining walls	$80,000.00	$90,000.00	$100,000.00
Soft landscaping	$3,000.00	$3,500.00	$4,000.00
Fencing	N/A	N/A	N/A
Natural Grass field (94m X 130m) (Sod, Topsoil, soil amendments, Irrigation, sub-surface drainage, goal nets)	$450,000.00	$500,000.00	$575,000.00
Sport Field Lighting	N/A	N/A	N/A
Subtotal	$790,500.00	$ 878,500.00	$1,002,000.00
Contingency Allowance (20%)	$158,100.00	$175,700.00	$200,400.00
Soft Costs (Design, Investigation, Studies) (10% of Construction)	$ 79,050.00	$ 87,850.00	$100,200.00
Estimated Total Project Cost	**$1,010,000.00**	**$1,120,000.00**	**$1,280,000.00**

3.4 Field Development Costs

3.4.3 | Natural Grass Cost Assumptions (Line Items)

Site Preparation

- Mobilization, Demobilization
- Mud Mat (10m x 6m)
- Construction Sediment Control
- Construction Fencing

Bulk Excavation and Backfill

- Clearing and Grubbing of the site
- Topsoil Stripping and Stockpiling (150mm)
- Common Excavation (Cut/Fill) including Compaction
- Fine grading of site to depths indicated on details and drawings. Find grading of profile by Laser Grading/automated unit
- Misc. Items

Site Drainage

- 100mm Diameter Perforated Lateral Pipe c/w 16mm clear rock, wrapped with non-woven geotextile
- Storm Connection to Existing Stormwater Sewer/Into SWM Pond

Site Infrastructure

- Electrical Service to Site
- Stormwater Management Misc. Items onsite

Paving, Pathways, & Retaining Walls

- Asphalt Surfacing (walkways) (100mm Asphalt, 200mm Base)
- Concrete Paving (100mm and 150mm aggregate base)
- Misc. Paving, Pathways & Retaining Walls

Soft Landscaping

- Seeding and 150mm topsoil – outside sport field and hardscaping area

Fencing

- Chain Link Fence 1.5m tall
- 1.5m wide Gate
- 3.6m wide Maintenance Gate
- Misc. Fencing Items

Natural Grass Field

- Sport Field Sod
- Topsoil (Sandy Loam or Sandy Clay Loam) - 300mm Depth
- Soil Amendments (Blended with existing topsoil)
- Sport Field Drainage
- Irrigation System
- Goal Nets
- Misc. Items

3.4 Field Development Costs

Replacement of Existing Sports Fields (Athletic Park & Community Site)
Redevelopment (replacement) of existing sports fields typically requires minimal additional infrastructure improvements.

Additional capital costs for redevelopment of an existing sports fields may include:

- Site Servicing and Stormwater Management
- Parking Lot Development or Expansion
- Site Access and Transportation Improvements, if required

As the additional capital costs described above are site specific, and may not be required, they are not part of these cost estimates. The costs are per sports field based on the surfacing type and the sizes indicated in Table 3.6.

Image Credit: Brett Ryan Studios

3.4 Field Development Costs

The primary difference between greenfield and redevelopment is that greenfield sites include land costs (estimated at $988,000 per hectare). It is assumed that field replacement projects are located on land already owned by the City. Note that for redevelopment, upgrading utilities in established communities may be required and new legislation would apply.

Table 3.6 - Cost Summary (Greenfield compared to Redevelopment)

Field Type	Greenfield (New)	Redevelopment
Artificial Turf (1.08 ha)	$5,682,690	$4,500,000
NT - Lit & Irrigated (1.22 ha)	$3,125,360	$1,920,000
NT - Unlit & Irrigated (1.22 ha)	$2,485,360	$1,280,000

Image Credit: Pexels Stock Photo

Image Credit: Arun Sharma, Unsplash

3.5 Budget Costing for New Representative Athletic Park

Two alternative layouts for a three-field athletic park with associated parking and amenities have been developed to confirm the minimum site size that would be required, and also for costing purposes. Fields can be adjusted to accommodate cricket (but this configuration is not shown here). The two site development options below are based on the following assumptions:

Concept Plan Option #1

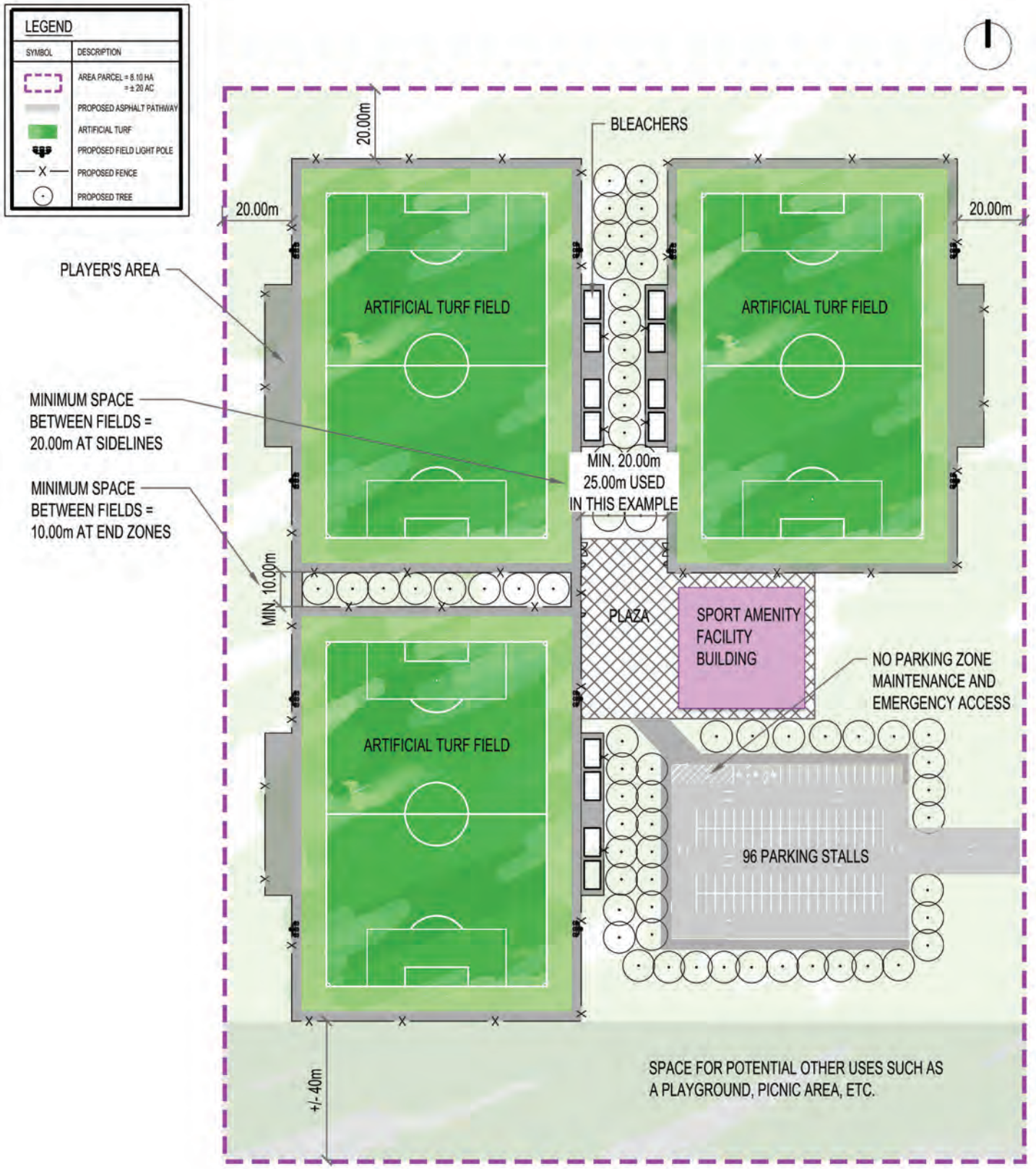
- 9.3 ha (23-acre) parcel of land
- Site Configuration
  - Three Artificial Turf Fields (Soccer/Multi-use – no Football)
  - Associated parking
  - Facility building (Public Washroom, Maintenance Area and Storage)
  - Plaza (gathering space)
- Additional Space on the site for other amenities

Concept Plan Option #2

- 9.3 ha (23-acre) parcel of land
- Site Configuration
  - One Artificial Turf Field (Soccer/Multi-use – no football)
  - Natural Grass - (Soccer/Multi-use – with Football)
  - Natural Grass - (Soccer/Multi-use – no Football)
  - Associated parking
  - Facility building (Public Washroom, Maintenance Area and Storage)
  - Plaza (gathering space)
- Additional space on the site for other amenities

3.5 Budget Costing for New Representative Athletic Park

Figure 3.1 – Concept #1



3.5 Budget Costing for New Representative Athletic Park

Table 3.7 - Concept Plan #1 Capital Costing - Class 5 (-50 to 100%)

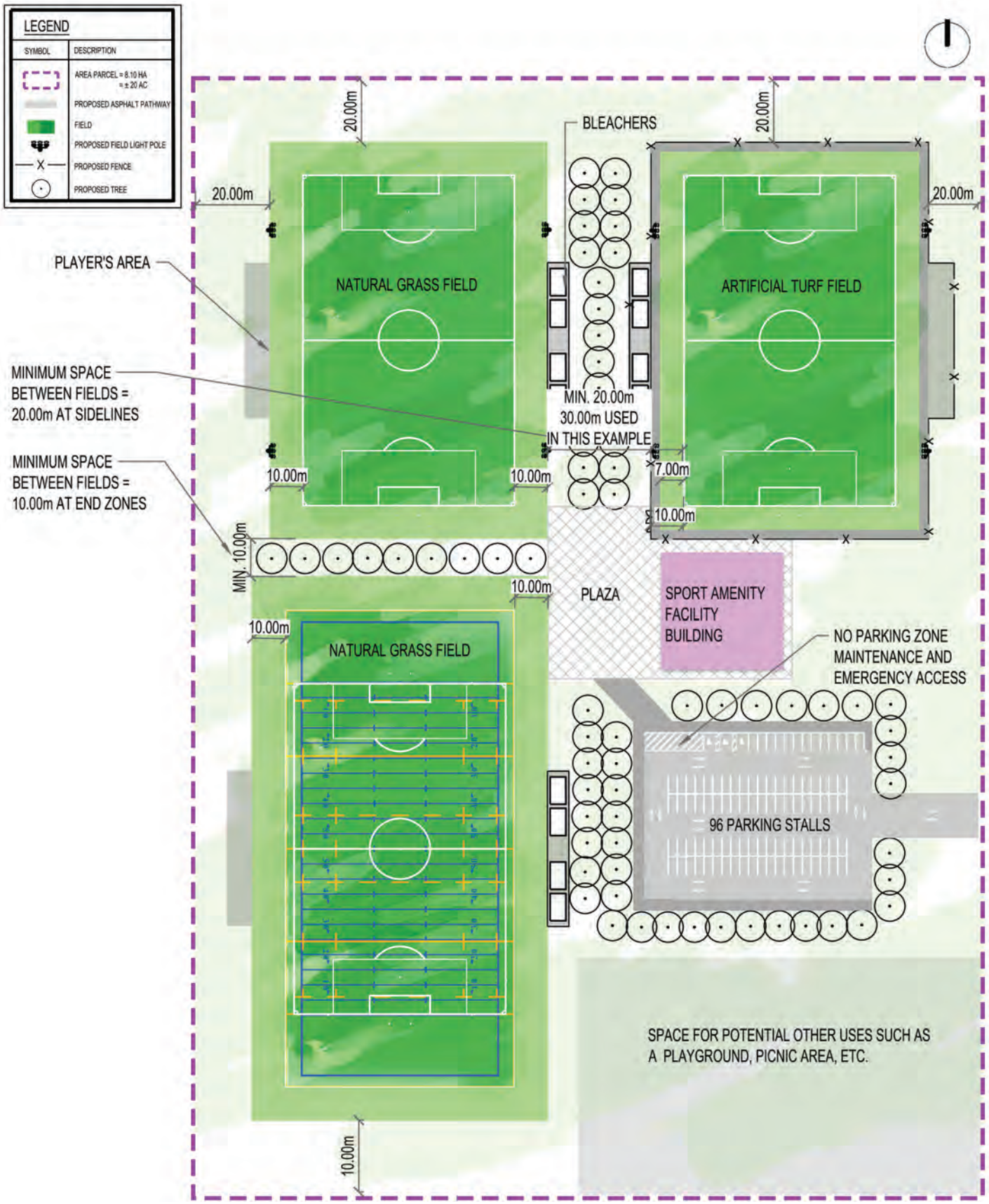
ITEM	DESCRIPTION	UNIT	UNIT PRICE	QTY	AMOUNT
Section 1 - Mobilization, Demobilization					
1.01	(Mobilization, Demobilization, Bonds, Insurance, Erosion Control, Construction Fencing) 2.5% of Construction Costs	LS	$325,000.00	1.00	$325,000.00
	Subtotal:				$325,000.00
Section 2 - Site Grading					
2.01	Clearing and Grubbing of the site	m2	$2.88	93,000.00	$267,840.00
2.02	Topsoil Stripping and Stockpiling (150mm)	m3	$4.03	13,950.00	$56,218.50
2.03	Common Excavation (Cut/Fill) including Compaction	m3	$9.20	46,500.00	$427,800.00
2.04	Fine grading of site to depths indicated on details and drawing. Fine grading of profile by Laser Grading/ automated unit.	m2	$2.01	93,000.00	$186,930.00
2.05	Misc. Items	allowance	$11,500.00	1.00	$11,500.00
	Subtotal:				$950,288.50
Section 3 - Stormwater Management					
3.01	Stormwater Management Improvements	allowance	$50,000.00	1.00	$50,000.00
	Subtotal:				$50,000.00
Section 4 - Site Infrastructure					
4.01	Electrical Service to Site	allowance	$28,750.00	1.00	$28,750.00
4.02	Water Service PVC Pipe - 200mm	lin.m.	$230.00	65.00	$14,950.00
4.03	Water Service Valve - 200mm	each	$2,835.00	1.00	$2,835.00
4.04	Sanitary Sewer Pipe - 200mm	lin.m.	$190.00	65.00	$12,350.00
4.05	Misc. Items onsite	allowance	$50,000.00	1.00	$50,000.00
	Subtotal:				$108,885.00
Section 5 - (Mobilization, Demobilization)					
5.01	Asphalt Surfacing	sq.m.	$57.50	4,647.00	$267,202.50
5.02	Rolled Low Profile Curb and 200mm Gutter Class 'A' Concrete	lin.m.	$126.00	302.00	$38,052.00
5.03	Misc. Paving, Pathways & Retaining Walls	allowance	$100,000.00	1.00	$100,000.00
	Subtotal:				$405,254.50
Section 6 - Misc. Pathways					
6.01	Asphalt Surfacing (3.0m Width)	sq.m.	$57.50	3,600.00	$207,000.00
6.02	Misc. Paving, Pathways & Retaining Walls	allowance	$100,000.00	1.00	$100,000.00
	Subtotal:				$307,000.00
Section 7 - Soft Landscaping					
7.01	Seeding and 150mm topsoil - outside sport field and hardscaping areas	sq.m.	$13.80	54,967.00	$758,544.60
7.02	Trees & Shrubs	each	$700.00	230	$160,740.74
	Subtotal:				$919,285.34

Table 3.7 - (Continued) - Concept Plan #1 Capital Costing - Class 5 (-50 to 100%)

ITEM	DESCRIPTION	UNIT	UNIT PRICE	QTY	AMOUNT
Section 8 - Fencing					
8.01	Chain Link Fence 1.5m	lin.m.	$103.50	1,322.00	$136,827.00
8.02	1.5m wide Gate	each	$862.50	3.00	$2,587.50
8.03	3.6m wide Maintenance Gate	each	$2,300.00	2.00	$4,600.00
8.04	Misc. Fencing Items	allowance	$57,500.00	1.00	$57,500.00
	Subtotal:				$201,514.50
Section 9 - Site Furniture & Signage					
9.01	Waste Receptacles	allowance	$2,000.00	12.00	$24,000.00
9.02	Wayfinding Signage	allowance	$50,000.00	1.00	$50,000.00
9.03	Entrance Signage	allowance	$100,000.00	1.00	$100,000.00
9.04	Misc. Furniture	allowance	$20,000.00	1.00	$20,000.00
9.05	Misc. Items	allowance	$50,000.00	1.00	$50,000.00
	Subtotal:				$244,000.00
Section 10 - Sports Amenity Facility Building					
10.01	Sports Amenity Facility Building	sq.m.	$2,500.00	1,273.00	$3,182,500.00
10.02	Family Area - BBQ & Site Amenities (Bench, BBQ, etc.)	allowance	$50,000.00	1.00	$50,000.00
10.03	Misc. Items	allowance	$25,000.00	1.00	$25,000.00
	Subtotal:				$3,257,500.00
Section 11 - Artificial Turf Rectangular Fields					
11.01	Supply and install perimeter concrete barrier curb per detail.	lin.m.	$230.00	384.00	$88,320.00
11.02	Artificial Turf without infill but including soccer lines per specifications	sq.m.	$57.50	8,892.00	$511,290.00
11.03	Infill - Artificial Turf Field	sq.m.	$23.00	8,892.00	$204,516.00
11.04	Supply and install pre-engineered shock pad	sq.m.	$23.00	8,892.00	$204,516.00
11.05	Artificial Turf Field Granular Base including but not limited to 500mm Granular and all associated items.	sq.m.	$74.75	8,892.00	$664,632.54
11.06	Supply and install Movable Soccer Goals (KWIK GOALS-2B9006SW)	pair	$20,000.00	1.00	$20,000.00
11.07	Supply and install Player's Benches per detail and specification	each	$2,300.00	1.00	$2,300.00
11.08	Supply and install Sport Field Lighting as Musco Lighting	LS	$488,750.00	1.00	$488,750.00
11.09	Misc. Items	allowance	$50,000.00	1.00	$50,000.00
	Subtotal:				$2,234,324.54
	Quantity of Fields	each	$2,234,324.54	3.00	$6,702,973.62
	Subtotal Construction Costs:				$13,471,701.46
	Contingency Allowance (50%):				$6,735,900.00
	Soft Costs (Design, Investigation, Studies) (10.0% of Construction):				$1,347,200.00
Total Estimated Total Project Cost (Class 5 Estimate):					**$21,554,801.46**

3.5 Budget Costing for New Representative Athletic Park

Figure 3.2 – Concept #2



3.5 Budget Costing for New Representative Athletic Park

Table 3.8 - Concept Plan #2 - Capital Costing (Class 5 [-50 to 100%])

ITEM	DESCRIPTION	UNIT	UNIT PRICE	QTY	AMOUNT
Section 1 - (Mobilization, Demobilization)					
1.01	(Mobilization, Demobilization, Bonds, Insurance, Erosion Control, Construction Fencing) 2.5% of Construction Costs	LS	$237,500.00	1.00	$237,500.00
	Subtotal:				$237,500.00
Section 2 - Site Grading					
2.01	Clearing and Grubbing of the site	m2	$2.88	93,000.00	$267,840.00
2.02	Topsoil Stripping and Stockpiling (150mm)	m3	$4.03	13,950.00	$56,218.50
2.03	Common Excavation (Cut/ Fill) including Compaction	m3	$9.20	46,500.00	$427,800.00
2.03	Fine grading of site to depths indicated on details and drawing. Fine grading of profile by Laser Grading/ automated unit.	m2	$2.01	93,000.00	$186,930.00
2.04	Misc. Items	allowance	$11,500.00	1.00	$11,500.00
	Subtotal:				$950,288.50
Section 3 - Stormwater Management					
3.01	Stormwater Management Improvements	allowance	$50,000.00	1.00	$50,000.00
	Subtotal:				**$50,000.00**
Section 4 - Site Infrastructure					
4.01	Electrical Service to Site	allowance	$28,750.00	1.00	$28,750.00
4.02	Water Service PVC Pipe - 200mm	lin.m.	$230.00	65.00	$14,950.00
4.03	Water Service Valve - 200mm	each	$2,835.00	1.00	$2,835.00
4.04	Sanitary Sewer Pipe - 200mm	lin.m.	$190.00	65.00	$12,350.00
4.05	Misc. Items onsite	allowance	$50,000.00	1.00	$50,000.00
	Subtotal:				$108,885.00
Section 5 - Parking Lot (96 Parking Stalls)					
5.01	Asphalt Surfacing	sq.m.	$57.50	4,647.00	$267,202.50
5.02	Rolled Low Profile Curb and 200mm Gutter Class 'A' Concrete	lin.m.	$126.00	302.00	$38,052.00
5.03	Misc. Paving, Pathways & Retaining Walls	allowance	$100,000.00	1.00	$100,000.00
	Subtotal:				$405,254.50

3.5 Budget Costing for New Representative Athletic Park

Table 3.8 - (Continued) - Concept Plan #2 - Capital Costing (Class 5 [-50 to 100%])

ITEM	DESCRIPTION	UNIT	UNIT PRICE	QTY	AMOUNT
Section 6 - Misc. Pathways					
6.01	Asphalt Surfacing (3.0m Width)	sq.m.	$57.50	1,224.00	$70,380.00
6.02	Misc. Paving, Pathways & Retaining Walls	allowance	$100,000.00	1.00	$100,000.00
	Subtotal:				$170,380.00
Section 7 - Soft Landscaping					
7.01	Seeding and 150mm topsoil - outside sport field and hardscape areas	sq.m	$13.80	50,400.00	$695,520.00
7.02	Trees & Shrubs	each	$700.00	230	$160,740.74
	Subtotal:				**$856,260.74**
Section 8 - Fencing					
8.01	Chain Link Fence 1.5m	lin.m.	$103.50	437.00	$45,229.50
8.02	1.5m wide Gate	each	$862.50	1.00	$862.50
8.03	3.6m wide Maintenance Gate	each	$2,300.00	1.00	$2,300.00
8.04	Misc. Fencing Items	allowance	$57,500.00	1.00	$57,500.00
	Subtotal:				$105,892.00
Section 9 - Site Furniture & Signage					
9.01	Waste Receptacles	allowance	$2,000.00	12.00	$24,000.00
9.02	Wayfinding Signage	allowance	$50,000.00	1.00	$50,000.00
9.03	Entrance Signage	allowance	$100,000.00	1.00	$100,000.00
9.04	Misc. Furniture	allowance	$20,000.00	1.00	$20,000.00
9.05	Misc. Items	allowance	$50,000.00	1.00	$50,000.00
	Subtotal:				$244,000.00
Section 10 - Sports Amenity Facility Building					
10.01	Sports Amenity Facility Building	sq.m.	$2,500.00	1,273.00	$3,182,500.00
10.01	Family Area - BBQ & Site Amenities (Bench, BBQ, etc.)	allowance	$50,000.00	1.00	$50,000.00
10.01	Misc. Items	allowance	$25,000.00	1.00	$25,000.00
	Subtotal:				**$3,257,500.00**
Section 11 - Natural Grass Rectangular Fields					
11.01	Sport Field Sod	sq.m.	$6.90	24,727.00	$170,616.30
11.02	Topsoil (Sandy Loam or Sandy Clay Loam) - 300mm Depth	sq.m.	$10.35	24,727.00	$255,924.45
11.03	Soil Amendments (Blended with existing topsoil)	cu.m.	$69.00	3,709.05	$255,924.45
11.04	Sport Field Drainage	lin.m.	$40.25	3,033.33	$122,091.67
11.05	Irrigation System	allowance	$86,250.00	1.00	$86,250.00

3.5 Budget Costing for New Representative Athletic Park

Table 3.8 - (Continued) - Concept Plan #2 - Capital Costing (Class 5 [-50 to 100%])

ITEM	DESCRIPTION	UNIT	UNIT PRICE	QTY	AMOUNT
11.06	Supply and install Movable Soccer Goals (KWIK GOALS-2B9006SW)	pair	$20,000.00	1.00	$20,000.00
11.07	Supply and install Player's Benches per detail and specification	each	$2,300.00	1.00	$2,300.00
11.08	Supply and install Sport Field Lighting as Musco Lighting	LS	$488,750.00	1.00	$488,750.00
11.09	Misc. Items	allowance	$50,000.00	1.00	$50,000.00
	Subtotal:				**$1,451,856.87**
Section 12 - Artificial Turf Rectangular Field					
12.01	Supply and install perimeter concrete barrier curb per detail.	lin.m.	$230.00	384.00	$88,320.00
12.02	Artificial Turf without infill but including soccer lines per specifications	sq.m.	$57.50	8,892.00	$511,290.00
12.03	Infill - Artificial Turf Field	sq.m.	$23.00	8,892.00	$204,516.00
12.04	Supply and install pre-engineer shock pad	sq.m.	$23.00	8,892.00	$204,516.00
12.05	Artificial Turf Field Granular Base including but not limited to 500mm Granular and all associated items.	sq.m.	$74.75	8,892.00	$664,632.54
12.06	Supply and install Movable Soccer Goals (KWIK GOALS-2B9006SW)	pair	$20,000.00	1.00	$20,000.00
12.07	Supply and install Player's Benches per detail and specification	each	$2,300.00	1.00	$2,300.00
12.08	Supply and install Sport Field Lighting as Musco Lighting	LS	$488,750.00	1.00	$488,750.00
12.09	Misc. Items	allowance	$50,000.00	1.00	$50,000.00
	Subtotal:				**$2,234,324.54**
		Subtotal Construction Costs:		**$10,072,142.15**	
		Contingency Allowance (50%):		**$5,036,100.00**	
		Soft Costs (Design, Investigation, Studies) (10.0% of Construction):		**$1,007,300.00**	
		Total Estimated Total Project Cost (Class 5 Estimate):		**$16,115,542.15**	

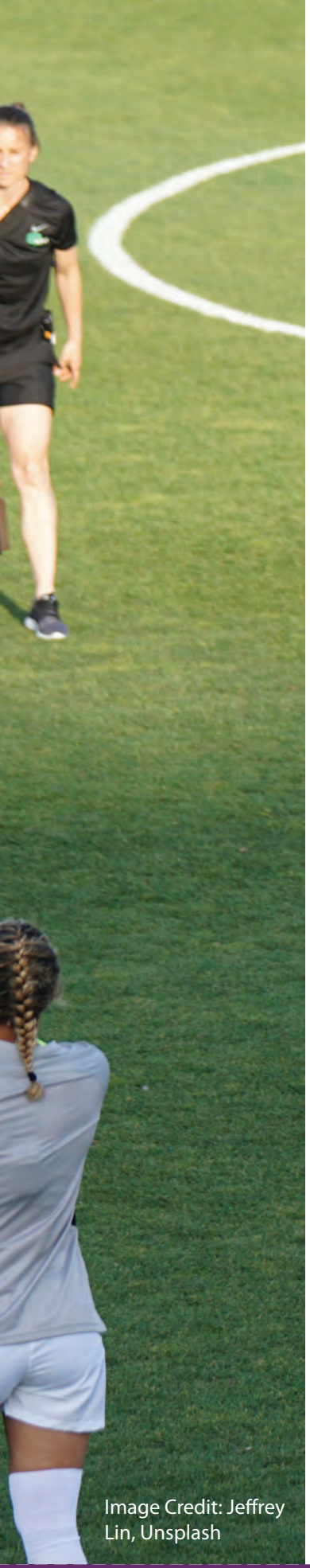


Image Credit: Jeffrey Lin, Unsplash

3.6 Lifecycle Costing

3.6.1 | Artificial Turf Fields

Lifecycle costing for artificial turf fields has been prepared based on the following assumptions:

- 10-year lifecycle replacement for artificial turf surface
- 20-year lifecycle replacement for pre-engineered drainage pad
- 25-30-year lifecycle replacement for Sport Field Lighting, assuming that it would be replaced within 2–3 years of the warranty's expiry. Review of structural components and lighting components should be completed 5 years prior to the warranty period ending
- Annual routine maintenance has not been included

Table 3.9 - Artificial Turf Field – Annual Life Cycle Cost (2019 Costs)

Infill (Annual Cost per Field)	Cost
Turf Infill Replacement (includes Equipment Costs)	$4,000 +/-
Maintenance and Operation Sub Total	$4,000 +/-

Table 3.10 - Artificial Turf Field – Replacement Life Cycle Cost (2019 Costs) 10-year Cycle

Item Description	Low Cost	Medium Cost	High Cost
Lifecycle Artificial Turf Removal	$50,000	$52,500	$60,000
Lifecycle Artificial Turf Infill Removal	$25,000	$26,250	$30,000
Lifecycle Artificial Turf Replacement	$610,560	$641,088	$732,672
Lifecycle Artificial Turf Pad - Replacement*			
Loss Revenue (Replacement Year)	$50,000	$52,500	$60,000
Total	**$735,560.00**	**$772,338.00**	**$882,672.00**

The pricing is based on 12.5% difference either way for high and low cost with medium cost being median cost.
**Based on the Lifecycle of the turf pad being replaced on two to three turf replacements.*

3.6 Lifecycle Costing

Table 3.11 - Artificial Turf Field – Replacement Life Cycle Cost (2019 Costs) 30-year Cycle

Item Description	Low Cost	Medium Cost	High Cost
Lifecycle Artificial Turf Removal	$50,000	$52,500	$60,000
Lifecycle Artificial Turf Infill Removal	$25,000	$26,250	$30,000
Lifecycle Artificial Turf Replacement	$610,560	$641,088	$732,672
Lifecycle Artificial Turf Pad - Replacement	$152,640	$280,476	$320,544
Loss Revenue (Replacement Year)	$50,000	$52,500	$60,000
Lifecycle Sport Field Lighting System (4 pole layout)	$468,450	$520,500	$598,575
Total	**$1,188,200.00**	**$1,400,314.00**	**$1,593,216.00**

The pricing is based on 12.5% difference either way for high and low cost with medium cost being median cost. Based on the Lifecycle of the turf pad being replaced on two to three turf replacements.

Table 3.12 – Sport Field Lighting – Replacement Life Cycle Cost (2019 Costs) 25-30-year lifecycle

Item Description	Low Cost	Medium Cost	High Cost
Lifecycle Sport Field Lighting System (4 pole layout)	$350,000	$400,000	$450,000

The pricing is based on 12.5% difference for high and low cost, with medium cost being median cost.

Image Credit: Brett Ryan Studios

3.6 Lifecycle Costing

Capital Reserve Budgeting

Annual contributions from Recreation's actual incremental net revenue generated by artificial turf field rental fees should be contributed into the Capital Reserve Fund. The fund should be obtaining a minimum of $75,000 to $95,000 per field on annual basis to obtain replacement cost of the artificial turf by end of the eight-year warranty period. The reserve fund should ideally be separated out for each artificial turf field. Assume the interest from the reserve account would be re-invested within the capital reserve account.

Artificial Turf Reserve Funds should be provided for the replacement and future maintenance of the artificial turf, shock pad and its related site furnishings and not to be used towards the construction of new artifical turf surfaces.

The City of Calgary should also pursue any grant funding opportunities to contribute to the replacement of the artificial turf surface.

Revenues

Information on field booking revenues was provided by the City of Calgary. This information was used to determine revenues per field in the lifecycle costing calculations.

Table 3.13 – Annual Revenues of Artificial and Natural Grass Fields in Calgary

	Artificial Turf Hours Booked (Four Fields)	Artificial Turf Revenues Collected (Four Fields)	Artificial Turf Average Revenues Per Booking Hour	Natural Grass Hours Booked (36 Fields)	Natural Grass Revenues Collected	Natural Grass Average Revenues Per Booking Hour
2018	3,724	$413,044.81	$110.92	7,979	$379,881.53	$47.61
2016	1893	$194,786.79	$102.88	6,582	$348,790.56	$52.99

**2017 data was not included due to a couple of artificial turf fields being offline.*

Image Credit: Brett Ryan Studios

3.6 Lifecycle Costing

Table 3.14 - Lifecycle Costing - Artificial Turf Field

Items	Lifecycle Costs in 2019	Replacement Year (11 Year)	Total Summary (10 Years)
Field Rentals		$0.00	$1,146,387.93
Total Revenues		$0.00	$1,146,387.93
Expenses			
Lifecycle Costs		Replacement Year	
Turf Infill Replacement (includes Equipment Costs) *	$4,000	$0	$45,856
Capital Reserve Allocation	$95,000	$1,089,069	$1,089,069
Lifecycle Artificial Turf Removal	$(50,000)	-$67,196	$0
Lifecycle Artificial Turf Infill Removal	$ (25,000)	-$33,598	$0
Lifecycle Artificial Turf Upgrade Replacement	$ (610,560)	-$820,542	$0
Lifecycle Artificial Turf Pre-Engineered Pad Replacement	$ (267,120)	$0	$0
Lifecycle Sport Field Lighting	$ (520,000)	$0	$0
Loss Revenue (Replacement Year)	$ (100,000)	-$134,392	$0
Lifecycle Costs Sub Total		($1,055,728)	$1,134,924
Gross Revenues Over Lifecycle Costs		**$33,342**	**$11,464**

1 - Based on infill and artificial turf selection at capital cost selection
2 - Artificial Turf Removal (based on local market demand)
3 - Artificial Turf Infill (use of recyclable infill material)
4 – Inflation rate of 3% per year
5 – Excludes routine maintenance
5 – Revenues are based on City of Calgary artificial turf field 2018 total revenues divided by number of artificial turf fields

3.6 Lifecycle Costing

3.6.2 | Natural Grass Fields

Lifecycle costing for natural grass fields (irrigated & lit, irrigated & unlit) are based on the assumption that construction standards are similar for all these field classes. Costs for natural grass fields are based on the following assumptions:

- 30-year lifecycle based on major reconstruction due to irrigation system replacement
- 20 to 30-year lifecycle replacement for irrigation system
- Annual maintenance is required (operation procedures and standard horticulture practices would be included)
- Rehabilitation of the sports field would occur on a 20-year to 30-year cycle
- 25-year to 30-year lifecycle replacement for Sport Field Lighting is required. Lighting would be replaced within two to three years of warranty ending and would also include a review of structural components. Lighting components should be completed five years prior to warranty period ending

Table 3.15 - Natural Grass - Lifecycle Costs (in 2019 dollars)

Item Description	Low Cost	Medium Cost	High Cost
Lifecycle Sod Replacement	$262,500	$300,000	$337,500
Lifecycle Irrigation Replacement	$218,750	$250,0000	$281,250
Lifecycle Major Renovation (increased Horticulture Practices for one season)	$43,750	$50,000	$56,250

The pricing is based on 12.5% difference either way for high and low cost with medium cost being median cost.

Table 3.16 - Natural Grass Life Cycle Costing

Item	Lifecycle Costs in 2019	Total Summary (10 Years)
Field Rentals		$114,329.27
Total Revenues		$114,329.27
Expenses		
Lifecycle Costs		
Capital Reserve Allocation	$9,000	$103,174.91
Lifecycle Sod Replacement	$337,500	
Lifecycle Irrigation Replacement	$281,250	
Lifecycle Major Renovation (increased Horticulture Practices for one season)	$56,250	
Lifecycle Costs Sub Total		$103,174.91
Gross Revenues Over Lifecycle Costs		**$11,154.35**

1 – Inflation rate of 3% per year
2 – Revenue for one field is based on dividing total revenue (per City of Calgary 2018 total NT revenues) for all 38 fields.

3.6 Lifecycle Costing

Capital Reserve Budgeting

Annual contribution from Recreation's actual incremental net revenue generated by natural grass fields rental fees or other allocation sources should be contributed into the Capital Reserve Fund. The fund should be obtaining a minimum of $9,000 to $20,000 per field on annual basis to obtain replacement cost of the natural grass field by end of lifecycle for a new irrigation system. The reserve fund should be combined into one general fund for all-natural grass fields. Assume the interest from the reserve account would be re-invested within the capital reserve account.

A recommendation for the City of Calgary moving forward is to establish a natural grass reserve fund to accomplish a similar objective to the artificial turf reserve. It will be based off of profits made and a re-development plan put in place for all athletic parks to allow the reserve fund to re-fill and contribute to all of the re-development projects. Caveat: the reserve fund will likely not be able to fund projects in their entirety unless bookings drastically increase.

Natural Grass Field Reserve funds would provide for the replacement and future major maintenance of the natural grass field, and its related equipment.

It is recommended that the City of Calgary pursue grant funding options for the replacement of natural grass and artifical turf fields, in whole or in separate components, at end of life.

Image Credit: Duffy Brook, Unsplash

Image Credit: Retha Ferguson, Pexels

3.7 Operational Costs

3.7.1 | Operation Cost Impacts

Operation Cost Impact
The following operation cost comparison table is based on assumptions and detailed costs included within this section.

Table 3.17 - Sport Field Annual Operating Costs

Artificial Turf	NG - Irrigated & Lit	Irrigated & Unlit
$15,560	$91,040	$91,040

Refer to Table 3.19 - Artificial Turf Field - Annual Operating Costs Maintenance, Table 3.20 - Natural Grass Field Operating Costs

Artificial Turf Fields
Staff or contractors involved in the maintenance of the artificial turf should possess the following:

- Demonstrated experience in the maintenance of artificial turf
- Training and experience in the operation of the broad spectrum of equipment required to perform artificial turf maintenance procedures as described above
- Worker's Compensation Board and liability insurance
- Occupational Health and Safety, Transportation of Dangerous Goods training
- Ability to assess turf conditions and communicate/ record information as needed

From a risk management perspective, it is recommend that maintenance of new artificial turf facilities be included in maintenance contracts for existing City-owned artificial turf facilities.

Table 3.18 - Artificial Turf Field - Annual Operating Costs Maintenance - Contractor

Maintenance and Operations (Annual Cost Per Field)	Cost
Grooming (18 times per season)	$9,000
Deep cleaning (annually)	$3,000
Surface cleaning (four times per season)	$2,500
Infill Depth Monitoring	$1,020
Maintenance and Operation Sub Total	**$15,560**

3.7 Operational Costs

3.7.2 | Long Term Maintenance

Maintenance practices of Artificial Turf surfaces should take into consideration on-field activities. As use of the Artificial Turf fields increase, the following maintenance practices will also need to increase proportionally:

- Grooming of the artificial turf surface
- Topping-up of the artificial turf surface may be required more frequently (e.g., two or three times a year) rather than annually. This will be based on usage and activities on the field

Field maintenance will also take into account the overall selection of the artificial turf system (fibre type, thatching, infill).

Natural Grass Fields

Within an athletic park site, staffing will be dynamic based on usage and community demand. However, trained sports field managers dedicated to each field or set of fields is crucial to meeting maintenance standards, especially if various contractors and unskilled staff are working on the site. There is more revenue for fields that are staffed because the users almost always pay to play on those fields. An unstaffed field would have less revenue from paid users but would have less labour cost.

Staffing requirements will be based on facility size, subsequent variations to the specific core standards, and variable costs associated with utilization rates.

In order to effectively assess operating costs, labor must be allocated first, which accounts for approximately 60% of the operating costs. Using a tool called the "Core Standards Template", the costs can be addressed by specifically highlighting the minimum maintenance requirements. Refer to Tables 21 and 23.

The irrigated & lit and irrigated & unlit optimum staffing model is 40 hours per week based on 10 events per week per field based on one staff person.

Typical operation costs for natural grass fields are based on approximately 3.1 acres per field, which includes the field and surrounding buffer.

The annual cost per field was based on labour at a $52.00 hourly rate applied to employee wages (benefits included, per City of Calgary information), and field expenses before capital and depreciation.

Image Credit: Chuttersnap, Unsplash

3.7 Operational Costs

Table 3.19 - Natural Grass Field Operating Costs

Expenses (Annual – Per Field)	Budget
Labour and Salaries	$73,840
Pesticides	$1,000
Topdressing Sand	$3,000
Fertilizer	$900
Fuel/Oil	$1,500
Repair & Maintenance - Irrigation and Drainage	$1,500
Repair & Maintenance - Equipment & Reels	$3,800
Office/Shop Supplies	$800
Project Supplies & Materials	$4,700
Total	**$91,040**

Image Credit: iStock Photos

Table 3.20 - Irrigated & Lit and Irrigated & Unlit (Staff Utilization)

Events factor (based on 10 events per week) - Core Standard Template				
Core Standard 1: Mowing	Time(hrs)	No. of fields	Days Per Week	Totals (Hrs)
Mowing playing surface	2	1	3	6.00
Mowing surrounds	2	1	2	4.00
Sub-total				**10.00**
Core Standard 2: Topdressing & Overseeding/ Fertilizing	Time(hrs)	No. of fields	Days Per Week	Totals (Hrs)
Calibrating/loading topdresser	1	1	1	1.00
Applying sand/soil topdressing	3	1	1	3.00
Dragmat	1	1	1	1.00
Fertilizing	1	1	1	1.00
Overseeding	2	1	1	2.00
Sub-total				**8.00**
Core Standard 3: Irrigation	Time(hrs)	No. of fields	Days Per Week	Totals (Hrs)
Irrigation Repairs	1	1	1	1.00
Programming, Scheduling	1	1	1	1.00
Test Rotors/hand watering	2	1	1	2.00
Sub-total				**4.00**
Core Standard 4: Compaction relief	Time(hrs)	No. of fields	Days Per Week	Totals (Hrs)
Core aeration	4	1	0.5	2.00
Solid tine aeration	2	1	0.5	1.00
Slicing	2	1	0.5	1.00
Rolling	2	1	0.5	1.00
Sub-total				**5.00**
Core Standard 5: Gardens, Trees Maintenance	Time(hrs)	No. of fields	Days Per Week	Totals (Hrs)
Weeding and Dead-heading	1	1	1	1.00
Gardens if applicable				0.00
Repairs: Bark Mulch, watering, bulbs,				0.00
Sub-total				**1.00**
Core Standard 6: Equipment Maintenance	Time(hrs)	No. of fields	Days Per Week	Totals (Hrs)
Sharpen/Adjust Mower Blades	0.5	1	3	1.50
Oil changes/Fluids/Filters	0.5	1	0.5	0.25
Equipment repairs	0.5	1	0.5	0.25
Misc.				2.00
Sub-total				**4.00**
Core Standard 7: Projects/Line painting	Time(hrs)	No. of fields	Days Per Week	Totals (Hrs)
Requirements Drag/Clay/Mound	1	1	1	1.00
Field Marking	1	1	1	1.00
Base Field Prep	0	0	0	0.00
Weed control/spraying	1	1	1	1.00
Tree maintenance, parking lot, blowing debris	1	1	1	1.00
Sub-total				**4.00**
Core Standard 8: Field Assessment and Amenities	Time(hrs)	No. of fields	Days Per Week	Totals (Hrs)
Field assessment	1	1	1	1.00
Field Rotation	1	1	1	1.00
Tennis, Playgrounds & Skateparks				0.00
Change rooms and bathrooms	1	1	2	2.00
Sub-total				4.00
Total per week (hours)				**40.00**

3.7 Operational Costs

Non-Irrigated & Non-Lit

Table 3.21 - Natural Grass Annual Operating Costs

Expenses (Annual – Per Field)	Actual
Labour and Salaries	$50,830.77
Pesticides	$967.69
Topdressing Sand	$3,025.00
Fertilizer	$887.00
Fuel/Oil	$1,319.64
Repair & Maintenance - Irrigation and Drainage	$1,319.64
Repair & Maintenance - Equipment & Reels	$329.91
Office/Shop Supplies	$329.91
Project supplies & Materials	$376.10
Total	**$59,399.67**

Image Credit: iStock Photos

Table 3.22 – Non-Irrigated & Unlit (Staff Utilization)

Events factor (based on 10 events per week) - Core Standard Template				
Core Standard 1: Mowing	Time (hrs)	No. of fields	Days Per Week	Totals (Hrs)
Mowing playing surface	2	1	1	2.00
Mowing surrounds	2	1	1	2.00
Sub-total				**4.00**
Core Standard 2: Topdressing & Overseeding/ Fertilizing	Time(hrs)	No. of fields	Days Per Week	Totals (Hrs)
Calibrating/loading topdresser	1	1	1	2.00
Applying sand/soil topdressing	3	1	1	3.00
Dragmat	1	1	1	1.00
Fertilizing	1	1	1	0.25
Overseeding	2	1	1	2.00
Sub-total				**8.25**
Core Standard 3: Irrigation	Time(hrs)	No. of fields	Days Per Week	Totals (Hrs)
Irrigation Repairs		1	1	0.00
Programming, scheduling		1	1	0.00
Test Rotors/hand watering		1	1	0.00
Sub-total				**0.00**
Core Standard 4: Compaction relief	Time(hrs)	No. of fields	Days Per Week	Totals (Hrs)
Core aeration	4	1	0.5	2.00
Solid tine aeration	2	1	0.5	1.00
Slicing	2	1	0.5	1.00
Rolling	2	1	0.5	1.00
Sub-total				**5.00**
Core Standard 5: Gardens, Trees Maintenance	Time(hrs)	No. of fields	Days Per Week	Totals (Hrs)
Weeding and Deadheading	0	1	1	0.00
Gardens if applicable				0.00
Repairs: Bark Mulch, watering, bulbs,				0.00
Sub-total				**0.00**
Core Standard 6: Equipment Maintenance	Time(hrs)	No. of fields	Days Per Week	Totals (Hrs)
Sharpen/Adjust Mower Blades	0.5	1	1	0.5
Oil changes/Fluids/Filters	0.5	1	0.5	0.25
Equipment repairs	0.5	1	0.5	0.25
Misc.	1	1	1	1.00
Sub-total				**2.00**
Core Standard 7: Projects/Line painting	Time(hrs)	No of fields	Days Per Week	Totals (Hrs)
Requirements Drag/Clay/Mound	0	1	1	0.00
Field Marking	3	1	1	7.50
Base Field Prep	0	0	0	0.00
Weed control/spraying	4	1	1	1.00
Tree maintenance, parking lot, blowing debris	0	1	1	0.00
Sub-total				**8.50**
Core Standard 8: Field Assessment and Amenities	Time(hrs)	Number of fields	Days Per Week	Totals (Hrs)
Field assessment	1	1	1	1.25
Field Rotation	1	1	1	1.00
Tennis, Playgrounds & Skateparks				0.00
Changerooms and bathrooms				0.00
Sub-total				2.25
Total per week (hours)				**27**

3.7 Operational Costs

3.7.3 | Artificial Turf Field Investment Return (Social, Economic, Environmental)

The rationale for determining whether an investment in artificial turf fields is warranted requires a number of different considerations to be taken into account. The following chart outlines a number of the Return on Investment (ROI) considerations related to increased artificial turf provision as observed in other urban municipalities. These considerations are often used a basis or rationale for developing new artificial surfaces or retrofitting existing natural grass fields to artificial turf.

Economic Benefits - Refer to Part A Section 1.5.1 for an overview of the economic benefits for Artificial Turf.

Visitation Characteristics & Potential Benefit - On average, domestic tourists (Alberta residents) spend $205 per person / per visit when they visit other communities in Alberta for tourism and related purposes.[29] Refer to Part A 1.5.3 Visitation Characteristics - Table 7 for more information.

Environmental - There is a water savings benefit for artificial turf fields, since they require minimal water. Consider that there could be a benefit to eliminating the riding mowers to cut the grass, which has a greenhouse gas benefit – the social cost of carbon in Canada is $45.10 per tonne.

Image Credit: Brett Ryan Studios

3.7 Operational Costs

3.7.4 | Opportunities for Investment in Maintenance Equipment

Artificial Turf Fields
The equipment list below reflects individual new replacement costs of equivalent equipment provided and utilized by current Artificial Turf maintenance providers.

Currently, the City uses a combination of owned equipment and fleet supplied (rented).

Table 3.23 – Equipment Replacement Costs of Artificial Turf (Capital Cost 2019)

Make	Model Description	New Cost	Supplier	Own by Municipalities
Redexim	Verti Brush	$12,000	Clark Supply & Service	X
Redexim	Verti Groom 2000	$8,000	Clark Supply & Service	X
Redexim	Verti Top 1800	$35,000	Clark Supply & Service	Specialized Equipment
Redexim	Eliminator	$50,000	Clark Supply & Service	Specialized Equipment
Jacobsen	Truckster/Topdresser	$55,000	Clark Supply & Service	X *
Turfco	CR-15 Bulk Spreader	$35,000	Clark Supply & Service	X*
Kubota Tractor	37 HP, turf rated, cab	$55,000	Tractorland Calgary	X*
Kubota Tractor	62 HP, turf rated, cab	$70,000	Tractorland Calgary	X*
Kubota Tractor	114 HP, turf rated, cab	$100,000	Tractorland Calgary	X*
Kubota Snow Blade	Turf modified	$10,000	Tractorland Calgary	Specialized Equipment
Kubota Snow Blower	Turf modified	$20,000	Tractorland Calgary	Specialized Equipment
	Misc. Equipment	$50,000		
	TOTAL	**$500,000**		

Notes:

- *'* This equipment does vary between municipalities, as the fleet operations may have varieties on each piece of equipment*
- *Specialized Equipment will be required staff to be trained to operate any specialized equipment. Specialized contractor typically owns and operate this equipment. These contractors typically specialize in installation and maintenance of artificial turf fields*
- *Artificial turf grooming equipment can be including in with capital cost of the installation of new artificial turf field and operational team would need to confirm if they have equipment that would be suitable to weekly or bi-weekly grooming maintenance of the field*
- *At the present time only three to four contractors in Canada with following equipment (Verti Top 1800 and Eliminator)*

3.7 Operational Costs

Natural Grass Fields
Specialized Turf Maintenance Expertise

The agronomic expertise required to manage irrigated & lit, irrigated & unlit sports fields includes a diploma in Turfgrass Management (Guelph University or Old's College). Where multi-field management is required, a 4-year degree in Turfgrass management is recommended. Additional credentials required includes pesticide applicator license, and applicable irrigation system training. Due to the high changeover of contracted staff, hiring a full-time staff member is recommended to be the field manager responsible to ensure:

- Contractors and suppliers perform quality duties
- Quality control regarding equipment maintenance
- Quality control regarding Sand/topdressing & quality
- Quality control in mowing and fertilization
- On-site management of irrigation systems
- Assurance that all drainage systems operating efficiently
- Maximize playability and safety through compaction management

Specialized Equipment will approach $133,000 for new acquisition. Pricing does not include GST or Delivery or any associated attachments associated with the equipment. Pricing was obtained in 2019. Average life expectancy of these units as a benchmark is close to 5,000 hours. Wherever possible, it is recommended that units may be shared among facilities, rotating their mowing days. Straight line depreciation is not to exceed 10 years, or the life expectancy hours indicated below.

Table 3.24 – Natural Grass Specialized Equipment – (Capital Costs 2019)

Make	Model Description	New Cost	Supplier	Life Expectancy	Own by Municipalities
Toro	Rotary Mower Groundmaster 3500-D	$35,000	Oak Creek Golf and Turf	5,000 hours	X*
Toro	Reel Master 5410	$54,000	Oak Creek Golf and Turf	8,000 Hours	X*
Toro	Multi-Pro Sprayer 1200	$12,000	Oak Creek Golf and Turf	10 years	X*
Toro	Workman HDX-D	$14,000	Oak Creek Golf and Turf	10 years	X*
Toro	Top Dresser 3300-D	$8,000	Oak Creek Golf and Turf	10 years	X*
Toro	ProCore 648	$10,000	Oak Creek Golf and Turf	10 years	X*
	TOTAL	**$133,000**			

** This equipment does vary between municipalities, as the fleet operations may have varieties on each piece of equipment*

PART D

SPECIAL CONSIDERATIONS FOR ARTIFICIAL TURF

Image Credit: Brett Ryan Studios

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4.0 SPECIAL CONSIDERATIONS FOR ARTIFICIAL TURF

Image Credit: Torontofoodtrucks.ca

4.0 SPECIAL CONSIDERATIONS FOR ARTIFICIAL TURF

4.1 Introduction and Overview

4.1.1 | Introduction

This section summarizes the key considerations and best practices in the development of athletic parks that are unique to artificial turf fields. Factors common to natural grass fields, or regarding athletic park development in general have been included within other sections of this report and are therefore not repeated here.

It should be recognized that technology surrounding artificial turf is continually evolving, as manufacturers seek to better respond to user group, regulatory and owner/operator requirements. Accordingly, the information contained herein is based on current technology and industry standards, which are anticipated to change in the future. A review of the recommendations and best practices should be completed periodically, and at a minimum prior to implementation.

4.1.2 | Overview

The section contains the following information:

- Overview of special considerations for artificial turf field development (e.g. initial construction)
- Summary of the different types of artificial turf systems and their suitability for different sports and uses
- Options for field access control
- Overview of emerging trends
- Considerations impacting the lifespan of artificial turf surfaces including maintenance, intensity of use and types of uses (e.g. open vs. restricted access, events, etc.)
- Identification of strategies to optimize lifespan
- Overview of special considerations for end of life surface removal and replacement
- Overview of warranty types and warranty considerations

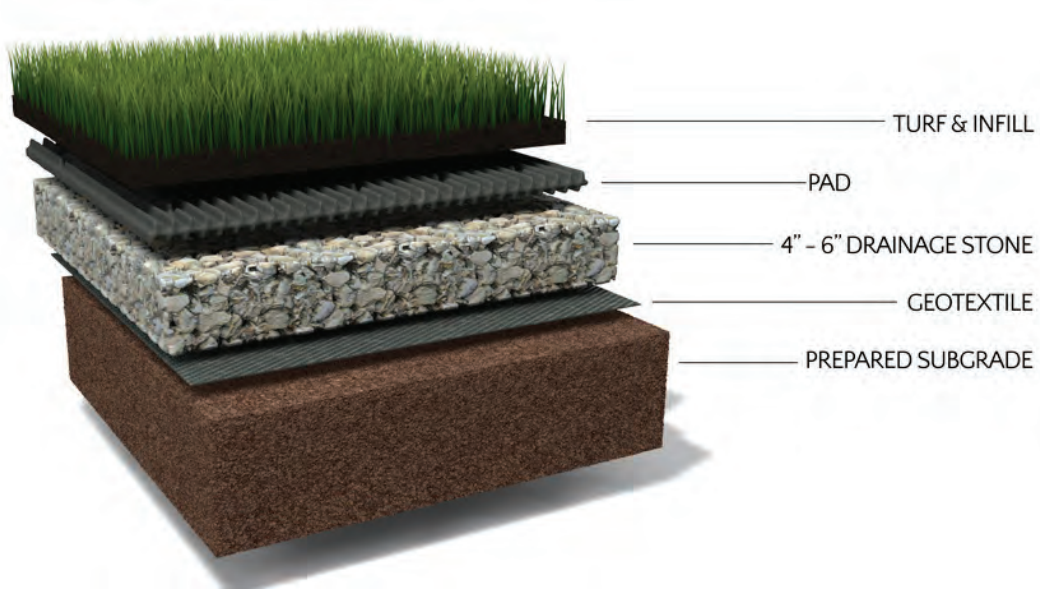


Image Credit: ArtificialGrassCork.ie

4.2 Development Considerations - Impact Mitigation

4.2.1 | Site Planning - Impact Mitigation

The use of artificial turf as a field surfacing material provides substantially increased utilization as it is not subject to the same wear and tear as natural grass – it could theoretically be played on 24 hours a day. While actual utilization does not approach that intensity for practical reasons, it is not uncommon for an artificial field in a popular, high use athletic park, to realize about 3 times the intensity of use compared to natural grass.

Furthermore, virtually all artificial fields are lit, meaning noise and traffic impacts typically extend into the evening hours, until 10 or 11 pm, up to seven days per week. Furthermore, artificial fields are often lit to a higher level of illumination than their natural grass counterparts. This understandably can place an undue burden on any residents immediately adjacent to the facility. From an operational and site development perspective, while highly beneficial for sport and utilization of field inventory, this high intensity of use presents several challenges. Part B Section 2.10.2 discusses the recommended road classifications that an artificial turf field would be suitable beside.

Field use is typically 'back to back', not only for occasional key events, but on a regular basis. This means that additional noise and traffic must be mitigated. It is therefore important that special consideration be given to the noise and traffic mitigation strategies indicated herein and elsewhere in this report for athletic parks in general.

While high level natural grass athletic parks often experience occasional intensity of use (for example, during a large tournament), due to the need to rest natural grass and limitations on sod wear, these high demand occurrences tend to be only a few per year. As a result, noise and traffic impacts tend to be generally tolerated by the facility and surrounding neighbourhood because they occur infrequently.

Image Credit: Brett Ryan Studios.

4.3 Site Planning – Winter Weather and Opportunities for Indoor Use

Artificial turf fields can used throughout the winter if they are surrounded by a structure. Since artificial turf does not rely on sunlight or watering, it won't be negatively impacted by the surrounding structure. Within Calgary there are currently both publicly and privately operated indoor artificial turf sports fields. Should the City decide to extend the use of artificial turf fields during the winter season, there are a few common options for providing indoor, covered and heated facilities (permanent or temporary) which include a pre-engineered rigid structure or air supported structure. Both pre-engineered steel and sprung structures are typically designed with up to a 25-year design life, however, this varies based on the design and manufacturer.

4.3.1 | Pre-Engineered Steel Structures

A pre-engineered steel building is a viable option for full size artificial turf fields, since some of these structures can span up to 90 m across, subject to local regional conditions (building code, climate, etc.). A pre-engineered building is less expensive than a conventional structure, but more expensive than a sprung or air supported structure.

Pre-engineered rigid structures are built to be year-round indoor facilities. Decision making criteria should consider aesthetics, impacts to neighbours, and City requirements (e.g. Sustainable Building Policy).

Image Credit: Coastal Steel Structures Website

4.3 Site Planning – Winter Weather and Opportunities for Indoor Use

4.3.2 | Pre-Engineered Sprung Structures


Image Credit: Sprung Structures Website

A fabric covered steel frame (e.g. sprung) structure is another indoor option, however, the span of these buildings is generally limited to approximately 60 m in width. These buildings are generally less expensive than a pre-engineered building.

4.3.3 | Air Inflated / Supported Structures


Image Credit: Farley Group Website

An air inflated or supported structure does not have a rigid frame and is instead inflated using either combination of electrical or natural gas-powered generator to pressurize air to inflate the structure. The fabric membrane is attached to a perimeter grade beam (e.g. foundation). Access is typically carefully controlled through pedestrian and vehicle airlocks to minimize pressure loss. These buildings are the least expensive indoor option for capital costs. Due to the nature of their construction, they can be seasonal (e.g. taken up and down).

Important considerations include the decreased life expectancy of the structure by inflating and deflating each year and the additional costs incurred for storage when not in use.

4.3 Site Planning – Winter Weather and Opportunities for Indoor Use

Additional Considerations of Air Inflated Structures include:

- These buildings are generally less than 76m in width
- Code requirements are typically the same as for pre-engineered buildings with respect to fire access, and life safety requirements/provisions
- Potential limitations of the structures are that a supporting building would need to be nearby for washrooms, change rooms, and kitchen/concession facilities
- Vandalism to the fabric membrane is a risk, and the structure should be secure during non-operating hours
- Air inflation, back-up generators and mechanical equipment may require noise mitigation measures
- Standard exterior design configurations (e.g. bubble/dome) are often not welcomed in high visibility urban areas. Special consideration regarding location within a community should be considered
- Proximity to other buildings and vegetation (especially trees) is a consideration for fire hazard and windfall
- A potential benefit of the air supported structure would be the ability to take the membrane down after winter ends, and re-erect the following winter. Considerations to the cost, wear and tear on the membrane and storage should be made
- Air Supported Structures have additional costs which include: take down/set up, down time and potential impact to indoor and outdoor playing seasons. Perimeter pathways need to be installed to allow snow clearing around the air supported structure. Snow clearing of parking lots and rental costs for dome storage should also be considered

Image Credit: Sprung Structures Website

4.3 Site Planning – Winter Weather and Opportunities for Indoor Use

4.3.4 | Covered Fields - Other Considerations

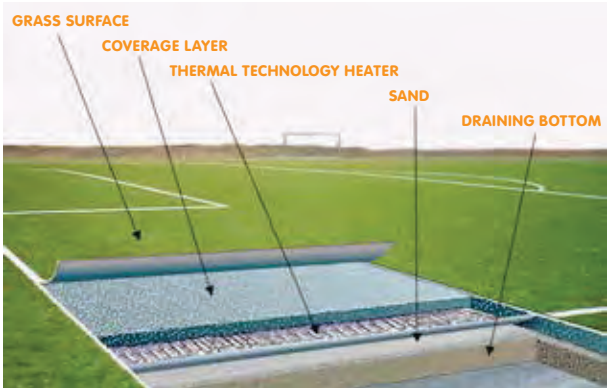
For any of the indoor artificial turf field options described in Section 4.3, development planning considerations should include:

- Infrastructure Requirements – Access to Phase III power, storm, sanitary, water and natural gas
- Spatial Requirements:
  - Typical 3 m access around air supported structure for snow clearing
  - Minimum interior area required assuming a full-size soccer field is 10,800 square meters
  - Additional land area requirements include parking, area zoning setbacks and any associated buildings

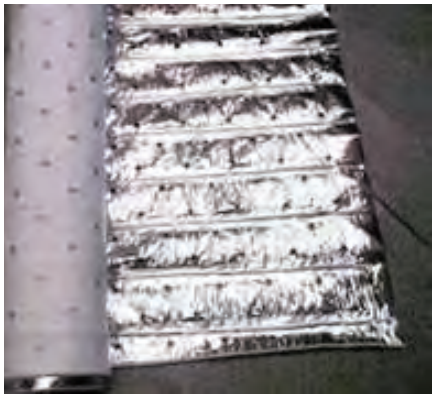
4.3.5 | Sub-Surface Heating - Snow and Ice Melt

Subsurface heating technologies are available and can provide heating to extend artificial turf field use into shoulder seasons (March, April, October, November). These systems are typically designed with heating coils directly under the shock pad, which are activated to melt snow and ice. Such systems have been installed at a very few high-profile university and professional fields in the United States and Europe.

There are no known examples of using heated systems for recreational fields in climates similar to Calgary. Such a system is impractical for recreational fields on a cost and energy use basis.



STRATIGRAPHY OF A HEATED FIELD



ROLLED HEATER

Images: Carbon Fiber Heating SRL Website (https://www.thermaltt.com/en/heating-system-for-surface)

4.4 Technical Considerations

Development of an artificial turf field presents several technical requirements that should be considered during planning and development. These items are in addition to the general technical considerations listed elsewhere in this report for athletic parks in general.

4.4.1 | Overview

Artificial turf fields are a high value City asset and they are considerably more expensive than natural grass. They are expected to remain in use and serviceable for an extended period into the late fall and early spring. As such they experience the following additional pressures:

- Snow removal (plowing) is periodically performed, resulting in more wear and tear on the fibres and infill migration. Subsequent snow melt dispatches collected fibre and infill (e.g. microplastics) into the surrounding areas
- Fields are heavily booked, therefore closures for unplanned seam, inlaid line or base repairs are not well received by users. Base construction must therefore remain stable and level over the long term (at a minimum 15 years)
- Surface planarity (flatness) and base stability requirements are very high, and repairs to planarity are difficult and expensive to carry out. As such, very careful attention to the geotechnical aspects of investigation, design and construction are required
- Damage arising from surface or subsurface (surcharging) flooding can be substantial and expensive to repair. Fields are designed to drain primarily vertically rather than via overland runoff. Stormwater management is therefore essential
- Synthetic turf can be damaged by unauthorized access from motor vehicles, fire and vandalism. Securing the site from vehicle access is essential, either through perimeter barriers, fencing or physical obstructions (trees, landscaping pathway bollards, boulders, etc.)

Image Credit: iStock Photo

4.4 Technical Considerations

4.4.2 | Geotechnical Investigation

A subsurface geotechnical investigation should be conducted with a grid-style onsite drilling program to determine the nature of underlying soils and their suitability for artificial turf. Organic, compressible, frost susceptible, loose and/or other unsuitable material (as determined by a qualified geotechnical engineer), should be removed and replaced with good quality clean structural fill, typically imported backfill, followed by the geotechnical engineer's review of the infill material with associated testing.

Unknown geotechnical conditions represent a potential significant risk to the project, and in some cases such risks have been cost prohibitive or project ending.

Once the site is stripped of unsuitable material, it should be constructed with free draining gravels to allow for collection of subsurface drainage (either runoff through the turf itself or lateral flow from adjacent soils) and discharge into a piped storm water system.

4.4.3 | Non-Uniform Fill Sites

Non-uniform fill sites are common in the Calgary region and are likely to have organic fill, dry land fill, unknown fill materials, or a combination from borrow pits. The variability of the underlying fills and their different rates of compression and decomposition will result in differential settlement. Differential settlement is the primary concern when constructing an artificial turf field. However, while total or uniform settlement of the whole play surface is also an issue, in transition areas it is generally not as much of a concern, and can be mitigated.

Differential settlement, which manifests as 'hills and valleys' across the surface, can result in potential hazards for players, reduced playability and function, and ultimately requiring costly repairs. A variety of problems can emerge:

- Subsurface drainage lines can break due to abrupt changes in grade. Water flow can slow or cease to drain due to grade changes over a longer distance decreasing pipe slopes to become flat or even reverse direction of flow
- Fence panels can tilt, sink, and/or heave
- Field lighting poles can tilt, sink, and/or heave
- Electrical conduits can break due to abrupt changes in grade
- Water lines can break due to abrupt changes in grade
- Concrete edge anchor curbs, pathways, and concrete pads can crack, sink, and/or heave
- Reflective dips and valleys on the artificial turf surfacing (and underlying permeable aggregates) will impact ball roll, ball bounce, footing, and player safety
- Sinkholes can develop (especially over perforated drainage lines) causing large cavities under the turf and potential hazards and maintenance issues
- Asphalt pathways and pads can crack, sink, and/or heave. As asphalt is flexible, it can tolerate some differential settlement before surface damage become major issues

4.4 Technical Considerations

Standard artificial field construction methods should inform the design approach to any artificial turf field. This includes perforated drainage pipes, high mast field lighting, concrete edge anchor, and an initial geotechnical investigation to confirm the site conditions and presence or absence of non-uniform fill. The design tolerances for settlement will vary accordingly:

- For construction at a site with little to no anticipated soil stability concerns, use a design maximum of 10 mm of differential settlement over 3 m over a 10-year period. This tolerance is consistent with the construction planarity requirements for an ideal artificial field
- At sites where ground conditions are not ideal or suitable for an artificial turf field, expect to apply a design maximum of 25 mm of differential settlement over 3 m over a 10-year period. While less than ideal, tolerance could be accommodated assuming a higher level field hockey pitch is not being constructed. When the artificial turf is removed and replaced in about 10 years' time, additional efforts can be made to level the base by removing the shock pad and re-grading the aggregate prior to the new turf being installed
- Sites with poor soils and a design maximum of 150 mm of differential settlement over 3 m over a 10-year period is not acceptable for artificial turf, but can be utilized for natural grass fields. Where feasible, poor soil should be remediated

Note that as the risk of settlement increases so do the anticipated capital costs to address and mitigate unsuitable conditions for artificial turf field development.

Image Credit: Monica Vogt

4.4 Technical Considerations

4.4.4 | Stormwater Management

Image Credit: Reyza Shayestapur, Unsplash

Artificial turf fields are subject to unique stormwater management requirements. Unlike natural grass fields which when exposed to flooding can simply be rested and allowed to 'dry out', artificial fields can, under certain circumstances, sustain significant damage from flooding.

Locating synthetic fields in major flood plains should be avoided to minimize potentially costly repairs to the surface and shock pad, as both are buoyant when subjected to upward hydraulic pressure. Furthermore, the drainage system, including the permeable gravel layer and perforated storm system should be designed to withstand a minimum 1 in 10-year storm without surcharging. For storms in excess of a 1 in 10-year return period, surcharged water collecting on the field surface should be directed away from the artificial turf. This can be achieved by incorporating a minor crown on the field (about 0.5%), and by sloping all adjacent surfaces (pathways, concrete pads, grass areas, etc.).

A robust drainage collection system should be installed around the field to ensure that drainage, including snow melt is collected. and discharged into a drainage system.

4.4.5 | Snow Removal and Ice Management

Image Credit: Sports Turf Canada

When specialized equipment is available, artificial fields may be plowed in Alberta to remove snow during the shoulder seasons to allow for increased early and later season use. Care should always be taken to minimize damage to the turf fibres when carrying out snow removal. There is increased risk in the early season as portions of the turf and infill may be frozen, causing the fibres to be trapped within ice and risk being ripped off by the plow.

With respect to snow plowed from the artificial turf, it is recommended that all snow storage/melt areas be directed to a series of suitably sized and positioned sumps so that synthetic grass fibres and infill collected with snow can be trapped and later collected for proper disposal. This material should not be permitted to be disposed of in the offsite drainage system or in water courses. For more information, refer to Part E - 5.4.3 Procedures for Snow and Ice Removal, and Part B for examples of field layouts which contain snow storage areas in their design.

Image Credit: Monica Vogt

4.5 Field Access Controls

4.5.1 | Access Controls

Unintended damage to artificial turf not due to natural forces typically arises from unauthorized access from motor vehicles, improper unauthorized use and vandalism. These forms of damage can be avoided or greatly minimized by constructing access controls.

The majority of artificial fields are secured from unauthorized access, either with a fence immediately around the field, or in the case of a field within a running track, a fence around the stadium or track. Occasionally a field will be only secured with a site perimeter barrier (typically a site fence or landscape screen).

4.5.2 | Vandalism Controls

Vandalism can rarely be prevented through field fencing. A determined vandal can climb over or cut through a fence. Prevention of vandalism can be better minimized through strategic site design principals such as lighting, programming and maximizing visibility of the field from the surrounding area. Locating artificial turf fields in high visibility urban areas, including at community hubs, rather than isolated industrial or remote locations, also provides a significant deterrent.

Other measures can include avoiding solid 'kick walls' (which blocks the view of the field), keeping player shelters and bleacher areas open to lines of sight, and avoiding locating artificial fields in heavily screened or hidden areas of the site. Crime Prevention Through Environmental Design is a multi-disciplinary approach of crime prevention and it is recommended to consider the organization's resources and guidelines.

4.5.3 | Motor Vehicle Controls

For fields without perimeter fencing directly around the sports field, preventing motor vehicle access can be relatively easily accomplished without impacting public access to the field. This can be achieved by constructing a vehicle-proof physical barrier around the site, and at all entrances off of internal roads and parking areas. Examples include bollards, baffles and offset locked gates, treed buffers, perimeter fencing, boulders, etc.

Restriction of motorcycles can be more difficult and will require a detailed review of narrower access points. Additional use of solid barriers (e.g. fencing) and more closely positioned baffles will be required.

4.5 Field Access Controls

4.5.4 | Public and Unprogrammed Access Controls

For artificial fields where access is to be restricted to booked user groups only, the most effective means of access restriction is through implementation of the following measures:

- Robust field bookings. If fields are booked and used frequently there will be reduced opportunity for unauthorized access
- Installation of complete perimeter fencing with self-closing, lockable gates at all field access points. Note that the locking and unlocking of gates can be cumbersome and is typically performed by operations staff. Lower fencing (1.2 m) is recommended along sidelines and higher fencing/ball control fencing (4.0 m to 6.0 m) along the end lines. These may vary depending on the position of the field. Higher fences may be required if the field is close to roadways, or main site pathways, or if enhanced ball control is needed at sidelines, such as for mini soccer. Chain link fabric should be installed on the play field side of vertical posts, as the fence experiences most impacts from that side
- Clear signage outlining field use protocols (e.g. 'Booked User Groups Only', 'No Un-booked Access') should be posted at all gates and entrances to the field
- Lights are turned off when the field is not formally booked. Lights should be programed to align with bookings, however a cellular system to control lighting should also be considered in case of cancellations or inclement weather
- Clear signage describing prohibited activities (e.g. no motorized vehicles, golf, javelin, smoking, pets, etc.)

Image Credit: Monica Vogt

4.6 Field Access - Open Public Use

In some municipalities, such as Toronto, there is a trend towards allowing more open, unscheduled access to artificial fields. This approach allows for greater use by the community and fits with increasing societal demand for spontaneous or unstructured recreation and national initiatives such as Sport for Life. Residents are increasingly demanding spaces that can support these activities. There is ample research that supports the community value of providing high quality and accessible spaces for 'pick-up' games.

The City could consider increasing open public access to artificial fields in a controlled manner. The following are strategies that could minimize risk of damage to the turf, while facilitating reasonable public access:

- Locate the artificial field on or adjacent to an active community park or joint use site (e.g. high school, universities, high density multi-family areas) where there is easy and frequent access to the field by a relatively large population. This would positively benefit downtown park sites where access to green space is limited or in in active urban areas where there is high usage of the green space
- Consider open access for a reduced size 'mini-field'. The field should be ideally large enough to accommodate mini-soccer (about 1/3 size of full size field), so the field could also be utilized as a booked practice field should not enough interest in public open use be generated. Consideration can also be made to program a full size field into several small sized playing areas
- The artificial turf surfacing for an open access field should be a non-infill turf product, or alternatively a slit film turf system. While these products are less desirable for field sports, they are harder wearing and maintenance of infill is minimized (or eliminated). Special footwear is also less important
- Communicate with site visitors the rules surrounding use of the surface, including the periods of open use
- Restrict user groups during public open use periods (e.g. 'no sports teams')
- Provide a mechanism for public feedback and adjust where required. For example, it may be appropriate to allow for some lunch hour or after work bookings, such as for informal games, if field conflicts are regularly occurring during these periods
- Clearly post prohibited activities at entrances to the field (e.g. no bikes, metal cleats, motorized vehicles, golf, javelin, smoking, pets, etc.)
- Consider partial fencing to define the space and for ball control

4.7 Field Access - Special Events and Uses

Artificial turf surfaces could be used for festivals and community events, however, with a few exceptions, the artificial surfaces must be covered with a protection cover. Protection covers can be purchased or rented. The purchase costs can be significant (in excess of $1.2 M), and if being purchased, the materials must be stored.

The types of events that can be accommodated on a properly protected synthetic field include virtually any event that would be considered for a grass field. However, due to the high cost of protection covers, an event on a grass field would typically incorporate a cover on the high wear areas (e.g. in front of the stage, main entrances and pedestrian routes).

With a synthetic field, the entire field should be covered in order to protect the surface from damage from tent poles, chairs, smoking, food, spectator seating, etc. For these reasons, and due to cover costs, unless the field is located in a key venue, or alternatively unless access can be limited to a portion of the field, a synthetic field may not be a practical choice to host a special event.

Parking and driving of public vehicles on the artificial turf should not be permitted, even with a cover.

Image Credit: Omni Deck

4.8 Artificial Turf Systems

4.8.1 | Turf Systems

The major types of artificial turf systems for outdoor field sports can be categorized as follows:

Infilled Artificial Turf for Multi-Use Fields
This is a synthetic grass with typically 45 and 60 mm high fibre containing infill material. The turf is underlaid by a shock pad. This turf is typically designed to meet FIFA Quality standards. It is suitable for soccer, football, field lacrosse, recreational field hockey and various other recreational uses.

Artificial Turf for Field Hockey
This is a synthetic grass with a typically 15 mm high fibre without any infill, and is underlaid by an elastic layer pad. A porous asphalt base is typically constructed under the elastic layer. A high capacity wet-down irrigation system is also required to lubricate the turf and to satisfy Federation Internationale Hockey (FIH) requirements. This turf system is designed for high level field hockey, or for fields purpose built for field hockey training and games. The turf requires special footwear (turf cleats) and is not a desirable surface for soccer and other field sports. These fields are approximately 50% more expensive that a multi-use infill turf field.

Infilled Artificial Turf for Baseball
This is a synthetic grass with a typically 25 mm high fibre containing either no infill material or 100% sand infill. The turf is underlaid by a thin shock pad. This type of turf is specifically designed for baseball and softball use.

4.8.1 | Turf Infill Materials

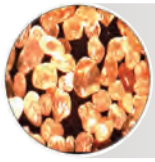
Infill Products
There are a variety of different infill materials available for use in artificial turf fields. These range from crumb rubber (ground tires), various organic materials (cork, coconut, walnut shells, etc.), silica sands, acrylic coated sands, thermoplastic elastomer (TPE), EPDM, ground zeolite, and other products.

Infill products other than crumb rubber will be significantly more expensive (about an additional $150,000 per field). Use of TPE and EPDM can provide an infill experience equivalent or superior to crumb rubber and are considered to be equivalent for performance. Use of other infill products including organic materials, sand and coated sands should be evaluated to ensure compatibility with climatic conditions (extended periods of freezing weather, dry summers, etc.) as well as performance for sport.

Recycled Rubber
Made from recycled car and/ or truck tires

Organics
Made from walnut shells, cork, coconut husks and olive cores

Virgin Rubber
Made from virgin polymers (e.g. Ethylene Propylene Diene Rubber (EPDM) Thermoplastic elastomer (TPE)



Mineral
Made up of non-coated or coated round sand granules

4.8 Artificial Turf Systems

Crumb Rubber Health Safety Considerations

For infill turf products, the vast majority of fields incorporate crumb rubber from recycling passenger vehicle and truck tires, which performs well for the majority of sports and is readily available. In addition, use of crumb rubber diverts substantial waste from our landfills making it a highly sustainable option. It is also the lowest cost option for synthetic turf infill, by a significant margin. While this product has been safely used for over 20 years in artificial turf, in 2014 human health safety concerns were raised regarding the use of crumb rubber in sports fields. However, it is still widely used.

It can be difficult for decision makers and professionals alike to navigate the very large number of studies. Most of these studies have not been peer reviewed, and make claims based on standards that are not adopted by the scientific community. As a result, we are basing our overview summary based on the current peer reviewed studies and findings conducted by government bodies including public health and environmental agencies, or alternatively, studies that have been accepted by government bodies.

To our knowledge, no peer-reviewed clinical studies have linked the use of crumb rubber infill (CRI) in recreation products to an increased risk of cancer in humans. Several limited studies have been conducted that are largely consistent in their conclusions regarding the low potential for chemical exposure causing human health impacts from CRI in synthetic turf fields. However, due to study limitations, some uncertainty remains. In response to public concern from this uncertainty in the United States, the US Environmental Protection Agency (EPA) is leading a study involving research/white paper review and CRI toxicity testing on 40 fields.

Other US agencies partnering with the EPA include the Center for Disease Control and Prevention's National Center for Environmental Health/Agency for Toxic Substances and Disease Registry (CDC-NCEH/ATSDR), and the US Consumer Product Safety Commission (CPSC).

To date, the EPA and their partners have released "Part 1 Report on Tire Crumb Rubber Characterization (July 2019)" summarizing their research. The report stated:

- In general, and not unexpected, the study found a range of chemicals (metals and organic compounds), and all fields tested positive for bacteria
- Chemical concentrations are generally similar to those found in other studies where these exist
- Bacteria were found at levels similar to those previously reported on common household products
- While a range of chemicals are present, air emissions of most organic chemicals, and bioaccessibility of metals are low
- Human exposure to the chemicals in the tire crumb rubber appears to be limited based on what is released into air or simulated biological fluids

4.8 Artificial Turf Systems

The final phase (Part 2) of the EPA's research has not yet been completed. Part 2 will include potential human exposures to the chemicals found in the tire crumb rubber and will be released along with results from a biomonitoring study being conducted by CDC to investigate potential exposure to crumb rubber.
The European Chemicals Agency (European Union Agency), evaluated the risk of synthetic turf on human health. The following are excerpts of their published findings (2017):

Based on the information available, ECHA concludes that there is, at most, a very low level of concern from exposure to recycled rubber granules:

- The concern for lifetime cancer risk is very low given the concentrations of PAHs typically measured in European sports grounds
- The concern from metals is negligible given that the data indicated that the levels are below the limits allowed in the current toys legislation
- No concerns were identified from the concentrations of phthalates, benzothiazole and methyl isobutyl ketone as these are below the concentrations that would lead to health problems
- It has been reported that volatile organic compounds emitted from rubber granules in indoor halls might cause irritation to the eyes and skin

With regards to the European Union's recommendation for crumb rubber testing, it is recommended to conduct heavy metal testing of existing or new crumb rubber infill. The test protocol currently recommended is EN 71-3 (used throughout Europe), which measures the levels of heavy metals found in crumb rubber and compares the levels to maximum limit standards for children's toys. All fields constructed should include CRI testing under EN 71-3.

Image Credit: iStock Photo

Image Credit: iStock Photo

4.9 Artificial Turf Lifespan

4.9.1 | Overview

A properly constructed, operated and maintained artificial turf field utilizing a current municipal-quality turf system should provide a service life of approximately 9 years to 12 years. The following factors can influence lifespan:

- Quality of installation
- Type of turf system
- Type and intensity of use (non standard uses aren't always permitted or covered by the warranty)
- Maintenance practices
- Climatic conditions
- Owner and user tolerance for ongoing repair
- Desire for new turf system

The following factors can influence lifespan, either positively or negatively.

4.9.2 | Positive Influences to Increase Lifespan

The following factors can positively influence lifespan:

- Regular Maintenance – completion of regular maintenance including sweeping, brushing, grooming is required to keep the field in good condition for sports use. Infill should be checked annually and topped up as required. Note that lack of proper maintenance will result in the warranty not being honoured by the manufacturer in the event of a warranty claim. There is no evidence that increased maintenance over and above the manufacturer's recommendation will extend the life of the field. In some cases over-grooming can adversely impact the lifespan of the surface
- Regular Inspection – the field should be inspected weekly during the regular season for damage to inlaid lines and any seam failures. A detailed inspection should be completed prior to the start of the regular season. The detailed inspection should include lines, seams, obvious planarity issues, and a measurement of infill depth. Repairs should be expected and they should be completed promptly
- Turf System Selection – some kinds of synthetic turf are harder wearing than others. Minimum requirements reflecting FIFA Quality standards will ensure a longer lasting turf. Selection of turf systems than exceed FIFA Quality with regard to wear and durability can also extend fibre life

A properly constructed, well maintained field with seam and line failure repairs carried out as discovered should last on the upper end of the 9 to 12 year range.

4.9 Artificial Turf Lifespan

4.9.3 | Negative Influences

The following factors can negatively influence lifespan:

- High Intensity Use – while artificial turf surfaces are designed for high, intense use, excessive use will have an impact on wear and overall longevity. For example, a sports field on a combined school park site (where the field is used during the day by the students and evenings/weekends by sports groups) would experience double the use of a typical field. Such combined use fields are commonly replaced at the lower end of the 9 to 12 year range. Some such fields are replaced at the end of the warranty period (e.g. 8 years)
- High Impact Use – fields with regular football and/or rugby use experience more stress on seams due to tackles and practices. In addition, football fields tend to contain a very high number of inlaid lines and markings/numbers. Any inlaid line is subject to failure and repeated repairs shorten the life of the field
- Poor Quality Installation – in spite of selecting a high-quality artificial turf, if the turf installation is done poorly, the lifespan will be negatively impacted. Signs of poor installation include inlaid lines becoming unglued and seam failures. These defects may not present for several years after initial installation
- Poor Maintenance Standards – over-grooming or too little maintenance can reduce the lifespan of the artificial turf and cause premature wear on the field. Lack of maintenance, and lack of documenting the actual maintenance practices also cause issues for any future warranty claims due to failure of the fiber, infill or poor G-Max ratings
- High exposure to UV light – artificial turf breaks down due to UV. Areas with high UV (such as the southern United States) experience higher fibre degradation and a shorter lifespan, compared to areas with lower UV levels (such as Canada). Furthermore, very cold winter weather appears to have a protective effect, however, this is thought to be related to field closure and lower annual use
- Freeze/Thaw cycles – there is some evidence that the number of freeze/thaw cycles experienced throughout the year can have an impact on the integrity of the artificial turf system. There have been several artificial fields in the northern United States where turf seams were split due to freezing conditions. None of these damaged fields experienced Chinooks; however, the mechanism of seam failure would be a solidly frozen field thawed during the day and refrozen at night. While the common cause of failure is under dispute, most of the fields were reported to be slow draining. In Calgary, a field built with a slow draining gravel base, inadequate drainage system or with frost susceptible subgrade, would be at high risk of damage arising from Chinooks

Fields that are subject to numerous negative influences typically are replaced at the end of their warranty period. This can vary, however, based on funding, and owner tolerance for ongoing repair work. In some cases, fields are replaced before they reach the end of their service life due to a desire for a new turf system.

Image Credit: Sports Turf Canada

4.10 Turf Replacement Considerations

Turf surfaces have a defined lifespan and will require replacement in about 9 to 12 years. End of life considerations for removal and replacement include:

Replacement Triggers
Artificial turf fibers wear slowly over time and the fiber will flatten impacting ball roll and playability. In addition, infill can migrate and compact causing G-Max (field hardness) to increase. Seams and inlaid lines separate requiring frequent repairs. Triggers for replacement include repair costs/down time, user satisfaction, safety and fiber wear.

Replacement Planning and Funding
The process of turf replacement should be anticipated and planned for several years in advance. Funding for a new turf surface should be planned and budgeted for when the original field is constructed. The field will typically be closed for about 3 to 4 months to facilitate removal, any base repair and replacement of the new surface. User group bookings will need to be accommodated elsewhere throughout the replacement construction period. Removal and replacement should be done in ideal weather conditions, commonly between May 15 and September 15.

Recycling and Disposal
Currently, limited opportunities are available for recycling of the removed artificial turf carpet and therefore the majority of removed turf is disposed of in a waste landfill. There are no recycling facilities in North America for artificial turf. While limited in scope, other possibilities may include re-use for non-sport applications (ground cover for equestrian areas, driving ranges, etc.). If the turf surface is proposed for reuse, assurance that the material will be responsibly disposed of in the future should be obtained by the City.

Recycling of crumb rubber infill is increasing and is now commonly reused as infill in the new field system.

LEED Credits for Artificial Turf
Leadership in Energy and Environmental Design (LEED) credits can be claimed by using artificial turf in projects. Areas for credits include water efficiency, materials and resources and sustainable sites.

4.11 Turf Warranty

Turf warranty conditions are an important but often overlooked component of a project. The owner (buyer) has an advantage at the time the project is tendered to stipulate the terms of the warranty as part of the project specifications for the synthetic turf. The Warranty terms and conditions, assuming they are reasonable and not beyond industry standards, will typically be agreed to by all tenderers. This allows the City to compare tenders with the understanding that all warranty terms are equivalent.

We recommend the warranty requirements include the following as a minimum:

- Warranty term - the industry standard warranty is 8 years
- List of all intended and permitted uses, both sports uses and any intended non-sport uses.
- The warranty should be co-signed by the turf manufacturer and the company (often a supplier or installer) entering into a contract with the City (if these are different entities). This is to protect the City if either party fails to honour the warranty or if one of the companies is no longer operating
- A list of criteria that the turf system is to meet (e.g. G-Max, fibre wear, mildew resistance, seam/inlaid line integrity, etc.) over the life of the warranty
- Confirmation that the warranty is not pro-rated, and that full replacement/repair is required up to the full term of the warranty
- A description of how warranty defects are to be determined, measured and repaired
- A description of the owners' obligation for maintenance, inspection and notification of required warranty defects/repair
- The location (Province) where disputes are to be settled

At this time we do not recommend warranty insurance as provided by the turf manufacturer. The terms of the insurance have been reviewed by some municipalities and deemed not of benefit. This should be reviewed by the City at the time any such insurance is offered.

Image Credit: Brett Ryan Studios

4.12 Part D Key Recommendations and Takeaways

Recommendations and key takeaways from Part D – Special Considerations for Artificial Turf include the following:

1. Artificial turf technology is continually evolving, as manufacturers seek to better respond to user group, regulatory and owner/operator requirements. Accordingly, a review of best practices and specifications should be completed periodically, and at a minimum prior to implementation. This review should be completed by a firm or individual highly experienced with artificial turf.

2. The high intensity of artificial turf use presents impact challenges due to increased traffic, noise and lighting. Impact mitigation strategies included in Part A – Planning should be considered.

3. Artificial turf presents an opportunity for indoor use. Pre-engineered steel and air supported structures are currently the most common field covers as they are much lower cost than a standard structure. Additionally, some Municipalities are converting under-utilized hockey areas to indoor artificial turf fields.

4. Unique geotechnical technical considerations for artificial turf include:

   - For sites with little to no anticipated soil stability concerns, apply a design maximum of 10 mm of differential settlement over 3 m over a 10-year period. This tolerance is consistent with the construction planarity requirements for an ideal artificial field
   - At sites where ground conditions are not ideal or suitable for an artificial turf field, apply a design maximum of 25 mm of differential settlement over 3 m over a 10-year period. While less than ideal, when the artificial turf is removed and replaced in about 10 years' time, additional efforts can be made to level the base by removing the shock pad and re-grading the aggregate prior to the new turf being installed. Sites that can not be practically or cost effectively constructed to the 25 mm standard are not considered suitable for artificial turf, but can be utilized for natural grass fields

5. Artificial fields should not be located in major flood zones or flood plains.

6. Snow removal should include snow storage and removal areas and sumps for collecting melting snow and broken turf fibres/infill.

7. Artificial turf should be protected from unauthorized vehicles including motorcycles. The majority of artificial fields are secured from unauthorized access, either with a fence immediately around the field, or in the case of a field within a running track, a fence around the stadium or track. Special non-sporting events will require a protective cover.

8. For maintenance, debris management, access and ball control purposes, a fence should be installed around the playing surface. Access gates may be locked or unlocked (or baffles can be used) depending on whether the field is to be for open or closed access.

4.12 Part D Key Recommendations and Takeaways

9. Signage outlining the field use, restrictions and recommended footwear should be provided at all access points.

10. Synthetic turf systems can be sport-specific. For example field hockey and baseball require different turf systems than soccer and football.

11. Turf replacement will be required about every 10 years. Plan for end of life disposal and budgeting for turf replacement.

PART E

MAINTENANCE

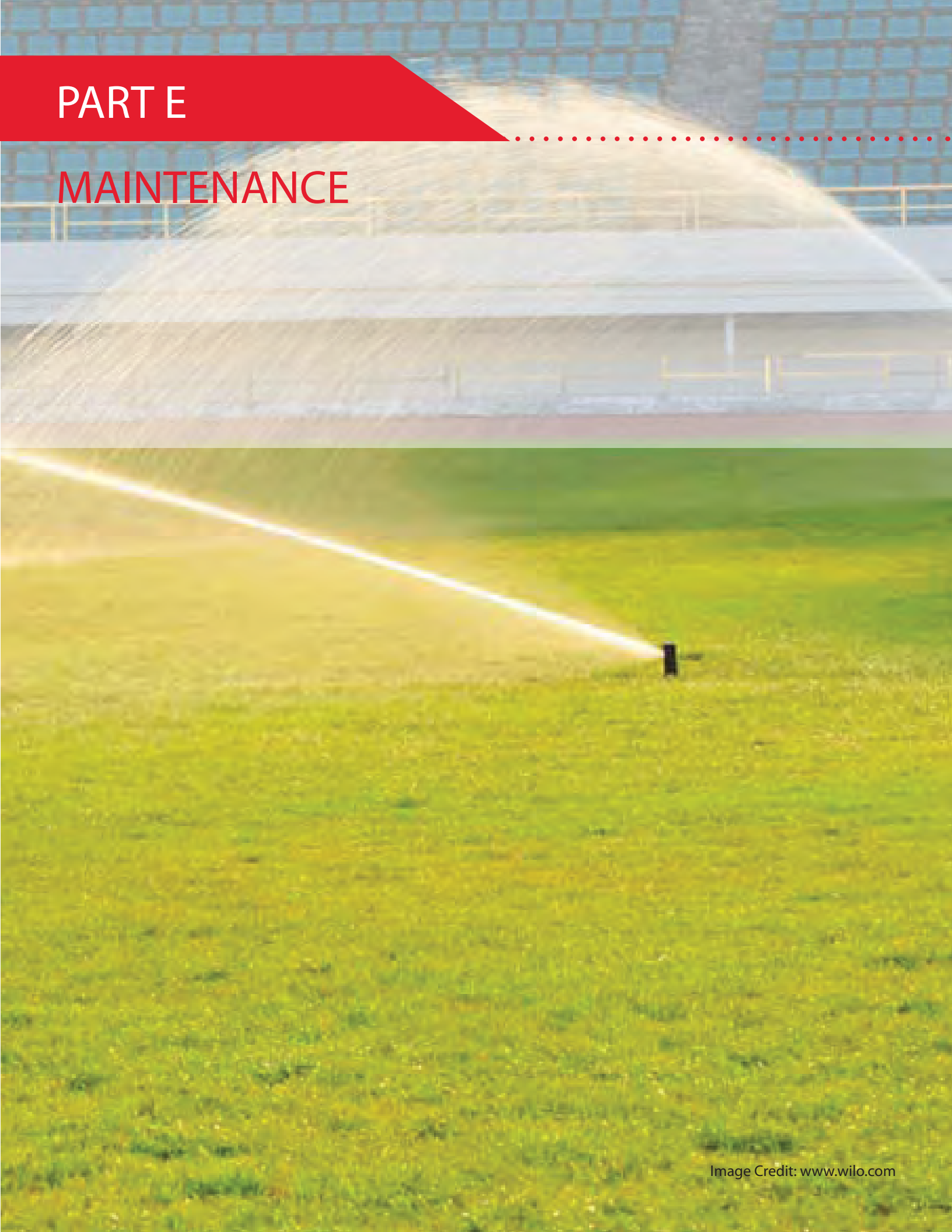


Image Credit: www.wilo.com

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5.0 MAINTENANCE

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Image Credit: www.pxhere.com

5.0 MAINTENANCE

5.1 Natural Grass Maintenance

5.1.2 | Natural Grass Maintenance Standards

Within Canada, the majority of natural grass standards are based on the golf industry, resulting in similar terminology, maintenance standards, and recommended equipment for natural grass maintenance programs. Most standards and recommendations appear to be minimal and at best remotely related to maximizing the playing season and quality of turf.

As a result, we have developed a maintenance program including standards, procedures, and equipment categories reflecting focused best practices to:

- Maximize field life expectancy
- Ensure a place in an increasingly competitive market from other facilities' higher end sports fields
- Enhance user experience and safety

Best management practices and annual operating efforts for natural grass fields are illustrated in Table 5.1, and align with the core standards list. Table 5.1 provides a sustainable maintenance model that should generally be adopted by the City. It demonstrates the different maintenance standards for each category of field. Maintenance frequencies vary, depending on the operation activity.

Table 5.1 – Recommended Natural Grass Maintenance Standards

Operation Activity	Field Type	
Classification	Irrigated & Lit	Irrigated & Unlit
Mowing	3 times per week	3 per week
Aerate	5 times per year	5 times per year
Field Marking	1 per week	2 per month
Fertilization	5 times per year*	5 times per year*
Topdressing & Overseeding	5 times per year*	5 times per year*
Irrigation & Drainage (Repairs)	1 per week	1 per week
Weed Control	1 per week	1 per week
Goal Mouth Repairs	As required	As required
Litter Pick Up	1 per 7 days	1 per 7 days
Staff Time	40 hours per week	40 hours per week

**The Operation Activities (e.g. aerate, field marking, fertilization, topdressing & overseeding) could potentially be reduced given the results of topsoil testing. If the utilization of the field is lower than the expected amount, the horticultural practices can be reduced accordingly.*

5.1 Natural Grass Maintenance

As the utilization of the field increases, the horticultural maintenance practices will also increase by a multiplication factor as identified in Table 5.2. We assume that the field utilization rate is 40% for irrigated & lit and irrigated & unlit.

The City needs to have consistent, centralized maintenance practices that take into account the hours used. Formal and regular communication between horticultural/summer crew leads and Site Complex Coordinators is key to making sure maintenance is conducted properly with the least disruption to permit holders and user groups.

The horticultural maintenance practices that will increase with additional usage include:

- Topdressing
- Fertilization
- Overseeding
- Core aeration
- Solid tine aeration
- Slicing
- Rolling


Image Credit: iStock Photo

Table 5.2 - Increased Maintenance Hours Based on Increased Field Utilization

Horticultural Maintenance Practice	Based on available % of Utilization	Standard Practice Min. (Hours) per week	Increase Hours per week (X)	Total
Topdressing, Fertilization, Overseeding, Core aeration, Solid tine aeration, Slicing, Rolling	30	8	0	8
	50	8	5	13
	75	8	7	15
	90	8	8	16

The overall definition of the growing season is between May to October in the Calgary region. The growing season is defined as frost free conditions, typically from May 22 to September 16.
(Government of Alberta, 1998)

Image Credit: Aral Tasher, Unsplash

5.1 Natural Grass Maintenance

The horticultural practices should be completed for all field types which are irrigated & lit and irrigated & unlit which are listed below. Detailed description of the tasks are listed in Section 5.2 - Natural Grass Maintenance Practices:

- Mowing
- Compaction Management
  - Annual or bi-annual core aeration as necessary
  - Monthly spiking or slicing
  - Annual rolling each spring to manage frost heave and field consistency
- Field Marking / Line Painting
- Fertilization
- Topdressing & Overseeding
- Irrigation and Drainage
- Weed Control

5.2 Natural Grass Maintenance Practices

5.2.1 | Mowing

Turf maintenance heights range from 6.3cm (2.5") to 7cm (2.75") for irrigated and lit fields. Grass trimming is typically carried out once a week.

Where fields are irrigated, the frequency of the watering should be adjusted according to rainfall, temperature, evaporation rates and requirements of the turf species.

Leaf removal has been addressed in other municipalities and mulching of leaves is promoted and practiced where possible.

5.2 Natural Grass Maintenance Practices

5.2.2 | Compaction Management (Aeration)

Coring, slicing, spiking, drilling, vertical mowing and injecting water into the soil are methods used to deal with soil compaction.

The reason why compaction management is important is because compaction breaks down soil structure and reduces the amount of pores for air exchange, which are necessary for root growth and microbial activity. It also reduces the amount and rate that water can infiltrate into the soil and percolate down through the soil profile. Compaction is more likely to occur with fine-textured soils and is less likely a problem for fields with coarse textured soils.

Management options include various cultivation practices such as coring, slicing, spiking, grooving, water and air injection, drilling and solid tine cultivation. These operations still must be done at the correct time, at the proper depth when soil conditions are not wet and are required more often on high use fields.

Core cultivation (often referred to as aerification) removes a core of soil, leaving a small hole which allows for better water and air movement into the root zone. Fertilizer and amendments can more easily reach the root zone resulting in a deeper more extensive root system.

Coring with hollow tines or spoons removes a soil core which can be collected or left on the soil surface. Tines can be placed in various spacings and can range 6.35mm to 19mm (¼"- ¾") in diameter and penetrate the soil 75mm to 150mm (3-6"). Keep in mind that the size and spacing of tines influences the area of impact. Soil cores left on the soil surface should be allowed to dry and then dragged with a mat to break them up. This process mixes soil into the thatch layer where microorganisms can begin to decompose the thatch. This would be a good time to apply lime or fertilizer if needed.

Solid tines disturb the soil surface less than coring, but they compact the bottom and sides of the holes.

Spiking uses solid tines to punch holes into the soil when less soil surface disruption is desired. This action actually causes compaction at the bottom and sides of the hole and is not as effective as hollow tine coring in improving soil physical properties. However, it is effective on heavily compacted areas especially when improving soil aeration is desired.

Deep drilling can create channels to a 300mm (12") depth with metal bits up to 25mm (1") in diameter. This kind of cultivation is often used to improve subsurface drainage on highly compacted areas of football and soccer fields. Fields may benefit from deep tine aerification once or twice a year if the drill goes deep enough to go below the depth of compaction.

Vertical mowing uses blades that cut vertically into the turf canopy to sever lateral stems. This practice helps to increase turf density, remove thatch at the soil surface and prepare the turf for overseeding. Injecting high pressured water into the soil through small-diameter nozzles opens channels for roots to grow with limited disruption of the surface.

Image Credit:
iStock Photo

5.2 Natural Grass Maintenance Practices

5.2.3 | Field Marking/Line Painting

Field Marking/Line Painting would be occurring as indicated in Table 5.1 – Recommended Natural Grass Maintenance Standards.

5.2.4 | Fertilization

The overall goal for the fertilization for sports fields is to provide adequate nutrition that promotes turf density and in turn improves field safety and playing conditions. Fertilization and topsoil testing is required to ensure that a proper amount of nutrients are being applied to turfgrass, and check that application levels are not lacking or excessive.

Many factors will influence the ultimate fertility program developed including grass species, soil type, time of year, intensity of field use, performance expectations, specific sport, budget, equipment, available labour, etc.

Soil Testing
Soil testing is an important routine management practice and an essential tool when developing a fertilizer program that promotes good turf growth while protecting the environment.

Soil testing by an agronomist laboratory should be conducted on a bi-annual basis for all natural grass fields. This practice will help with the fertilization program and assist with the topdressing program to select the correct products to be used for the natural turf grass fields.

5.2.5 | Topdressing

Topdressing is the application of a uniform thin layer of soil or finely granulated organic materials applied over the turf surface. It is used to level the playing field when minor variations or depressions are apparent, helps to amend physical soil properties, and creates a better growing environment for the turf and helps reduce thatch.

5.2.6 | Overseeding

Overseeding is the periodic application of seed to an existing turfgrass stand to improve turf density. The overseeding must be done on a routine basis on high-use fields, as this gives the turfgrass the chance to improve density and provide a more uniform and safe playing surface. Overseeding of the field also provides an opportunity to apply more aggressive types of turf seed including perennial rye and Kentucky Blue Grass to fill in high wear patterns which include goal mouths and centrelines of the field.

5.2 Natural Grass Maintenance Practices

5.2.7 | Irrigation

The sports field should have the irrigation system reviewed or inspected on weekly basis for leaks and breaks. The program should be adjusted to ensure that the field is not being overwatered. The irrigation system should be inspected weekly to ensure there are no leaks and that preventative repairs can be made. An overall water management program for the field itself ensures the field is not being under or over watered. When technology is used with the irrigation system (which could be a moisture sensor, central control system or smart irrigation controller), it can reduce the amount of the water used for sport field irrigation.

5.2.8 | Drainage

The sports field should be reviewed on a weekly basis for any drainage issues. This should be conducted during grass cutting.

5.2.9 | Weed Control

Weed control needs to occur with the correct herbicides and application methods on an as-needed basis. For example, around bleacher areas and general weed control in fields. A good fertility program will make these costs marginal.

Image Credit: Daniel Borker, Pixabay

5.3 Artificial Turf Maintenance

Maintenance is essential to keep an artificial turf field in top performance, maximize its expected lifespan of 10-15 years, improve field appearance, enhance user experience, and remain covered by the manufacturer's warranty. Maintenance is also needed to meet safety requirements, as "artificial turf lacks biodegrading properties of natural surfaces, making it more susceptible to unsanitary conditions for users."[1]

There are many components to a maintenance program, but the most critical ones according to the synthetic turf council are: surface cleaning, debris removal, grooming and infill replenishment, redistribution and decompaction. The following document provides an overview of the components of an artificial turf field maintenance program.

It is important to know that manufacturers have different standards and maintenance recommendations. Owners should receive warranty information and maintenance guidelines from the field builder upon construction completion. They should follow the instructions in the manufacturer's manual as a minimum, and supplement with additional resources such as this one, and the Synthetic Turf Council's Guidelines for Maintenance of Infilled Synthetic Turf Sports Fields.

Figure 5.1 - Image of an Artificial Turf System

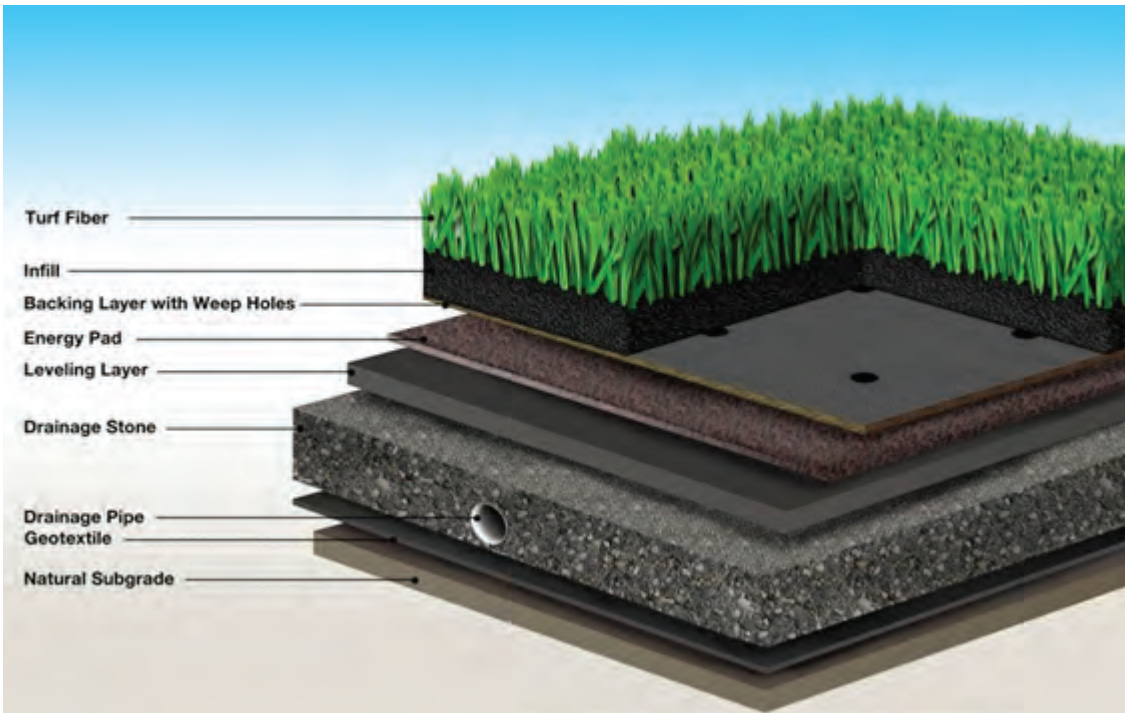

Image Credit: Sports Turf Canada

5.3 Artificial Turf Maintenance

5.3.1 | Reducing the Extent of Maintenance

Strategically locating the artificial turf field in an area that is away from contaminants (such as mature trees, pollen, high dust areas, or flood prone areas) will make maintenance easier . Restricting access to the fields by installing fencing or bollards will restrict vehicle and pedestrian traffic. Installing boot brushes will collect dirt before it goes onto the field. Pathways surrounding the field can also reduce contamination. Site grading should ensure that water drains away from the field. In addition, garbage cans should be provided for litter disposal. Daily or weekly disposal should be included in the maintenance plan so the litter does not move onto the field. In an ideal situation, the field is located next to a recreation center or a staffed facility with knowledgeable maintenance personnel to supervise its use. This proximity is also helpful for groups to notify staff about any issues or damage. For further information about site decision criteria, refer to Part A Section 1.3 - Athletic Park Planning and Design Framework - Artificial Turf.

5.3.2 | Requirements for Staff

Maintenance can be performed by the owner, a qualified maintenance company (approved by the artificial turf manufacturer or local representative of an artificial turf supplier) or the artificial turf manufacturer or local artificial turf installation/maintenance crew. Regardless of which option is selected, the personnel involved in the maintenance should meet the following requirements:

- Demonstrated experience in the maintenance of artificial turf. The staff should have a background in natural or artificial turf in additional to education and training for both natural and artificial turf. The education and training course should be conducted by Synthetic Turf Council and/or Sports Canada Turf for artificial turf and Sports Turf Canada or Olds College for natural grass fields
- Training and experience in the operation of the equipment required to perform artificial turf maintenance procedures
- Worker's Compensation Board and liability insurance
- Occupational Health and Safety, Transportation of Dangerous Goods training
- Ability to assess turf conditions and communicate/record information as needed
- Knowledgeable about the warranty, the field builder's maintenance guidelines and synthetic turf council field maintenance guidelines. Ensure these expectations are clearly communicated to the staff and/or maintenance service provider

From a risk management perspective, it is recommended that maintenance of new artificial turf facilities be included in maintenance contracts for existing City-owned artificial turf facilities.

5.3 Artificial Turf Maintenance

5.3.3 | Activities

Maintenance standards/frequencies should be developed for each artificial turf field. The individual maintenance program should consider the following so that the field is maintained and repaired effectively:

- Individual turf system components (e.g. fibre type, infill type, presence of an e-layer or shock pad)
- Seasonal usage variances
- Programs, bookings, rentals, special events
- Proximity to major traffic arteries
- Proximity to trees
- Precipitation (rain and snowfall)
- Product warranties
- The type of equipment used and if it is under the maximum allowed weight

Every time a maintenance activity occurs, it should be recorded in a maintenance log. Refer to Section 5.3.5 for more information about maintenance logs.

Field usage hours directly impact the frequency of maintenance activities. Therefore, maintenance checklists can be developed for the following field use amounts: <10h per week, 10-20h per week, 20-30h per week, >30h per week.

The following maintenance best practices are included in the maintenance checklists, and are explained in detail below:

- Removal of litter - manually or with a lawn sweeper or dust sweeper
- Measuring infill level (using an infill depth gauge) and topping up infill as needed.
  - Measurements should be conducted in a grid pattern and recorded
  - The infill level should be 12.7-19.0mm below the fiber tips based on 50mm to 63mm turf fibre product
  - Infill affects cushioning and player safety
  - The reveal (how much fibre is left standing above the infill) affects ball roll
  - Groom areas of infill that are too high into areas that are too low
  - If there is not enough infill, replace it with new material of the same type that's already there, otherwise the warranty will be voided
  - Add infill in hot spots (major wear areas). These should be easy to identify as the field visually looks different where the infill has been dislodged or displaced. Hot spots are the centre spot, corner kick, penalty spot, goal mouths and penalty area, as shown in Figure 5.2

5.3 Artificial Turf Maintenance

Figure 5.2 - Wear Areas (Magnifying Glasses and Red Outlines)

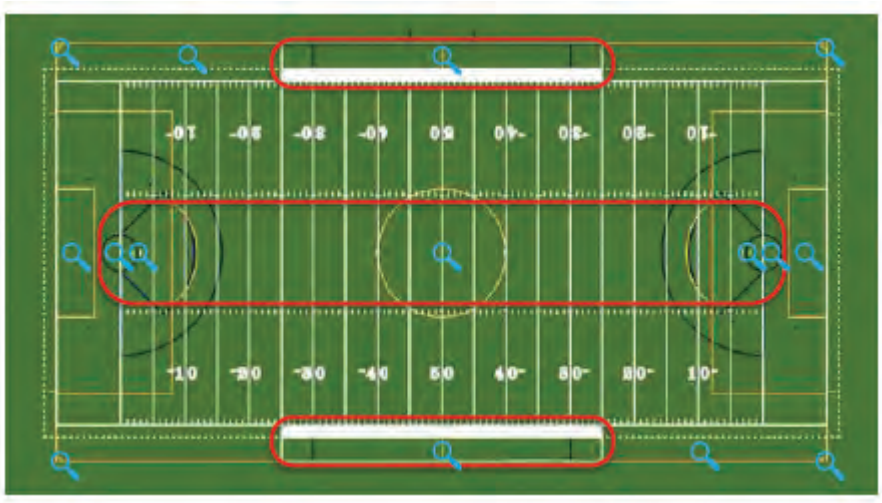

Image Credit: Astro Turf

- In most cases, topping up the infill is done yearly but it depends on the material and rate of its migration off the field. On average, 3% of infill on a field needs replenishing
- De-compaction and aeration of infill – should be done with specialized equipment and experienced staff. This is important because when rubber compacts and settles, water doesn't drain, and algae forms
- Surface cleaning, brushing, sweeping with a broom or brush to remove weeds, bird waste, mud and moss. This will stop decomposition of organic material which can encourage algae and moss growth. When a field it new, infill will take some time to settle into the turf, so during this time, more brushing may be needed to help with this process
- Inspection of seams and panels - a thorough inspection should be conducted every 3-6 months. The frequency is higher (2x a month) for heavily used fields and fields near the end of their life. Inspect each turf panel for rips, shifting and check the firmness of the under padding. Open seams are tripping hazards. If the seam opening is <300mm (12") it can be repaired by the personnel maintaining the field. If it is >300mm (12") it should be reported to the field builder for their expertise
- Snow and ice removal should be completed by experienced staff who use proper equipment
- Specialist maintenance/professional cleaning
- Grooming - keeps infill particles loose and allows for better drainage
- Irrigation - If it doesn't rain much, irrigate the field to remove dust, pollen and other airborne pollutants. The amount of water needed depends on rain, dew and humidity and type of infill. Water as needed for organic infill materials such as coconut/cork blend infill to keep it at the optimum 20% moisture level. For 100% cork, watering is not needed. It's also not recommended to water cork during warm months to reduce static
- Disinfecting – as needed, for spills, body fluids on field
- Deep cleaning – Done with specialized equipment and experienced staff. Consists of brushing and vacuuming infill dust and fibers, removing debris and returning infill to the field

5.3 Artificial Turf Maintenance

- G-Max Testing – Measures the surface hardness. International standard is ASTM 1936 and F355. At construction completion, testing should be conducted to see if the field meets the performance specifications. The initial test can be a good reference to benchmark future tests with. Future tests are to be completed as needed
- Painted lines may need 2-3 separate applications in the first year; in subsequent years just one should suffice. Apply paint lightly, not too thick, and to the fibers themselves (not the infill). If using temporary paint, 4 applications can be made before the buildup needs to be fully removed. Temporary lines should be removed as soon as possible, after the event has been completed to remove the risk of ghost lines appearing on the field. Paint designed for use on artificial turf should only be applied for either permanent or temporary markings

Figure 5.3 - Paint Removal

Image Credit: Sports Turf Canada

Image Credit: Soccerwholesale.com

If there is a problem with static electricity on the field, applying liquid laundry fabric softener can help reduce it.

5.3 Artificial Turf Maintenance

5.3.4 | Artificial Turf Maintenance Schedule

The maintenance schedule is based on the artificial turf type, infill type and usage. Each site may need to have a breakdown of items listed in Tables 5.3 and 5.4 to ensure that maintenance practices are adhered to for each specific site.

Table 5.3 - Artificial Turf Field – Parameters on Artificial Turf Type (Example)

Technical	
Turf Type	Polytan Ligaturf RS+ Coolplus 240, Smooth fibres
Installation	2012, 8-year warranty
Infill	SBR Crumb, low static build-up, low migration
Fibre Length	65 mm
Base	E-layer providing secondary shock absorption
Primary Use	Soccer
Secondary Use	Football
Site Location	Adjacent to major traffic artery and minimal landscaping. The roadway generates significant inorganic deposits on the field.
Season	April 1 – December 1
Equipment Storage	May require storage of tractor, turf cleaning and top-dressing equipment.
Special Notes	Due to SBR crumb infill, this field has minimal crumb infill loss and medium infill migration requiring regular maintenance frequency. Regular shallow and deep cleaning is recommended.

5.3 Artificial Turf Maintenance

Table 5.4 – Recommended Annual Maintenance Schedule of Artificial Turf Field

Frequency (Week)	Groom Brush	*Deep Clean	*Surface Clean	Visual Inspect	Infill Depth	Top Dress	Foreign Object	G-Max
MAY								
1	X O Z	X O Z	O	X O Z	X Z	X O Z	X O Z	X
2	X O Z			X O Z				
3	X O Z			X O Z				
4	X O Z			X O Z				
JUNE								
1			X O Z	X O Z				
2	X O Z			X O Z				
3	X O Z			X O Z				
4	X O Z			X O Z				
JULY								
1			X O Z	X O Z	X Z			
2	X O Z			X O Z				
3	X O Z			X O Z			X O Z	
4	X O Z			X O Z				
AUGUST								
1			X O Z	X O Z				
2	X O Z			X O Z				
3	X O Z			X O Z				
4	X O Z			X O Z				
SEPTEMBER								
1			X O Z	X O Z	X Z			
2	X O Z			X O Z				
3	X O Z			X O Z				
4	X O Z			X O Z				
OCTOBER								
1								
2	X							
3								
4	X							
NOVEMBER								
1	optional		optional					
2								
3								
4								

- X denotes proposed frequency (green)
- O denotes approximate existing frequency (red)
- Z denotes Turf Manufacturer's Estimate on Frequency
- Snow Clearing would occur as needed, based on weather conditions
- * denotes specialized equipment combining elements of dethatching, surface or deep dust/trash removal and crumb redistribution

5.3 Artificial Turf Maintenance

5.3.5 | Maintenance Log

Using a maintenance log is typically a requirement to remain covered by the warranty. If there is a problem with the field, you need to be able to prove that you were following your owner's manual and completing a maintenance log (as it provides valuable evidence in case of a claim). Even minor maintenance activities should be documented. The basic information needed is the type of activity, date, notes and inspector's initials. A sample maintenance log is below.

Table 5.5 – Sample Maintenance Log

Official FieldTurf Maintenance Log

FieldTurf® A Tarkett Sports Company

Date Form Submitted (M/D/Y): _____ Organization: _____

Name of Field: _____ Name of Maintainer: _____

STAGES	DATE	NAME	SIGNATURE
Surface Brushing **Recommended Frequency:** Every 4-6 weeks	M/D/Y		
	M/D/Y		
	M/D/Y		
	M/D/Y		
Surface Aerating **Recommended Frequency:** Maximum 2-3 times/year (beginning in 2nd year)	M/D/Y		
	M/D/Y		
	M/D/Y		
	M/D/Y		
Surface Raking **Recommended Frequency:** Every 4-6 weeks	M/D/Y		
	M/D/Y		
	M/D/Y		
	M/D/Y		
Surface Sweeping **Recommended Frequency:** As needed	M/D/Y		
	M/D/Y		
	M/D/Y		
	M/D/Y		
Additional Maintenance Activities (specify) **Recommended Frequency:** As needed	M/D/Y		
	M/D/Y		
	M/D/Y		
	M/D/Y		
Complete Inspection of Line Markings, Seams and High Traffic Areas **Recommended Frequency:** As needed	M/D/Y		
	M/D/Y		
	M/D/Y		
	M/D/Y		
Infill Top Dressing (high-traffic areas) **Recommended Frequency:** As needed	M/D/Y		
	M/D/Y		
	M/D/Y		
	M/D/Y		
Snow Removal (if applicable) **Recommended Frequency:** As needed	M/D/Y		
	M/D/Y		
	M/D/Y		
	M/D/Y		

5.4 Artificial Turf Equipment and Materials

5.4.1 | Considerations

- Have a stock of extra infill and repair materials that are easy to access should they be needed
- Use appropriate maintenance equipment that has been approved by the artificial turf manufacturer
- Do not use a pressure washer in excess of 300psi
- Turf tires should be pneumatic on vehicles (no chains, studs etc.). Tires should be clean
- Do not drive faster than 16 kilometers per hour, and no sudden braking or sharp turns
- Eliminate heavy loads, especially long-term ones. No more than 2 psi (432 lbs/sq. ft.) static load should be allowed. No more than 35 psi dynamic load. Use field protective panels or plywood (See Part F Section 6.1 - Turf Protection Systems) to distribute any potentially damaging loads
- Never change fluids in maintenance equipment on the artificial turf
- For artificial baseball diamonds there may be 2 levels of pile heights, so adjust the groomer accordingly, otherwise the turf will get damaged if it is set too deep

Figure 5.4 - Adjusting the Brush Height

Image Credit: Sports Turf Canada

- Do not use a motorized vacuum cleaner if the air temperature is over 30°C
- Irrigate with potable water only
- Do not use tarps during freezing weather, ice will form underneath
- Tarps should be used to protect the field from neighbouring renovations, such as a new track surface, cleaning bleachers, lighting repairs, etc. Preferred tarp material is vinyl or poly coated
- If there is the threat of flooding, place a specialized tarp on the field which will reduce the amount of sediment that will be deposited during the flood

5.4 Artificial Turf Equipment and Materials

5.4.2 | Equipment

- When topping up infill, apply thin layers with a hand spreader and brush it into the fibers with a plastic rake or broom. Infill can also be applied with a motorized spreader, or a drop spreader (Gandy) The artificial turf should be groomed after infill top-up

Figure 5.5 - Topping up Infill

Top Image: Neograss.co.uk
Bottom Image: Hope Depot

Figure 5.6 - Topping up Infill

Image Credit: Sports Turf Canada

Figure 5.7 – Drop Spreader (Gandy) for Infill Top-up

Image Credit: Sports Turf Canada

5.4 Artificial Turf Equipment and Materials

- Debris removal can be done with a commercial leaf-blower followed by manual pickup, or equipment such as a LitterKat or S.S.S.10

Figure 5.8 - LitterKat

Image Credit: Sports Turf Canada

Figure 5.9 - S.S.S.10

Image Credit: Sports Turf Canada

- Sweeping is done using a brush that is attached to a light motorized vehicle (e.g. Gator or tractor) which gets rid of surface debris. A magnet can be attached to the brush to collect hairpins and other metal items. The brush should be made of synthetic fibre bristles (nylon, polyolefin), but never metal as this could damage the fibers. Sweeping should not occur during the hottest part of the day as synthetic turf backing and infill tend to expand in heat and should only occur when the field is dry , if the field groomed in the infill tends to bunch together. Some sweepers have a motorized vacuum attachment

Figure 5.10 - Field Sweeper

Image Credit: Mid South Synthetic Turf Cleaning

Figure 5.11 -Field Sweeper

Image Credit: Sports Turf Canada

5.4 Artificial Turf Equipment and Materials

- Grooming re-distributes the infill and brings the fibres to a more upright position. The plastic grooming brush attaches to a motorized vehicle (e.g. Gator or tractor). The direction of grooming should be alternated in consecutive sessions. It should follow the direction of the seams (not crossing over them, as this can damage them). The height of the brush should be set to barely touch the fibers. Using a vehicle to do the brushing on a standard football field should take an hour

Figure 5.12 - Field Grooming Equipment

Image Credit: SMG Sportplatzmaschinenbau GmbH

Figure 5.13 - Deep Grooming Equipment

Image Credit: Synthetic Turf Council

This Turf Care TCA1400 machine can accomplish both sweeping and grooming:

Figure 5.14 - Field Sweeping and Grooming Equipment

Image Credit: Sportplatzmaschinenbau GmbH Website

5.4 Artificial Turf Equipment and Materials

Figure 5.15- Sweeping and Grooming Pattern

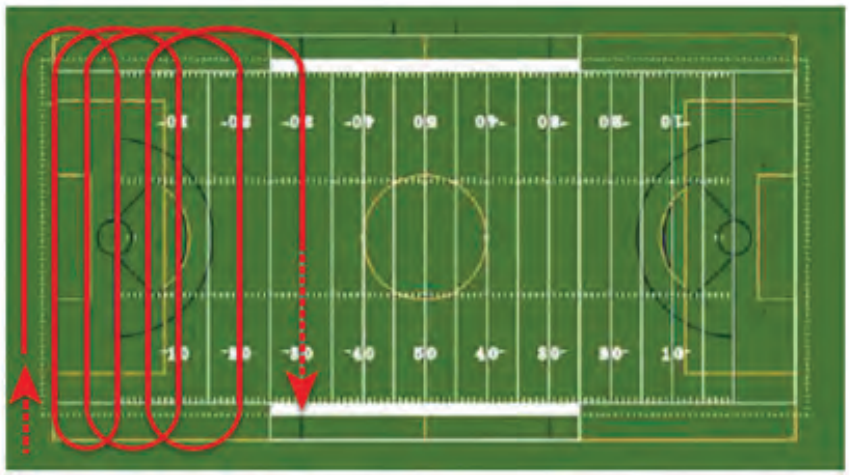

Image Credit: Astro Turf

Figure 5.16- Sweeping and Grooming Patterns

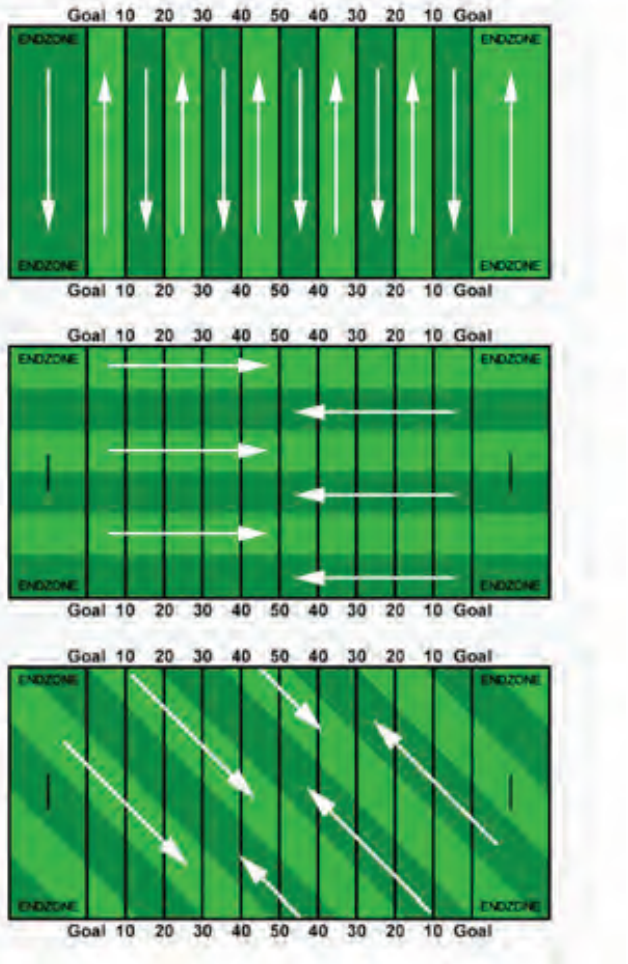

Image Credit: Synthetic Turf Council

Deep Cleaning equipment – Verti-top – Vacuums infill, cleans it and returns it to field.

Figure 5.17– Deep Cleaning Equipment

Image Credit: Synthetic Turf Council

5.4 Artificial Turf Equipment and Materials

5.4.3 | Procedures for Snow and Ice Removal

Snow and ice are generally not harmful. They should be left to melt naturally.

- Dry snow – can be removed with a rotary brush, followed by a mechanical broom with fiber brush set to the proper height. Never use a metal wire brush
- Wet snow – can be removed by attaching half a PVC pipe to a snowplow blade or light tractor and plowing. Rubber tipped snowplows with PVC pipe is preferred. Attach the pipe with straps. The snow removal crew should be experienced with snow removal on artificial turf field
- Don't make large snow piles, put the snow into front end loaders to take off the site or place in snow storage zones off of the field
- Leave about 2cm of snow on field to melt by itself
- Remove in layers, not all at once
- If you need to remove it for an event, do this as close to the event time as possible so that ice doesn't form, as ice is harder to remove than snow
- Ice can be removed by a small weighted lawn roller, then swept off. If there is too much ice, then you can use a product called ZCAP (Zeolite clinoptilolite) which are granules for preventing ice. Or use urea dispersed @ 100lbs per 3000 sq. ft. Leave it for at least 30 min. Remove with water, a squeegee, sweeper etc. It is less effective at -12°C and won't work at-18°C. Flush ZCAP and urea off when the temperature is warmer (otherwise residue remains). Don't use salt or other chemicals because they will damage equipment and potentially the player's health

Figure 5.18 - Snow Removal - Image from Sports Turf Canada

Image Credit: Sports Turf Canada

5.5 Cleaning Artificial Surfaces

5.5.1 | Spill Removal

It is good practice to get rid of spills as soon as they're known, because they can discolour the turf and pose sanitation hazards. If the spill has dried up, use a dull knife or spatula to remove the residue. If it is still wet, most stains can be removed using soap (e.g. household laundry detergent) and water, scrubbed with a stiff brush, cleaned up with a cloth or paper towel, followed by a flush of water. Cat litter also works and needs to be vacuumed or swept up. If the stain is stubborn, a 3% solution of ammonia in water can be used. Always confirm with artificial turf manufacturer's maintenance guidelines when cleaning spills.

Figure 5.19 - Cleaning up a Spill

Image Credits: Astro Turf

Water-Borne Spill

Mix Soap and Water

Scrub the Residue and Rinse

5.5 Cleaning Artificial Surfaces

For specific spills that can't be removed using the methods listed above, use the following:

Table 5.6 – Methods to Remove Spills

Name of Spill, Debris	How to remove
Animal waste	Mix equal parts vinegar and water, pour onto stain, rinse thoroughly with water after
Gum	Freon (available as an aerosol spray from a carpet cleaning supplier) or dry ice or ice cube to freeze the gum, it will then be easier to scrape off
Fungus, algae, mold, moss, mushrooms	These pose health hazard to players. Use a 1% hydrogen peroxide solution with water. Sponge on, rinse off. There are mixed opinions among turf manufacturers on the use of bleach. If using exterior bleach, mix it 50/50 with water.
Oil paint	Apply turpentine or paint remover, then sponge with water
Blood	Use a paper towel to absorb it, treat it with disinfectant applied with a low-pressure sprayer <300 psi. Let the disinfectant sit 10 minutes, then rinse with clean water.
Weeds	Manually remove weeds including roots. Use 1 gal. vinegar, 2 cups epsom salt, ¼ cup dish detergent on the area to stop regrowth. Flush with water.
Coffee, Food	Detergent
Oil-Based stains – Pen ink, sunscreen, shoe polish, rubber cleat marks, lipstick, crayons, asphalt, motor oil, paraffin wax, tar, asphalt	Use perchloroethylene (a dry-cleaning solution that is commonly used for nylon carpets). Use sparingly and blot with towels to absorb. For motor oil spills, remove the infill in the affected area from the field, clean the turf fibers, and add new infill.
Clay (e.g. from a ball diamond infield)	To clean clay out of turf, vacuum, then use a stiff brush. Do not power wash. Replace rubber infill.

When removing stains, remember to keep safety in mind. Do not smoke when using solvents as these are flammable; and ensure adequate ventilation. Do not use any liquids with >5% alcohol, and do not use acetone. Remember that the turf is part of a system. Chemicals that are safe to use on the turf fibers may not be safe for other components such as the infill or shock pad. Always confirm with artificial turf manufacturer's maintenance guidelines when cleaning up spills.

5.6 Minor Repairs

Major repairs should generally be completed by a professional or the manufacturer whereas minor repairs can be completed by city staff. When inspecting the field for damage, mark on a plan where the damaged areas are located to keep track of them. Repair them as soon as possible because small damages could get bigger and cost more to repair over time. Seams that are loose need to be fixed. If using adhesives, don't apply them in wet conditions; warm dry weather (above 15°C) is best.

Differential settlement, which appears as 'hills and valleys' across the surface, can result in potential hazards for players, reduced playability and function, and ultimately require costly repairs. Electrical conduits, and/or water lines can break due to abrupt changes in grade. Look for differential settlement and address it sooner rather than later.

For cigarette burns, separate the fibers that have fused together with metal brush. If that doesn't work, cut them apart with a knife, then brush.

Each turf manufacturer's product will come with specific instructions on how to repair the seams properly and a seam repair kit may be provided.

Figure 5.20 – Repairs

Minor Repairs

Major Repairs

Repair Kit

Image Credit: Astro Turf

A general overview of a minor repair is as follows:

- Repairs should be done in dry conditions. Use a leaf blower or the reverse function on a vacuum to dry the area if needed
- Remove the infill from the area needing repair (e.g. using a shop vac)
- Use angle irons to hold back the turf to expose the area that needs gluing
- Apply adhesive using a putty knife
- Place the turf onto the glue
- Check after 15 minutes to see if it has bonded
- Wait at least 1 hour before adding infill – use the gauge to fill it to the appropriate level
- The field can be played on in 2 hours but note that the adhesive won't be fully dry for 24 hours

5.6 Minor Repairs

Figure 5.21- Line Gluing

Image Credit: Sports Turf Canada

Figure 5.22- Seam that Needs Repair

Image Credit: Sports Turf Canada

5.7 References

Trade Associations:

- Synthetic Turf Council Guidelines for Maintenance of Infilled Synthetic Turf Sports Fields
- Sports Turf Canada

Turf Manufacturers:

- Astro Turf Operation and Maintenance Manual
- Carpell Surfaces (ACT Global Sports Ltd.) - Xtreme Turf Maintenance Manual
- Field Turf Inc. Maintenance Guidelines
- GTR Turf (Shaw Sports Turf) – Protect your investment, Maintenance is Important
- Worldwide Turf Inc. – How to Care for Your Artificial Turf
- Edel Grass B.V. - Davan Group – Method Statement of Edel Grass Artificial Turf Pitches

Other:

Toronto Public Health. Health Impact Assessment of the Use of Artificial Turf in Toronto. April 2015. City of Toronto. <https://www.toronto.ca/wp-content/uploads/2017/11/9180-HIA_on_Artificial_Turf_Summary_Report_Final_2015-04-01.pdf>

PART F

ALLOCATIONS AND OPERATION

Image Credit: Ben Wiens, Unsplash

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Image Credit: wallpapercave.com

6.0 ALLOCATIONS AND OPERATION

6.1 Introduction and Overview

6.1.1 | Introduction

This section summarizes the key considerations and best practices in the allocation, use and operation of athletic parks. This includes factors common to athletic parks containing natural grass fields, artificial fields or a mix of both artificial and natural grass fields.

Factors unique and specific to artificial turf are detailed in Part D – Special Considerations for Artificial Turf and are therefore not repeated here.

6.1.2 | Overview

The section contains the following information:

- Optimal capacity and uses of fields
- Optimal staffing models
- Field signage and protection
- User restrictions
- User rates, bookings and allocations

6.2 Field Capacity

6.2.1 | Field Playing Capacity Guidelines

Field booking and usage data, will help to better plan and distribute use more evenly across City fields to address over and underutilized fields. A usage cap system can help to regulate use on specific fields and allow shifting hours to underutilized fields and reduce pressure on over utilized fields.

The table below provides general guidance on sports field capacity. Refer to Part B - 2.3 Programming & Amenities Based on Classification System.

Table 6.1 – Sport Field Usage/Capacity Artificial Turf and Natural Grass

Rectangular Play Field		
Field Class	Maximum Usage Hours	Source
AT Field	3,000 hours per year	Maximum hours based on industry warranty standards
Natural Grass (Irrigated & Lit) Category 3 Field– Horticulture Standard	700 hours per year	Based on Athletic Construction Manual of Sports Turf Canada
Natural Grass (Irrigated & Non-Lit) Category 3 Field– Horticulture Standard	700 hours per year	Based on Athletic Construction Manual of Sports Turf Canada
Natural Grass (Non-Irrigated & Non-Lit) Category 4 Field– Horticulture Standard	450 hours per year	Based on Athletic Construction Manual of Sports Turf Canada

6.2 Field Capacity

Natural grass fields will have a recommended maximum usage or playing capacity that is further refined by day/week/season and is based on maintaining a high-quality playing field. For the purpose of this study the following recommended usage capacity shown below assumes that adequate maintenance resources and appropriate turf management strategies for rest and recovery will be in place to maintain and preserve the standards of construction.

Figure 6.1 – Natural Grass Field Utilization Guidelines, Sports Turf Canada[1]

Table 3.2.1 A Guideline for the Permitting Hours of the Five Categories of Athletic Fields				
Category	Permitted Days	Permitted Hours Per Day	Permitted Hours Per Season	Consecutive Days of Use
1*	90	5	450	2
2	110	5	550	3
3	140	5	700	4
4	180	2.5	450	4
5	180	2.5	450	5

*Category 1 fields may have significant down time for restoration during the playing season
Category 1 fields require a high level of on site supervision and management knowledge
Category 1 fields shall have controlled access

Consecutive days of use cannot be determined as intensity of play on fields may vary according to the frequency of use by user groups or tournament schedules. Consecutive Days of Use: Tournament play requires greater duration of play on individual days and play on consecutive days during the tournament. The recuperation of the grass from this intensive use requires a longer rest period prior to next schedule use.[2]

6.2 Field Capacity

6.2.2 | Capacity Benefit Analysis

Further to the "optimization of available spaces" and "sport / recreation experience" benefits outlined in the previous sub-section, a common rationale for the installation of artificial turf in winter climates is the ability to extend seasons of play and provide a greater degree of utilization certainty during "shoulder seasons" (e.g. April / May and October / November). The following parameters were used to conduct a high-level capacity benefits comparison of an artificial vs. natural grass field:

- "Prime time" use of sports fields occurs between the hours of 5 p.m. and 9 p.m. on weekdays and 11 a.m. to 9 p.m. on weekends. These hours shift during certain periods of time within a season but are generally valid as parameters for this exercise based on available data.
- Artificial turf fields are generally playable in similar climates from, at minimum, early April to late October (7 months). Natural grass fields are generally playable at full capacity from early May to late Sept (5 months). These seasons of play are fluid and fluctuate depending on weather patterns but have been set as parameters based on a review of available weather data.

The following chart summarizes the impact of the capacity analysis using the above parameters. As reflected in the chart, an artificial turf field provides 336 hours of incremental time in comparison to a natural grass field.

Table 6.2 – Prime Time Capacity: Artificial Turf vs. Natural Grass

	Months of Use	Prime Time Hours Available
Artificial Turf	7	1,176
Natural Grass	5	840
Additional Capacity Provided by an Artificial Turf Field	+2 Months	+336 Hours

It is important to note that the above comparison also does not take into account downtime associated with field rest, weather, maintenance, and repair that often limits the use of natural grass fields.
Applying an additional factor of 15% to the previous comparison to account for the likelihood of natural grass field downtime, the difference expands to 462 extra hours of "prime time" capacity provided every year by artificial turf fields.

For context, available utilization data reflects that the City's current artificial turf inventory was booked on average for 882 hours per field in 2018, while natural grass rectangular fields were booked on average for 211 hours per field in 2018.

6.2 Field Capacity

6.2.3 | Field Operational Best Practices

Artificial Turf Operating Standards

Macro Operating Standards
In reviewing available artificial turf manufacturers' and Artificial Turf Council's operating / maintenance documents, we noted a considerable variance in terminology, maintenance standards, and recommended equipment regarding artificial turf maintenance programs. Most standards / recommendations appeared to be minimal and at best remotely related to maximizing turf life cycle potential.

As a result, we have developed a maintenance program (refer to Part E) including standards, procedures, and equipment categories reflecting focused 'best practices' to:

- Maximize field life expectancy
- Maximize field investment potential
- Ensure a place in an increasingly competitive market
- Enhance user experience and safety

Comprehensively, this maintenance program reflects an investment to extend field life expectancy and ensure each field is a financial asset, not a liability.

It is noted that the City of Calgary has adopted this program through its current maintenance contract for the seven City Artificial turf fields. Refer to Part E Section 5.3 Artificial Turf Maintenance.

Micro Operating Standards
In reviewing the provision of artificial turf facilities from an contractor's (owner/operators) perspective, we have identified that there is a considerable void in comprehensively defining 'key considerations ' initiatives respective to public or not-for-profit sector best practices. The following provides a high-level perspective as to public / not-for-profit administrative synergies which may be included in development of guidelines for sustainable artificial turf economic and operating models.

Sustainability
For operational purposes, sustainability is defined as annual revenues meeting or exceeding annual Artificial Turf administrative, maintenance, and life cycle costs.
Maintenance standards/frequencies should be development for each field. The individual maintenance programs should include consideration of:

- Individual turf and infill types
- Seasonal usage variances
- Weekly usage hours
- Programs, bookings, rentals, special events
- Proximity to major traffic arteries, treed landscaping, and bunny runs
- Precipitation (rain and snowfall)
- Product warranties

6.2 Field Capacity

6.2.3 | Field Operational Best Practices

Natural Grass Operating Standards

These are similar in terminology, maintenance standards, and recommended equipment regarding natural grass maintenance programs within Canada as majority of the natural grass standards are based on terminology from Golf Industry. Most standards / recommendations appeared to be minimal and at best remotely related to maximizing playing season and quality of the turf life cycle potential.

As a result, we have developed a maintenance program (refer to Part E) including standards, procedures, and equipment categories reflecting focused 'best practices' to:

- Maximize field life expectancy
- Ensure a place in an increasingly competitive market from other facilities higher end sports fields
- Enhance user experience and safety

Comprehensively, this maintenance program reflects an investment to extend field life expectancy and ensure each field is a financial asset, not a liability.

Best management practices and annual operating costs for irrigated & lit, and irrigated & unlit fields are illustrated below and align to the core standards list.

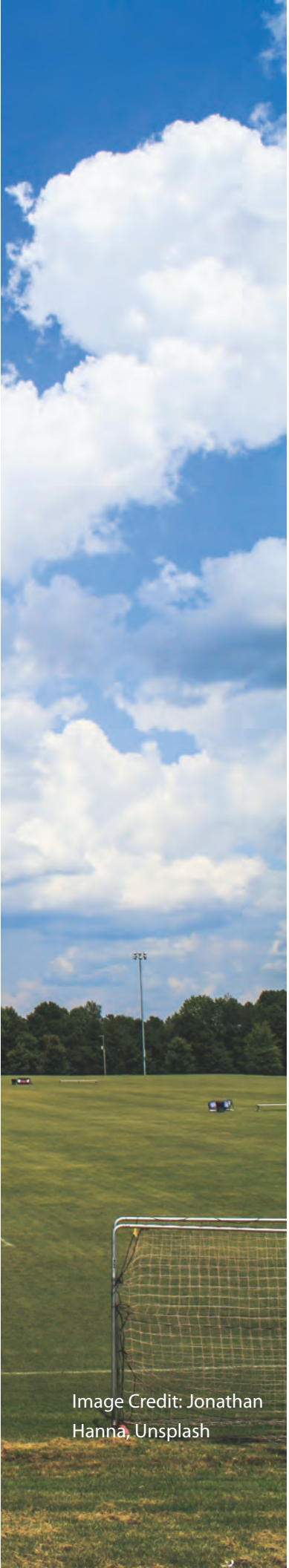

Image Credit: Jonathan Hanna, Unsplash

6.3 Athletic Park Site Program Optimization and Considerations

6.3.1 | Sustainable Operation Model

To operate sustainably, natural grass and artificial turf fields should be within the same parcel or adjacent to city assets (recreational centres, operational buildings, community association buildings, etc.). This allows staff to supervise the activities on the field and prevent damage to the fields.

6.3.2 | On-Site Staffing Optimal Staffing Models

The optimal staffing model for either artificial turf or natural grass field athletic parks includes having an on-site trained supervisor or sports field manager dedicated to each field or set of fields. This is crucial to maintain standards of maintenance among the various contractors and unskilled staff.

6.3.3 | Sustainable Economic Model (Artificial Turf and Natural Grass Fields)

The overall layout of the sports field should be towards the outside of the site within community hub (concessions, washroom, etc.) being the central point of the space. The overall location of the parking lot should be centrally located on the site with sports field on either side of the parking and amenities building.

Figure 6.2 - Functional Layout

6.3 Athletic Park Site Program Optimization and Considerations

The design of the building will need to consult the Alberta Building Code and Land Use-Bylaws for supporting washroom facilities, and the overall building program will need to be developed for each site or generic building program that could suit multiple sites. The overall number of change rooms, storage space, meeting rooms, and non-commercial kitchens will need to be developed for each site.

Optimizing Athletic Parks

Whenever possible, field users should be aligned with the types of fields that are best aligned for their needs and nature of use. Ensuring that allocations processes consider these factors can help maximize the use of fields and the revenues that can be generated. Identified as follows are additional considerations related to optimizing the functionality and revenue potential of athletic park sites:

- Athletic field sites need to balance having a mix of field dimensions with having multiple fields of the same field typology that can support tournaments and competitions. For example, a primary tournament site could be targeted for having multiple artificial turf or premium natural grass fields to support tournaments that require multiple fields of a similar typology on the same site.
- Support amenities should be based on:
  - The nature of use (e.g. sites that accommodate football may require more storage and locker room capacity than soccer)
  - The anticipated spectator load of the site or specific fields (e.g. sites that are likely to host tournament, major competitions, or considered "game" sites for higher level amateur sports should provide a high level of amenity than sites which are designed for recreational use)

Financial Sustainability of the Inventory

The financial sustainability of providing recreation spaces and amenities are dependent on two overarching factors:

- The level of subsidization that the municipality is willing to incur
- The capacity of users and groups to pay

Engagement conducted in 2015 and 2016 for the Sport Field Strategy affirmed that user groups have a desire for access to better quality fields. Relevant findings included:

- The quality or condition of sport fields was identified as the top barrier to accessing / using sport fields by respondents to the public **Resident Survey**
- Only 12% of **User Group Survey** respondents indicated that the current sport fields in Calgary meet the need of your organization
- **Stakeholder Discussion Session** participants strongly expressed the importance of quality over quantity, including a demand for increased artificial turf provision
- Over two-thirds of **User Group Survey** respondents (77%) indicated that they have not turned away members due to lack of access to sport field facilities

While these findings suggest a preference for more artificial turf provision, it is unclear to what extent user groups have the capacity to pay current rates in order to access more artificial turf.

Image Credit: Jonathan Hanna, Unsplash

6.3 Athletic Park Site Program Optimization and Considerations

One potential indicator of optimization is current capacity. The following chart summarizes the estimated utilization of the current inventory of natural grass and artificial turf athletic fields in Calgary.

Table 6.3 – Inventory of Artificial Turf and Natural Grass Fields in Calgary

Type	Number of Fields	% Utilization
Natural Grass Athletic Fields	38	17%
Artificial Turf Athletic Fields	4	69%

**Does not include artificial turf fields located at the Calgary Soccer Centre.*

Artificial turf utilization of 69% is strong and may result in capacity challenges during some peak times and seasons; however, this level of utilization does not suggest critical capacity challenges.

Relating hours of use to revenues, artificial turf fields do significantly outperform natural grass fields. As reflected in the chart below, artificial turf fields generate approximately double the revenues of natural grass fields on an hourly basis.

6.3 Athletic Park Site Program Optimization and Considerations

Table 6.4 – Revenues of Artificial Turf and Natural Grass Fields in Calgary

Year	Artificial Turf Hours Booked	Artificial Turf Revenues Collected	Artificial Turf Average Revenues Per Booking Hour	Natural Grass Hours Booked	Natural Grass Revenues Collected	Natural Grass Average Revenues Per Booking Hour
2018	3,724	$413,044.81	$110.92	7,979	$379,881.53	$47.61
2016	1893	$194,786.79	$102.88	6,582	$348,790.56	$52.99

**2017 data was not included due to Shouldice artificial turf fields being offline.*

The following chart provides an estimate of the revenue impact of transferring existing utilization from natural grass athletic fields to artificial turf fields.

Table 6.5 – Impact of Converting Natural Grass to Artificial Turf

Amount of Natural Grass Booking Hours Transferred to Artificial Turf	Hours	Approximate Field Equivalents	Incremental Gross Revenues
5%	399	<0.5	$ 25,258
10%	798	0.5 - 1	$50,515
15%	1,197	1 - 1.5	$75,773
20%	1,596	1.5 - 2	$101,030
25%	1,646	1.5 - 2	$104,188
30%	2,394	2 - 2.5	$151,546

6.4 Utilization Optimization and Market Saturation (Artificial Turf Fields)

As indicated in the chart below, artificial turf field usage accounts for a disproportionately high proportion of athletic park bookings and revenues. This data validates to a large degree user preference and demand for artificial turf fields.

Table 6.6 - Booking Utilization

	Number of Fields Included	Hours Booked (2018)	Total Revenues	Avg Revenues per Hour of Booking
Artificial Turf Fields	4* (10% of the athletic park inventory)	3,724 (average 882 hours per field, 32% of all bookings)	$413,045 (56% of athletic park field revenues)	$110.92
Natural Grass Fields	38 (90% of the athletic park inventory)	7,979 (average 211 hours per field, 68% of all bookings)	$379,882 (54% of athletic park field revenue)	$47.61

**Artificial turf fields located adjacent to the Calgary Soccer Centre not included*

The City's current artificial turf utilization is estimated at 69% (2018) of capacity, with the remaining 31% available for use. The seasonal capacity of the City's four artificial turf fields totals 4,878 hours (1,220 hours per field) and 1,154 hours remain available for use. Using these parameters, the following chart (Table 6.7) reflects the impact of transferring 5% - 30% of current natural grass field bookings to artificial turf fields. The chart also outlines the number of artificial turf fields required to meet these increased hours for artificial turf bookings (using the assumption that 1 field = 1,220 hours of capacity).

6.5 Benefits of Optimizing Artificial Turf Utilization

Some of the benefits of transferring user group bookings (e.g. hours) from natural grass to artificial turf include:

- Overall revenues are increased
- Utilization of the higher value asset is increased, generally without a corresponding increase in surface maintenance
- Artificial turf can withstand high levels of increased play, whereas natural grass cannot
- Grass fields can be 'rested' allowing for better grass surface recovery, reduced damage and lower risk of costly repairs

6.5 Benefits of Optimizing Artificial Turf Utilization

Table 6.7 - Transfer of Booking hours from Natural to Artificial Turf Fields

% of Natural Grass Field Booking Hours Transferred to Artificial Turf	Hours	Incremental Gross Revenues	Required AT Fields Equivalents
5%	399	$ 25,258	0 – 0.5 (current inventory would likely be sufficient)
10%	798	$ 50,515	0.5 – 1 (current inventory could handle this increase but would stretch capacity during peak times)
15%	1,197*	$ 75,773	1 (at this threshold, begin to exceed the current hours available)
20%	1,596	$ 101,030	1 .5
25%	1,646	$ 104,188	1.5 – 2
30%	2,394	$ 151,546	2 - 3

*1154 hours available according to 2018 City use patterns.

Key Considerations

1. While available data confirms user preference for artificial turf and illustrates the revenue benefit of this field typology, the capacity of the market to pay for incremental artificial turf field is unclear. Also user groups may have different capacity or willingness to pay more or less at different times within their seasons of play. The information and analysis in this section should be further tested with user groups to help clarify and confirm the supply the market is able/wants to support.
2. Measuring demand is challenging as users are already consuming field time, and increasing artificial turf simply shifts them to another field typology.
3. Available data (69% utilization in 2018) suggests that while capacity challenges may exist at certain peak times, the overall inventory is not at or nearing capacity. Therefore, the decision to increase artificial turf provision should be based primarily on:
   - The level of service that the City wants to provide users
   - Operational considerations
4. As a next step, focused engagement with user groups should be undertaken to test and validate the amount of incremental artificial turf field capacity they are willing and able to consume. This engagement should include both existing artificial turf user groups as well as those who currently use natural grass fields and may be considered recreational in nature.

6.6 Allocation Practices

6.6.1 | Comparable City Allocation Practices

The following chart summarizes our review of the comparable city allocation practices.

Table 6.8 - Comparable City Allocation Practices

Municipality	Key Findings
Calgary	• Preference for non-profit over for profit • Preference for minors over adults (may be a negotiation in the case of Adult historical bookings) • Preference provided to under-represented groups including girls/women, first nations (e.g. white goose flying), emerging sports • Refer to section 6.6.3 Calgary Allocation Practices
Edmonton	• Standards of play consistent (reviewed regularly by a committee that consists of the City and user group representatives) • The City has a handful of partnership agreements in place that impact artificial turf bookings on its high-performance fields (e.g., University of Alberta for Foote Field; Edmonton FC for Clarke Park; and Edmonton Eskimos for Commonwealth Stadium).
Mississauga	• City operated artificial turf and premium natural grass venues fall under the Outdoor Sports Field Management Policy • Priority order: 1) City programming, 2) Affiliated sport providers, 3) School board, 4) Community sport/recreation providers • Criteria: 1) Priority ranking, 2) Utilization numbers, 3) Historical 4) Intended sport uses • The city uses an allocations formula to assign time
Ottawa	• Policy update in 2016 • Intended to help create more equity across all recreation facility allocations and to provide additional structure

6.6 Allocation Practices

6.6.2 | Alberta Sport for Life Allocation Practices

Alberta Sport For Life recommends several principles and practices for allocating facilities to sport groups. These principles and practices are aligned with the fundamentals of the Long-Term Development in Sport and Physical Activity framework (LTDSPA) and are as follows.

- Allocation practices are based on 'standards of play' principles regarding the time and space required by each group
- Allocation policies are transparent and reviewed with the groups
- Allocation is not done by tradition, but rather on actual requirements of all groups, including the needs of emerging sports
- Seasonal allocation meetings are held with common user groups to review their requests and try to achieve consensus on sharing available spaces and times
- As seasons progress, groups are encouraged to be flexible in the reallocation of spaces with other groups when no longer needed, either temporarily or for longer periods
- User fees and subsidies need to reflect community taxpayers support, and the rationale should be shared with sport organizations
- National and Provincial sport organizations (NSOs and PSOs) are required to demonstrate alignment with Sport for Life and LTD principles

Most major NSOs in Canada have developed resource materials and frameworks specific to their sport which outline training and practice guidelines, standards for the ideal size of playing surface specific to each age category, and practice-to-game ratios that align with Sport For Life and LTD notions. Increasingly, many municipalities are also adapting allocation policies and procedures to reflect these standards and suggested allocation practices.

Image Source: Henrique Macedo - Unsplash

6.6 Allocation Practices

6.6.3 | Calgary Allocation Practices

Allocations principles currently used at City of Calgary:
Athletic parks are currently booked to groups based on a combination of historical/roll-over bookings and allocation principles associated with the Sport for Life Policy. The number of hours given to any group is based off the number of hours they book across all field types. Other allocation priorities/principles include:

- Preference for non-profit over for profit
- Preference for minors over Adults (may be a negotiation in the case of Adult historical bookings)
- Preference provided under-represented groups including girls/women, first nations (e.g.. White Goose Flying), emerging sports

A participation survey is also completed at the end of every season, where groups provide participation numbers. The survey worksheets are continuously being improved and the allocations system is being slowly moved through all booking groups which will better align existing bookings practices with LTAD.

Recommendations for improving Calgary's allocations principles include:

- Continue with the existing allocation principals with priority given to historic use, non-profit, minor sport, underrepresented groups and emerging sports
- As user groups needs change, encourage reallocation of spaces with other groups on a short-term basis
- Place higher priority on allocations based on actual requirements of each groups, including the needs of emerging sports, rather than historical priority. Consider verifying participant numbers for each user group (require supporting documentation

Image Source: Jeffrey-f-lin, Unsplash

6.7 Athletic Park Operations Staffing

Within an athletic park site, staffing will be dynamic based on usage and community demand. However, trained sports field managers dedicated to each field or set of fields is crucial to meeting maintenance standards, especially if various contractors and unskilled staff are working on the site. Whenever possible, we recommend the technicians take entry level turfgrass management training via Turf Science Certificate or Diploma.

We recommend that the City appoint a Senior Superintendent of Sports Fields to oversee facility specialists. Some other roles and qualifications are summarized below:

City of Calgary	Proposed Operational Organizational Structure
Superintendent	Senior Superintendent
Site Coordinator (Crew Lead)	Complex Coordinator
City Crews or Contractor	Crew Lead – Summer Crew

Senior Superintendent:
Degree in Turf/Golf Management, with 10+ years of facility management experience. The superintendent will provide maintenance programs and leadership to all sports field facilities within their portfolio. Responsible for leadership, training, and ultimately accountable for all properties, they will direct the facility managers to improve / maintain their facilities. This role would be similar to "Superintendent" role within City of Calgary Recreation Environment.

Complex Coordinator (in charge of summer crew)
Minimum Qualifications include a diploma in turf management, sports field management certificate, pesticide applicators license, and irrigation training. The facility manager should be accountable to ensure quality control during construction and renovation, and effective coordination of contractors. Responsible for fertility, pesticide application, irrigation management, field rotation, and cultural programs, specific items listed in the 'core standards' list. This role would be similar to "Crew Lead" role within City of Calgary Recreation Environment.

Staffing requirements will be based on facility size, subsequent variations to the specific core standards, and variable costs associated with utilization rates.

6.8 Field Signage - Artificial Turf

Signage provides rules for users to follow when on an artificial turf field, which helps prevent damage and keeps the field clean. Information that could be listed on signage includes:

- No food or drink or glass containers on the field. Plastic water bottles permitted
- No spitting
- No alcohol
- No smoking
- No chewing tobacco
- No pets (animals) on the field
- Avoid tracking infill material off the field. Before leaving the field, shake off any visible infill and use the boot brush area
- Clean and disinfect wounds and cover them as soon as possible
- No footwear with metal spikes or metal cleats
- Clean footwear on boot brushes before entering field
- No scooters, skateboards, in-line skates, roller blades or motorized vehicles (e.g. ATVs or battery-operated scooters) on the field. This is to protect the artificial turf surface from wheel damage

Image Source: Jeffrey F Lin, Unsplash

6.9 Artificial Turf Fields – Regular and Special Uses

The owner should keep track of field usage hours, as an artificial turf field can be used max. 3000 hours per year (based on industry warranty standards). We recommend to shift use from over-utilized fields to under-utilized where possible. Be knowledgeable of the high-wear areas on the field itself. Encourage field users to rotate their warm-up drills to areas that are not highly worn, so that wear is more evenly distributed.

Artificial turf surfaces can be used for non-standard activities (e.g. festivals and community events), but it is important to protect the surface during these activities.

Based on standard industry practices, artificial turf warranties cover the following activities:

- Soccer
- Football
- Lacrosse
- Ultimate (Frisbee)
- Field Hockey
- Marching band
- Rugby
- Physical exercises
- Baseball
- Physical education activities
- Softball
- Military/Police marching drills
- Field cover for special events and concerts
- Pedestrian traffic and other similar uses
- Pneumatic rubber-tired maintenance and service vehicles
- Other miscellaneous sport and recreation activities

All alternate activities should take into consideration the warranty and exemptions that are listed within warranty clauses. The following activities should not be performed on the field:

- Fireworks
- All activities that may melt the artificial turf fibers
- Parking vehicles for long periods of time, especially when the field is wet
- Loading/storing heavy items on the field
- Idling of maintenance vehicles, as the exhaust pollutes the field and the heat may melt the fibers

6.10 Turf Protection Systems

Turf protection systems allow for alternative higher impact uses to be carried out on the field. Turf protection systems can be used on artificial turf or natural grass.

It is important to use load spreaders to distribute pressure. Even high heels and chairs will damage turf. The goal is to keep loads below 2.46kg/cm3 (35lbs/in2). Turf protection covering is recommended to maximize field facilities programming for multi-use as a venue not only for sport but large-scale community events. Temporary event flooring helps to protect and preserve the sensitive field surface and capital investment. The initial cost of protective covering (9,800 m2) ranges from $1,200,000 – $1,600,000* (per local sourcing in the Calgary Region obtained in 2019). It is important to ensure the protective material is flat (not corrugated or textured) as this would put uneven pressure on the turf fibers.

Some of the more common systems include:

- ArmorDeck is one type of heavy-duty temporary special event flooring and turf protection system of interlocking panels (1.067 m x 1.067 m x 5.08 cm). With roughly 44 panels per pallet, each pallet can provide approximately 50 m2 coverage. A total of 270 pallets would be required to cover a multi-purpose field size of approximately 13500 m^2. ArmorDeck can easily be triple-stacked (or more) to cover smaller areas and/or provide extra layers of protection. The footprint would be approximately 3,500 - 4500 m2. ArmorDeck 1, a pedestrian system, costs $10.50/sq. ft plus GST and freight. Armor Deck 3, a driveable system, costs $14.45/sq.ft. plus GST and freight. Product information and pricing were provided by a representative based in the Calgary Region*
- OmniDeck – Driveable turf protection system. 3' x 6' panels suitable for event flooring. Pricing for this option is $14.45/sq. ft plus GST and freight*

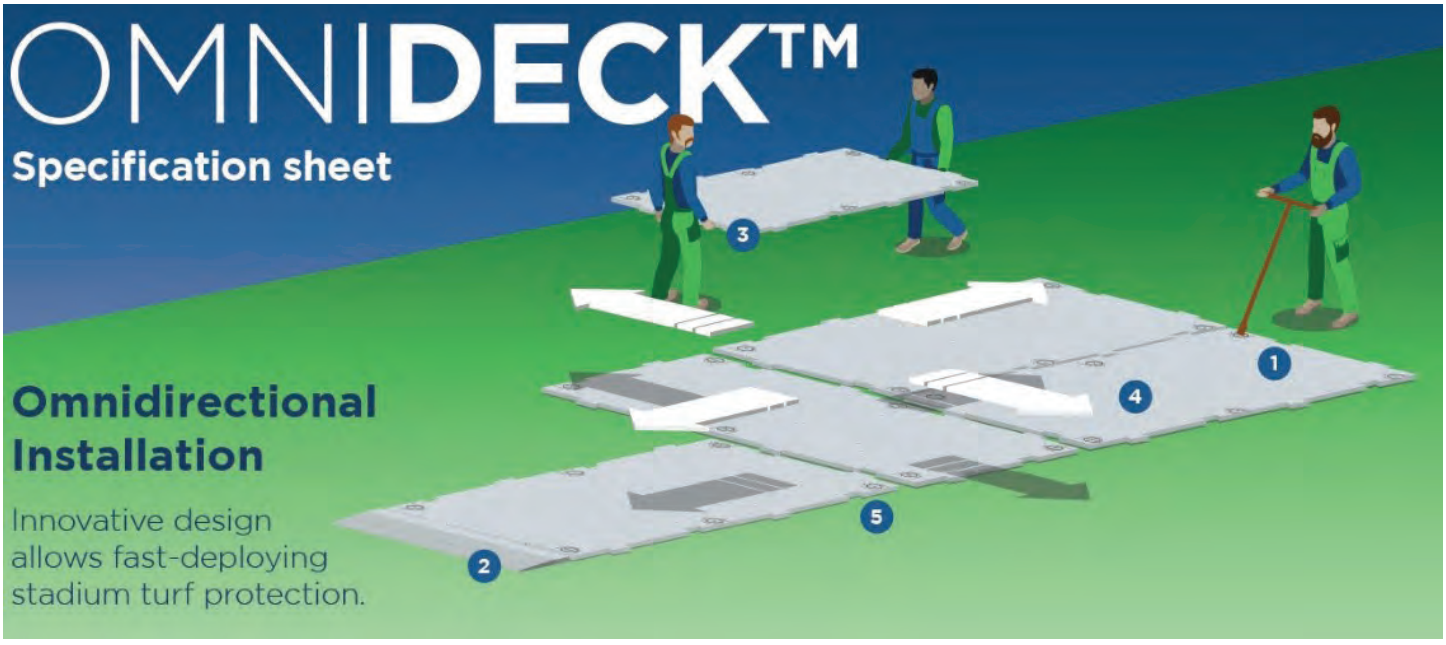

Figure 6.3 - Omni Deck Turf Protection System

**All pricing was obtained in 2019*

6.10 Turf Protection Systems

- UltraDeck1 – Pedestrian system, 1' x 2' panels suitable for pedestrian traffic, trade shows, forklifts, etc. No tools required, and fast to install. Pricing is $5.75/sq. ft plus GST and freight*
- Plywood (19mm thickness) on top of plastic tarp can be used instead of a commercial plastic system. The tarp is necessary to keep plywood particles from polluting the infill. Note that plywood can shift, which could pose a hazard if not well-secured

**All pricing was obtained in 2019*

Figure 6.4 – Unprotected Field After Rock Concert

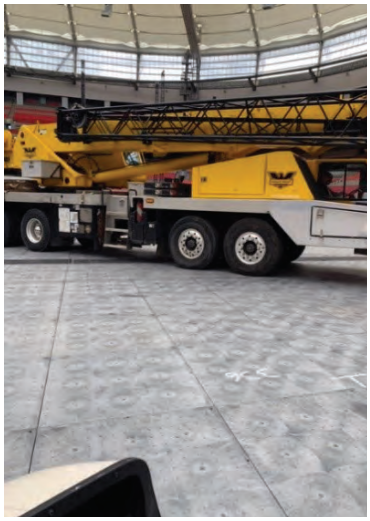

Figure 6.5 – ArmorDeck, a Protective Covering System

Image Source: PhilippeDesoche - Istock

6.11 Part F Key Recommendations and Takeaways

Recommendations and key takeaways from Part F – Special Considerations for Artificial Turf include the following:

1. The City's artificial turf fields were booked 882 hours while natural grass fields were 211 hours (per field based on average bookings in 2018). This is consistent with the industry standard 4:1 ratio for artificial vs. natural grass.

2. Artificial fields can be utilized up to 3,000 hours per year, and natural grass up to 700 hours per year (subject to adequate maintenance and weather conditions). For practical purposes, artificial turf fields in Calgary are available for about 1,200 hours of prime time use per year, whereas natural grass is available for about 400 hours per year.

3. Based on bookings, Calgary's natural grass and artificial turf fields could be better utilized.

4. Calgary records bookings and not actual field utilization. An audit of how well bookings align with actual utilization should be conducted.

5. Calgary does not charge separately for lighting. As a result, users pay the same rate for a field used during daylight hours when lights are not used. A fairer system, which is used by many Municipalities, is to charge a separate fee for lights.

6. Consideration should be made to transferring bookings from natural grass to artificial turf where feasible. Benefits include increased revenues, utilization of the higher value asset, opportunity to 'rest' natural grass fields, reduced risk of grass damage/repair.

7. Allocation recommendations include:

   - Continue with the existing allocation principals with priority given to historic use, non-profit, minor sport, underrepresented groups and emerging sports
   - As user groups needs change, encourage reallocation of spaces with other groups on a short-term basis
   - Place higher priority on allocations based on actual requirements of each groups, including the needs of emerging sports, rather than historical priority. Consider verifying participant numbers for each user group (require supporting documentation)

8. A Senior Superintendent of Sports Fields should be appointed to oversee facility specialists. Ideally the individual should have a degree in Turf/Golf Management, with 10+ years of facility management experience. In addition, appoint a complex coordinator (in charge of the summer crew).

9. Whenever possible, athletic park turf maintenance technicians should have entry level turfgrass management training via Turf Science Certificate or Diploma.

PART G

CASE STUDIES

Image Credit: R.F. Binnie & Associates Ltd.

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7.0 CASE STUDIES

SUMMARY OF TABLES

Image Credit: R.F. Binnie & Associates Ltd.

7.0 CASE STUDIES

7.1 Introduction and Overview

A review of other comparable cities that own and operate artificial and natural grass athletic parks has been completed. The objectives of the case study assessment include comparing athletic park facilities in the City with selected similar cities for the purposes of:

- Summarization of typical athletic park field inventory (e.g. artificial and natural grass)
- Review of field utilization, including booking rates and length of playing season
- Identification of climatic operational challenges and solutions
- Identification of typical provisions for athletic park supporting amenities (e.g. washrooms, change rooms, bleachers, lighting, etc.)
- Summarization of typical athletic park maintenance practices for both natural grass and artificial turf fields
- Identification of emerging athletic park trends including relationships with other community facilities/spaces (e.g. schools, recreation centres, community hubs, etc.)
- Review of strategies for community-based (e.g. open use/low booking) artificial turf fields

Image Credit: www.oakville.ca

7.2 Comparable Case Study Cities

Case study cities were chosen for their comparison to the City of Calgary based on use of both artificial and natural grass sports fields in their athletic parks, proximity to Calgary, as well as similarities in population, field programming and climatic conditions. Similar climatic conditions were deemed to be a particularly important characteristic as the Calgary experiences extended periods of very cold winter weather, which impacts the utilization of outdoor sports fields in winter. Conversely, cities in more temperate climates such as Metro Vancouver, can program outdoor artificial turf fields year-round, thereby gaining substantially increased annual utilization. Comparing utilization rates for outdoor fields in Calgary to Metro Vancouver would therefore be inappropriate. In addition, due to 'Chinook' warming, which is a unique and uncommon weather pattern in North America, temperatures can vary substantially in the Calgary throughout the day.

The case study cities selected for the athletic park review included:

- Denver, Colorado
- Edmonton, Alberta
- Mississauga, Ontario
- Ottawa, Ontario
- Toronto, Ontario
- Toronto District School Board

Many of these cities were also included in the review carried out as part of the City's 2016 Sport Field Strategy. All of the case study cities exhibit cold winter weather and total winter field closures; however, none are subject to the extreme daily temperature differentials (-20 C to +10 C) which appear to be fairly unique to Calgary.

Image Credit: Regent Park, BHHSToronto.ca

Image Credit: Google Maps

7.2 Comparable Case Study Cities

7.2.1 | Denver, Colorado

The City of Denver (2018 pop. 716,492) was used for comparison in the 2016 Sport Field Strategy and has a similar playing seasons (Spring, Summer and Fall) as the City of Calgary. Denver has a large number of sports fields and comparable winter conditions.

7.2.2 | Edmonton, Alberta

The City of Edmonton (2019 pop. 972,223) and the City of Calgary are two major cities in Alberta which have similar populations and cold winter climate. The City of Edmonton was also used for comparison in the 2016 Sport Field Strategy and has a similar playing season (Spring, Summer and Fall).

7.2.3 | Mississauga, Ontario

The City of Mississauga (2016 pop. 721,599) has a similar population as the City and currently has an artificial turf field within one of its festival areas. Mississauga has also developed management and maintenance guidelines for their natural grass fields.

7.2.4 | Ottawa, Ontario

The City of Ottawa (2016 pop. 934,234) has similar a population to the City of Calgary and has a similar playing season (Spring, Summer and Fall). It was also used for comparison in the 2016 Sport Field Strategy.

7.2.5 | Toronto District School Board (TDSB)

The Toronto District School Board was selected as its facilities are often used for community-based recreational programming, they participate in public-private partnerships for artificial turf field construction/operation, and they are also involved in the strategic planning for artificial turf field developments on joint-use sites.

7.2.6 | Toronto, Ontario

The City of Toronto (2016 pop. 2,731,571) is much larger than Calgary, however, the playing season is similar (Spring, Summer and Fall). In addition, Toronto has developed facility classification and ratings for its three field classification types. The City of Toronto has also researched and developed a Public Health document and position statement related to Artificial Turf Fields.

There is also currently a comparable community open access artificial turf field example within City of Toronto at Canoe Landing Park.

7.3 Case Study Cities - Single Site References

The following sites were considered for specific considerations only (as outlined below) and were not included in the review and assessment of the primary case study cities for general comparison to the City of Calgary.

Image Credit: Google Maps

Image Credit: Google street view

7.3.1 | Burnaby, British Columbia – Burnaby Lake Sports Complex

The City of Burnaby, British Columbia (2016 pop. 232,755) with a population that is less than a quarter the size of the City of Calgary, has one of the largest athletic parks in Metro Vancouver containing five artificial turf fields. Their fields are typically used year-round, including for National and Provincial level tournaments. There is also a park maintenance yard on-site, as well as offices for City park staff within the fieldhouse. This site provides useful information concerning amenities for large tournament sites, as well as effective synergies with park operations and onsite staffing. Burnaby Lake Sports Complex was also the first infilled artificial turf athletic park in Canada, and therefore provides substantial historic information available on durability, life cycle costing, maintenance, turf replacement and operation.

7.3.2 | Winnipeg, Manitoba – Saint Vital Memorial Park

Saint Vital Memorial Park in the City of Winnipeg (2016 pop. 705,244) was selected because of its function as a community use artificial turf field, where public access is permitted. It has limited fencing and is adjacent to a public school and recreation centre.

7.4 Climate Adaptation - Playing Season

7.4.1 | Length of Playing Season

The following table summarizes the length of playing season for each comparison city and outlines access to artificial and natural grass fields for users during a typical season.

Table 7.1 - Length of Playing Season

	Field Type	Calgary	Calgary Playing Season Length	Denver	Edmonton	Mississauga	Ottawa	TDSB*	Toronto	Median Rate	Playing Season Length Median
ARTIFICIAL TURF	Lit	Mar/01 to Dec /02	9.0 Months	March 1 – Dec. 1	Spring (varies) to Nov. 1	April 1 – Nov.1	April 1 – Nov. 15	April 1 – Oct. 31	April 1 – Nov. 30	April 1 – Nov. 15	8 months
NATURAL GRASS	Type 1 - Lit and irrigated	May/** to Sept/**	4 .0 Months	March 1 – Dec. 1	Spring (varies) to Sept. 30	May 11 – Nov.27	May 10 – October 31	May 15 – Oct. 15	May 11 – Sept. 29	May 15 - Oct. 1	5 months
	Type 2 -Unlit and irrigated	May/11 to Sept/29	4.5 Months	March 1 – Dec. 1	Spring (varies) to Sept. 30	May 11 – Nov.27	May 10 – Oct.31	May 15 – Oct. 15	May 11 – Sept. 29	May 15 - Oct. 15	5 months

**Toronto District School Board*
*** The site opening dates are flexible dates in May based on City of Calgary staff decisions*
**** Spring as Late April to Late May for City of Edmonton*
Sources: (City of Calgary, 2019), (City of Edmonton, 2019), (Toronto District School Board, 2019), (City of Toronto, 2019)

7.4 Climate Adaptation - Playing Season

7.4.2 | Key Findings - Length of Playing Season

Overall the playing season length is similar across most of the comparison cities with respect to natural grass fields which are generally available for user groups from May to October, not considering closures for adverse weather conditions. In comparison, the playing season, access and use of artificial turf fields is generally from April to November. On average, users are able to access artificial fields a month earlier in the spring, and two months later in fall for a total of a three-month extension to the playing season (as compared to natural grass).

How does this compare to the City of Calgary?

- For artificial turf fields the City allows access and use one month earlier than most case study cities but is similar to Denver (March 1st start)
- The City's natural grass fields, whether lit & irrigated or unlit & irrigated, are open for use during the same time frames as many of the comparison cities (the May long weekend to end of September)
- The opening dates from field to field may vary within all communities and are affected by the condition of the natural grass, maintenance, specific site conditions (e.g. snow coverage, seasonally flooding, saturated soil conditions)
- In our experience, and based on our discussions with numerous city operations staff, the driving condition affecting field open and close times is weather. Fields remain open while they are serviceable and playable, based on historic conditions that are unique to each geographic area. For the extreme shoulder seasons, snow removal is typically utilized to keep artificial fields open and playable

Image Credit: iStock Photos

Image Credit: Brett Ryan Studios

7.5 Climate Adaptation - Weather Conditions

7.5.1 | Weather Condition Considerations and Mitigation

The development, design and implementation of natural and artificial turf sport fields must include climate considerations and solutions, as site conditions can be affected by a variety of changes in weather patterns or conditions. These conditions may include:

- Flooding (due to heavy rain or snow melt)
- Chinook temperature extremes
- Drought and heat
- Excessive rainfall
- Weather-related turf grass disease

There is limited information about how the selected case study communities are impacted by climate changes and including whether they have adopted any unique solutions for mitigation. Research suggests industry measures are currently being taken to address flooding, drought and heat, excessive rainfall, temperature variations, and weather-related turf grass disease.


Image Credit: Mattie Zepernik


Image Credit: www.medium.com

7.5 Climate Adaptation - Weather Conditions

7.5.2 | Key Findings - Climate Mitigation Measures

Various industry standards exist for climate impact mitigation for the design, construction and maintenance of both natural grass and artificial turf fields. In addition, artificial turf manufacturers have detailed requirements for construction, operation and maintenance of their respective products. These standards consider weather impacts on the sport surfaces.

Some of the typical effective measures employed by the case study facilities to mitigate climate considerations are summarized below:

- **Flooding –** Flooding is a common issue due to winter snow melts and heavy rainfall events that can occur during the playing season. Mitigation solutions include designing for an effective overland drainage system combined with adequate area drains, swales and/or ditches to direct runoff away from the field and into a stormwater management system (e.g. storm sewer, pond or offsite drainage system). In flat terrain, or in areas prone to flooding, playing field surfaces should be constructed above the surrounding area, so that the surcharging flood water can drain away. Wherever possible, avoid locating artificial fields in flood plains, or if feasible, construct the surface of the field above the historic flood plain level
- **Chinook –** Severe Chinook conditions are unique to the Calgary Region; however other communities have similar issues with respect to multiple freeze thaw cycles occurring over a 24-hour period. The sudden warm dry Chinook winds can cause snow and ice melt followed by overland flooding. The quick return to freezing temperatures causes subsequent ice build up on fields when the excess melted water refreezes over frozen ground conditions. The same measures used to prevent flooding can be utilized to minimize Chinook impacts. For artificial turf fields, where sports surface drainage is primarily vertical (due to high vertical permeability of the turf and pad), a highly effective granular base is essential. Furthermore, the sub-base should be designed to minimize frost heave to the greatest extent
- **Drought & Heat (Natural Grass) –** Prolonged periods of drought and heat are a common occurrence for many areas of the country during the summer months. For natural grass, drought is typically managed through irrigation, and an increasing number of municipalities are starting to install irrigation systems on their higher-level natural grass sports fields. The City of Edmonton has started installing irrigation systems in their lower-level grass fields to transition them to unlit irrigated fields over the next two years. The City of Denver experiences extreme drought and heat and also has water restrictions. However, Denver continues to irrigate athletic parks, following a water conservation plan, aiming for a 20% reduction in athletic field irrigation, or up to 35% reduction for extreme drought events for irrigation watering reductions. The decision to reduce the watering levels may shorten the playing season and close selected fields. (Denver Parks & Recreation Water Management Plan, 2019)

7.5 Climate Adaptation - Weather Conditions

- **Heat (Artificial Turf)** While more common in the southern United States, artificial turf fields can be urban heat islands during extremely hot summer periods. Overheating can be a safety concern for some players. Mitigation measures can include utilization of infill materials other than crumb rubber (e.g. Organic, Thermoplastic Elastomers [TPE] and Ethylene Propylene Diene Monomer [EPDM] infill), and selective scheduling of playing times to avoid peak activity during the hottest times of the day. In Canada, Toronto has implemented such scheduling guidelines (Toronto Public Health, April 2015)
- **Excessive Rainfall –** The most common reason for the inability to play on natural grass fields as reported through the media in 2018 and 2019 is that they were too wet. The key to addressing this issue is to include a full underground drainage system as part of the design for new natural grass fields, or to renovate existing fields with a complete field drain system. Constructing the field rootzone and granular base with adequate vertical and lateral permeability to enable runoff to reach the perforated drains is essential as the drainage allows the excess water to drain into the stormwater management system. Any underground storage provided should be located outside of the field footprint or below the rootzone, with adequate capacity to ensure the rootzone remains well-drained during most rainfall events
- **Disease (Natural Grass)** – Turf grass disease (e.g. pink and grey snow mould) occurs on natural grass fields and results from a lack of consistent horticulture maintenance practices, increased playing time, and reduced recovery and regeneration time for the grass. This can lead to increased stress on the turf (plants) and makes them vulnerable to diseases. To address this, ensure provision of appropriate industry horticulture maintenance practices, monitor and limit playing time when appropriate, and allow time for grass (plant) regeneration. Increasing care and maintenance on specific fields where wear areas are occurring and maintaining regular field drainage improvements to allow for increased drainage are recommended strategies (City of Toronto, 2012)
- **Disease (Artificial Turf)** – In the United States, concern has been raised regarding bacteria, in particular MRSA (*Staphylococcus aureus* and *Methicillin resistant S. aureus*) growth and survival on artificial turf surfaces. This is of special concern during extended periods of warm dry weather where players are frequently subjected to abrasions (e.g. tackle Football). During prolonged periods of dry weather, artificial turf should be washed down to address and prevent any sanitary issues. This can be achieved by locating water sources (e.g. quick couplers/hose bibs) near the field to enable wash down. Also, users, and maintenance staff should be reminded or educated about proper hygiene before and after accessing the field (e.g. hand washing, cleaning areas affected by body fluids) *(Toronto Public Health, April 2015).*

7.5 Climate Adaptation - Weather Conditions

How does this compare to the City of Calgary?

Many of the above measures utilized to mitigate climate impacts are implemented by the City of Calgary and other municipalities to varying degrees, subject to original field construction, and operating budgets and maintenance practices. While each city strives towards such optimal standards, due to the aforementioned constraints, this is not always achieved.

In summary, while there is general consensus on what should be done to mitigate climate impacts, in practice there is no uniformity on implementation.

Please refer to the other sections in this report that outline recommended design, construction and maintenance guidelines for synthetic turf and natural grass fields for additional information.

7.6 Typical Athletic Park Amenities

We have reviewed the amenities provided at athletic parks for the case study cities. For each city we have reviewed all artificial turf fields as well as selected representative natural grass fields. For the natural grass fields, our objective was to identify natural grass locations that were similar in function to the City's Class B or C natural grass fields.

Image Credit: Chris Thornton, Pixabay

Image Credit: Monica Vogt

7.6 Typical Athletic Park Amenities

7.6.1 | Key Findings – Athletic Park Field Amenities

Table 7.2 – Summary of Amenities – Typical Artificial Turf Athletic Park

The following table lists the type and frequency of amenities at each city's artificial field athletic parks.

- Where Calgary's rate is higher than the average, the average rate is indicated in red
- Where Calgary's rate is lower than the average, the average rate is indicated in blue

Amenity Type	Calgary	Denver	Edmonton	Mississauga	Ottawa	Toronto	Avg.	Calgary
Press Box	3/7	0/10	2/4	0/9	3/6	2/7	20%	42%
Score Clock	6/7	4/10	4/4	4/9	4/6	3/7	53%	85%
Fencing (full)	6/7	8/10	4/4	9/9	6/6	5/7	84%	85%
Lighting	7/7	9/10	4/4	9/9	6/6	7/7	97%	100%
Washrooms	6/7	10/10	4/4	9/9	5/6	6/7	94%	85%
Change rooms	6/7	7/10	4/4	9/9	5/6	5/7	83%	85%
Players' Benches	7/7	4/10	4/4	9/9	4/6	7/7	78%	100%
Bleachers	7/7	7/10	4/4	9/9	5/6	6/7	86%	100%

The case studies reflect that artificial turf fields are generally well equipped with more associated amenities (Bleachers, Change rooms, Washrooms, Press Box, Score Clock) than natural grass fields. The additional amenities are justified, and in most cases required, to accommodate high frequency and intensity of use. The artificial fields commonly host larger tournaments requiring spectator seating, players benches and change rooms. The vast majority are lit, which allows for utilization in evenings. Many artificial turf fields are located adjacent to an arena, stadium or high school where synergies can be achieved with respect to parking, washrooms, change rooms and ancillary site features such as playground areas.

How does this compare to the City of Calgary?

Based on the case study comparisons, the City provides a comparable rate of amenities as other cities for artificial turf fields. The above table indicates a higher rate of provisions for press boxes and score clocks, however, this is because 3 of 7 artificial fields operated by the City are located at Shouldice Park, which is a top tournament facility in Calgary. Refer to Part B – Development of Athletic Parks for recommended amenities based on field classification.

7.6 Typical Athletic Park Amenities

Table 7.3 - Summary of Amenities – Typical Natural Grass Athletic Park

The following table lists the type and frequency of amenities at a representative natural grass field athletic park.

- Where Calgary's rate is higher than the average, Calgary's rate is indicated in red
- Where Calgary's rate is lower than the average, Calgary's rate is indicated in blue
- Where there is no meaningful difference Calgary's rate is indicated in black

Amenity Type	Calgary	Denver	Edmonton	Mississauga	Ottawa	Toronto	Avg.	Calgary
Press Box	0/36	1/76	0/39	0/11	0/65	0/58	0%	0%
Score Clock	1/36	0/76	0/39	0/11	1/65	0/58	0%	3%
Fencing (Complete)	0/36	1/76	0/39	11/11	16/65	0/58	11%	0%
Lighting	4/36	2/76	2/39	11/11	43/65	39/58	21%	10%
Washrooms	23/36	2/76	6/39	Unknown	Unknown	Unknown	7%	64%
Change rooms	21/36	0/76	6/39	Unknown	Unknown	Unknown	5%	58%
Players' Benches	14/36	0/76	6/39	11/11	27/65	58/58	41%	38%
Bleachers	20/36	1/76	6/39	11/11	65/65	58/58	57%	55%

Based on the case study examples of comparable cities, a typical natural grass field at an athletic park is serviced at a relatively low level (below 50%) for associated amenities indicated, in particular when compared to the amenities provided at artificial turf athletic parks.

Additional information and comments from the table above include:

- City of Mississauga has 211 rectangular fields and approximately 11 fields would be comparable to Calgary's Class A or B fields
- City of Ottawa has 482 rectangular fields. Approximately 65 would be classified as Class A or B fields
- City of Toronto has 324 rectangular comparable to Calgary's. The fields classified as Premier or A which are 58 fields in the inventory have more amenities than lower classifications fields levels
- City of Edmonton has 867 rectangular fields and approximately 39 fields would be comparable to Calgary's Class A or B fields
- City of Denver has 76 rectangular fields and all would be comparable to Calgary's Class A or B fields. There are only two large soccer complexes in Denver which have either restrooms facilities via a structure and remaining sites would have portable restrooms

7.6 Typical Athletic Park Amenities

How does this compare to the City of Calgary?

The City's natural grass fields at athletic parks provide a higher level of amenities than the case study cities with respect to washrooms, and change rooms. Lighting is rarely provided (consistent with other cities), however, the added cost of lighting is rarely justifiable due to surface wear limitations on field utilization (e.g. natural grass cannot withstand the extra wear arising from increased use during non-daylight hours). Most of the City's natural grass athletic parks are strategically situated adjacent to an arena, stadium or recreation center where washrooms and change rooms are provided as part of the indoor facility. As separate stand-alone facilities are not required, there is little to no extra cost in the provision of washrooms and change rooms for these athletic parks.

Complete perimeter fencing is provided at very few of Calgary's natural grass athletic parks ; however, most fields include ball control fencing behind goal areas and some form of barrier (landscaping, property line fencing boulders, etc.) to restrict motor vehicles from accessing the grass playing surface.

Image: New Brighton Park

Image Credit: iStock Photos

7.7 Field Rental Rates

We have summarized the rental rates for various types of sports facilities as outlined in the tables below.

Please note the following:

- Calgary field rental rates include lighting (whether it is used or not)
- City of Denver charges an additional $45 ($35 USD - 2019) per hour for lighting (based on use)
- City of Edmonton charges an additional $48 for lighting (based on use)
- City of Mississauga charges an additional $5.00 to $10.00 per hour for lighting (based on use)
- City of Ottawa charges an additional $28.75 per hour for lighting (based on use)
- For Denver, the rates are indicated in US dollars. However, a conversion of 1 USD = $0.75 CDN has been applied when calculating the average rate
- The City of Calgary has not been included in the average rate computations
- Where Calgary's rate is higher than the average, the average rate is indicated in red
- Where Calgary's rate is lower than the average, the average rate is indicated in blue

7.7 Field Rental Rates

7.7.1 | Hourly Rates – Natural Grass - Type 1 - Lit and Irrigated

Table 7.4 – Hourly Rates: Natural Grass – Lit and Irrigated (without Lighting)

User	Calgary (Class B)		Denver (USD)	Edmonton	Mississauga	Ottawa	Toronto District School Board	Toronto	Avg. Rate
Youth Group	Minor	$52.99	$35.00	$22.50	$3.80	$9.50	$7.82	$38.45	$21.26
Sport Camps		$52.99	$35.00	$22.50	$3.07	$9.50	$7.82	$38.45	$21.14
Comm. Group	Adult	$105.88	$35.00	$45.05	$4.78	$49.00	$16.01	$38.45	$33.13
Resident		$105.88	$54.00	$45.05	$13.64	$49.00	$19.51	$38.45	$39.31
Non-Resident		$105.88	$54.00	$45.05	$15.00	$51.40	$70.44	$38.45	$48.42
Commercial		$105.88	$54.00	$45.05	$19.21	$51.40	$70.44	$38.45	$49.13

Table 7.5 – Hourly Rates: Natural Grass – Lit and Irrigated

User	Calgary (Class A)		Denver (USD)	Edmonton	Mississauga	Ottawa	Toronto District School Board	Toronto	Avg. Rate
Youth Group	Minor	$52.99	$70.00	$70.50	$8.80	$38.25	$7.82	$38.45	$42.47
Sport Camps		$52.99	$70.00	$70.50	$8.07	$38.25	$7.82	$38.45	$42.35
Comm. Group	Adult	$105.88	$70.00	$93.05	$9.78	$77.75	$16.01	$38.45	$54.34
Resident		$105.88	$89.00	$93.05	$23.64	$77.75	$19.51	$38.45	$61.35
Non-Resident		$105.88	$89.00	$93.05	$25.00	$80.15	$70.44	$38.45	$70.47
Commercial		$105.88	$89.00	$93.05	$29.21	$80.15	$70.44	$38.45	$71.17

7.7.2 | Hourly Rates – Natural Grass - Type 2 - Unlit and Irrigated

Table 7.6 – Hourly Rates: Natural Grass –Unlit and Irrigated

User Group	Calgary (Class C)		Denver (USD)	Edmonton	Mississauga	Ottawa	TDSB	Toronto	Median Rate
Youth Group	Minor Rate	$39.18	$35.00	$5.40	$3.80	$7.65	$7.82	$19.90	$15.01
Sport Camps		$39.18	$35.00	$5.40	$3.07	$7.65	$7.82	$19.90	$14.89
Comm. Group		$39.18	$35.00	$10.65	$4.78	$37.15	$16.01	$19.90	$22.33
Resident	Adult Rate	$78.77	$54.00	$10.65	$13.64	$37.15	$19.51	$19.90	$28.51
Non-Resident		$78.77	$54.00	$10.65	$15.00	$39.00	$70.44	$19.90	$38.87
Commercial		$78.77	$54.00	$10.65	$19.21	$39.00	$70.44	$19.90	$38.23

7.7 Field Rental Rates

7.7.3 | Hourly Rates – Artificial Turf

Table 7.7 – Hourly Rates: Artificial Turf – Without Lighting

User Group	Calgary		Denver (USD)	Edmonton	Mississauga	Ottawa	TDSB	Toronto	Average Rate
Youth Group	Minor Rate	$108.54	$40.00	$75.00	$65.63	$80.80	$135.56	$105.50	$85.75
Sport Camps		$108.54	$75.00	$75.00	$77.26	$80.80	$135.56	$105.50	$95.27
Comm. Group		$108.54	$65.00	$105.00	$107.39	$137.25	$165.32	$105.50	$117.49
Resident		$108.54	$125.00	$105.00	$119.33	$137.25	$165.32	$105.50	$132.48
Non-Resident	Adult Rate	$137.75	$125.00	$105.00	$131.26	$148.25	$198.39	$105.50	$141.82
Commercial		$137.75	$125.00	$105.00	$175.55	$148.25	$198.39	$105.50	$149.20

Table 7.8 – Hourly Rates: Artificial Turf – With Lighting

User Group	Calgary		Denver (USD)	Edmonton	Mississauga	Ottawa	TDSB	Toronto	Average Rate
Youth Group	Minor Rate	$108.54	$75.00	$123.00	$70.63	$109.55	$135.56	$105.50	$106.96
Sport Camps		$108.54	$110.00	$123.00	$82.26	$109.55	$135.56	$105.50	$116.48
Comm. Group		$108.54	$100.00	$153.00	$112.39	$166.00	$165.32	$105.50	$138.70
Resident		$108.54	$160.00	$153.00	$124.33	$166.00	$165.32	$105.50	$153.69
Non-Resident	Adult Rate	$137.75	$160.00	$153.00	$141.26	$177.00	$198.39	$105.50	$163.86
Commercial		$137.75	$160.00	$153.00	$185.55	$177.00	$198.39	$105.50	$171.24

Image Credit: Brett Ryan Studios

7.7 Field Rental Rates

7.7.4 | Hourly Rates – Key Findings

Based on our review of the case study cities, there is a relatively wide discrepancy on field rental rates. In general, the following are some key findings:

- A sliding rate scale, from low to high, is applied based on whether the user is a youth, adult, resident, non-resident or commercial group , refer to section 7.7 Field Rental Rates
- The use of field lighting, where available, is typically charged separately and not included as a blended hourly rate
- The City of Calgary does not charge separately for lighting, and instead charges a blended rate, irrespective of whether the field is rented for daytime hours (where lights are not used)
- The City of Calgary has fewer rate classes than other cities. Calgary applies rates base on Youth or Adult classifications, whereas most other cities include resident, non-resident rates as well as commercial uses
- The City of Calgary rates are higher than the average rates for lit and unlit natural grass fields, across all rate classes, and in many cases considerably higher
- The City of Calgary rates are slightly higher than the average rates for lit and unlit artificial turf fields for youth groups and sports camps rate classes
- The City of Calgary rates are lower than the average rates for lit and unlit artificial turf fields for adult resident and non-resident rate classes

Image Credit: iStock Photos

Image Credit: www.pexels.com

7.8 Maintenance Practices

7.8.1 | Typical Maintenance Practices

The chart below illustrates the maintenance standards of Calgary, other comparison cities as well as those considered to be industry standards.

Table 7.9 – Median Maintenance Standards

Field Class	Grass Cutting	Fertilize	Aerate	Top-dressing	Overseeding	Goal Mouth Repairs	Lining	Litter Pick up
CITY OF CALGARY								
LIT AND IRRIGATED	-	-	-	-	-	-	-	-
UNLIT AND IRRIGATED	2 per 7 days	3 per year	2 for Soccer and 1 for Ball per year	With aeration 2-3 mm screened sand 33 M3 (one truck and pup)	With aeration 2-3 mm screened sand 33 M3 (one truck and pup)		Turf (weekly)/ Infields (after dragging)	NA
ATHLETIC FIELD CONSTRUCTION MANUAL – RECOMMENDATIONS BASED ON FIELD CATEGORIES								
LIT AND IRRIGATED	1 per 7 days	4 PER YEAR	4 per year	2 per year	2 per year	As required	As required	As required
UNLIT AND IRRIGATED	1 per 7 days	4 PER YEAR	2 per year	2 per year	2 per year	As required	As required	As required
CITY OF DENVER								
LIT AND IRRIGATED	3 per 7 days	3-5 per year	3 - 4 per year	As required	3 per year	As required	2 per year	1 per 7 days
UNLIT AND IRRIGATED	3 per 7 days	3-5 per year	3 - 4 per year	As required	3 per year	As required	2 per year	1 per 7 days
CITY OF EDMONTON								
LIT AND IRRIGATED	18 times per year	2 per year	1 per year	NA	As required	As required	As required	As required
UNLIT AND IRRIGATED	12 times per year	2 per year	1 per year	1 per year	NA	NA	As required	As required

7.8 Maintenance Practices

Table 7.9 – (Continued) - Median Maintenance Standards

Field Class	Grass Cutting	Fertilize	Aerate	Top-dressing	Overseeding	Goal Mouth Repairs	Lining	Litter Pick up
CITY OF MISSISSAUGA								
LIT AND IRRIGATED	3 per 7 days	5 per year	3 per year	1 per year or as required	1 per year or as required	As required	1 per 7 days	1 per 7 days
UNLIT AND IRRIGATED	3 per 7 days	1 per year	2 per year	1 per year or as required	1 per year or as required	As required	1 per 14 days	1 per 7 days
CITY OF OTTAWA								
FIELD MAINTEN-ANCE	NA	NA	NA	NA	NA	NA	NA	NA
TORONTO DISTRICT SCHOOL BOARD								
ALL FIELDS	1 per 7 days	As required	As required	As required	As required	As required	As required	As required
CITY OF TORONTO								
PREMIER	3 per 7 days	3 per year	4 per year	2 per year	4 per year	As required	As required	1 per 7 days
LIT AND IRRIGATED	2 per 7 days	2 per year	3 per year	1 per year	3 per year	As required	As required	As required
UNLIT AND IRRIGATED	2 per 7 days	2 per year	3 per year	1 per year	3 per year	As required	As required	As required

7.8 Maintenance Practices

Other natural grass sports field maintenance standards not addressed in Table 7.9 are as follows:

- Turf maintenance heights range from 5.08cm (2.0") to 6.98cm (2.75") to 7.6cm (3.0")
- Leaf removal has been addressed in other municipalities and mulching of leaves is promoted and practiced where possible
- Where fields are irrigated, the frequency of the watering should be adjusted according to rainfall, temperature and requirements of the turf species
- Grass trimming is typically carried out following each cutting
- Turf rolling is not a necessary turf maintenance practice. Heavy rolling of saturated or clay soils in spring will cause soil compaction and increase soil moisture stress later during the summer. Rolling should never be used to correct surface undulations on fields

Image Credit: www.pxhere.com

7.8 Maintenance Practices

7.8.2 | Field Resting

Field resting has been described in variety of sport turf maintenance standards within municipalities in Canada. Field resting should take into consideration type of use and level of play to determine appropriate field rest periods and improved horticulture practices during resting period. Some of the resting programs are described as follows:

City of Edmonton Resting Standard:

- A maximum of twelve (12) fields (6 north and 6 south) are taken out of service to be rested at any one time, citywide. The rest period will begin on a Monday and last twenty-six (26) days
- During the entire playing season, at least 126 large rectangular fields receive rest and repair. This program is above their ongoing turf maintenance programs. After the twenty-six (26) days of rest, the difference in turf quality is very evident

Other Field Resting Practices:

- Field Rotation reduces compaction due to overuse and wear. Different fields should be used for practice by alternating user schedules. Also, shifting the entire playing surface can be done simply by remarking the lines on the field which will reduce repetitive wear on the turf in places such as goal areas. An athletic field with a dense coverage of turf is an effective tool to reduce erosion and runoff

Image Credit: Ruben Leija, Unsplash

7.9 Recreation Facility Adjacencies, Trends & Commonalities

Most artificial turf fields are located adjacent to a high school, existing natural grass athletic park, recreation centre or sports stadium. This is the case in Edmonton, Ottawa, and Mississauga for those facilities operated by municipalities and are run through their booking system. Most of the sites include perimeter fencing around the artificial turf fields with controlled access points. Common amenities between all the artificial turf facilities include player benches, small bleachers (50 people), sports lighting and close proximity to portable washrooms or access to washrooms at an adjacent recreation facility. There are two examples found in these case studies where this is not the case - Valverde Park in Denver and Cherry Beach Sports Fields in Toronto.

Locating an artificial turf field near or beside other community facilities (recreation centre, school, or within an existing natural grass sports complex) considers the following efficiencies:

- Increased utilization by the community for passive sports use if the field is located near community facilities
- Increased utilization by youth during non-peak hours (e.g. during the school day) if the field is located adjacent to a school
- Shared use of associated infrastructure and amenities such as parking, washrooms, change rooms, sport courts and storage

Image Credit: GEC Architecture

7.9 Recreation Facility Adjacencies, Trends & Commonalities

Some notable trends with regarding the location of siting of artificial fields include:

- A trend with the development of new facilities now considers opportunities to establish a community hub including collaboration with libraries, school boards and possibly the private sector industry. As the trend of community hubs grows, these facilities have the ability to support multiple or single artificial fields within the site, based on programming and use by the community. Care should be in the design of the sports field to ensure the field achieves a good balance between programmed and non-programmed use. Considerations include sports line markings, type of turf selected, infill material (consider sand, TPE, organic, and non-crumb rubber infills). Balancing of field protection (e.g. fences) with open access is also important. Furthermore, with reduced field bookings, alternative funding sources for future turf replacement and maintenance will be required
- Many municipalities are partnering with school districts in constructing new artificial turf fields on new school sites, especially high school sites. Collaboration early in the new high school site planning and design stage allows for optimization of infrastructure (e.g. design of external separate access to shared washrooms and change rooms). Additionally, school districts may contribute their budget allowance for a new sports field (typically grass) towards the construction of the artificial turf field. This approach has proven to be mutually beneficial for both the school district, municipality and most importantly the youth who now have access to a safe, reliable and durable sports field during school hours
- The location of new artificial turf fields should consider the impact of increased noise, traffic and lighting on the surrounding area. For this reason, locating artificial turf fields in residential neighborhoods, except at an athletic park that already exists, is typically avoided to minimize noise, traffic and lighting impacts. New artificial turf fields work best in areas already developed for recreation or community use
- Artificial turf fields work well in conjunction with athletic parks containing natural grass or other artificial turf fields as intensity use on a field is more easily achieved when there is more than one field
- Indoor artificial turf facilities are an uncommon asset within municipal infrastructure and most of these facilities are either private, non-profit, or public-private operating models

Image Credit: Brett Ryan Studios

Image Credit: Brett Ryan Studios

GLOSSARY OF TERMS

AFCM	Athletic Field Construction Manual - Reference material by Sports Turf Canada
AMENITIES	A desirable or useful feature or facility of a building or place; in the context of athletic fields, associates amenities can include washrooms, water fountains, bike racks, playgrounds, etc.
ARTIFICIAL TURF	Refers to a synthetic sports field surface.
ATHLETIC PARK	A facility comprised of two or more natural grass fields with supporting amenities; or alternatively, one or more artificial turf fields with amenities
CANADIAN SPORT FOR LIFE - LONG-TERM ATHLETE DEVELOPMENT FRAMEWORK	An internationally recognized and Sport Canada endorsed movement to improve the quality of sport and physical activity in Canada. Canadian Sport for Life recommends many principles and practices for the allocation of sport fields to user groups.
COMMUNITY ATHLETIC PARK	An athletic park that is mainly used by the immediate neighbourhood. Equivalent to Calgary's Class C and D facilities.
DEMAND THRESHOLD	When service area demand meets service area capacity
DISTRICT ATHLETIC PARK	An athletic park that draws in user groups from across the city. Equivalent to Calgary's Class B facilities.
G-MAX	A measure of shock absorbency. One 'G' represents one unit of gravity.
NATURAL TURF	Refers to natural grass sports field surface
SAFETY ZONE / SAFETY BUFFER	The area extending from the limit of play and is sloped consistently with the field and is clear of any obstacles.
THIRD GENERATION ARTIFICIAL TURF	The type of artificial turf currently on the market. It has longer turf fibres compared to the previous two generations, and contains infill (either crumb rubber, organic or other material).

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