DISTRICT OF PORT HARDY
AGENDA FOR THE
COMMITTEE OF THE WHOLE MEETING
5:45 PM TUESDAY JUNE 23, 2026
COUNCIL CHAMBERS - MS TEAMS

We respectfully acknowledge that this meeting is being held on the traditional territory of the Kwakiutl people, Gilakas'la

PAGE

A. CALL TO ORDER

B. APPROVAL OF AGENDA AS PRESENTED (or amended)

Motion. *1.* *2.*

C. ADOPTION OF MINUTES

2 - 4 1. Minutes of the Committee of the Whole meeting held May 12, 2026. For adoption.

Motion. *1.* *2.*
COMMITTEE OF THE WHOLE - 12 May 2026 - Minutes

5 - 7 2. Minutes of the Committee of the Whole meeting held May 26, 2026. For adoption.

Motion. *1.* *2.*
COMMITTEE OF THE WHOLE - 26 May 2026 - Minutes

D. DELEGATIONS & PRESENTATIONS

None in agenda package.

E. STAFF REPORTS

8 - 132 1. Heather Nelson-Smith, Chief Administrative Officer. Re: MINI PEAKS Legacy Project – Phase 2 Advancement and Site Selection Considerations For discussion.
Heather Nelson-Smith MINI PEAKS Legacy Project – Phase 2 Advancement and Site Selection Considerations
2025-042_Understanding and Managing Artificial Turf_Klasios

F. ADJOURNMENT

Motion. *Time.*

MINUTES
DISTRICT OF PORT HARDY
COMMITTEE OF THE WHOLE MEETING
HELD MAY 12, 2026
8890 CENTRAL STREET - MS TEAMS

We respectfully acknowledge that this meeting is being held on the traditional territory of the Kwakiutl people, Gilakas'la

PRESENT:	Mayor Pat Corbett-Labatt, Councillors Janet Dorward, Dennis Dugas, Fred Robertson, and John Tidbury Online via MS Teams: Councillor Treena Smith
ALSO PRESENT:	Heather Nelson-Smith, Chief Administrative Officer, Noramay Isaac, Director of Finance/Deputy CAO, Naomi Heith, Manager of Recreation and Community Services, and Louisa Bates, Manager of Corporate Services
REGRETS:	Councillor Brian Texmo
PRESS/PUBLIC:	None/Two

A. CALL TO ORDER

Mayor Corbett-Labatt called the meeting to order at 6:15 pm and respectfully acknowledged that the meeting is being held on the traditional territory of the Kwakiutl people.

B. APPROVAL OF AGENDA AS PRESENTED (OR AMENDED)

1. **COW 2026-009**
Councillor Tidbury made a motion THAT the May 12, 2026 agenda of the Committee of the Whole meeting be approved as presented. Councillor Dugas seconded the motion. Carried.

C. ADOPTION OF MINUTES

1. Minutes of the Committee of the Whole meeting held March 10, 2026.

COW 2026-010
Councillor Tidbury made a motion THAT the minutes of the Committee of the Whole meeting held March 10, 2026 be adopted as presented. Councillor Dorward seconded the motion. Carried.

D. DELEGATIONS & PRESENTATIONS

1. Derek Lamb, CPA, CA and Pieter de la Rey, CPA, CA, Chan Nowosad Boates Re: Draft Financial Statements and Audit Findings Report for Year Ending December 31, 2025.

Audit Findings Report was presented; highlights included:

Significant audit matters-

Tangible Capital Assets:

- $3,871,099 of capital assets acquired in 2025; $2,672,420 in 2024.
- $1,826,342 accounted for with the newly built Water Reservoir #2.
- Capital works in progress $733,315; includes the Tsulquate Park Centrifuge and distribution system projects ($433,364 and $61,370 respectively).
- No amortization on projects still in progress.
    - Misstatements:
        - Adjusted proposed to record capital additions and amortization.
        - 2% inflationary adjustment proposed for Asset Retirement Obligations.
        - No significant control deficiencies identified as a result of the above.

Accounting System Conversion:

- Switched accounting systems from MAIS to Catalis.
- New system effective as of February 23, 2025.
- Trial balances were obtained to verify both systems aligned; where balances didn't match journal entries made to confirm the two systems agreed.
- Control Deficiencies:
- No significant control deficiencies were identified with the exception of one related to the processes employed to implement the new accounting software.

Significant Accounting Practices-

- Accounting policies deemed appropriate for nature of organization and operation.
- No significant changes to accounting policies for reporting period.
- Misstatements:
    - Identified and categorized accordingly as uncorrected and corrected.
    - Misstatements below $17,900 not investigated further.
- Control Deficiencies:
    - Required to obtain understanding of Internal Control over Financial Reporting (ICFR) for opinion on financial statements, not on effectiveness of internal controls.

2025 Consolidated Financial Statements were presented; highlights included:

- Independent audit report.
- Clean audit opinion.

Statement of Financial Position:

- Financial assets- $16,758,256.
- Liabilities- $7,577,172.
- Net Financial Assets- $9,181,084.
- Non-Financial Assets- $47,991,140.
- Accumulated Surplus- $57,172,224.

Statement of Operations:

- Total revenues- $12,100,013 (actual); $12,486,087 (budgeted).

E. ADJOURNMENT

COW 2026-012
Councillor Dugas made a motion THAT the meeting be adjourned at 6:39 pm.

CORRECT

_____
CORPORATE OFFICER

APPROVED

_____
MAYOR

MINUTES
DISTRICT OF PORT HARDY
COMMITTEE OF THE WHOLE MEETING
HELD MAY 26, 2026
COUNCIL CHAMBERS - MS TEAMS

We respectfully acknowledge that this meeting is being held on the traditional territory of the Kwakiutl people, Gilakas'la

PRESENT:	Mayor Pat Corbett-Labatt, Councillors Janet Dorward, Dennis Dugas, Fred Robertson, Treena Smith, and John Tidbury
ALSO PRESENT:	Heather Nelson-Smith, Chief Administrative Officer; Naomi Heith, Manager of Recreation and Community Services; and Louisa Bates, Manager of Corporate Services
REGRETS:	Councillor Brian Texmo
PRESS/PUBLIC:	None/None

A. CALL TO ORDER

Mayor Corbett-Labatt called the meeting to order at 6:19 pm and respectfully acknowledged that the meeting is being held on the traditional territory of the Kwakiutl people.

B. APPROVAL OF AGENDA AS PRESENTED (OR AMENDED)

COW 2026-013
Councillor Robertson made a motion THAT the May 26, 2026 agenda of the Committee of the Whole meeting be approved as presented. Councillor Tidbury seconded the motion.

C. NEW BUSINESS

1. 2026 Union of BC Municipalities AGM & Convention. Minister meeting requests.

The following Provincial ministries and meeting topics were discussed:

- Premier:
  - Regional economic diversification and investment readiness;
  - Forestry, mining and marine sector opportunities;
  - Transportation and logistics infrastructure;
  - Renewable energy opportunities, including wind and run-of-river expansion potential;
  - Housing shortages, poverty, and cancelled housing projects affecting overall well-being and misalignment with provincial priorities;
  - Reconciliation and partnership opportunities with Indigenous communities; and,
  - Provincial support to position Port Hardy and the North Island as a strategic economic gateway.

- Ministry of Forests:
    - North Island Community Forest expansion opportunities;
    - Improved access to fibre and local wood allocation;
    - Long-term forestry sustainability and economic certainty;
    - Support for value-added forestry opportunities;
    - Partnership opportunities that support reconciliation and regional economic resilience.
- Ministry of Housing and Municipal Affairs:
    - Cancellation of the Sanala culturally supportive housing project;
    - Cancellation of the Women's Transition Housing project previously approved prior to COVID-19;
    - Rural homelessness and supportive housing needs;
    - Workforce housing barriers impacting economic growth; and,
    - Opportunities for renewed provincial housing partnerships and funding access.
- State of Local Governments and Rural Communities:
    - Poverty;
    - Homelessness;
    - Boundary expansion;
    - Municipal capacity;
    - Readiness for mine;
    - Rural grant funding accessibility; and,
    - Economic transition support.
- Ministry of Health:
    - Need for sustainability of emergency healthcare services on the North Island, including emergency room continuity, and emergency medical transport; and,
    - Challenges and increasing service vulnerability associated with recruitment, retention, emergency response, and patient transfers.
- Ministry of Transportation and Transit:
    - Highway 19 paving and maintenance priorities;
    - Road condition concerns affecting safety and economic activity;
    - Roadside woody debris and slash management adjacent to provincial highways;
    - Signage and corridor way-finding improvements; and,
    - Transportation reliability for remote and northern communities.
- Indigenous Relations & Reconciliation:
    - Museum funding;
    - Cenotaph pole replacement;
    - Indigenous veteran recognition; and,
    - Cultural preservation partnerships.
- Ministry of Environment and Parks:
    - Cape Scott Provincial Park preservation and ecological stewardship;
    - Impact of increased tourism and visitation pressures,
    - Visitor education and safety, and,
    - Proactive management strategies.
- Ministry of Mining and Critical Minerals:
    - If needed.

Additional discussion:

- Letter to Hon. Mark Carney, Prime Minister to advocate for economic readiness and investment.
- Letter to Hon. Mark Carney, Prime Minister to request an update on the status of the aquaculture transition plan consultation and concerns.

D. ADJOURNMENT

COW 2026-014
Councillor Robertson made a motion THAT the meeting be adjourned at 7:02 pm.

CORRECT APPROVED

_____ _____
CORPORATE OFFICER MAYOR

REGULAR COUNCIL

STAFF REPORT

To:	Mayor and Council
Subject:	MINI PEAKS Legacy Project – Phase 2 Advancement and Site Selection Considerations
Meeting:	REGULAR COUNCIL - 09 Jun 2026
Department:	Senior Staff
Staff Contact:	Heather Nelson-Smith, Chief Administrative Officer

PURPOSE:

The purpose of this report is to inform Council that the District of Port Hardy has successfully advanced to Phase 2 of the MINI PEAKS Legacy Project application process and to outline key considerations related to site selection, municipal responsibilities, staff capacity, financial implications, and community consultation prior to any further commitment.

BACKGROUND:

The MINI PEAKS Legacy Project is a FIFA World Cup 2026 legacy initiative delivered through a partnership between Vancouver Whitecaps FC, viaSport, and the Province of British Columbia. The program provides successful communities with a professionally installed synthetic turf mini-pitch, grassroots soccer programming support, coach development opportunities, and community activation resources.

The District of Port Hardy submitted a Phase 1 Expression of Interest following the regular Council Meeting of May 26, 2026, identifying the need for improved year-round soccer infrastructure to serve Port Hardy and surrounding North Island communities.

Following review of the submission, the District received confirmation that the application has successfully met the preliminary eligibility and community need requirements and has been approved to advance to Phase 2 – Technical Site Assessment.

The project team has advised that:

- The District's position in the application queue has been secured based on the original submission date.
- Final technical specifications and geotechnical requirements are currently being finalized with the project supplier.
- Detailed Phase 2 submissions will commence once those requirements have been released. Advancement to Phase 2 does not guarantee project approval but confirms that Port Hardy has been identified as a strong candidate under the program criteria.

Discussion

Community Need and Project Benefits

The original application identified a significant regional need for year-round soccer infrastructure. Port Hardy serves as a recreation hub for the North Island and supports participation from surrounding communities, including Port McNeill, Port Alice, Kwakiutl First Nation, Gwa'sala-'Nakwaxda'xw Nations, Quatsino First Nation, and other rural and Indigenous communities.

Local soccer programming is largely volunteer-driven and relies on natural-grass fields that are frequently affected by weather, drainage limitations, and seasonal closures. and are not owned by the District.

A mini-pitch would provide:

- Year-round soccer opportunities.
- Increased physical activity and youth engagement.
- Additional recreation opportunities for North Island families.
- Coach development and training.
- A lasting FIFA World Cup 2026 community legacy.

Staff acknowledge there is demonstrated interest in the project from local soccer organizations and community members.

Site Selection Considerations
As part of the Expression of Interest process, staff identified several potential locations, including:

- Recreation Centre tennis court.
- Park Drive ball field outfield area.
- Cedar Heights Park.
- Upper Carnarvon Park.
- and Other municipally owned recreation lands.

Subsequent discussions with the project team provided additional clarification regarding site requirements.

The project team confirmed that:

- The mini-pitch requires a paved base surface.
- Communities are responsible for all site preparation costs.
- The synthetic turf surface is intended primarily for soccer.
- Pickleball or Tennis cannot be played in its intended format on the surface.
- The facility must remain consistent with FIFA World Cup legacy design requirements.

While the Recreation Centre tennis court location may be one of the most "site-ready" options due to existing servicing, parking, washrooms, and accessibility features, converting the tennis court would remove an existing recreation asset and would not support future tennis/pickleball use.

Alternative locations such as Park Drive, Cedar Heights Park, or Upper Carnarvon Park would preserve existing recreation assets but would require substantial site preparation, including grading, drainage improvements, paving, and servicing.

At this time, we have applied for the tennis court as the preferred location; this may change if the Council identifies a more suitable location we did not consider.

Asset Management Considerations
Staff believe this opportunity should be evaluated through an asset management lens.

Although the mini-pitch itself would be funded through the MINI PEAKS Legacy Project, the District would remain responsible for:

- Site preparation and construction readiness.
- Drainage and servicing requirements.
- Ongoing operations and maintenance.
- Security and inspections.
- Future lifecycle replacement costs.
- Long-term stewardship of the facility.

The District currently maintains a significant inventory of recreation and park infrastructure, including that which requires investment:

- Recreation Centre Tennis Courts.
- Cedar Heights Park.
- Upper Carnarvon Park.
- Park Drive sports field.
- These assets require ongoing investment, renewal, and maintenance.

From an asset management perspective, staff generally recommend maintaining and improving existing infrastructure before expanding the overall municipal asset inventory. The addition of another dedicated recreation facility will create ongoing maintenance obligations and future replacement liabilities that must be considered alongside current infrastructure priorities.

Staffing and Operational Impacts
This project was not identified within the District's current financial plan, departmental work plans, or approved capital projects.

Advancing through Phase 2 and beyond would require staff involvement in:

- Site assessments (District cost)
- Technical reviews (District cost)
- Engineering coordination (District Cost)
- Public Works consultation
- Environmental review (District Cost)
- Preparation of technical documentation (District Cost)
- Grant writing
- Stakeholder engagement
- Coordination with project partners
- Financial amendment to the budget
- Program planning and implementation

If the project ultimately proceeds, additional staff resources may be required to support:

- Grassroots programming commitments
- Facility activation
- Reporting requirements
- Ongoing maintenance oversight
- Community partnerships.

Given existing workloads and priorities, staff believe the administrative and operational requirements of the project should be carefully evaluated before proceeding.

Community Partnership Opportunity
Staff have received strong indications that support from the North Island Soccer Association may be available. The Association has expressed interest in assisting with fundraising efforts and pursuing additional grant opportunities to help offset potential project costs and support long-term programming and activation.

Given that the project was not identified within the District's current financial plan, capital budget, or departmental work plans, Council may wish to consider a partnership approach that leverages community support while limiting impacts on municipal resources.

Under this approach, the District would continue to provide leadership with respect to site selection, municipal approvals, and coordination with the MINI PEAKS project team, while the North Island Soccer Association and community volunteers could assist with:

- Fundraising initiatives.
- Additional grant applications.
- Community engagement and promotion.
- Volunteer recruitment and coordination.

Once final site requirements and cost implications are known, Council would be in a better position to determine the level of municipal investment required and whether additional community fundraising or grant funding is necessary.

This collaborative approach would allow the District to continue exploring the opportunity while leveraging the enthusiasm, capacity, and community connections of the local soccer community, thereby reducing pressure on municipal staff resources and budgets.

Community Consultation Considerations
Staff anticipate that selecting a preferred site may generate differing perspectives within the community.

Council may wish to consider the community's concerns around removing the tennis/pickleball court.

Public engagement would provide an opportunity to gather feedback, identify concerns, and build community support. However, consultation activities would require additional staff time and resources and could affect project timelines.

Given that the MINI PEAKS program operates on a rolling intake basis, Council will need to balance the value of public engagement against project timing considerations and available staff capacity.

FINANCIAL:

Based on the requirements, without evaluating the costs if the servicing does not meet the specifications and further upgrading if required, resurfacing the tennis courts would range between $100,000 and $180,000 (Note staff will need to bring forward in 2027 as the courts are in need of resurfacing) but we want to confirm that the current court surface for the mini pitch (one court) may be suitable. And the assessment estimate would be approximately $37,500. Staff project oversight administration is estimated at 10% of total project costs.

OPTIONS:

1. Direct staff to continue with the Phase 2 Technical Assessment and report back with a preferred site, estimated costs, and long-term maintenance implications.

2. Continue to Phase 2 while working with the North Island Soccer Association to support fundraising, grant applications, community engagement, and future programming.

3. Withdraw the application and focus available resources on existing recreation infrastructure priorities.

RECOMMENDATION:

Staff recommend Option 2, as it allows the District to continue exploring the opportunity while sharing responsibilities with the local soccer community and deferring any final financial commitment until site requirements and costs are better understood.

Respectfully submitted,

Heather Nelson-Smith, CRM
Chief Administrative Officer

Understanding and Managing Artificial Turf Impacts on Rainwater, Urban Heat, and Biodiversity for the City of Vancouver

Sustainability Scholar Project 2025-042

Prepared by Natasha Klasios (Ph.D., UBC), Sustainability Scholar

Prepared for Gord Tycho, Senior Sustainability Planner, and Hanna Demyk, Planning Assistant, at City of Vancouver

August 2025

Disclaimer

This report was produced as part of the UBC Sustainability Scholars Program, a partnership between the University of British Columbia and various local governments and organizations in support of providing graduate students with opportunities to do applied research on projects that advance sustainability across the region.

This project was conducted under the mentorship of the City of Vancouver staff. The opinions and recommendations in this report and any errors are those of the author and do not necessarily reflect the views of the City of Vancouver or the University of British Columbia.

Territory Acknowledgement

The author acknowledges that the work for this project took place on the unceded and ancestral territories of the xʷməθkʷəy̓əm (Musqueam), Sḵwx̱wú7mesh (Squamish), and səlilwətaɬ (Tsleil-Waututh) Nations.

Table of Contents

Executive Summary

The City of Vancouver faces various climate adaptation challenges, including extreme rainfall, urban heat, and biodiversity loss, which are intensified by rapid urban development and population growth. Artificial turf installations on private property, while perceived by some as low-maintenance alternatives to natural landscaping, present significant environmental and policy concerns. This study examines the impacts of artificial turf on rainwater management, urban heat mitigation, and biodiversity conservation, and provides policy recommendations for managing artificial turf on private property that better align with, and advance, the City's climate adaptation objectives.

Using a three-part methodology, (1) analysis of the City of Vancouver's policy context and departmental approaches, (2) literature review and subject matter expert interviews, and (3) case study research, this report finds that artificial turf contributes to increased stormwater runoff, chemical and microplastic pollution, elevated surface and ambient temperatures, and habitat loss. The life cycle of artificial turf, from fossil-fuel-based production to disposal, is associated with greenhouse gas emissions, toxic chemical use (including PFAS), and significant recycling challenges.

The findings demonstrate that artificial turf use undermines key objectives in several City of Vancouver strategies, including the Climate Change Adaptation Strategy, Rain City Strategy, Urban Forest Strategy, and Biodiversity Strategy, among others. Specifically, its implementation on private properties conflicts with Vancouver's climate adaptation goals and poses risks to sustainable rainwater management, urban heat mitigation, and biodiversity conservation. Jurisdictional comparisons with the cities of Langford (BC), Toronto (ON), and Millbrae (CA, USA) show that municipalities are increasingly adopting partial or full bans on artificial turf, coupled with education, enforcement, and green infrastructure promotion.

While some City of Vancouver departments limit or restrict artificial turf use through impermeability regulations or landscaping guidelines, there appears to be no city-wide policy statement governing its use on private property in Vancouver. To address this gap, this report recommends that the City consider developing a coordinated policy approach, informed by evidence and public education, that further protects water quality, reduces heat risks, and enhances biodiversity and related sustainability objectives. Recommended actions span four key focus areas to strengthen artificial turf management on private property: (1) Research and Evidence Building, (2) Educational Resources and Outreach, (3) Policy and Regulatory Alignment, and (4) Supporting Tool Development.

1. Introduction

1.1 Background and Problem Statement

The City of Vancouver is facing challenges with respect to both the impacts of climate change and implementing climate adaptation measures. Population growth, urban development practices, and climate change are increasing urban heat, reducing biodiversity, raising sea levels, and increasing the frequency and intensity of rainfall, which is affecting community wellbeing, straining the City's aging sewer system, and leading to chronic water quality impacts on receiving waters such as False Creek and the Fraser River.

The City of Vancouver's Climate Change Adaptation Strategy (CCAS, 2024) and other related initiatives seek to address risks associated with impacts from urban heat, sea level rise, extreme rainfall, drought, poor air quality due to wildfire, and biodiversity loss. The Rain City Strategy (RCS, 2019), which was developed in response to the CCAS action plan, calls for a shift to a more holistic and integrated approach for achieving the goals of improved water quality, increased resilience, and enhanced livability. This ambitious approach treats rainwater as a valuable resource and aims to mimic the natural hydrologic cycle by capturing and treating rainwater where it lands using green rainwater infrastructure (GRI) such as green roof systems and ground infiltration systems. Other city strategies that include actions to address rainwater management, urban heat, and biodiversity include the Healthy Waters Plan (HWP, in progress), Urban Forest Strategy (UFS, 2025), and Biodiversity Strategy (2016). Given these policy objectives, activities that may impede climate adaptation efforts, particularly those affecting rainwater management, urban heat mitigation, or biodiversity conservation, are of interest to the City.

It has been observed that some private developments in the City of Vancouver are using artificial turf products in their landscaping treatments, either as new builds or as retrofits. Artificial turf poses several environmental concerns, including increased stormwater runoff, heat retention that can exacerbate the urban heat island effect, and habitat loss. Artificial turf systems may also leach harmful chemicals, raising concerns about long-term ecological and human health risks. In addition, artificial turf also emits greenhouse gases during production and disposal, and it is difficult to recycle, meaning it often ends up in landfills at the end of life. Given the environmental concerns associated with artificial turf, the City desires to better understand these impacts and potential responses.

1.2 Project Purpose and Objectives

The purpose of this project is to better understand the impacts of artificial turf on three specific climate adaptation challenges: rainwater management, urban heat, and biodiversity conservation. Specifically, the project seeks to undertake best practices research, conduct subject matter expert (SME) interviews, develop relevant case studies from other jurisdictions, and provide recommendations for the City of Vancouver to better manage artificial turf on private property as part of its climate adaptation objectives. Projects that contribute toward the advancement of CCAS and RCS implementation goals will contribute to progress on sustainability, climate adaptation, and equity.

The specific objectives for this project are listed below:

1. **Summarize context and policy approach:** Review the City of Vancouver's climate adaptation challenges, strategies, and relevant bylaws, with a particular focus on rainwater management, urban heat, and biodiversity conservation, and summarize the City's policy approach for managing artificial turf on parks, city-owned 'streets and boulevards', other city-owned properties, and private property.
2. **Evaluate artificial turf systems and expert perspectives:** Conduct a literature review and engage with subject matter experts to assess artificial turf systems and their life cycle characteristics.
3. **Analyze case studies and municipal approaches:** Conduct detailed case study research on leading jurisdictions. This includes examining climate adaptation strategies related to rainwater management, urban heat reduction, and biodiversity enhancement; identifying allowable turf uses, the rationale for any limitations, and mechanisms used to restrict use such as bylaws or permitting systems; and documenting lessons learned in the development and implementation of artificial turf use restrictions, with attention to interest holder and decision-maker involvement, implementation processes, and progress reporting.
4. **Develop recommendations:** Based on research findings, provide a list of recommendations and actions for the City of Vancouver to consider in managing artificial turf on private property in support of its climate adaptation, sustainability, and equity goals.

2. Methodology

This study was conducted during a three-month Sustainability Scholars project. The author of this study is a graduate student (Ph.D.) in the Department of Zoology and Biodiversity Research Centre at the University of British Columbia (Vancouver Campus). The study was borne out of growing concerns about the potential proliferation of artificial turf installations on private properties in Vancouver, and interest from the City of Vancouver's Climate Adaptation and Equity Group within the Planning, Urban Design, and Sustainability (PDS) department to understand if artificial turf installations pose risks to environmental and human health and impede the City's climate adaptation and related sustainability strategies and objectives.

The methodology of this study consists of three parts: 1) City of Vancouver contextual understanding, 2) academic literature review and subject matter expert interviews, and 3) case study research.

2.1 Contextual Understanding of the City of Vancouver's Policy Context and Current Approaches to Artificial Turf Management

The initial phase of the study focused on developing an understanding of the City's climate adaptation and artificial turf policy context. This included a review of the City's climate adaptation challenges, strategies, and relevant bylaws, with particular focus on rainwater management, urban heat, and biodiversity.

To understand the City's current approach to managing artificial turf, semi-structured interviews with various internal departments and groups were conducted. Although the interviews primarily focused on individuals with knowledge of the City's approaches and policies for artificial turf on private property, applicable insights were also sought by interviewing knowledgeable individuals from other key departments that encounter artificial turf on other land ownerships and uses such as parks, streets and boulevards, and city-owned properties. Understanding the City's varying departmental contexts and policy approaches is important i) for identifying lessons learned that could be transferrable to private property, and ii) when considering the applicability of best practices and lessons learned from other jurisdictions.

A total of five municipal departments were contacted, and four semi-structured interviews occurred with select groups within Development, Buildings, and Licensing (DBL), Engineering Services (ENG), Planning, Urban Design, and

Sustainability (PDS), Real Estate, Environment, and Facilities Management (REFM), and the Vancouver Board of Parks and Recreation (PARKS). The interviews were 30 minutes to one hour in length and were conducted remotely using Microsoft Teams. The interviews were audio-recorded with permission from the interviewees to ensure an accurate transcription of responses. The purpose of the interviews was to:

- Determine, if possible, the relative magnitude of artificial turf use in the city.
- Understand the department's specific policy approaches related to artificial turf.
- Obtain relevant information sources and any lessons learned from managing artificial turf use to date.

Interview questions are included in Appendix A1.

2.2. (a) Literature Review and (b) Subject Matter Expert Interviews

(a) Literature Review

The second part of the study was a scoping review of academic literature to determine the impact of artificial turf on the three focal climate adaptation challenges: rainwater management, urban heat, and biodiversity. The Web of Science was used to systematically identify relevant scholarly articles. The Web of Science is a bibliographic database of scholarly articles from over 22,000 peer-reviewed journals globally.

Keywords and phrases related to the research topics (identified below) were used in combination with Boolean operators (AND, OR) to refine search results in the advanced search function. No additional filters were applied to limit the peer-reviewed journal articles to a specific time frame or subject area.

Keywords and phrases used to find relevant articles on the impacts of artificial turf on rainwater management (water quality and water quantity):

- ALL = ((“artificial turf” OR “synthetic grass” OR “synthetic turf” OR “artificial grass”) AND (“water*” OR “rainwater”))

Keywords and phrases used to find relevant articles on the impacts of artificial turf on urban heat:

- ALL = ((“artificial turf” OR “synthetic grass” OR “synthetic turf” OR “artificial grass”) AND (“heat” OR “urban heat” OR “temp*”))

Keywords and phrases used to find relevant articles on the impacts of artificial turf on biodiversity:

- ALL = ((“artificial turf” OR “synthetic grass” OR “synthetic turf” OR “artificial grass”) AND (“organism” OR “biodiversity” OR “terrestrial” OR “aquatic”))

Articles retrieved from the initial keyword search were screened by reviewing their titles and abstracts to assess their relevance. Articles identified as potentially relevant were then reviewed in full to evaluate whether the study should be included in the final literature review. Studies that were not directly relevant to the themes were excluded. Citation tracking and the “Related Records” feature in Web of Science were used to identify additional sources missed in the initial search. In addition to academic literature, grey literature sources from nonprofit organizations and government agency websites, and reports from other jurisdictions in North America were also investigated. The methodology for the literature review and the number of articles included is shown in Figure 1.

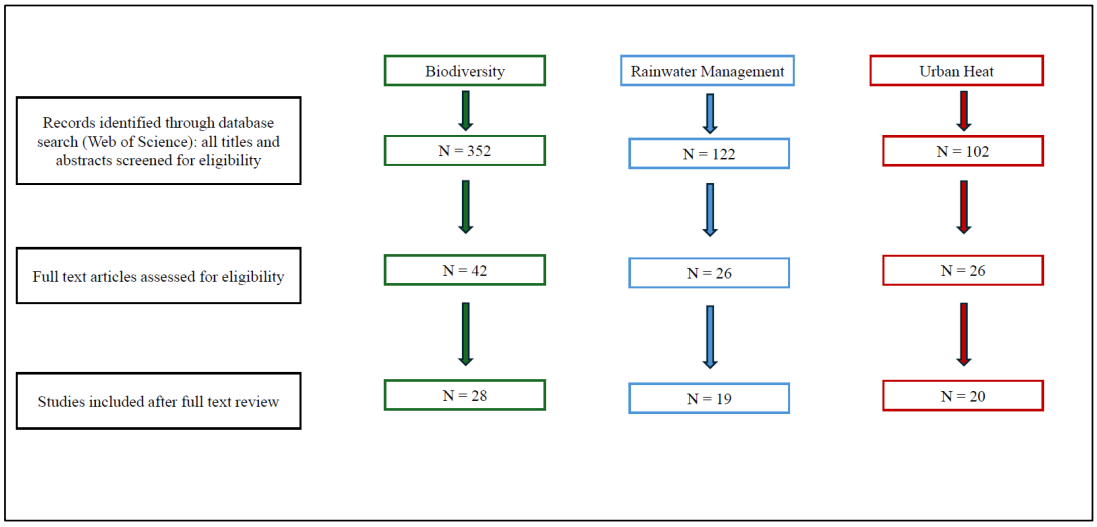


Figure 1. PRISMA Flow diagram displaying the systematic review process for the academic literature review. N = number of articles.

(b) Subject Matter Expert (SME) Interviews

To supplement information collected from the academic literature review, this study also conducted interviews with local and international subject matter experts (SMEs) to explore the impacts of artificial turf on rainwater management, urban heat, and biodiversity. Interviewees were given the option to be interviewed remotely over Microsoft Teams or to answer the interview questions over email. Two SME interviews were conducted over Microsoft Teams, and one was

completed through written responses via email. The remote interviews lasted between 30 minutes and one hour and were audio-recorded, with permission from the interviewees, to ensure an accurate transcription of responses.

The SME interviewees included:

1) Dr. Rachel Scholes
    - Dr. Scholes is an Assistant Professor at the University of British Columbia in the Department of Civil Engineering. Her research group focuses on protecting human and environmental health by addressing contaminants of concern in urban water systems. Scholes' research focuses on the chemical composition and leaching of chemicals from artificial turf, specifically crumb rubber infill, and impacts on water quality. Her work contributes to the broader understanding of urban pollutants and their effects on both human health and the environment.
2) Rachel Massey and Susan Chapnick
    - Rachel Massey is a Senior Science and Policy Advisor at the Collaborative for Health and Environment (CHE), and a Senior Research Associate at the Lowell Center for Sustainable Production at the University of Massachusetts Lowell. She previously served as Senior Associate Director and Senior Policy Analyst at the Massachusetts Toxics Use Reduction Institute (TURI). She has published on the risks posed by tire crumb rubber and its chemical leachates to the environment and human health. TURI and CHE have published several resources on the environmental hazards of artificial turf.
    - Susan Chapnick is the President and Senior Scientist at the environmental consulting firm New Environmental Horizons Inc. Susan is focused on environmental advocacy and local climate change resilience policy, and she is an expert in the environmental and human health impacts of artificial turf. She has advised several municipalities and guided efforts on environmental testing and health risks of artificial turf sports fields. In her hometown of Arlington, MA, her advocacy led to a municipal study, which ultimately resulted in the banning of crumb rubber infill for artificial turf fields.
3) California Department of Toxic Substances Control (DTSC), Safer Consumer Products (SCP) Program (California, USA)

- The California Department of Toxic Substances Control (DTSC) is a state agency responsible for protecting residents and the environment from the harmful effects of toxic substances. The Safer Consumer Products (SCP) Program is part of the DTSC and aims to reduce toxic chemicals in products and promote safer alternatives. The 2021-2023 Priority Product Work Plan described the Program's intention to research artificial turf and the candidate chemicals it contains. The Program has identified artificial turf as an important issue to address due to concerns over potential exposure to PFAS and other chemicals, especially as the product is frequently used by sensitive subpopulations such as children.
- Following preliminary screening and public engagement efforts, the Program is currently drafting a Product-Chemical Profile document for artificial turf containing PFAS.

The interview questions, included in Appendix A2, were designed to explore the following themes:

- Life cycle of artificial turf.
- Impacts of artificial turf on rainwater management, urban heat, and biodiversity.
- Impacts of artificial turf on climate change.

2.3 Case Study Research

To understand how other municipalities are managing artificial turf, this study employed a qualitative case study approach through semi-structured interviews with contacts at the following municipalities: City of Langford (British Columbia, Canada), City of Toronto (Ontario, Canada), and City of Millbrae (California, USA). Although the interviews primarily focused on municipal approaches and policies for using artificial turf on private property, applicable insights were also sought from any municipal experiences with artificial turf on other land ownerships and uses such as parks, streets and boulevards, and city-owned properties.

Each municipality offered distinct perspectives and experiences with artificial turf management:

- City of Langford previously had a policy that promoted the implementation of artificial turf on boulevards, which was ultimately reversed.
- City of Toronto regulates the use of artificial turf on private property by requiring that a portion of landscaped areas be made up of soft

landscaping, which artificial turf does not satisfy under current zoning regulations (partial ban). Toronto also has a position statement on artificial turf and is in the process of explicitly including artificial turf as “not soft landscaping” in their bylaw.

- City of Millbrae has a complete ban on artificial turf on private property.

Semi-structured interviews with contacts in the City of Toronto and City of Langford were conducted remotely on Microsoft Teams, each lasting between 30 minutes to one hour. Interviews were recorded with permission from the interviewees to ensure accurate transcription of responses. Although representatives from the City of Millbrae were unable to meet virtually, staff sent over several documents that were used to develop the case study.

The case study research for each municipality was based on interview questions that were designed to explore three main themes:

- Artificial turf use and policy approach: The first set of questions informed how artificial turf is used in the municipality and the associated former and/or current policy approach for regulating artificial turf.
- Policy development and implementation: The second set of questions focused on how the policy was developed (who was involved, what was the rationale), and how it is implemented (compliance, enforcement, progress reporting).
- Lessons learned: The third set of questions sought to understand any lessons learned from the municipality with respect to their policy approach to artificial turf, with the goal of using their lessons learned to inform the City of Vancouver’s approach to this topic.

Interview questions are included in Appendix A3.

3. Findings

3.1 Contextual Understanding: Climate Mitigation and Adaptation Issues, Supporting Strategies, and Departmental Approaches to Artificial Turf

3.1.1 Introduction

This section i) provides a contextual overview of climate change mitigation and adaptation approaches at the City of Vancouver, ii) introduces the related issues of rainwater management, urban heat, and biodiversity, iii) provides an overview of some of the City's policy tools and specific clauses relevant to these issues (which may be impacted by artificial turf installation on private properties), and iv) summarizes current City departmental approaches to artificial turf use.

3.1.2 Climate Change Mitigation and Adaptation in the City of Vancouver

In 2019, the City of Vancouver declared a climate emergency and set targets in line with recommendations by the global scientific community to 1) reduce carbon pollution by 50% relative to 2007, and 2) become carbon neutral by 2050 by addressing the largest sources of emissions: buildings (57%) and transportation (36%) (Climate Emergency Action Plan, 2020). Despite efforts to limit greenhouse gas emissions, it is widely accepted that global temperature will continue to increase in the near term because of cumulative emissions to date.

While climate mitigation efforts are important for limiting the extent of climate change, climate adaptation has also become urgent as cities look to reduce climate impacts. Climate adaptation refers to actions taken to prepare for and respond to the impacts of climate change, both by reducing risk from climate change impacts and enhancing resilience to withstand these impacts (CCAS, 2024).

The City of Vancouver's Climate Change Adaptation Strategy (CCAS, 2024) is the guiding plan for climate adaptation in Vancouver. Within the Strategy, there are five adaptation challenges (or hazards) that the City is looking to address to reduce risks and enhance resilience to the impacts of climate change. They include: extreme heat, poor air quality, drought, extreme rainfall, and sea level rise.

Other city strategies similarly support these mitigation and adaptation objectives and/or identify other associated concerns and objectives. For example, the Biodiversity Strategy addresses habitat and associated biodiversity loss, which is

also exacerbated by climate change. Some relevant City strategies are addressed in greater detail in Section 3.1.4.

3.1.3 Climate Adaptation Objectives of Interest for this Project: Rainwater Management, Urban Heat, and Biodiversity

Artificial turf applications may impact three major climate adaptation objectives of interest to the City: 1) rainwater management (water quality and quantity), 2) (extreme) urban heat, and 3) (habitat and) biodiversity. The climate adaptation objectives of interest are briefly described below.

3.1.3.1 Rainwater Management

Rainwater management involves the strategic planning and implementation of methods to effectively control rainfall in a manner that achieves stated quantitative and qualitative goals and objectives. The approach taken can have significant environmental, social, and economic implications. Conventional systems (“grey infrastructure”) often replace natural landscapes with impervious surfaces, underground piping, and centralized treatment facilities. These systems typically disrupt the natural hydrological cycle by reducing the volume of rainwater infiltrating into the ground and increasing the volume of rainwater conveyed over impervious surfaces (e.g. runoff). Rainwater runoff can carry pollutants, contribute to erosion, and negatively affect water quality. An alternative to grey infrastructure is green rainwater infrastructure (GRI), which is promoted by the City’s Climate Change Adaptation Strategy, Integrated Rainwater Management Plan, Rain City Strategy, and other associated strategies and policies. GRIs such as green roof systems and ground infiltration systems are designed to manage rainwater by mimicking natural hydrological processes using vegetation, soil, and other natural and manufactured components to slow, absorb, filter, and evaporate rainwater where it falls.

Vancouver is facing increasing challenges in rainwater management due to urban development and climate change (Figure 2). Increasing development has led to more impervious surfaces and reduced vegetation, resulting in higher stormwater runoff volumes. Population growth and increasing density further strain the aging combined sanitary sewer and drainage systems. Vancouver also experiences Combined Sewer Overflows (CSOs), which carry untreated wastewater and stormwater into the environment. Climate change intensifies these risks through rising sea levels and shifting precipitation patterns, culminating in greater volumes of runoff and potential flooding events. Consequences may include damage to buildings and infrastructure, health risks, displacement of residents and

businesses, reduced access to public spaces, landslides, and degraded water quality. Biodiversity may also be impacted by altered seasonal flows and the pollutants carried by runoff to receiving waters.

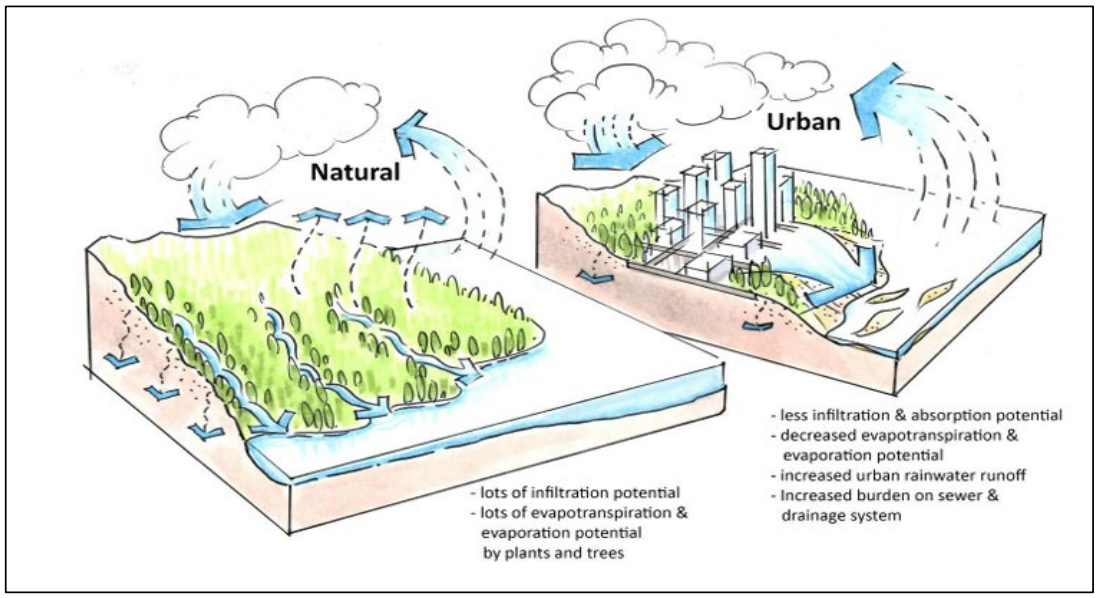


Figure 2: Diagram showing natural and urban water cycles (Source: Rain City Strategy).

3.1.3.2 Urban Heat

The urban heat island effect describes the phenomenon where urban areas experience higher temperatures than nearby rural regions (Figure 3). This temperature disparity arises because urban infrastructure absorbs, retains, and emits more heat than natural environments. The limited presence of vegetation, restricted airflow, numerous heat-generating sources, and widespread use of impervious materials all contribute to hotter temperatures in cities.

Climate change will increase temperatures and the duration and frequency of heat wave events. Updated local climate projections for the 2050s (using scenario SSP585) for Western Canada show that warmer temperatures are anticipated, with more extreme heat days in summer and more frequent, longer heatwaves. Increasing temperatures in cities are anticipated to have a range of negative consequences for human health, the environment, and the economy, including increased heat-related illnesses, higher energy consumption for cooling, and potential impacts on water quality.

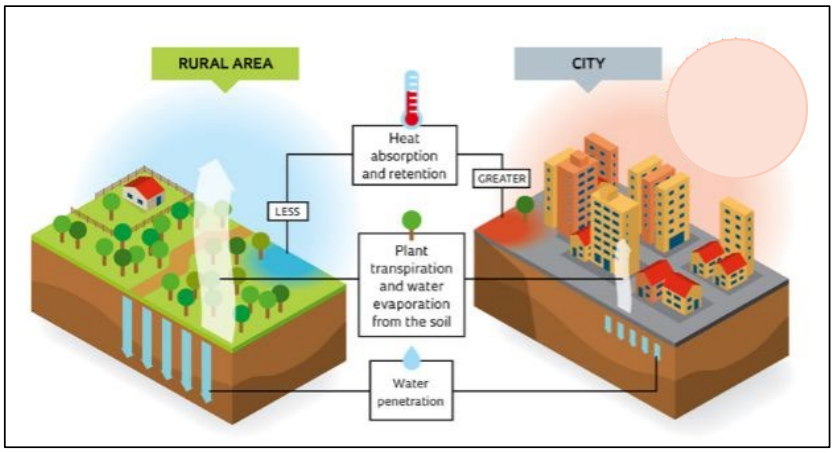


Figure 3: Diagram illustrating the urban heat island effect (Source: The Royal Meteorological Society).

3.1.3.3 Biodiversity

Biodiversity encompasses the variety of life found within ecosystems. In Vancouver, the urban environment supports a wide diversity of species and a wide range of ecosystems, including forests, wetlands, meadows, streams, and coastal marine areas (Figure 4). With ongoing urban development and climate change, each of these ecosystems faces varying degrees of threat. These changes have led to habitat loss, fragmentation, and degradation, all of which contribute to declining urban biodiversity. Other challenges to Vancouver's biodiversity include anthropogenic pollution affecting soil, air, and water quality, as well as climate change-induced rising sea levels, ocean acidification, temperature warming, and altered precipitation patterns.

Biodiversity plays a vital role in sustaining ecological stability and enhancing resilience to environmental disruptions, including those driven by climate change. A diverse range of species increases the likelihood that some will possess traits that support adaptation and survival under changing conditions. Biodiversity also underpins essential ecosystem services, such as food production, clean water provision, and overall human well-being. The preservation of biodiversity relies heavily on the availability and connectivity of habitats, which enable species to move between areas and maintain healthy populations.

Figure 4: Species of native salmon/trout, birds, and frogs found in Vancouver, BC (Image Source: Biodiversity Strategy).

3.1.4 Climate Adaptation and Related Strategies, Bylaws, and Policies Impacted by Artificial Turf

As introduced in Section 3.1.2, the City of Vancouver is addressing climate mitigation and adaptation challenges through the implementation of various strategies, bylaws, and related policies for public and private lands. The following section provides an overview of some of these policy tools and specific clauses relevant to rainwater management, urban heat, and biodiversity, which may be impacted by artificial turf installation on private properties. Policy documents summarized below include: Biodiversity Strategy (2016), City of Vancouver United Nations Declaration on the Rights of Indigenous Peoples Strategy (UNDRIP, 2022), Climate Change Adaptation Strategy (CCAS, 2024), Climate Emergency Action Plan (CEAP, 2020), Healthy City Strategy (HCS, 2014), Healthy Waters Plan (HWP, in progress), Rain City Strategy (RCS, 2019), Rezoning Policy for Sustainable Large Developments, Urban Forest Strategy (UFS, 2025), Vancouver Bird Strategy (and Bird Friendly Design Guidelines) (2020), Vancouver Plan 2050 (VanPlan, 2022) and Official Development Plan (ODP, in progress), and the Zoning and Development Bylaw (3575). This is not an exhaustive list.

Biodiversity Strategy (2016): Biodiversity is the richness of plant and animal species, their habitats, and the ecological processes that sustain them. Biodiversity supports critical ecosystem services such as rainwater management, pollination, carbon sequestration, and coastal resilience to sea level rise. Biodiversity in urban landscapes depends on maintaining an “ecological network” of connected natural areas anchored by larger patches. Threats to biodiversity include historical habitat

and species loss, invasive species, disruption to ecological processes, environmental contaminants, climate change, and direct impacts to wildlife. A priority species status states that: Many native birds are declining (barn swallows by more than 90% since the 1970s); native frogs are rare and declining; native bees (important pollinators) are declining (western bumble bee rare); and species at risk are poorly surveyed.

A note on the importance of private property to biodiversity: Private property comprises approximately 57% of the city's land area. The character, structure, and diversity of gardens, buildings, and trees on private property strongly influences biodiversity values in urban landscapes. So called "back yard" habitat has an essential role to play in sustaining birds and invertebrates such as native butterflies and bumble bees and increasing access to nature. Private lands can also function as corridors to allow wildlife to move between parks or provide habitat for species tolerant of developed neighbourhoods such as eastern grey squirrels, coyotes, and Cooper's hawks.

This Strategy aims to support biodiversity in parks, public lands, and private lands across Vancouver. It provides a foundation for protecting and restoring natural areas, species, and ecological processes while improving access to nature in all neighborhoods. The Strategy seeks to increase the amount and ecological quality of natural areas to support biodiversity and enhance access to nature.

Some relevant Objectives include:

- Objective 1: Restore habitats and species.
    - Strategy 1-1: Build the City's ecological network.
- Objective 2: Support biodiversity within parks and streets.
    - Strategy 2.3: Manage water to improve ecological health and enhance biodiversity.
- Objective 3: Protect and enhance biodiversity during development.
    - Strategy 3-1: Protect and enhance biodiversity during development. Action (21) improves the development review and permitting process to better protect and enhance biodiversity during development.
    - Strategy 3-2: Encourage enhancement on private lands. Action (23) works with stewardship organizations to support private landowners

with biodiversity enhancement through landscaping, habitat features, and other elements.

- Objective 4: Celebrate biodiversity through education and stewardship on private and public lands.

City of Vancouver United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) Strategy (2022): UNDRIP is the most comprehensive international instrument on the rights of Indigenous Peoples and is a framework for Reconciliation to uphold and protect Indigenous Peoples' rights and their enjoyment of those rights. As part of the UNDRIP Strategy, the City's task force identified specific calls-to-action under the four themes of the BC Declaration on the Rights of Indigenous Peoples Act (Declaration Act):

- Theme 1: Social, Cultural, and Economic Well-being,
- Theme 2: Ending Indigenous-specific Racism and Discrimination,
- Theme 3: Self-determination and Inherent Right of Self-government.
- Theme 4: Rights and Title of Indigenous Peoples.

Some relevant Calls to Action include:

- 2.5 Complete a regular review of the City's infrastructure (e.g. stormwater system and sewage outflows) to identify issues and make repairs to avoid further environmental harms. Provide updates to Musqueam, Squamish and Tsleil-Waututh on progress.
- 4.7.d. Support the restoration of self-determined cultural practices and food sovereignty, through reducing entry of contaminants into air, waters and soils to meet benchmarks protective of Indigenous values (e.g. Burrard Inlet Water Quality Objectives), and through remediation of contaminated areas.

Climate Change Adaptation Strategy (CCAS, 2024): This Strategy is a city-wide initiative for both public and private sectors with actions aimed at mitigating the impacts of the five key climate-related hazards: extreme heat, poor air quality, drought, extreme rainfall, and sea level rise. The purpose of the Strategy is to reduce risks and enhance resilience to climate-related hazards, and integrate climate adaptation into local policies, strategies, and planning.

Some relevant Objectives and Actions include:

<u>Objectives Relevant to Extreme Heat</u>

Objective H1: Support indoor cooling and thermal safety at home.

- Actions H1.1-1.8: Improve thermal comfort and safety in private lands and buildings by supporting retrofits, incentivizing cooling measures, developing new building requirements, and advocating for policy changes to reduce heat-related health risks.

Objective H3: Stewarding the urban forest and greenspaces to support urban cooling. This objective aims to protect and grow Vancouver's greenspace to mitigate impacts from the urban heat island, which will provide additional benefits, including rainwater management and access to outdoor spaces.

- Action H3.1: Continue to advance tree planting on public land to support efforts to increase the urban forest canopy to 30% by 2050, with a focus on below average canopy neighbourhoods.
- Action H3.4: Explore priority areas for tree planting and retention on private land.

<u>Objectives Relevant to Extreme Rainfall</u>

Objective R2: Managing rainwater through green rainwater infrastructure and the built environment. This objective aims to manage rainwater in ways that support the natural water cycle and remove pressure from the City's sewer and drainage infrastructure while providing other benefits like access to green space and mitigation of the urban heat island effect.

- Action R2.5: Implement rainwater management requirements in the VBBL for Part 3 buildings and multiplexes.

Climate Emergency Action Pan (CEAP, 2020): The Climate Emergency Action Plan is a comprehensive framework for addressing climate change in Vancouver, tackling the City's biggest sources of emissions: transportation (36%) and buildings (57%), and doing so in an equitable way. The Plan sets bold targets to cut carbon pollution in half (relative to 2007) by 2030 and be carbon neutral by 2050, with 6 Big Moves:

- BM 1: Complete walkable neighbourhoods (90% people within easy walk of daily needs).
- BM 2: Active transportation and transit (67% trips by active transportation and transit).
- BM 3: Zero emission vehicles (50% km driven to be by zero emission vehicles).

- BM 4: Zero emission space and water heating (50% reduction (2007 baseline) in building carbon output).
- BM 5: Low carbon materials and construction practices (40% reduction (2018 baseline) in embodied emissions from new buildings).
- BM 6: Restored coasts and forests (2050 target: sequester 21,000 tCO2e per year).

Some relevant Big Moves include:

- BM 5 (low carbon materials and construction practices) and BM 6 (actions to expand natural systems that are critical to support carbon sequestration) are particularly relevant.

Healthy City Strategy (HCS, 2014): The Healthy City Strategy seeks a healthy city for all, increased health and well-being for vulnerable populations, and shaping liveable environments now and in the future. Three focus areas include: Healthy People (taking care of the basics), Healthy Communities (cultivating connections), and Healthy Environments (ensuring livability now and into the future). Some relevant goals include providing opportunities for: 7. Cultivating connections, 8. Active living and getting outside (that enable access to nature), and 12. (access to healthy) Environments to thrive in.

Some relevant Goals and policies include:

- Goal 8: Active living and getting outside.
    - By 2020: all Vancouver residents live within a 5-minute walk of a park, greenway or other green space.
- Goal 12: Environments to thrive in.
    - Add [...] a biodiversity target and a target related to toxins prevention.

Healthy Waters Plan (HWP, in progress): The City is addressing various sewage and rainwater management issues such as aging infrastructure and Combined Sewer Overflows (CSOs), which occur when combined sewers are over capacity and release a mixture of rainwater and sewage into receiving water bodies such as Burrard Inlet and the Fraser River. CSOs have a detrimental impact on the health of the aquatic environment. The Healthy Waters Plan is a 50-year strategy to guide the growth and renewal of the City's sewer and drainage system across five major drainage basins and their associated receiving waters. Thes plan will address sewage and rainwater management and guide long-term investments, policies, and programs to address pollution from CSOs and impacted urban rainwater

runoff while meeting the needs of urban growth and addressing key climate change risks and aging infrastructure. The Plan utilizes both 'green' system solutions (e.g. creek daylighting, rain gardens, other GRI) and 'grey' system solutions (e.g. traditional pipes, treatment plants) to achieve success in a holistic manner on public and private properties in the following goal areas: Healthy waterways, Healthy and liveable watersheds, Adapt to risk and uncertainty, and Affordable and optimal service delivery.

Key issues include:

- Reducing pollution from city sewer and drainage services.
- Increasing sewer capacity to accommodate population growth and related development.
- Mitigating impacts of climate change on city sewage and rainwater system.
- Maintaining infrastructure condition and replacing assets.

Key directions include:

- Enhance our approach to sewer separation.
- Increase green rainwater infrastructure (GRI).
- Optimize rainwater management policy.

Some relevant Goal areas and Objectives include:

- Healthy waterways.
    - Eliminate pollution of waterways by urban runoff.
- Healthy and liveable watersheds.
    - Restore the retention and absorption of rainwater close to where it falls.
    - Restore the amount and quality of natural areas within the sewer and rainwater management system.
- Adapt to risk and uncertainty.
    - Minimize overland fooding risk to people, critical infrastructure, and property.
- Affordable and optimal service delivery.
- Minimize overall, public, and private investment requirements.

As part of the ongoing work in the Healthy Waters Plan, new rainwater management targets for private properties may be introduced, e.g., Key Direction 3.1.7 Optimize rainwater management policy for redevelopment.

Rain City Strategy (RCS, 2019): This Strategy's vision is to embrace rainwater as a valued resource for community and natural ecosystems. The purpose is to address water challenges including pollution, flooding, climate change, and aging infrastructure, by setting ambitious goals for rainwater management through design standards that utilize green rainwater infrastructure practices. Implementation of the Strategy is divided into three city areas: Parks and Beaches (P&B), Streets and Public Spaces (S&PS), and Buildings and Sites (B&S). Each has its own high-level action plan. The targets of the Strategy are to:

- Manage urban rainwater from 40% of impervious surfaces by 2050.
- Capture and treat 90% of the annual rainfall volume.

The specific aspirational rainwater design standard for private properties (Buildings & Sites) is to:

- Capture and clean 48 mm of rainfall per day (note that prior to January 1, 2024, the City used a retention-based design standard for private property of 24 mm of rainfall per day with treatment (for total suspended solids). Afterward, requirements were changed to a detention-based design standard of 24 mm per day with no treatment).

Some relevant Objectives include:

- Removing pollutants from water and air.
- Reducing the volume of rainwater entering the pipe system.
- Increasing the managed impermeable area that treats urban rainwater runoff.
- Mitigating the urban heat island effect.
- Increasing the total green area.

Rezoning Policy for Large Sustainable Developments: The Rezoning Policy for Sustainable Large Developments is triggered for parcel sizes greater than or equal to 8,000 m^2 or with new floor area greater or equal to 45,000 m^2. This policy encourages leadership in sustainable design that contributes to meeting the Urban Forest Strategy, Biodiversity Strategy, and Rain City Strategy objectives through the categories of sustainable site design, sustainable food systems, green

mobility, potable water management, groundwater management, zero waste planning, and affordable housing.

Some relevant policies include:

- Sustainable Site Design:
    - A.2 Intent (paraphrased): Sites should retain or mimic natural processes and re-model healthy systems that link to rainwater management by improving community health and well-being, providing habitat, enhancing ecosystem function and services, creating public open space for people to gather, socialize, and experience nature.
    - A3.2 Non-accessible roofs should include extensive green roof treatment in combination with other sustainable features (e.g. solar panels, water storage). Accessible rooftops should prioritize common use (rather than private) with intensive green roof areas. Residential uses proposing significant private rooftop patios and decks may be subject to rooftop vegetative cover targets that strike a balance between hardscape and softscape ratio.
    - A3.4 Sites should explore and identify opportunities to maximize ecosystem benefits, biodiversity, and habitat provision through the redevelopment.
    - A3.6 Projects should strive to meet the canopy cover and vegetative cover targets specified in the Sustainable Large Developments Admin Bulletin.

Urban Forest Strategy (UFS, 2025): Vancouver's urban forests are comprised of all trees within the city. Examples include native forests within Stanley Park and other parks, ornamental park trees, fruit trees in community gardens and orchards, street trees, trees on school grounds, and trees on private property, Urban forests are increasingly recognized as a critical part of a healthy and sustainable city. The Urban Forest Strategy guides efforts to protect, plant, or manage trees and acknowledges the important role played by trees in advancing climate change adaptation, managing rainwater, reducing heat exposure, enhancing habitat, and supporting biodiversity and community well-being.

Some relevant policies include:

- The Strategy supports private landowners in planting and retaining trees, encouraging habitat connectivity across the city.

- Section 2.0 Value of the Urban Forest acknowledges the role that the urban forest canopy plays in helping mitigate and adapt to increasing urban heat impacts.

Vancouver Bird Strategy (2020) and Bird Friendly Design Guidelines (2017): Habitat loss is the leading cause of bird population declines in British Columbia. In Vancouver, it is estimated that approximately 87% of the forest cover has been replaced with urban development since the 1850's. As urban development increases, habitat loss is expected to become the single largest driver of bird extinction in this century. Other threats to population decline include invasive species, predation, building collisions, and direct human disturbance. The Vancouver Bird Strategy, and associated guidelines, focus on creating conditions for native birds to thrive by reducing threats, enhancing habitat, improving access to nature, enhancing awareness, and growing bird-related tourism. The Bird Friendly Design Guidelines include Landscape Design Guidelines and Building Design Guidelines.

Some relevant policies from the Bird Friendly Design Guidelines include:

- 2.2 Landscape Design Goal.
    - To protect, enhance and create bird habitat in the city, as well as reduce threats to birds in the urban environment.
- 2.4 Landscape Design Guidelines.
    - (a) Protect and enhance large patches of habitat. (b) Green the urban landscape by planting native trees and shrubs for birds. (c) Incorporate a mix of habitat types including: coniferous forest, deciduous/mixed forest, shrubland, meadow, freshwater wetland, riparian and coastal shoreline. (d) Increase vertical vegetation structure by planting and maintaining native trees and shrubs. (e) Select a diversity of native and non-invasive plants. (f) Control invasive plants without disturbing breeding birds. (g) Minimize direct disturbance from humans. (h) Reduce light pollution. (i) Minimize lawn area. (j) Incorporate snags and downed wood. (k) Provide water for birds to drink and bathe.

Vancouver Plan 2050 (VanPlan, 2022): The Vancouver Plan is a visionary long-range land-use plan to guide growth and change of various types of buildings, structures, public facilities, parks, open space, and ecological networks over the next 30 years. The foundations of the Plan are Reconciliation, Equity, and Resilience. The aspirations of the Plan are based on three Big Ideas: Equitable

housing and complete neighbourhoods; An economy that works for all; and Climate protection and restored ecosystems. This plan emphasizes the integration of nature-based solutions and green infrastructure across the city and advocates for building and site design that provides space for nature, and contributes to the capture, retention, and infiltration of rainwater.

As part of VanPlan implementation, a city-wide Official Development Plan (ODP) is currently under development. The ODP builds on VanPlan and will serve as a legal framework to guide future rezoning, development, and infrastructure decisions.

Some relevant Directions and Policies include:

- Direction 3.1 Eliminate Carbon Pollution.
    - 3.1.2 Advance area planning to enable and encourage low carbon footprints for residents through denser housing forms. Balance this with consideration for low carbon construction materials.
- Direction 3.3: Climate Change Adaptation.
    - 3.3.1: Advance natural climate solutions that buffer impacts of climate change, sequester carbon, and improve biodiversity.
    - 3.3.4: Consider public health impacts of a changing climate in the development and renewal of the built environment; New development should respond to, and help mitigate air pollution, extreme heat, and flooding, particularly in areas with higher hazard risk.
- Direction 4.1 Embed Ecosystems in Planning.
    - 4.1.1 Establish a ‘whole systems’ approach to land use planning, including planning at the watershed scale, that incorporates the protection, restoration, and maintenance of key ecological features and areas.
- Direction 4.2 Make Space for Nature.
    - 4.2.1 Establish a healthy, city-wide ecological network through transforming road space, parkland acquisition, and naturalization of parks and other City-owned public property. Increase the urban forest canopy and expand the blue green network.
    - 4.2.4 Retain and grow a healthy and resilient urban forest, using City tools such as zoning, servicing and subdivision bylaws, and upgraded

street designs to provide more space for permeability, quality soil, and increased tree canopy across the city.

- Direction 4.3: Protecting Nature.
    - 4.3.4: Protect urban soil to support the hydrological cycle and the urban forest.
    - 4.3.6: Strengthen policies and regulations to protect and create natural assets on private property, with requirements and consideration for restoration, to increase biodiversity city-wide, and connectivity within natural systems.
    - 4.3.7 Develop and incorporate economic valuation of the ecosystem services that natural assets, habitats, and ecosystems provide into the City's financial planning processes.
- Direction 10.1 City-Wide Water Resource Planning.
    - 10.1.2 Protect and manage groundwater by minimizing contamination, enhancing recharge, and ensuring sustainable use of the resource.
- Direction 10.3: Make Space for Water in Buildings and on Sites.
    - 10.3.1: Develop land acquisition plans and design guidelines to create room for natural buffers and green rainwater infrastructure.

The Zoning and Development By-law (3575): The Zoning and Development By-law establishes regulations for the development of land in Vancouver and specifically regulates:

- The types of land uses allowed.
- Where a building can be located on a site.
- The building's maximum height and size.
- Other provisions necessary to enable good city building.

There are various kinds of Zoning District Schedules, including (not exhaustive) Agricultural, Residential, Commercial, Industrial, Heritage, and Comprehensive Development. The Bylaw is comprised of various chapters, including: Sections 1-15, which include administration, definitions, general regulations, use-specific regulations, and enforcement.

Some relevant policies from the Zoning and Development Bylaw include:

- Section 2 (Definitions)
    - Impermeable Materials: The projected area of the outside of the outermost walls of all buildings, including carports, entries, porches and verandahs, asphalt, concrete, brick, stone, permeable pavers, and wood.
    - Permeable Materials: Materials including gravel, river rock less than 5 cm in size, wood chips, bark mulch, wood decking with spaced boards and other materials which, in the opinion of the Director of Planning, have fully permeable characteristics when placed or installed on grade with no associated layer of impermeable material, such as plastic sheeting, that would impede the movement of water directly to the soil below.
- A range of Residential zones have stated maximum allowable areas for impermeable materials. For example, RT-10 and RT-11 allow a maximum area of 70% of the site to be covered by impermeable materials (this percentage includes allowable site coverage for all buildings).

3.1.5 City of Vancouver's Current Approach to Artificial Turf Management

To understand the City of Vancouver's current approach to artificial turf management, we identified and interviewed the following departments based on their involvement with matters pertaining to artificial turf: Development, Buildings and Licensing (DBL), Engineering Services (ENG), Planning, Urban Design and Sustainability (PDS), Real Estate, Environment, and Facilities Management (REFM), and Vancouver Board of Parks and Recreation (PARKS). These departments/ groups and descriptions of their roles are described below:

Development, Buildings, and Licensing (DBL)

- Development, Buildings and Licensing (DBL) enables the development of vibrant communities, ensures the quality and safety of buildings, and strategically leverages the use of permits, licenses and enforcement to advance Council priorities. DBL engages with a diverse group of customers and interest holders, including developers, architects, small and large business owners and residents. The department is responsible for the Vancouver Building Bylaw. There are different teams within DBL.
- Permitting Services is responsible for reviewing applications, coordinating approvals, and issuing Development Permits (DPs) for a wide range of

developments. Their work involves reviewing zoning, development guidelines, and technical aspects during the development phase of the permitting process (rather than Building Permit or Occupancy stages).

Engineering Services (ENG)

- Engineering Services is responsible for infrastructure essential to the quality of life for residents and businesses, which includes water supply and distribution, sewage and drainage, garbage and recycling collection, zero waste recovery, streets, public spaces, and transportation.
- The Street Activities Branch works with community partners to design and steward public gathering spaces; manages community-based placemaking, mural, and green streets programs; and oversees graffiti management, street horticulture and street furniture. The Green Streets Program facilitates gardeners caring for planted traffic circles and street corners across Vancouver. Gardening on boulevards is encouraged as a way for residents, property owners, and business operators to take care of and maintain the City boulevard next to their property.

Planning, Development, and Sustainability (PDS)

- Planning, Development, and Sustainability (PDS) is responsible for creating plans, policies, and bylaws that guide the physical and economic development of the City. Through its two core functions of long range and current planning, PDS helps create sustainable, liveable, and inclusive neighbourhoods that enable density and growth, protect the beauty of the city and surroundings, incorporate parks and landscaping, and facilitate high quality urban design.
- The Landscape Review Group reviews rezoning and development applications for private properties and City-owned properties, focusing on landscape design within property lines, including compliance with the Tree Bylaw.
- Involvement begins early in the planning process and continues through Development Permit (DP) approval.

Real Estate, Environment, and Facilities Management (REFM)

- Real Estate, Environment & Facilities Management (REFM) is responsible for the acquisition, sale, leasing, and management of real estate property. The department's portfolio of facilities and properties includes indoor and outdoor pools, ice rinks, community centres, childcare centres, housing, arts

and culture spaces, theatres, seniors' centres, entertainment and exhibition spaces, park buildings, archives, and library buildings. REFM also covers the maintenance of civic-use buildings, including janitorial and security services.

- Facilities Management oversees activities such as building systems maintenance and operations, life cycle replacements, interiors planning and design. Although REFM is responsible for Parks building maintenance and replacement, landscape maintenance of Parks buildings is typically undertaken by the Parks Department.

The Vancouver Board of Parks and Recreation (PARKS)

- The Vancouver Board of Parks and Recreation (PARKS) oversees a system of parks, recreation, and cultural assets which enhances the livability of the city, protects natural areas, and provides health benefits from physical activity, play, and connections to nature and community. The Board mission is to provide, preserve, and advocate for parks and recreational services to benefit all people, communities, and the environment.
- PARKS manages and operates 250 public parks, various beaches, VanDusen Botanical Garden, Bloedel Conservatory, and a large public recreation system of community centres, pools, rinks, fitness centres, golf courses, street trees, marinas, sports fields, and playgrounds.
- The Planning and Park Development Division plans, designs, and implements new and renewed parks, natural areas, outdoor recreation, and supporting infrastructure to ensure service levels keep pace with growth. The Division includes the Park Development group and the Planning, Policy and Environment group.

Each of the department's/group's policy approach and knowledge about artificial turf are described below in Table 1:

Table 1: Overview of Policy Approaches and Artificial Turf Knowledge in Each Department/Group

Department and group	**Artificial turf use and data/ tracking** **USE: Is artificial turf used within the areas of the City overseen by the department?**	**Policies, mechanisms, and corresponding rationale relating to the use of artificial turf**	**Supporting information and tools**

	TRACKING: Does the department have data on artificial turf installations?		
Development, Buildings, and Licensing (DBL); Group: Permitting Services	USE: Artificial turf is used on private properties, but it is rarely seen listed as a material on development applications. If artificial turf is used, it will likely be installed after permitting. TRACKING: DBL/Permitting Services does not currently track artificial turf installations on private properties.	Artificial turf is not encouraged, aligning with the City's preference for real vegetation and impermeability requirements. Artificial turf is regulated through site impermeability requirements and landscaping guidelines. The Zoning and Development By-law No. 3575 establishes land development regulations for various Zoning Districts such as Agricultural, Residential, Commercial, Industrial, and Heritage. Depending on the Zoning District, there are clauses that allow a maximum area of the site to be covered by impermeable materials (this percentage includes allowable site coverage for all buildings). For example, RT-10 and RT-11 allow a maximum area of 70% of the site to be covered by impermeable materials. Although artificial turf is not explicitly listed as impermeable, it is treated as such due to its material properties and base compaction. In some Zones, the Director may vary the	Refer to the PDS section for information on the PDS Bulletin titled, *Artificial Turf on Private Property (2016)*. DBL Inspections operates on a complaint-based system. In cases involving artificial turf on private property, complaints are reviewed on a case-by-case basis to assess compliance with impermeability requirements and consistency with approved landscaping plans. While inspections staff do receive complaints and inquiries related to artificial turf, these represent only a small fraction of the more than 10,000 complaints received last year.

		maximum area of impermeable materials in non-conforming situations.	
Real Estate, Environment, and Facilities Management (REFM); Group: Facilities Management	USE: Artificial turf is used minimally within or around REFM buildings and facilities. It may appear in limited areas such as golf course driving ranges, but it is largely avoided. TRACKING: REFM/Facilities Management does not currently track artificial turf installations on REFM properties.	REFM addresses artificial turf use in two internal guidelines: the Childcare Technical Guidelines and the Facilities Standards Manual (which applies to all city-owned buildings). These documents state that natural plantings are preferred, and artificial turf can only be considered for small areas if it meets specific requirements. Approval must also satisfy Vancouver Coastal Health's Community Care Facilities Licensing (CCFL). REFM facilities typically avoid artificial turf due to the City's preference for green roofs and natural landscaping, in addition to concerns about permeability.	Reference to artificial turf can be found in *Section 3.5 Landscaping* of the *Childcare Technical Guidelines REFM (2024)*, and *Section C.3 Landscaped Areas/Playgrounds (general)* in the *Facilities Standards Manual – REFM (2024)*.
Engineering Services (ENG); Group: Street Activities Branch	USE: Artificial turf is not used in streets and boulevards. Streets Activities and Streets Designs have rejected requests to install artificial turf, based on alignment with various city strategies and the *Boulevard Gardening Guidelines*. TRACKING: ENG/Street Activities Branch does not currently track artificial turf	The *Boulevard Gardening Guidelines* do not currently include specific information on artificial turf; however, the Guidelines do promote natural landscaping, which "supports environmental benefits such as increasing ecological diversity and providing bird, butterfly, and pollinator habitats". The *Boulevard Gardening Guidelines* is currently	Any inquiries about artificial turf on boulevards are met with the following response: "If your strata is having challenges maintaining grass in this area, there is an option to install shrubs or other vegetation according to the *Boulevard Gardening Guidelines*. Artificial turf installation is not supported by the City. Other hardscape treatments are

	installations on public property, including streets and boulevards.	undergoing an update, and the updated draft will include the following section: "5.2 Artificial Turf: The City does not support the installation of artificial turf on boulevards. Artificial turf is a synthetic material that does not provide any of the benefits that soil and vegetation offer, such as water absorption, heat mitigation, ecological diversity, etc."	[supported]. Hardscape treatments are standardized for different areas of the City. You must follow the proper permitting procedures and install the appropriate hardscape. Permitting procedures are established to help confirm trees are protected, there is no conflict with utilities, and construction activities meet City standards for traffic control, protection of work, public safety etc."
Planning, Development, and Sustainability, (PDS); Group: Landscape Review	USE: Artificial turf can be used and is only encountered when it is proposed by private developers or landowners during private property redevelopment. If artificial turf is included in a landscape drawing, the team reviews it as part of the overall development application. Artificial turf is rarely proposed in development applications and, when proposed, is typically associated with high-traffic areas. TRACKING: Installations are not tracked, and the full extent of turf use is unclear, as many applications are installed after	Artificial turf is not encouraged, aligning with the City's preference for natural vegetation and existing limits on impermeable materials in several Zones. Broader planning guidelines promote permeable surfaces and natural plantings, but artificial turf is not explicitly mentioned or regulated in current PDS-wide policies or guidelines. Refer to the DBL section for more information, including some applicable content from the Zoning and Development By-law on allowable impermeable area.	The PDS Bulletin titled, *Artificial Turf on Private Property (2016)*, prohibited the use of artificial turf on private property (see Appendix A4). The Bulletin was created primarily to address RS-1 zones. These low-density zones were replaced by R1-1 zoning in 2023 as part of the R1-1 District Scheduling, which replaced numerous Residential Zones. Consequently, the PDS Bulletin is no longer posted.

	inspections are complete or may not be listed in approved landscape plans.		
Board of Parks and Recreation (PARKS); Group: Planning and Park Development Division	USE: Artificial turf is used on sports fields and in one dog park. TRACKING: The Park Board actively tracks artificial turf installations and usage by user groups.	In alignment with the 2024 Sports Field Strategy, the Parks Board is gradually expanding artificial turf installations. The primary rationale for artificial turf adoption is maximizing usability of sports fields throughout the year.	The Park Board had a moratorium on new synthetic turf installations in effect from 2019 while a health and environmental study was conducted, which reviewed available literature considering artificial and natural turf surfaces. In 2024, the Sport Field Strategy and its accompanying Health and Environment Study were reviewed and subsequently adopted. Sport Field Strategy includes considerations around health, environmental impacts, user demands, and field durability. As part of the Strategy development, the City collaborated with Vancouver Coastal Health, which provided a letter of support, ultimately concluding that synthetic turf was safe for human use when managed with best practices.

3.2 Literature Review and Subject Matter Expert Interviews

3.2.1 Introduction

This section provides information from literature review and subject matter expert (SME) interviews on the i) the historic development and projected market for artificial turf systems, ii) components of artificial turf systems, iii) the life cycle of artificial turf systems, and iv) impacts of artificial turf use on rainwater and receiving water bodies (quantity and quality), urban heat, and biodiversity.

3.2.2 Background

Artificial turf, also referred to as synthetic turf, synthetic grass, or artificial grass, is a synthetic surface material that visually mimics natural grass. Artificial turf was first developed in the United States in the 1960s as a replacement for natural grass on sports fields to provide greater playing time, more resilience, and less maintenance (Jastifer et al., 2019). Over the years, many design improvements have been made to improve performance, usability, and aesthetic properties. These improvements have resulted in “third generation systems”, which are widely used today (State Government of Victoria, 2011). There continue to be changes in the design of artificial turf systems to improve performance and address consumer concerns (Toronto Public Health, 2015).

Artificial turf is predominantly used for sporting fields, but it is becoming increasingly popular in non-sporting contexts, such as home gardens, residential lawns, and commercial landscapes, due to perceived lower maintenance requirements (Department of Toxic Substances Control, 2024). The global market size for artificial turf has been steadily growing since 2020 and it is currently valued between 5-7 billion USD and projected to increase to 9-10 billion USD by 2030 (Figure 5) (Grandview Research, 2025; Root Analysis, 2025). In Canada, the artificial turf market generated a revenue of 394 million USD in 2024 and is expected to reach 550 million USD by 2030 (Grandview Research). Based on the types of usage, the global artificial turf market is segmented into sports, landscape, and leisure, and although sports currently captures over 60% of the market share, the landscape segment is expected to witness the fastest compound annual growth rate (CAGR) of approximately 9% by 2035 (Root Analysis, 2025), due to the rising trends in residential and commercial landscaping applications of artificial turf.

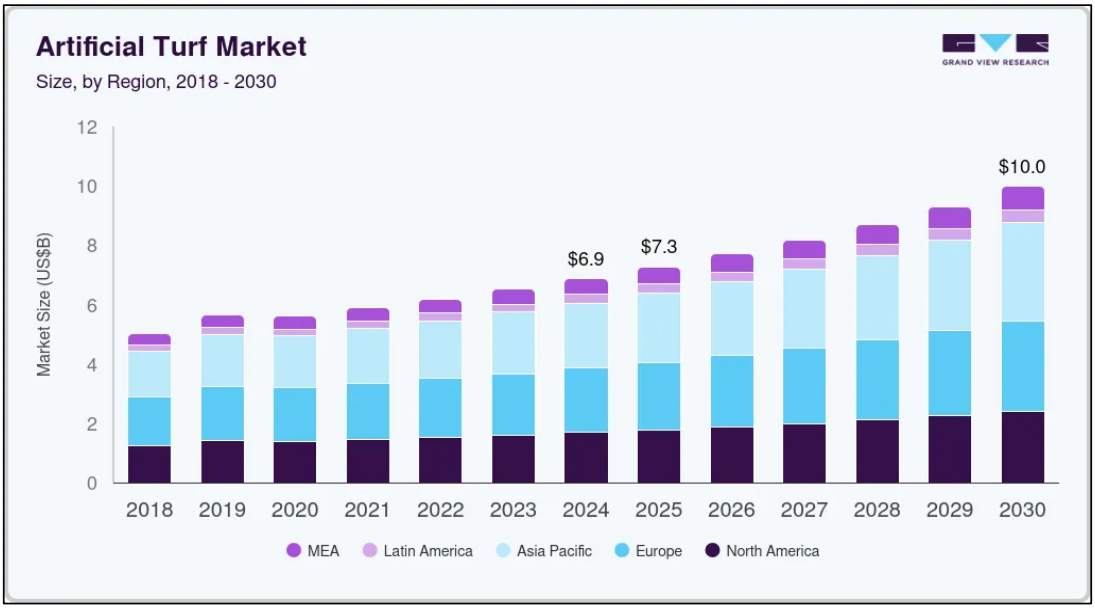


Figure 5: Artificial turf market size by region, 2018-2030, in USD (Source: Grand View Research).

Artificial turf is widely promoted by the industry as a cost-efficient, maintenance-free, and environmentally friendly product that can replace natural grass on a variety of surfaces and for a variety of applications (Synthetic Turf Council, 2022). The environmental benefits promoted by the artificial turf industry include reduced water use and elimination of fertilizers and pesticides. In contrast, concerns raised by various groups such as researchers, environmentalists, citizen groups, local governments, and schools include higher life cycle costs, microplastics pollution, and the presence and potential leaching of toxic chemicals from artificial turf, including PFAS ("forever chemicals") which are linked to cancers, endocrine disruption, organ damage, and other serious health problems (Sierra Club, 2024).

3.2.3 Components of Artificial Turf Systems

Artificial turf has three distinct layers: synthetic grass fibers, backing, and infill (Figure 6). Specifics for each layer are described below (Cheung & Livesley, 2025; Galkina, 2023):

- **Synthetic grass fibers:** These fibers are made of polyamides or polyolefins such as polyethylene, polypropylene, generally 35-65 mm in length.

- **Backing layer:** The backing system is engineered to enhance the structural integrity of artificial turf. The primary backing typically consists of a stretch-resistant woven polypropylene mesh, which serves as a foundation where the synthetic grass fibers are tufted into organized rows. The secondary backing, usually composed of rubber or polyurethane, binds and secures the entire turf structure. The backing system affects drainage capabilities.
- **Infill:** The infill helps to maintain the fibers in an upright position and can be composed of recycled rubber (crumb rubber), or alternative synthetic (i.e., thermoplastic elastomers (TPE), ethylene propylene diene monomer (EPDM)), or natural materials such as silica, cork, or walnut shells.

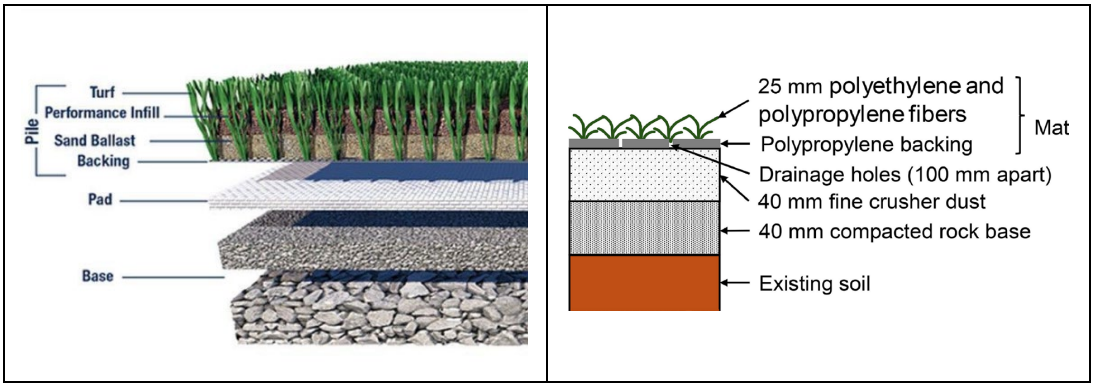


Figure 6: Diagrams illustrating the different components of artificial turf for sports fields/recreational (left) and residential/commercial applications (right) (Source: Susan Chapnick/Town of Arlington and Cheung & Livesley (2025)).

The installation of artificial turf for both sport/recreational and residential/commercial applications involves multiple stages, each contributing a distinct layer above the existing soil (Murphy & Warner, 2022). The process begins with creating a stable base, typically using compacted gravel. A layer of synthetic fabric is then laid down to inhibit weed growth. This is followed by a shock-absorbing plastic layer (optional[1]) that provides cushioning. On top of this, a synthetic mat embedded with artificial grass fibers is stretched to form the turf-like surface. Finally, infill (optional[2]) is distributed across and between the fibers to improve surface stability and performance (Sánchez-Sánchez et al., 2018).

[1] typically not used in a commercial / residential application
[2] typically not used in a commercial/ residential application

As alluded to above, depending on the intended use (sports fields/recreational vs. commercial/residential), artificial turf systems may include optional material layers as described below (Synthetic Turf Council, 2020):

- **Shock pads:** Sports fields have shock pads to improve performance, but these are not present in commercial or residential systems.
- **Drainage systems:** Sports fields will potentially have engineered drainage systems underneath the installation.
- **Infill materials:** The use of infill materials often distinguishes artificial turf applications designed for sports activities from applications designed for commercial or residential settings. Specifically:
    - Infill is required for helping to achieve performance standards on sports fields, and crumb rubber is the most popular infill material.
    - In contrast, the use of infill in non-sports applications depends on the user's preference and many residential or commercial applications do not contain any infill.

3.2.4 Life Cycle of Artificial Turf

Artificial turf is composed primarily of petroleum-based plastics, with both the grass blades and the backing material made from virgin fossil fuel-derived polymers. Throughout its life cycle, artificial turf contributes to greenhouse gas emissions, plastic pollution, and chemical contamination (Cheng et al., 2014). Below is a summary of the environmental considerations associated with artificial turf at the four key life cycle phases of 'Raw Material Extraction', 'Production', 'Use During Life Span', and 'End of Life and Disposal'.

Phase I: Raw Material Extraction

Artificial turf is manufactured using plastics derived from fossil fuels (oil and natural gas). Oil is extracted from the earth via drilling, offshore drilling, and enhanced recovery, while natural gas is often coextracted with oil, using hydraulic fracturing (fracking). Alternative infill materials such as cork, coconut husks, and other natural materials also involve raw material extraction (Galkina, 2023).

The environmental burdens associated with raw material extraction include:

- Carbon emissions associated with extraction methods for oil and natural gas, and the transport of raw materials from extraction sites to production.
- Habitat destruction.

- Potential for oil spills, air and water pollution, methane leaks.

Phase II: Production

The production of artificial turf requires a high energy input, resulting in substantial greenhouse gas emissions (Bø et al., 2024). The manufacturing process includes the formation of plastic components (grass blades and backing) and the addition of chemical compounds to ensure structural integrity and longevity. For example, in addition to forming the plastic polymers, various chemical additives such as PFAS and UV stabilizers are used to enhance color stability, material durability, and resistance to sunlight (Magnusson & Mácsik, 2017).

The environmental burdens associated with production include:

- Potential release of additives and chemicals of concern into the air and water during manufacturing.
- Carbon emissions from plastic production.
    - It is estimated that a typical 60 square metre segment of artificial lawn can generate approximately 435 kilograms of CO_2 from manufacturing alone (Greenmatch, 2024).

Depending on the application, artificial turf systems may also include infill materials, most commonly crumb rubber infill, which is produced from recycled tires and has been touted as an environmentally friendly alternative to traditional tire disposal methods such as incineration or landfilling (Murphy & Warner, 2022). Recycling tires to create crumb rubber infill is touted as environmentally beneficial because it reduces landfill waste, prevents tire fires, conserves natural resources, and supports a circular economy (Falsafi et al., 2025). However, there is ongoing concern about potential chemical exposure from the rubber when used an infill material, as it can contain heavy metals, polyaromatic hydrocarbons (PAHs), PFAS, and volatile organic compounds (VOCs) (Massey et al, 2022), which may leach into the environment during use.

Phase III: Use During Life Span

Artificial turf has a life span of approximately 8 to 15 years (Murphy & Warner, 2022), depending on the specific product and type of use. While artificial turf reduces the need for irrigation, mowing, pesticides, and fertilizers, it is not maintenance-free (Russo et al., 2022).

Maintenance can include (Bertling et al., 2021):

- Brushing (1x per week) to realign blades.

- Debris cleaning as needed.
- Deep cleaning (1 to 3x per year for sports fields).
- Irrigation during heat events (approx. 6 to 8 L/m^2 for non-infill turf).
- Minor repairs (tears, holes).
- Infill replenishment for applicable installations.

The environmental burdens associated with use include:

- Release of plastic pollution (including microplastics) into the environment (i.e., soil, water, air) via fiber shedding, infill migration, and the degradation of backing materials (de Haan et al., 2023).
- Leaching of harmful chemicals from infill, backing material, or fiber blades (e.g., heavy metals, PFAS, PAHs) to the environment (i.e., soil, water, air) via volatilization, weathering, and runoff (Bø et al., 2024).
- Water use from irrigation during heat events.

Phase IV: End of Life and Disposal

Every 8 to 15 years artificial turf requires replacement, and end-of-life handling presents major environmental challenges (Falsafi et al., 2025). In 2021, only 10%, or 6.2 million square metres, of the world's end-of-life artificial turf was recycled (Applied Market Information, 2022). Even the European Union, the region with the most stringent disposal requirements, recycles only 15% of its volume of artificial turf at the end of life. According to the Synthetic Turf Council (2017), recycling remains a significant challenge due to the complexity of separating the different components of artificial turf systems. Industry-promoted chemical recycling methods like pyrolysis are largely ineffective, often yielding low-value fuels (e.g., syngas) rather than high-quality recycled materials (expert insight from SME interviews). Due to these challenges, the majority of artificial turf is landfilled or incinerated (DTSC, 2024).

The environmental burdens associated with end of life and disposal include:

- Landfilling consumes space and carries risks of groundwater or soil contamination from chemicals or microplastics (Cheng et al., 2014; Liu et al., 2017; STC, 2017).
- Incineration emits harmful gases and contributes to toxic air pollution (Magnusson & Mácsik, 2017).

In conclusion, artificial turf presents a complex environmental profile. While it may offer operational benefits such as lower overall water use and the elimination of pesticide use, it comes with significant drawbacks related to plastic production, chemical additives, greenhouse gas emissions, and disposal challenges. Moreover, maintenance is still required. The sustainability of artificial turf is questionable as recycling remains largely ineffective and long-term environmental risks persist.

To summarize, the key environmental impacts of artificial turf across its life cycle include:

1. **Fossil Fuel Dependence**
    - From raw material extraction to end-of-life incineration, artificial turf's life cycle is deeply tied to fossil fuels.
2. **Greenhouse Gas Emissions**
    - Significant emissions are generated during raw material extraction and plastic production, as well as during transportation (i.e., of raw materials and finished products).
3. **Plastic and Chemical Pollution**
    - Artificial turf contributes to microplastic proliferation and introduces harmful chemicals (e.g., PFAS, heavy metals) into the environment.
4. **Recycling Limitations**
    - No effective recycling infrastructure currently exists and claims of "circularity" by the industry remain unsubstantiated.

3.2.5 Impacts of Artificial Turf on Water, Urban Heat, and Biodiversity

3.2.5.1 Introduction

This section provides information on the impacts of artificial turf use on rainwater and receiving water bodies (quantity and quality), urban heat, and biodiversity. Information obtained from literature reviews is augmented by information obtained from subject matter expert (SME) interviews.

3.2.5.2 Impacts on Water

Artificial turf alters natural hydrological functions in landscapes by contributing to increased rainwater runoff, contaminant leaching, and plastic pollution. The installation of artificial turf, therefore, has both water quantity and water quality impacts and poses challenges to climate-resilient rainwater infrastructure and to

the ecosystem health of receiving water bodies such as aquifers, streams, rivers, lakes, and the ocean.

3.2.5.2.1 Water Quantity

The permeability of artificial turf varies with the brand or type of artificial turf product installed (Hudepohl et al., 2016). Larger installations, such as turf fields, sometimes contain a built-in drainage system to capture rainwater. However, this is unlikely for residential or commercial installations of artificial turf. Artificial turf is installed over compact surfaces, which limit the underlying soil's ability to absorb rainwater. In a field experiment comparing runoff between different residential landscape types, artificial turf was found to have 5 to 10 times higher runoff flows and greater cumulative runoff volumes compared to natural grass (Figure 7) (Chang et al., 2021). Landscapes with greater compaction, such as artificial turf, have higher runoff potential and lower infiltration rates (Simpson & Francis, 2021).

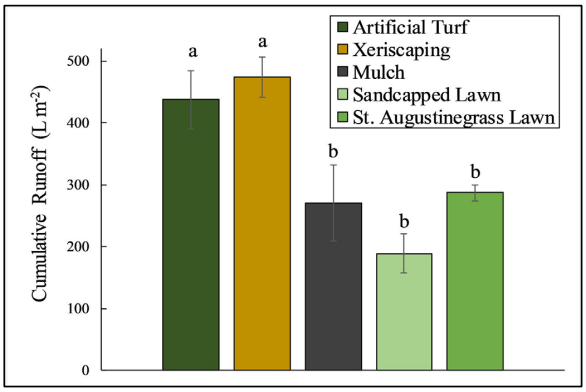


Figure 7: Cumulative runoff volume derived from rainfall for landscapes including Artificial Turf, Xeriscaping, Mulch, Sandcapped Lawn, and St. Augustine grass Lawn, during the study period (September 2018 to August 2020) (Source: Chang et al., 2021).

3.2.5.2.2 Water Quality

In addition to changing hydrology, artificial turf is a source of a complex mixture of chemicals (Figure 8). Water-soluble compounds, including heavy metals and organic additives, can leach from artificial turf and percolate into soil and groundwater underneath installations or be transported via surface runoff (Cheng et al., 2014; Celeiro et al., 2021). The lower water retention capacity of artificial turf compared to natural grass leads to increased runoff and the subsequent transport of contaminants to surrounding environments during rainfall events, posing significant threats to water quality (Simpson & Francis, 2021). A field experiment demonstrated that runoff from artificial turf contained elevated nitrate

concentrations compared to other landscapes, which was attributed to the lack of plant absorption of inorganic nitrate (Chang et al., 2022).

Runoff from artificial turf surfaces has been found to contain elevated levels of zinc, copper, lead, and cadmium, as well as polyaromatic hydrocarbons (PAHs), phthalates, and other organic compounds (Cheng et al., 2014; Celeiro et al., 2018; Diekmann et al., 2019; Gomes et al., 2021; Zhang et al., 2023). Zinc has been detected at concentrations exceeding ecological thresholds for aquatic life, at >4000 µg/L in field runoff (Zhang et al., 2021). A sample of runoff from a crumb rubber infill artificial turf field found the concentration of 6PPD-Quinone to be above the 50% lethal concentration reported for coho salmon (Kryuchkov et al., 2023). Although many of these contaminants originate from the crumb rubber infill (Gomes et al., 2021), toxic substances including stabilizers and PFAS are known to be present in artificial turf fibers. However, more research is needed to understand their specific leachability from artificial turf systems (Awonaike et al., 2021; Galkina, 2023).

Many of the concentrations of chemicals found in field drainages and surface runoff are often not above local regulatory limits (Cheng et al., 2014). However, it is important to note contaminant release and impacts to water quality are variable from site to site, depending on age, condition, and design of the artificial turf (Wachtendorf et al., 2017). Additionally, the cumulative release of chemicals should be considered, as artificial turf will release contaminants into surrounding environments continuously over its entire life cycle (Cheng et al., 2014).

Chemical Functional Class	Function	Example Additives
PFASs*	Enhance plastic extrusion and reduce surface defects (3M 2016)	Vinylidene fluoride-hexafluoropropylene polymer* (3M 2016; 3M 2018)
Ortho-phthalates*	Aid in plastic processing (Hansen et al. 2014)	Di(2-ethylhexyl) phthalate (DEHP)*, diisononyl phthalate (DINP)* (Plesser and Lund 2004)
Colorants	Add color to blades (BASF 2022a)	Green copper metallic complexes* or yellow azo compounds (Nilsson et al. 2008)
Antioxidants	Prevent degradation caused by oxidation (Nilsson et al. 2008)	Phenols and organic phosphites (Nilsson et al. 2008)
Light Stabilizers	Prevent degradation caused by light and heat (BASF 2022b)	Hindered amine light stabilizers (HALS) (BASF 2022b)
UV Light Stabilizers	Prevent degradation caused by UV light (Nilsson et al. 2008)	Zinc tinuvins, hindered amine light stabilizers (HALS) (BASF 2022b; Nilsson et al. 2008)
**Present on DTSC's Candidate Chemicals List (DTSC 2023a). Items without an asterisk are broad functional classes of chemicals and may contain compounds on the Candidate Chemicals List.*		

Figure 8: Chemical functional classes used as additives in artificial turf blades and backing. From California Department of Toxic Substances Control (Source: DTSC, 2024).

Artificial turf is also a source of plastic pollution, as infill and surface materials have been documented in runoff and nearby aquatic environments (Figure 9) (Harusato & Kato, 2025; Hua et al., 2024). One study reported >5000 particles per L in runoff, with plastic fibers being the most abundant microplastic found in the samples, followed by granules (infill) and fragments (Zhang et al., 2025). The microplastic fibers found in runoff exhibited varying lengths, demonstrating that wear and tear result in the formation of secondary microplastics. A field study illustrated that artificial turf fibers composed of polyethylene and polypropylene accounted for 15% of the total plastics found in samples, and the researchers estimated up to 20,000 fibers a day flow from the river to the nearshore marine environment (de Haan et al., 2023).

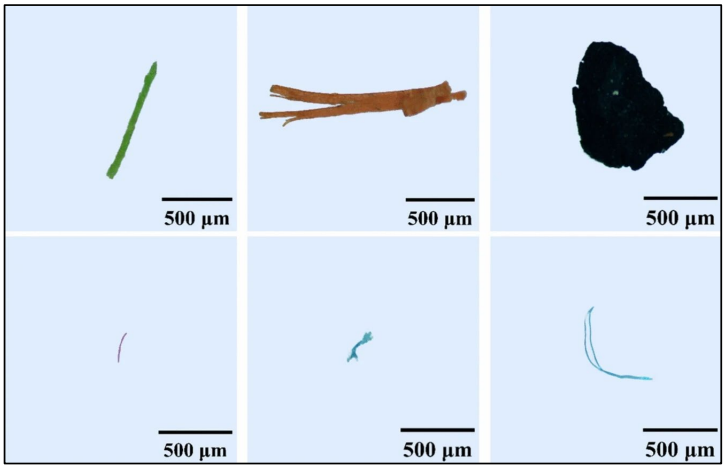


Figure 9: Microplastics found in runoff from athletic fields (Source: Zhang et al., 2025).

SME Insights into Artificial Turf Pollution, Chemical Hazards, and Rainwater Management

Artificial turf contributes to pollution through the release of plastics and chemicals into the environment, which can occur during weathering or runoff. Much of the literature to date has focused on the environmental concerns from chemical leaching from crumb rubber infill, due to the documented presence of harmful chemicals and heavy metals (e.g., zinc). However, other components of artificial turf, including the blades and backing, are also sources of chemical pollutants and possibly heavy metals. Some of these chemicals are associated with human health and environmental hazards such as respiratory toxicity, endocrine toxicity, developmental and reproductive toxicity, immunotoxicity, environmental persistence, and bioaccumulation.

Key chemical classes and pollution hazards from artificial turf include:

- Toxic metals such as lead and zinc
- Polyaromatic hydrocarbons (PAHs)
- Per- and polyfluoroalkyl substances (PFAS) *
- Ortho-phthalates *
- Colourants *
- Plastic chemicals such as phthalates and bisphenol A
- Antioxidants *
- Light and UV stabilizers *
- Microplastics (from infill, backing, and fiber blades)
- Over 350 chemicals have been identified in Environmental Protection Agency literature for tire crumb rubber, with confirmed presence of known carcinogenic and neurotoxic chemicals.

**Indicates chemical classes evaluated by the Department of Toxic Substances SCP Program as they are potentially present in artificial turf blades and backing materials.*

One of the key concerns about artificial turf is the leaching of contaminants. There is sufficient evidence that artificial turf contains hazardous chemicals, and studies have shown that its components, particularly crumb rubber infill, can release various chemicals (i.e., heavy metals and PFAS) into the environment. However, the amount of contaminants leached during rainfall or over time (e.g., the total contaminant loading introduced into the environment) is not fully understood.

While the **hazards** of these chemicals are known, the **exposure levels** and **precise environmental risks** to receiving waters are less understood. The leachability of chemicals depends on properties specific to each chemical, but all artificial turf systems will eventually generate microplastics as the blades and backing disintegrate due to physical abrasion and weathering processes. Microplastics are persistent and mobile in the environment, and they have been detected in all environmental media, ecosystems, and food chains.

There is some evidence that artificial turf increases the volume of stormwater runoff. However, uncertainties remain regarding the amount of runoff compared to actual infiltration, which affects where contaminants end up and how they ultimately affect the environment. Private installations often lack drainage systems, which can lead to contaminated surface runoff that carries chemicals, plastics, and other pollutants. The surface runoff may enter nearby receiving waters or be transported into storm drains and into municipal sewer systems.

The risk of artificial turf contaminants and plastics ending up in aquatic environments has been identified as a significant concern. Runoff entering storm drains can reach receiving waters during sewer overflow events. Furthermore, current wastewater treatment facilities have limited effectiveness in filtering out certain pollutants. As storm intensities increase due to climate change, capturing and managing rainwater contaminants will become more challenging, with larger rain events likely transporting greater amounts of contaminants.

3.2.5.3 Impacts on Urban Heat

3.2.5.3.1 Surface Impacts

The urban heat island effect refers to the phenomenon where urban areas experience higher temperatures compared to surrounding rural areas (Mohajerani et al., 2017). The temperature difference is primarily caused by human activities and the replacement of natural landscaping with built environments. Artificial turf significantly increases land surface temperatures compared to natural grass, exacerbating the urban heat island effect.

Numerous studies have documented significant temperature differences between artificial turf fields and natural landscapes. On hot days when the ambient air temperature reaches around 35°C, artificial turf surfaces have been recorded at over 70°C, making them 35 to 60°C hotter than natural grass, which typically remains just 1 to 2°C above the air temperature (McNitt et al., 2008; Jim, 2016; Jim, 2017; Kanaan et al., 2020; Shi & Jim, 2022) (Figure 10). Despite advancements in artificial turf design, third-generation artificial turf systems show similarly high temperatures relative to first-generation artificial turf systems (Cheung & Livesley, 2025; Mantas & Xian, 2021).

In a recent California study, Schiavon et al. (2024) found artificial turf lawns consistently exhibited the highest land surface temperatures compared to other landscaping and even exceeded 70°C during a heat event. Artificial turf was also found to have the hottest surface temperature compared to other urban street elements, including pavement materials, in Seoul, South Korea (Lee et al., 2018). Newer generations of artificial turf, such as Coolgrass, can be designed with cooling technologies like reflective pigments or modified yarns. However, they were still found to be 10 to 20°C hotter than natural grass (Petrass et al., 2015).

Research into how structural components of artificial turf affect temperature has demonstrated that, although factors such as infill type influence heat retention and fiber type can affect solar radiation (Thoms et al., 2014; Petrass et al., 2014;

Villacañas et al., 2017), material design improvements alone are insufficient to substantially mitigate the overall heat load of artificial turf.

Health Risks of Artificial Turf Surface Temperatures

Artificial turf can reach surface temperatures over 70°C on hot days, far exceeding the 45°C threshold associated with heat-related discomfort (Liu & Jim, 2021). These extreme temperatures pose health risks for users, especially infants, children, the elderly, and those with existing medical conditions who are more susceptible to heat stress and skin burns (Liu & Jim, 2021).

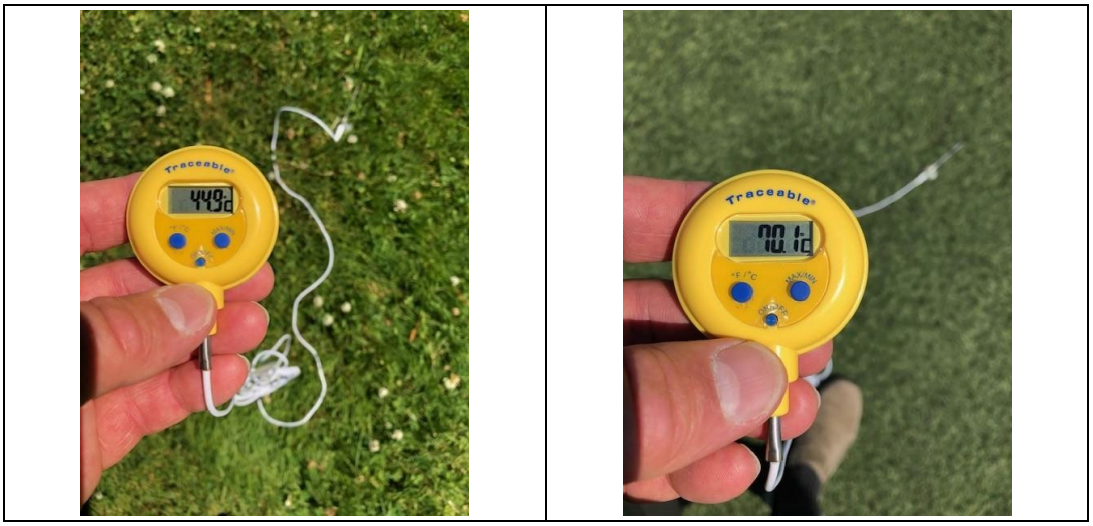


Figure 10: Temperature readings (°C) from grass field (left) and artificial turf field (right) during the peak of the 2021 Heat Dome in B.C at Jericho Park in Vancouver (Source: Gary MacIsaac).

3.2.5.3.2 Ambient Air Impacts

Concerning air temperature, artificial turf has been found to increase ambient air temperature by 0.5 to 1.2°C (Xiao & Cao, 2013; Jim, 2016; Singh et al., 2024). A modeling study found that replacing natural grass with artificial turf added 2.3 kWh/m^2/day of heat into the atmosphere, which would result in increasing air temperature in the city by 4°C (Yaghoobian et al., 2010). Even small incremental increases in air temperature can exacerbate heat-related health risks (Grundstein et al., 2018).

The physical and synthetic properties of artificial turf materials drive these temperature differences. Artificial turf has a low albedo and therefore absorbs rather than reflects solar radiation (Jim, 2017; Carvalho et al., 2021). Components of artificial turf systems have low specific heat and water-holding capacities, which causes them to rapidly heat up when solar energy is absorbed (Devitt et al., 2007). Furthermore, unlike natural grass, artificial turf lacks evapotranspiration, the natural cooling process where water evaporates from surfaces and removes heat from the environment (Goward et al., 1985). As a result, artificial turf absorbs and emits more thermal radiation, resulting in increased surface and air temperatures, exacerbating the urban heat island effect (Carvalho et al., 2021). Attempts to cool artificial turf with irrigation are temporary, inefficient, and require significant amounts of water (McNitt, 2008).

SME Insights into Artificial Turf Impacts on Urban Heat

Artificial turf fields absorb and retain heat at dangerous levels. The urban heat island effect is exacerbated by artificial turf, as evapotranspiration (the cooling process undertaken by natural grass and other plants) is absent. This ultimately contributes to increasing heat stress and the potential for heat-related illness in urban environments. In comparison, natural grass can cool the environment by remaining below ambient temperatures. It is also possible that runoff from artificial turf will be warmer, which may be a concern for terrestrial organisms.

3.2.5.4 Impacts on Biodiversity

Artificial turf has significant negative ecological impacts, specifically for urban biodiversity. Compared to living landscaping, artificial turf provides no habitat or resources for plants and animals (Francis, 2018; Cunninghame & Stanley, 2024). Plants cannot grow on the synthetic surface and the underlying soil beneath the turf is compacted and then topped with synthetic layers during installation, which prevents gas exchange, water filtration, and organic inputs from decomposing materials (Cheng et al., 2014). As a result, soil underneath artificial turf becomes sterile, lacking microbial biodiversity and essential nutrients. This condition is likely to stress nearby trees and affect their overall health, though more research is needed to understand the long-term impacts on trees.

Natural grass supports a diverse community of soil microbes and invertebrates, whereas artificial turf eliminates these habitat niches. The conversion of natural habitats to artificial turf has been found to decrease biodiversity through reductions in bird species richness and abundance, as well as changes in bird community composition (Bernat-Ponce et al., 2020; Sánchez-Sotomayor et al.,

2023). These reductions in biodiversity were attributed to the diminished food resources as ground feeding birds were most severely affected (Sánchez-Sotomayor et al., 2023). Natural landscapes play a critical role in supporting urban biodiversity by offering trophic resources such as plant material, seeds, and invertebrates, and the conversion to artificial turf eliminates the provision of these resources. The homogenization and fragmentation of habitats caused by artificial turf installation is also expected to result in losses of beta diversity, meaning a reduction in the variety of species found between different locations or habitats (Sánchez-Sotomayor et al., 2023).

Artificial turf systems, with or without infill, also pose significant risks to the environment and biodiversity through chemical leaching and microplastic pollution (Massey et al., 2020; Bø et al., 2024). However, installations with infill tend to have more significant ecological impacts due to mobile particles and higher contaminant loads. Infill from artificial turf fields was identified as the most significant annual contributor to microplastic pollution in Toronto, estimated at 237 tonnes (Zhu et al., 2024). Once in the environment, these particles do not biodegrade like natural turf grass components.

Synthetic infills, particularly crumb rubber derived from recycled tires, poses a significant threat to biodiversity because these materials contain heavy metals (e.g., zinc, lead), polyaromatic hydrocarbons, volatile organic carbons, and phthalates (Negev et al., 2022; Zhang et al., 2023; Bø et al., 2024), which can volatilize into the air or leach and solubilize into water, impacting water quality and aquatic organism health (Cheng et al., 2014; Krüger et al., 2013; Lu et al., 2021; McMinn et al., 2024). Chemicals found in tire crumb rubber infill are known as carcinogens, mutagens, neurotoxins, and endocrine disruptors (Murphy & Warner, 2022). Ecotoxicity studies on crumb rubber infill have evaluated the potential impact on organisms whose habitats are directly impacted by artificial turf installation or those that may encounter leachates. These studies have documented decreased growth rates, increased mortality, and developmental malformations/abnormalities (Pochron et al., 2017; Pochron et al., 2018; Xu et al., 2019; Lu et al., 2021; Halsband et al., 2020; Tian et al., 2021; Cunningham et al., 2022; Fort et al., 2022).

Non-infill artificial turf still threatens biodiversity through microplastic pollution and the release of embedded chemicals (Galkina, 2023). Through mechanical abrasion (including during maintenance), UV exposure, and weathering processes, other components of artificial turf (i.e., plastic fibers and backing layers) break down into microplastics and get dispersed by wind or water (Cheng et al., 2014; Kole et al., 2023). Microplastic migration from artificial turf has been documented

in soil, stormwater ditches, and downstream aquatic environments (Chiba et al., 2023; de Haan et al., 2023; Takahasi et al., 2023).

The ingestion of plastic fibers and backing material has been demonstrated by fish, mussels, and earthworms (Chiba et al., 2023; Takahashi et al., 2023; Yin et al., 2023); however, the specific health implications from ingestion are not described. One study, which found that high-density polyethylene (HDPE) plastic fibers from artificial turf were not toxic to *Daphnia magna* (Hua et al., 2024), is consistent with other findings from the broader microplastics field that HDPE is non-toxic. However, artificial turf fibers can, depending on the product, be made of other materials such as nylon, polypropylene, and other synthetic polymers (Gomes et al., 2021). Concerns with the plastic fibers stem not only from the plastic itself, but also from the chemical additives: plastic turf fibers may contain per- and polyfluoroalkyl precursors (Massey et al., 2020; Galkina, 2023) and lead (Cheng et al., 2014), which can leach into aquatic environments and harm aquatic organisms (de Haan et al., 2023). Not only do microplastics carry the inherent toxicity of additives, but they also serve as vectors for environmental contaminants due to their high surface area and sorption capacity (Rochman, 2013).

SME Insights into Artificial Turf Impacts on Biodiversity

If contaminants leach from artificial turf into underlying groundwater, nearby streams, or end up in downstream aquatic environments, water quality will be affected by the presence of these pollutants. Consequently, there will be risks to aquatic biodiversity as many of the contaminants in artificial turf are known to be toxic. More specific data is needed to determine the quantity of contaminants released from artificial turf systems to accurately assess the risk to water quality and aquatic organisms.

Some documented risks to biodiversity include:

- 6PPD, an additive in tire rubber that forms a toxic byproduct, 6PPD-Quinone, is highly toxic, even at low concentrations, to species such as coho salmon and other salmonids. 6PPD-Quinone is known to leach out of crumb rubber infill and has been detected in streams and creeks in British Columbia above acute lethal concentrations.
- Whole effluent toxicity (the aggregate toxic effect of wastewater discharge on aquatic organisms) and zinc toxicity were found to exceed the EPA's acute aquatic toxicity criteria from stormwater runoff samples from artificial turf fields.

    - Zinc is toxic to aquatic organisms at elevated concentrations. Consequences of zinc toxicity can include reduced diversity and abundance of benthic invertebrates, gill changes and altered respiration in fish, and increased mortality, behavioral changes, and reproductive issues across various aquatic species.

- Artificial turf also affects biodiversity as it disrupts wildlife habitats by replacing natural landscapes with plastic surfaces that cannot support biodiversity in the same way. There is a loss of habitat for insects, birds, and small mammals that rely on natural vegetation and soil for foraging and shelter. Installing artificial turf also results in a loss of habitat connectivity as plastic surfaces sever ecological corridors that animals rely on to move between areas.

3.3 Case Studies

3.3.1 Introduction

This section discusses findings from case study research on the experiences and policies associated with artificial turf use in the three municipalities of i) Langford, British Columbia, ii) Toronto, Ontario, and iii) Millbrae, California. For each case study, information is provided on location and population, context, policies, rationale, and lessons learned.

3.3.2 The City of Langford, British Columbia, Canada

Location and Population

The City of Langford is located on southern Vancouver Island, to the east of the City of Victoria, and within the Capital Regional District (CRD) (Figure 11). Langford was incorporated as a District in 1992, became a City in 2003, and has a population of approximately 46,584 people (2021 Census), making it the third largest jurisdiction in the CRD.

Figure 11: A) Location map (Google Maps), B) Photos of the City of Langford (Photo Credit: City of Langford (top right) and The Westshore (bottom right)).

Context

In 2023, the City of Langford rescinded a 2017 bylaw that required artificial turf installation on boulevards adjacent to new developments.

Historically, Langford's planning decisions were closely aligned with development goals, and the City's desire to find efficient practices and relationships with the development industry may have influenced infrastructure choices, including the use of artificial turf as a low-maintenance, cost-saving solution. However, following a change in local government, Langford signaled a shift toward more environmentally conscious decision-making. For example, the City is currently developing a revised Official Community Plan (OCP), which will help guide future climate adaptation strategies. While earlier policies emphasized limiting gas-powered maintenance equipment and reducing water use, this OCP will take a more comprehensive approach to addressing climate change and promoting greener urban planning.

Policies

In 2017, developers were required to install artificial turf on boulevards adjacent to new developments, as described in the Subdivision and Development Servicing Bylaw No. 1000, Bylaw No. 2103. The Bylaw, presented in Appendix A5, included the following specifications for artificial turf products:

- The policy applied only to the public realm (boulevards). The landscaping on private property still had to adhere to design permit guidelines, which require a certain portion of the landscaping to be natural (not artificial grass or concrete).
- The requirement was not applied city-wide and was limited to major roads with sufficient boulevard space, specifically those where a separated boulevard between the road and sidewalk existed. Langford avoided installing artificial turf directly adjacent to private property unless a clear boundary existed to prevent confusion about who maintained the artificial turf.
- There were no strict minimum width requirements as part of the policy, so staff used discretion to avoid installing turf in impractical spaces. Any space narrower than two feet wide was considered too difficult to install and maintain. The bylaw contained flexible language to allow for exceptions where artificial turf installation would not be practical.

As of 2023, Langford officially rescinded the requirement for developers to install artificial turf on boulevards adjacent to new developments. Developers must now install grass. Artificial turf remains in the bylaw as a discretionary option (e.g., if a section of existing artificial turf must be replaced). The amendment to the bylaw is included in Appendix A6.

Rationale

For the policy:

The main driver of the original policy, which required artificial turf, was financial:

- Langford contracts out all public works and installing artificial turf was initially thought to be a way to reduce the frequency and cost of maintenance visits, lower emissions, and minimize traffic disruptions from service crews. A life cycle analysis initially suggested artificial turf would be cost effective over its 20-year lifespan.
- A cost-sharing approach to artificial turf installation was created between the City of Langford and developers. The City reimbursed 65% of the cost of installation to the developers, and the city took responsibility for the maintenance of the artificial turf after installation.

For reversing the policy:

Anticipated savings from artificial turf did not materialize:

- Maintenance turned out to be 2 to 3 times more frequent than projected due to frequent damage from vehicles driving over the artificial turf, which required costly and premature replacements.
    - Although artificial turf was originally only scheduled for maintenance twice a year, debris and waste (cigarette butts, pet waste, etc.) buildup led to unsanitary and unappealing conditions, which then required non-contract work orders (more expensive than regular maintenance).
        - Instead of reducing effort and emissions, this resulted in increased use of gas-powered equipment, which undermined the intended benefits.
    - Boulevards were a poor choice for installation because the durability and actual lifespan of artificial turf depends on damage and environmental exposure. The surface and subsurface layers were compromised when vehicles and equipment drove over them (which

occurred frequently). Unlike natural grass, artificial turf cannot be patched up or re-leveled with soil. Repairing damaged artificial turf is costly and involves pulling back the surface layer to assess structural integrity.

- Environmental concerns pertaining to urban heat, chemical runoff, and sustainability were acknowledged during Council meetings; however, the City did not include these issues as rationale for removing the requirement (i.e., the rationale was only cost-related).

Lessons Learned

1. **Shorter Lifespan:** Artificial turf lifespans were found to be less than anticipated. Heavy traffic areas are likely not ideal candidates for artificial turf installations.
2. **High Maintenance Costs:** Artificial turf maintenance requirements and costs were found to be higher than anticipated. Maintenance was 2 to 3 times more frequent and costly due to damage from vehicles and machinery. Although there was eventual recognition of this cost issue, the installation of artificial turf created a short-term/long term funding tradeoff problem. Even though it is expensive to replace even small sections of artificial turf, it was still deemed more practical and "cost-effective" in the short-term to replace any damage with new artificial turf rather than remove it all and install grass and irrigation.
3. **Quality and Installation Methodology is Important:** The durability of artificial turf depends on product quality and proper installation. Subpar product and installation will make the system more susceptible to weathering processes, thereby resulting in more maintenance.
4. **Environmental and Disposal Concerns:** Artificial turf end-of-life disposal remains an unresolved and likely costly issue.

3.3.3 The City of Toronto, Ontario, Canada

Location and Population

The City of Toronto is located on the northwestern shore of Lake Ontario (Figure 12). Toronto was established in 1793 (as York), incorporated in 1834 (as Toronto), amalgamated in 1998, and has a population of approximately 2,794,356 people (2021 Census), the largest in Canada and fourth largest in North America.

Figure 12: A) Location map (Google Maps), B) Photos of the City of Toronto (Photo Credit blogTO – Louise).

Context

The City of Toronto (Parks and City Planning), in collaboration with Toronto Public Health, was among the first municipalities to investigate the environmental and human health impacts of artificial turf. They published a Health Impact Assessment on artificial turf in 2015. A concerned City staff member advocated for the study.

Although Toronto does not have a ban on artificial turf, the City regulates artificial turf through its zoning bylaws, specifically through soft landscaping* requirements. While the definition of soft landscaping does not explicitly exclude artificial turf, City staff interpret it as such in practice. Toronto is also in the process of consulting on bylaw revisions to explicitly define artificial turf as not qualifying as soft landscaping.

**Soft landscaping is defined in Chapter 800 Definitions of Zoning Bylaw 569-2013 as "landscaping excluding hard-surfaced areas such as decorative stonework, retaining walls, walkways, or other hard-surfaced landscape-architectural elements".*

Toronto Public Health has an official position statement on artificial turf, as described on the City's website:

> *"Natural surfaces are important features of an urban landscape. They provide valuable environmental services by helping cool our air, absorb rainwater, and remove carbon dioxide from our atmosphere. Based upon a review of the available evidence, artificial turf can be associated with urban heat island effects and surface water management issues that may require some limits to be placed on its use in Toronto. Overall the main concerns relating to the use of artificial turf are linked to climate change mitigation and adaptation. Widespread use of artificial turf would make Toronto less resilient to extreme weather events and increase adverse health impacts associated with these events. The 2014 Provincial Policy Statement directs municipalities to address climate change mitigation and adaptation, including maximizing the use of vegetation and pervious surfaces. Toronto addresses this through the Toronto Green Standard and zoning bylaw, which limit the use of hard surfaces, including artificial turf, on properties in the city and encourage natural landscaping to reduce the urban heat island impacts of development."*

The City of Toronto has several integrated strategies and policies that address climate adaptation challenges, including urban heat, biodiversity, and rainwater management. These form a coordinated approach to climate adaptation and are the key mechanisms to enforce sustainable practices through the development review process. They include:

- **TransformTO:** a climate adaptation plan with goals and targets to reduce greenhouse gas emissions.
- **Resilience Strategy:** a framework to build climate resilience across the City.
- **Official Plan Policies:** long-standing (since 2000) policies that guide land use and environmental planning.
- **Toronto Green Standard:** the primary implementation tool, which requires new developments to meet sustainable performance measures, including those relating to urban heat, biodiversity, and stormwater management.
- **Ravine and Biodiversity Strategies:** strategies focused on protecting and managing natural areas and enhancing biodiversity.

<u>Policies</u>

Artificial turf is regulated through Toronto's Zoning Bylaw 569-2013 and the Toronto Green Standard. The Toronto Green Standard is used to review development site plans for developments over 10 units. Private property single-family homes do not require permission for landscaping but are still required to conform to Zoning Bylaw 569-2013.

Zoning Bylaw 569-2013 applies to all lands, uses, buildings and structures in the City, including the Residential Zone Category, and contains explicit regulations about landscaping:

- Section 10.5.50.10 Landscaping (included in Appendix A7) outlines the different landscape requirements depending on the property zone category, lot width, and other factors such as adjacent zone categories.
- Generally, a certain percentage of the yard (front, side, and rear) must be landscaped, and a certain percentage of the landscaped area must use soft landscaping (25-75%). For example:
    - See 10.5.50.10 (1)(B): On a lot with a detached house, semi-detached house, duplex, triplex, fourplex or townhouse, and for lots with a frontage between 6.0 m to less than 15.0 m, a minimum of 50% of the front yard must be landscaped. Of the required landscaping in the front yard (see 10.5.50.10 (1)(D)), 75% of the landscaped area must be soft landscaping.
    - See 10.5.50.10 (3)(A): On a lot with a residential building (other than an apartment building), and on a lot with a frontage of more than 6.0 m, at least 50% of the rear yard must be made up of soft landscaping.

Artificial turf is not considered soft landscaping in the Zoning Bylaw and it is considered hardscape by the Toronto Green Standard. To reinforce the current interpretation, the City is currently consulting on a Zoning Bylaw clarification to explicitly exclude artificial turf from the definition of soft landscaping.

The following is a quote extracted from the proposal for action submitted by the Planning and Housing Committee (page 11 of the Report for Action: Growing Space for Trees) (April 17, 2025):

> *"To implement Official Plan policies encouraging green infrastructure and the growth of healthy trees, staff recommend the definition of "soft landscaping" in the Zoning By-law be updated to expressly indicate that it does not include artificial turf or permeable pavements."*

<u>Rationale</u>

The intention of Toronto updating its city-wide Zoning Bylaw to explicitly exclude artificial turf from the definition of soft landscaping is to reinforce its treatment as a hard surface. By doing this, the policy will support broader City goals relating to climate resilience, biodiversity, urban heat reduction, and rainwater management. The rationale stems largely from the Health Impact Assessment, which found

artificial turf may be acceptable in certain scenarios, such as sports fields (as the benefits of usability currently outweigh health risks), but should not be recommended elsewhere due to environmental impact concerns.

The rationale for excluding artificial turf from soft landscaping is rooted in the following concerns:

- **Biodiversity:** Artificial turf does not support soil life or habitat for plants or animals.
- **Urban Heat:** Artificial turf contributes to localized heating and lacks the cooling benefits of natural vegetation.
- **Rainwater Management:** Despite marketing claims of permeability, artificial turf installations involve compacting sublayers, which reduce permeability, making them functionally similar to paving.

The following is a quote justifying the rationale, extracted from the proposal for action submitted by the Planning and Housing Committee (page 12 of the Report for Action: Growing Space for Trees) (April 17, 2025):

> *"Artificial turf is not defined in the City-wide Zoning By-law. In their interpretation of the Zoning By-Law, staff do not consider it to be soft landscaping, and it is considered hardscape in the Toronto Green Standard. This is because, while its appearance resembles turf grass, it performs like a paved surface. It does not provide healthy soil or growing space for existing and future trees or other vegetation. It also does not allow for organic matter inputs, nutrient cycling, mycorrhizal associations, regulation of soil temperature, and habitat for soil insects. Site preparation to receive artificial turf is similar to that for hard landscaping, typically involving topsoil removal, compaction of the remaining parent soil, and installation of a drainage layer (e.g., crushed stone or gravel), also compacted, atop the remaining parent soil. Artificial turf also contributes to the urban heat island effect, since it can get very hot in the sun; its lack of or reduced permeability can lead to increased stormwater run-off; it may remove carbon-consuming plant material for its installation, and it produces plastic waste at the end of its life. Staff propose an update to the definition of soft landscaping in the City-wide Zoning By-law to confirm that artificial turf is not soft landscaping."*

The impacts associated with the use of artificial turf identified in the Report for Action: Growing Space for Trees contradict advancement of the goals outlined in Toronto's Official Plan, which emphasizes restoring biodiversity, enhancing urban forests, and designing environmentally friendly built environments. As the intent of the city-wide Zoning Bylaw is to ensure the provision of growing space for healthy tree canopies and vegetation, the use of artificial turf impedes this objective. The staff recommendation to amend the Zoning Bylaw to clarify that artificial turf does not qualify as soft landscaping helps to better ensure that

landscaping regulations support the City's environmental goals, and that property owners clearly understand their responsibility.

Public consultation to date has revealed strong support for the exclusion of artificial turf from the soft landscaping definition, which affirms public alignment with strategy and policy priorities. The final report with the amendment is expected to go to Council in October 2025 after the consultation phase is complete.

Lessons Learned

1. **Climate Mitigation and Adaptation Impacts:** The impacts associated with the use of artificial turf contradict advancement of the environmental goals outlined in Toronto's Official Plan.
2. **Definitions:** To clarify expectations and better advance climate mitigation and adaptation objectives, it is important to clearly define 'artificial turf', and whether it is explicitly included or excluded in any associated terms that may be used to limit its use (such as 'hard landscaping' and 'soft landscaping'), in applicable bylaws and policies.
3. **Compliance:** Under the Zoning Bylaw, compliance is largely complaint-driven. The presence of a rule acts as a deterrent, and enforcement for non-compliance only occurs if someone reports the violation. Site approval plans tied to development applications are more strictly enforced, as projects won't receive approval if they don't comply with the landscaping requirements.
    - When reviewing private property developments, City staff consider stormwater impacts of artificial turf via the developer's stormwater management report. However, staff rely on manufacturing claims about permeability, and this information may not be accurate.
4. **Tracking:** Toronto reports that additional resources would be useful for tracking the extent of artificial turf use in the private realm.
5. **Public Advocacy:** Toronto has experienced some individual advocacy for artificial turf on the grounds of reduced maintenance and lower carbon emissions. Toronto has not experienced advocacy from industry.
6. **Other Policy Development Considerations:** The City recognizes other considerations when managing artificial turf use on private property, including homeowners' preferences, reducing development barriers during

the housing crisis, and effectiveness of current policies that limit the extent of hardscaping (and hence artificial turf).

7. **Education:** Providing educational guidance on this issue to the public and development industry may be an effective strategy. Toronto assumes that behavioural changes may be best realized by promoting the benefits of soft landscaping such as trees and vegetation, rather than the negative environmental impacts associated with artificial turf.

3.3.4 The City of Millbrae, California, USA

Location and Population

The City of Millbrae is bordered to the northeast by the San Francisco International Airport, to the southwest by San Andreas Lake, and is within the northern section of San Mateo County (Figure 13). Millbrae was incorporated as a District in 1948 and has a population of approximately 23,216 people (2020 Census).

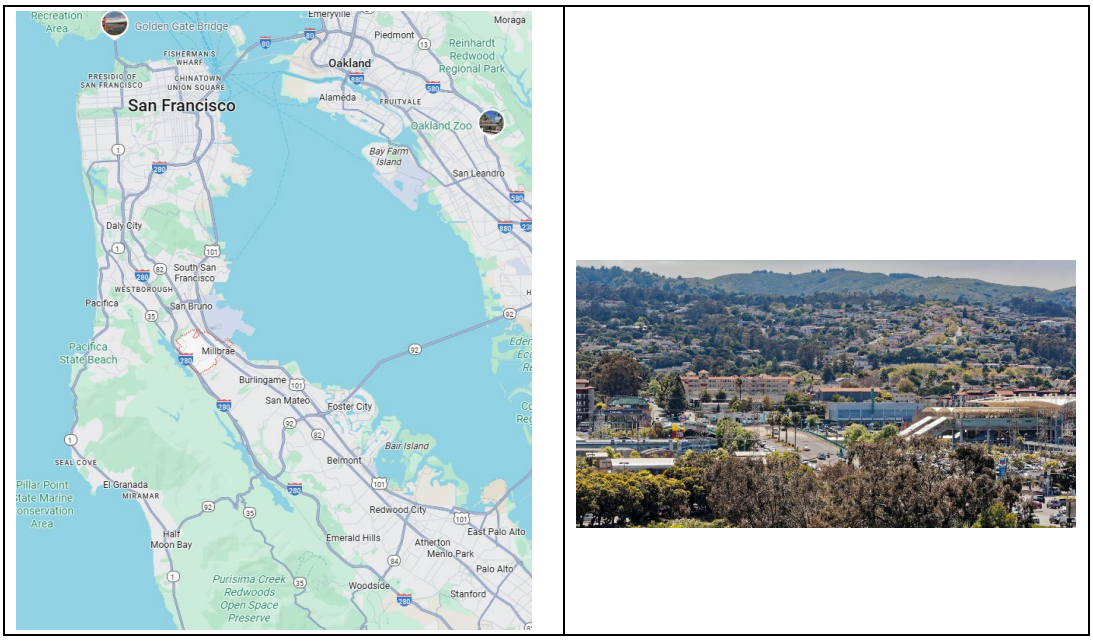


Figure 13: A) Location map (Google Maps), B) Photos of the City of Millbrae (Photo Credit: City of Millbrae).

Context

The City of Millbrae, California, was among the first cities in North America to enact a ban prohibiting artificial turf in 2023. During a severe drought several years prior to the ban, Millbrae observed a proliferation of artificial turf landscaping due to a major water rate increase caused by the drought. Millbrae provides its own water and sewer utilities, and the water rate was already among the highest in the region. Many residents turned to artificial turf landscaping as a way to reduce water use and lower financial bills.

Millbrae is built on hilly terrain, which slopes directly into the San Francisco Bay, and the widespread installation of artificial turf landscaping resulted in increased stormwater runoff as artificial turf is not as effective as natural grass in enabling

water to percolate into the ground. The increased runoff contained microplastics (nylon turf fibers, plastic backing, and crumb rubber infill), which were flowing directly downhill into the Bay. Microplastic pollution from artificial turf was documented in stormwater downstream of artificial turf installations. The influx of pollution to the Bay was the primary driver behind the municipality lobbying the state to change the law* to allow a full artificial turf ban.

**California experienced one of the driest periods recorded in its history between 2011-2016. To encourage landscaping alternatives that use less water, the Governor of California signed a law (AB 1164, Chapter 671) in 2016, which prohibited local agencies from banning or regulating artificial turf. After lobbying from Millbrae, the State passed Senate Bill 676 (Chapter 498), which enabled local governments to restrict or regulate artificial turf grass landscaping in their jurisdictions.*

In addition to concerns about microplastic pollution entering the Bay, Millbrae notes that artificial turf is also problematic from a solid waste management perspective. Due to a lack of viable recycling infrastructure, large quantities of artificial turf end up in landfills after their 8 to 10 year lifespan (as per lifespan data provided by Millbrae staff), which has negative impacts on their state-regulated waste stream diversion targets.

The key motivations driving the lobbying for this legislative change included:

- Environmental concerns (i.e., increased stormwater from insufficient percolation, pollution from artificial turf debris).
- Solid waste management challenges.

Policies

The installation and use of artificial turf landscaping is completely prohibited in the City of Millbrae. In 2023, the City Council passed an ordinance that prohibits the installation as part of Chapter 8.65 of the Millbrae Municipal Code, and the ordinance went into effect on January 1st, 2024. With the ban, residents who have existing artificial turf landscapes are required to remove and replace them with natural landscaping when their installations begin to show visible signs of degradation, or if their installations are unable to accommodate the permeability of stormwater during rain events. The full ordinance is included in Appendix A8.

The following is an excerpt from the Municipal Code Title 8, Chapter 8.65:

8.65.040 Prohibition

The use and installation of synthetic grass and artificial turf landscaping material is prohibited within the city.

Rationale

Millbrae cites the following broad reasons for regulating artificial turf:

- Health and safety of synthetic materials.
- Environmental impact.
- Stormwater capture and percolation.
- Quality and appearance.
- Maintenance and durability.

Specific impacts associated with using artificial turf, which were used to support the ordinance and ban of its use, include:

- **Temperature:** Artificial turf is much hotter than natural grass and can create heat islands, with average temperatures reported during hot and sunny conditions of over 104°F.
- **Toxins:** Artificial turf contains a wide range of toxins, and leakage into the environment will cause irreparable damage to the ecosystem and watershed.
- **Unexpected water use:** Water is still needed to wash and cool artificial turf.
- **Health risks to residents:** Chemicals documented in certain artificial turf and synthetic grass products are known to be toxic and carcinogenic.
- **Stormwater:** Artificial turf prohibits natural absorption of rainwater into aquifers (groundwater), and excess surficial rainwater creates the risk of overwhelming the capacity of the City's stormwater drainage system.
- **Impacts to water quality and runoff:** Microplastics from artificial turf will i) leach into underlying soil and groundwater, and ii) migrate overland within surface runoff, which travels faster over impermeable surfaces, to receiving waters or sewer systems.
- **Biodiversity:** Artificial turf depletes the soil microbiome, prevents landscaping from absorbing water, and dries out the soil, which reduces soil quality and decreases biodiversity. This can also affect the health of adjacent landscaping.

In addition, artificial turf requires an 8- to 10-year investment per installation. The cost of materials and labour is higher than assumed, which can lead to residents choosing to purchase and personally install cheaper, lower quality artificial turf

products. These choices can exacerbate environmental and human health concerns related to toxin exposure, pollution, and stormwater. Currently, there is no technology or infrastructure to recycle artificial turf in California, and the only legal method of disposal at the end of its life is landfilling.

Lessons Learned ("*How they did it*")

Millbrae took the following approach to prohibit the installation of synthetic grass and artificial turf landscaping:

1. A temporary moratorium was put into place in 2021, which paused all artificial turf installations. During this time, an interim ordinance was established by the City Council.
    - City staff prepared a draft ordinance that addressed the types of artificial turf and the methods of installation (best practice guideline).
2. In 2023, the draft ordinance was reviewed and approved by the Community Enhancement Advisory Committee and the Planning Commission and then sent to the Council for consideration and reading.
3. Additionally, in 2023, the Council authorized the City's legislative advocate to lobby in support of Senate Bill 676, which aimed to overturn the current language in Government Code Section 530.87.7, allowing local government agencies to restrict or further regulate synthetic turf and artificial grass landscaping in their jurisdictions.
    - Adoption of a resolution in support of this Bill would further support the City's advocacy efforts.
    - The Council directed staff to monitor state legislation and bring back an ordinance reflective of the outcome.
4. Senate Bill 647 was signed by the governor in October 2023.
    - Millbrae Staff recommended that the City Council introduce an ordinance to amend Title 8, Public Works, Chapter 8.65, Synthetic Grass and Artificial Turf of the Millbrae Municipal Code, prohibiting the installation of synthetic grass and artificial turf (total ban).

As it was unknown if Bill 647 would be reformed to allow municipalities to enact a full ban on artificial turf, Millbrae created a draft ordinance that would have allowed the City to impose restrictions on the type of artificial turf that may be installed and the installation method (best practices guideline). The following topics were identified in the draft ordinance for this guideline:

- Coverage and placement.
- Permeability.
- Materials.
- Durability.
- Installation methodology.
- Maintenance.

Since enactment of the ban, Millbrae has reported routine issues with residents continuing to install artificial turf, which has forced them to increase education and enforcement. The situation is made more challenging by artificial turf vendors who often disregard local regulations.

Other cities in California also have regulations on artificial turf. Examples include:

- **Carson:** Regulates the height of piles and the method of installation to provide sufficient drainage.
- **Cerritos:** Provides guidelines to residents and requests an 8-year warranty for artificial turf.
- **Cypress:** Provides standards pertaining to the quality/character of materials and requests a warranty.
- **Long Beach:** Non-permeable paving and non-permeable artificial turf cannot cover more than 30% of open on-site areas.
- **Norwalk:** Limits permitted area of artificial turf to 70% of the landscaped area, while the remaining portion must contain live, natural plant materials. It also regulates the pile height and colour of artificial turf, and requires a permeable sub-base.
- **San Marino** and **San Fernando** have also banned artificial turf.

Lessons Learned (*General*)

1. **Climate Mitigation and Adaptation Impacts – Policy Alignment:** The impacts associated with the use of artificial turf contradict advancement of the environmental goals outlined in Millbrae's 2040 General Plan (2022), specifically the City's objectives for Natural Resource Conservation.

2. **Climate Mitigation and Adaptation Impacts – Supporting Evidence:** The impacts cited to justify the artificial turf ban align with findings from the literature review and other sources documented in this Scholar report.
3. **Making the Case Locally:** Clearly identify and document the issues associated with artificial turf, such as water quality impacts observed in stormwater runoff, and topographic features that may exacerbate environmental impacts, which helped build a strong, locally grounded case for regulation.
4. **Education is Important:** Guidelines and resources (such as Appendix A9) serve as effective educational tools that can also work well as a precursor for strengthening policies on allowable turf uses.
5. **Management and Regulatory Options:** Various cities in California have decided to implement regulations or management strategies to reduce the environmental impacts of artificial turf. While approaches may vary, there are multiple pathways to mitigate impacts and align with local goals.
6. **Guideline Content:** If considering developing guidelines, it would be beneficial to include the topics outlined in the Millbrae Best Practices Guideline to help ensure comprehensive and practical guidance.
7. **Enforcement Planning:** It is important to develop an enforcement program in advance to help ensure effective implementation of artificial turf regulations.

4. Discussion

4.1 Artificial Turf: Material Composition and Impacts on Climate Adaptation Challenges of Rainwater, Heat, and Biodiversity

4.1.1 Introduction

This section discusses how the material composition of artificial turf contributes to the climate adaptation challenges of rainwater management, urban heat, and biodiversity.

4.1.2 Material Composition

Artificial turf products vary in structure and material composition depending on the specific product and its intended application. However, they generally fall into two broad categories: sports field/recreational-grade (typically with infill) and residential/commercial-grade (often without infill). As illustrated, these differences influence environmental impacts. Much of the research on these impacts, particularly the leaching of chemicals, focuses on artificial turf sports field/recreational applications with crumb rubber infill, as this material is currently understood to contain the majority of chemical contaminants. Crumb rubber infill can migrate off turf fields during precipitation events, general use, and maintenance activities. As a result, it contributes significantly to microplastic pollution.

Residential/commercial applications of artificial turf do not always contain crumb rubber infill, so the chemical and plastic pollution may be reduced compared to sports fields installations. However, the fiber blades and backing, as demonstrated, also contain hazardous chemicals and remain a source of plastic pollution. More research is needed to understand the potential environmental exposure from these components, including leaching during precipitation and loss of material through use or from weathering processes.

The findings from the academic literature review and interviews with SMEs provide evidence that artificial turf installations on private property could likely undermine the City of Vancouver's sustainability and climate adaptation objectives, particularly those related to rainwater management, urban heat mitigation, and biodiversity conservation.

4.1.3 Impacts on Rainwater Management

Artificial turf poses a challenge for municipalities looking to manage rainwater, as it increases surface runoff and serves as a long-term source of plastic and chemical pollutants. Higher runoff flows were illustrated in research comparing artificial turf to natural landscaping on residential properties. This may exacerbate the City's CSO challenges, particularly as climate change leads to increased precipitation and more frequent and intense weather events. Furthermore, the environmental risks associated with artificial turf are neither short-term nor localized, as pollutants can be transported across ecosystems and accumulate over time, with cumulative loads becoming substantial over its estimated 8- to 15-year lifespan.

In addition to these concerns, replacing natural landscapes with artificial turf often involves the removal of trees, which can further undermine sustainable rainwater management. Trees are essential for intercepting rainfall, absorbing water, and facilitating transpiration, all of which help reduce runoff, prevent erosion, and improve water quality by filtering pollutants.

4.1.4 Impacts on Urban Heat Mitigation

In the context of climate adaptation and sustainable urban planning, artificial turf is a counterproductive choice when considering urban heat mitigation. It is well documented that all types of artificial turf exacerbate the urban heat island effect. This occurs because artificial turf has a low albedo (e.g. low ability to reflect solar radiation), meaning it absorbs relatively more solar radiation, and it does not perform evapotranspiration, which is the cooling mechanism used by trees, grass, and other natural landscaping. As a result, artificial turf emits greater thermal radiation. Surface temperatures on artificial turf can exceed 70°C on hot days, making them 35 to 60°C hotter than natural grass, which typically remains only 1 to 2°C above air temperature. These temperatures pose significant risks for heat-related illness and injury.

Natural urban green spaces provide residents with cooling areas on hot days, such as shaded spots under trees or grassy surfaces. In contrast, artificial turf installations do not offer the same benefit, especially given that trees are often removed during installation. As cities face rising temperatures and more frequent heatwaves, natural landscaping should be prioritized over synthetic alternatives in residential settings. Doing so can help mitigate the urban heat island effect and reduce the associated heat-related health impacts.

4.1.5 Impacts on Biodiversity Enhancement and Conservation

Lastly, the installation of artificial turf does not support biodiversity enhancement or conservation. Unlike natural landscapes, artificial turf provides no habitat or trophic resources for plants, soil organisms, or wildlife, and actively degrades soil health through compaction, lack of organic inputs, and disruption of microbial communities. The reduction of habitat space and resources, combined with the fragmentation of ecological corridors, is expected to contribute to declining bird, invertebrate, and small mammal populations, ultimately reducing overall urban biodiversity. Furthermore, artificial turf systems pose chemical and physical threats to terrestrial and aquatic biodiversity through the leaching of harmful contaminants, microplastic pollution, and toxic infill materials.

4.2 Artificial Turf: Impacts of Use on City of Vancouver's Climate Policy Framework of Strategies, Goals, and Objectives

4.2.1 Introduction

This section discusses the impacts of artificial turf use on the City of Vancouver's goals and objectives relating to rainwater management, urban heat, and biodiversity.

Artificial turf installations on private property undermine the City of Vancouver's objectives, strategies, and policies related to sustainable rainwater management, urban heat mitigation, biodiversity enhancement, and other climate adaptation challenges. As introduced in Section 3.1.4, this includes, but is not limited to, the Biodiversity Strategy (2016), City of Vancouver United Nations Declaration on the Rights of Indigenous Peoples Strategy (UNDRIP, 2022), Climate Change Adaptation Strategy (CCAS, 2024), Climate Emergency Action Plan (CEAP, 2020), Healthy City Strategy (HCS, 2014), Healthy Waters Plan (HWP, in progress), Rain City Strategy (RCS, 2019), Urban Forest Strategy (UFS, 2025), Rezoning Policy for Sustainable Large Developments, Vancouver Bird Strategy and Bird Friendly Design Guidelines (2020), the Vancouver Plan 2050 (VanPlan, 2022), and the Official Development Plan (ODP, in progress).

These strategies and plans all emphasize the importance of natural landscapes, tree canopy, and green infrastructure in mitigating climate-related hazards such as extreme heat, biodiversity loss, and management of urban rainwater runoff.

4.2.2 Undermines Urban Heat Mitigation and Thermal Safety

Artificial turf retains significantly more heat due to its low albedo, lack of transpiration, and synthetic composition. The use of artificial turf likely contradicts, as example:

- **The Climate Change Adaptation Strategy** Objectives H1 and 3, which call for improving thermal comfort and expanding greenspaces and tree canopy on both public and private lands to reduce urban heat. Artificial turf neither supports vegetation nor provides shade or cooling benefits, thereby increasing heat stress risks in residential areas and contradicting Actions H1.1-1.8, H3.1, and H3.4.
- **The Healthy City Strategy**, which seeks to reduce urban heat through sustainable urban design.
- **The Healthy Waters Plan**, whose goal areas and Objectives include healthy and liveable watersheds (which include addressing urban heat issues).
- **The Rain City Strategy**, whose Objectives include mitigating the urban heat island effect.
- **The Rezoning Policy for Sustainable Large Developments**, whose purpose is to encourage leadership in sustainable design that contributes to meeting the Urban Forest Strategy, Biodiversity Strategy, and Rain City Strategy objectives. Topics include sustainable site design, sustainable food systems, green mobility, potable water management, groundwater management, zero waste planning, and affordable housing. Policy A3.4 states that sites should explore and identify opportunities to maximize ecosystem benefits, biodiversity, and habitat provision through the redevelopment. Natural spaces are also effective for addressing urban heat mitigation.
- **The Urban Forest Strategy** (Section 2.0 Value of the Urban Forest), which acknowledges the role that the urban forest canopy (e.g. natural space) plays in helping the City mitigate and adapt to increasing urban heat impacts.
- **The Vancouver Plan** (Direction 3.3 Climate Change Adaptation), which i) promotes natural climate solutions that buffer the impacts of climate change, sequester carbon, and improve biodiversity, and ii) considers public health impacts by stating that new development should help mitigate air pollution, extreme heat, and flooding.

4.2.3 Reduces Rainwater Infiltration, Treatment, and Management, and Increases Runoff and Contaminants

Artificial turf systems are often comprised of impermeable or semi-impermeable layers and are built on compacted gravel and soil. These characteristics significantly reduce rainwater infiltration and natural groundwater recharge, and increase surface runoff, temperature, and associated contaminant loads (chemicals and plastics), thereby adding stress to the City's rainwater infrastructure. The use of artificial turf likely contradicts, as example:

- **The City of Vancouver's United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) Strategy** (Call to Action 4.7.d.), which supports the restoration of self-determined cultural practices and food sovereignty, through reducing entry of contaminants into air, waters and soils to meet benchmarks protective of Indigenous values (e.g. Burrard Inlet Water Quality Objectives), and through remediation of contaminated areas.
- **The Healthy Waters Plan**, whose goal areas and Objectives include healthy and liveable watersheds, which involves i) restoring the retention and absorption of rainwater close to where it falls, and ii) restoring the amount and quality of natural areas within the sewer and rainwater management system.
- **The Rain City Strategy** and the **Climate Change Adaptation Strategy** (Objective R2), which aim to use green rainwater infrastructure to reduce stormwater volume and pollution.
- **The Urban Forest Strategy** (Section 2.0 Value of the Urban Forest), which acknowledges the role that the urban forest canopy (e.g. natural space) plays in helping the City mitigate and adapt to anticipated increases in rainfall intensity (including reducing runoff and combating soil erosion).
- **The Vancouver Plan** (Direction 3.3 Climate Change Adaptation), which i) promotes natural climate solutions that buffer the impacts of climate change, sequester carbon, and improve biodiversity, and ii) considers public health impacts by stating that new development should help mitigate air pollution, extreme heat, and flooding.

4.2.4 Reduces Urban Biodiversity and Ecological Connectivity

Artificial turf typically replaces natural vegetation and underlying soil with plastic materials that provide no habitat, food, or ecological function for urban wildlife,

Isolated installations also serve to fragment surrounding habitat and connectivity. The use of artificial turf hinders biodiversity and likely contradicts, as example:

- **The Biodiversity Strategy** (Objectives 1-4) and the **Urban Forest Strategy**. These strategies aim to build an ecological network through private and public lands, encourage native plantings, and enhance habitat connectivity.
- **The City of Vancouver's United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) Strategy** (Call to Action 4.7.d.), which supports the restoration of self-determined cultural practices and food sovereignty, through reducing entry of contaminants into air, waters and soils to meet benchmarks protective of Indigenous values (e.g. Burrard Inlet Water Quality Objectives), and through remediation of contaminated areas. Protecting and enhancing habitat and biodiversity is implicit in this Call to Action.
- **The Healthy City Strategy**, which includes goals include environments to thrive in (with corresponding recommendations for developing supporting biodiversity targets and toxins prevention).
- **The Healthy Waters Plan**, whose goal areas and Objectives include healthy and liveable watersheds, which involves i) restoring the retention and absorption of rainwater close to where it falls, and ii) restoring the amount and quality of natural areas within the sewer and rainwater management system.
- **The Rain City Strategy**, whose Objectives include mitigating the impacts of climate change.
- **The Rezoning Policy for Sustainable Large Developments**, whose purpose is to encourage leadership in sustainable design that contributes to meeting the Urban Forest Strategy, Biodiversity Strategy, and Rain City Strategy objectives. Topics include sustainable site design, sustainable food systems, green mobility, potable water management, groundwater management, zero waste planning, and affordable housing. Policy A3.4 states that sites should explore and identify opportunities to maximize ecosystem benefits, biodiversity, and habitat provision through the redevelopment.
- **The Vancouver Bird Strategy** and **Bird Friendly Guidelines**, whose Landscape Design Goal (section 2.2) is to protect, enhance and create bird habitat in the city, as well as reduce threats to birds in the urban environment. The corresponding Landscape Design Guidelines (section 2.4)

include a range of actions that focus on increasing quantities, qualities, and varieties of natural landscape features into the city.

- **The Vancouver Plan** (Direction 3.3 Climate Change Adaptation), which promotes natural climate solutions that buffer the impacts of climate change, sequester carbon, and improve biodiversity; and (Direction 4.3 Protecting Nature), which calls for strengthening policies and regulations to protect and create natural assets on private property, with requirements and consideration for restoration, to increase biodiversity city-wide, and connectivity within natural systems.

In conclusion, artificial turf installations on private property are likely to impede the effectiveness of Vancouver's comprehensive policy framework aimed at fostering a climate-resilient, ecologically healthy, and liveable city. Replacing natural landscaping with artificial turf on private property increases urban rainwater runoff challenges, exacerbates urban heat island effects, and disrupts the urban ecological network that is critical for biodiversity, natural cooling, and overall community wellbeing.

4.3 Considerations: Policy Approaches to Regulation

4.3.1 Introduction

Given the potential for artificial turf use on private property to undermine the City of Vancouver's climate adaptation objectives, it is recommended that the City consider strengthening current approaches to regulating artificial turf use on private property. The case studies included in this report offer valuable insight into how other municipalities regulate artificial turf use and may serve as beneficial models for the City of Vancouver.

This section discusses policy approaches and applicable case study findings from the City of Langford, City of Toronto, and City of Millbrae, followed by an overview of the City of Vancouver's current and potential approaches to regulating artificial turf on private property.

4.3.2 The City of Langford

The City of Langford initially mandated artificial turf installation on boulevards through a subdivision bylaw, based on anticipated cost savings. However, the policy was later reversed after actual costs exceeded initial projections, and maintenance challenges and environmental concerns ultimately outweighed the perceived benefits. The Langford experience is valuable in demonstrating how decisions driven primarily by perceived cost efficiencies from limited cost-benefit

analyses may prove unsustainable and misaligned with long-term climate adaptation strategies and environmental goals. Langford's shift away from mandatory artificial turf use is also a positive example of applying an ongoing adaptive management approach. Specifically, a policy was created (mandate turf), the impact was assessed, gaps were documented between expected and actual outcomes (maintenance hours, costs, and environmental concerns), and the policy was amended accordingly. Langford's progressive use of adaptive management can provide valuable insight for other municipalities who are currently using artificial turf in their jurisdictions.

4.3.3 The City of Toronto

The City of Toronto regulates artificial turf use through a combination of its Zoning Bylaw (569-2013) and the Toronto Green Standard. For Residential zones, as example, the Zoning Bylaw states that a certain percentage of the yard (front, side, and rear) must be landscaped and a certain percentage of the landscaped area must use "soft landscaping". Although artificial turf is not explicitly included under the definition of soft landscaping in the Zoning Bylaw, it is treated as such by staff, given that artificial turf is considered hardscape by the Toronto Green Standard. Though not an outright ban, the use of artificial turf is indirectly limited by limiting hardscape on residential lots of a certain size. An upcoming amendment (pending Council approval in Fall 2025) will further clarify this approach by explicitly referencing artificial turf in the bylaw language (i.e., the soft landscaping definition). A key strength of Toronto's approach is that it includes: regulation, clarity, and rationale. This regulatory approach is mandatory, is supported by consistent policy language, and is based on a strong rationale focused on climate adaptation objectives such as biodiversity protection and heat resilience. That said, enforcement remains a challenge as it is complaint-based.

4.3.4 The City of Millbrae

The City of Millbrae implemented a full ban on the installation and use of artificial turf through a municipal code amendment (Chapter 8.65), citing significant environmental concerns including stormwater pollution and landfill impacts. Enforcement includes mandatory replacement of degraded turf with natural landscaping. As with the Toronto example, Millbrae also exhibits an approach that includes regulation, clarity, and rationale. The mandatory nature of the ban, combined with clear and consistent expectations and a strong environmental rationale, have contributed to its effectiveness. However, such bans require sustained public education and dedicated enforcement resources to ensure compliance.

4.3.5 The City of Vancouver

The City of Vancouver's current approach to artificial turf use varies depending on the type of land use involved. The four major relevant land use types include: private property, city-owned property, city-owned "streets and boulevards", and parks. A brief summary is included below:

- **Private Property:** Maximum impermeability requirements exist for certain residential zones and artificial turf is interpreted by staff and the City as an impermeable material. Although artificial turf is not explicitly referenced nor included in the definitions of "permeable" or "impermeable" materials in the Zoning Bylaw, the department states that broader planning guidelines promote the use of permeable surfaces and natural plantings. Artificial turf is not currently tracked on private property.
- **City-owned Property:** Artificial turf is not typically encouraged nor permitted to be installed on city-owned property. Although not explicitly mentioned or regulated in policies used by REFM, the department states that broader planning guidelines promote the use of permeable surfaces and natural plantings.
- **City-owned "Streets and Boulevards":** Artificial turf is not permitted to be installed on city-owned property because it does not have fully permeable characteristics. Staff are currently working to revise language in the Boulevard Gardening Guidelines to explicitly exclude artificial turf use.
- **Parks and Sports Fields:** The Vancouver Board of Parks and Recreation, through its Sport Field Strategy, supports the use of artificial turf for high-demand sport field applications. Consequently, artificial turf is permitted to be installed and is also tracked. This position is informed by a comprehensive assessment of usability, durability, and year-round playability. The Strategy reflects a cost-benefit analysis that prioritizes increased access to recreational space and consistent field conditions, while acknowledging environmental considerations within the broader planning and operational context.

To strengthen the management of artificial turf on private properties, the City of Vancouver could consider the following approaches, guided by 'lessons learned' from our case study research:

- **Policy Alignment with City-wide Goals:** The City of Vancouver could consider establishing a more unified and enforceable approach that better

aligns artificial turf regulation on private property with its broader climate adaptation and environmental goals.

- **Bylaw Amendment:** Following the City of Toronto's approach, the City of Vancouver could consider undertaking a bylaw amendment to include explicit language classifying artificial turf as an impermeable material. A zoning-based approach would offer greater enforceability and consistency across development reviews. Alternatively, the City could introduce guidelines or bulletins. While these tools can provide useful direction as a supplementary tool, they may lack the regulatory weight of a bylaw if used as a stand-alone document.
- **Guidelines:** Drawing from the City of Millbrae's experience, Vancouver could also consider developing a best practices guideline to encourage better choices in the use and installation of artificial turf on private property. While not necessarily regulatory in nature, such a guideline would promote better environmental outcomes by informing residents, developers, and staff of preferred materials and methods. The City of Millbrae initially used this approach before ultimately implementing a full ban. Although a complete prohibition would most effectively address environmental concerns and support climate adaptation goals, it may present enforcement challenges, based on insights shared by the City of Millbrae.
- **Consultation:** To ensure alignment and avoid conflicting policies, any policy change process should include consultation with key interest holders, particularly across internal departments. Additionally, engaging with external interest holders, such as Vancouver Coastal Health, SMEs (e.g., those consulted during this research), industry representatives, and the public, can further strengthen the policy development process by incorporating diverse perspectives and expertise.

4.4 Considerations: Enforcement, Education, and Adaptative Management

Enforcement: One of the key challenges identified through internal departmental interviews and case study research is the issue of enforcement. Ensuring effective enforcement is essential to maintaining compliance with artificial turf regulations, upholding the credibility of the regulatory framework, and preventing unauthorized installations of artificial turf after development approvals. While enforcement is currently complaint-driven in the City of Vancouver, incorporating more proactive measures, such as turf inspections during construction and post-

occupancy, could improve compliance. Additionally, providing consistent definitions and clear guidance as part of the development application process can help reduce the enforcement burden by minimizing ambiguity and improving compliance from the outset.

Education (staff and public): Education is an important tool for supporting the successful regulation of artificial turf, both for internal staff and the public. While artificial turf may not be disclosed in development applications and may be installed after approval, **staff** involved in permitting, planning, and inspections still play a key role in shaping public understanding. Providing staff with accessible resources can help them respond to public inquiries and guide residents toward more sustainable alternatives to artificial turf. These resources should explain the environmental impacts of artificial turf and highlight how it can impede climate adaptation efforts. For the **public**, outreach should emphasize the benefits of natural landscaping, such as natural cooling, stormwater infiltration, and habitat creation, rather than focusing solely on the drawbacks of artificial turf. The City of Toronto's approach, which promotes tree canopy cover and soft landscaping, offers a strong example of positive framing.

Tracking: A robust tracking system is necessary for effective artificial turf management. Currently, no department in the City of Vancouver monitors installations on private property, making it difficult to assess the scale of the issue or evaluate the impact of policy interventions. Tracking installations through permitting processes, aerial imagery, and inspections and public inquiry data would provide valuable insights into where and how artificial turf is being used. This information is essential for using adaptative management approaches to assess the effectiveness of artificial turf policy over time. Given that adaptive management approaches depend on accurate, up-to-date data to guide decisions, adjust strategies over time, and respond to emerging trends or unintended consequences, tracker data is essential.

Other considerations include:

Equity: Artificial turf may be installed in lower-income neighborhoods due to perceptions of affordability and ease of maintenance. Any regulatory approach should consider equity impacts and potential remedies (e.g., education, subsidized tree planting, or low-maintenance native landscaping).

Waste Management: The end-of-life disposal of artificial turf systems contributes to landfill burden. Consideration should be given to expanding the responsibilities of product producers or banning specific turf material components to better align with city-wide waste diversion goals.

Industry Influence: The artificial turf industry may promote misleading claims of product sustainability. The City may benefit from partnerships with UBC researchers and others to independently evaluate these sustainability claims.

5. Recommendations

Artificial turf installations on private property likely undermine the City of Vancouver's goals and objectives related to sustainable rainwater management, urban heat mitigation, biodiversity enhancement, and other climate adaptation challenges. To address these concerns, it is recommended that the City of Vancouver consider strengthening its current approach to artificial turf use on private property by exploring and potentially advancing Actions in the following four Focus Areas:

1. Research and Evidence Building.
2. Education and Outreach.
3. Policy and Regulatory Alignment.
4. Supporting Tool Development.

Focus Area 1: Research and Evidence Building

Purpose: Generate science-based evidence on the water quantity and quality impacts from different artificial turf products commonly used on private property in Vancouver. This information would supplement the science-based evidence currently known about the water quantity, water quality, urban heat, and biodiversity impacts from artificial turf products used on sports field/recreation facilities.

Recommendation 1.1: Supplement research on sport field/recreational turf products with specific research on private property turf products.

Significant information is already known about artificial turf products commonly used on sports fields and recreational facilities; but, as discussed in this report, there can be design differences between artificial turf products used on sports fields and those used on private property. For example, many artificial turf products used on private property do not contain infill materials such as crumb rubber, which may vary water quality impacts on the environment. Consider partnering with UBC researchers to investigate the water quantity and quality impacts of popular artificial turf products used on private properties in Vancouver. Some examples of studies to be conducted include:

- Analyzing chemicals present in artificial turf blades and backing.
- Determining chemical and plastic pollution exposure to environments (i.e., leachability of chemicals/microplastics) over different weather scenarios and temporal scales.

- Characterizing permeability of artificial turf systems.

Recommendation 1.2: Categorization of artificial turf products used on private properties.

Consider differentiating and defining major categories of artificial turf products used on private property based on their impacts on rainwater management, urban heat, biodiversity, or other issues of concern to guide management approaches. This categorization could be aided by research findings and other information sources. The information could be used to identify potentially less harmful products in a best practices guide.

Focus Area 2: Educational Resources and Outreach

Purpose: Support internal capacity building and public awareness about how artificial turf installations on private property likely undermine the City of Vancouver's goals and objectives related to sustainable rainwater management, urban heat mitigation, biodiversity enhancement, and other climate adaptation challenges.

Recommendation 2.1: Educational resources (staff).

Consider developing an internal educational resource (factsheet/pamphlet) for City of Vancouver staff that truncates the content described in the external education resource.

Recommendation 2.2: Educational resources (public).

Consider developing a City (web-based) external educational resource (factsheet/pamphlet) that a) describes the environmental issues associated with artificial turf use, b) explains how turf use may impede the City's climate adaptation and related sustainability objectives, c) provides or directs individuals to resources on alternative low cost and low maintenance natural landscaping options, and d) promotes the benefits of natural landscaping for rainwater management, urban heat mitigation, and biodiversity conservation and enhancement. An example of an external education resource is included in Appendix A9.

Focus Area 3: Policy and Regulatory Alignment

Purpose: Ensure that bylaws and policies pertaining to artificial turf regulation are updated to align with the City of Vancouver's goals and objectives related to sustainable rainwater management, urban heat mitigation, biodiversity enhancement, and other climate adaptation challenges.

Recommendation 3.1: Create a Position Statement.

Given that artificial turf installations on private property likely undermine the City of Vancouver's goals and objectives related to sustainable rainwater management, urban heat mitigation, biodiversity enhancement, and other climate adaptation challenges, consider creating a Position Statement that clarifies the City's position on the use of artificial turf on private property. As example, the City of Toronto's Position Statement provides some content that may be suitable for the City of Vancouver.

Recommendation 3.2: Bylaw and policy review.

Consider undertaking a review of bylaws and other policies that regulate artificial turf on private property. Identify gap areas that require modification to better support the Position Statement.

Recommendation 3.3: Clarify and strengthen existing regulations.

Consider explicitly including artificial turf in the definition of "impermeable materials" in the Zoning Bylaw.

Recommendation 3.4: New policy development.

Consider developing new policies and /or regulations to manage artificial turf use on private property and its impacts. This process should be comprehensive and include the following components:

- **Interest Holder Engagement:** Consult with relevant interest holders (e.g., Internal departments, SMEs, industry representatives, Vancouver Coastal Health, and members of the public).
- **Policy Scope and Effectiveness:** Determine whether classifying artificial turf as an impermeable material in The Zoning Bylaw is sufficient for reducing risks from impacts to urban heat, biodiversity, and rainwater management, especially given the range of acceptable impermeable surface percentages and coverages across different zone types. If this is not sufficient in reducing risk, then more stringent measures should be taken (e.g., consider a full ban).
- **Product Differentiation:** Be specific in differentiating between artificial turf products and uses, such as non-infill (residential) and infill (sports fields) to ensure that risk assessments and management strategies are appropriately targeted.

- **Enforcement Considerations:** Identify enforcement challenges and how enforcement can be effectively funded and applied throughout all stages of compliance.

Focus Area 4: Supporting Tool Development

Purpose: Develop tools and practical technical guidance to support i) the regulation of use, installation, and maintenance, and ii) the tracking of artificial turf on private property.

Recommendation 4.1: Documentation, Location Tracker, and Adaptive Management Monitoring Program.

Consider requiring documentation (labelling) requirements on design drawings and developing a location tracker for any artificial turf that is proposed and approved as part of private property development submissions.

Consider developing a monitoring program that uses and reports on artificial turf tracker information to support adaptive management efforts and any associated artificial turf policy refinement.

Recommendation 4.2: Best Practices Guide.

Consider developing a best practices guideline for artificial turf use, installation, and maintenance on private property, which could include the following content (topics taken from Millbrae's guideline on implementation and use, provided by Andrew Morgensen):

Table 2: Examples of Best Practices Guidelines Content for Artificial Turf Use, Installation, and Maintenance.

Consideration	Details
Coverage and Placement	• Consider establishing a maximum allowable percentage of artificial turf lot coverage to support site permeability. • Discourage hardscape and impermeable materials on private property. • Identify areas where coverage should be avoided (e.g., to allow for stormwater drainage or within the dripline of trees).
Permeability	• Recommend selecting permeable turf materials to support stormwater infiltration and reduce runoff.

	• Encourage the inclusion of setbacks with natural landscaping and bioswales to help limit runoff to streets and enhance site permeability.
Materials	• Assess blade composition to ensure materials are non-allergenic, non-toxic, and flame-resistant. • Strongly discourage the use of PFAS. • Recommend selecting materials that allow for a percolation rate of at least 20 inches per hour. • Suggest using infill made from clean silica sand, zeolite, or organic material. • Strongly discourage the use of crumb rubber, recycled tires, and petroleum-based backing or infill mixes. • Avoid the use of plastic sheeting and impermeable weed barriers to maintain site permeability and reduce runoff.
Durability	• Recommend a tear strength of at least 200 pounds with triple-layer primary backing with a tuft bind strength of at least 10 pounds. • Suggest a minimum lifespan guarantee of 8 years to promote more sustainable and durable installations.
Installation Methodology	• Recommend installing turf on a level surface with a maximum slope of 5 to 10%. • Seams should be firm, tight, and anchored with the grain pointing in a single direction, and not visible. • Recommend removing pre-existing irrigation systems prior to installation. • Recommend installing a solid barrier between artificial turf and adjacent live plant material or soil to prevent contamination and edge deterioration.
Maintenance	• Clearly define what is considered an “attractive and clean condition” for maintenance standards (e.g., free of weeds, litter, holes, tears, stains, and discoloration).

	• Recommend reparation, removal, or replacement of damaged or worn areas. • Strongly discourage vehicle parking on artificial turf.

6. Conclusions and Limitations

This study reviewed and summarized the City of Vancouver's climate adaptation challenges, strategies, and relevant bylaws, with a particular focus on rainwater management, urban heat, and biodiversity; summarized the City's policy approach for managing artificial turf on parks, streets and boulevards, other city-owned property, and private property; and conducted a literature review and engaged with subject matter experts to assess artificial turf systems and their life cycle characteristics. Case study research was then undertaken on three jurisdictions to gain insight pertaining to allowable turf uses, the rationale for any limitations; mechanisms used to restrict use such as bylaws or permitting systems; and 'lessons learned' in the development and implementation of artificial turf use restrictions, with attention to interest holder and decision-maker involvement, implementation processes, and progress reporting.

This study provides insight into how artificial turf installations on private property likely undermine the City of Vancouver's goals and objectives related to sustainable rainwater management, urban heat mitigation, biodiversity enhancement, and other climate adaptation challenges. Drawing from the literature review, subject matter expert interviews, and case study research, it is evident how artificial turf can impact rainwater management, urban heat, and biodiversity, and pose several significant environmental and human health concerns. The City of Vancouver may consider implementing the recommendations outlined in this study to help ensure climate adaptation objectives are not being inadvertently impeded by artificial turf use across the City's private lands.

The key findings of this work include:

- As a synthetic material, artificial turf contributes to climate change through emissions during its life cycle (resource extraction, production, use, and at the end of life). Recycling of artificial turf at this time is unavailable at scale, and thus most product ends up in landfills after use.
- Artificial turf installations can adversely affect rainwater management (water quantity and water quality), urban heat, and biodiversity, through the following mechanisms:
    - Increases rainwater runoff volumes (due to lower ground infiltration) compared to natural landscaping.
    - Reduces rainwater absorption, filtration, and aquifer recharge (due to lower ground infiltration) compared to natural landscaping.

    - Contributes plastic and chemical pollution from its components that contain hazardous substances, which can volatize, migrate, or leach into surrounding environments.
    - Intensifies the urban heat island effect by not performing evapotranspiration and by absorbing, retaining, and emitting more heat relative to natural landscaping.
    - Does not perform carbon sequestration and eliminates habitat for microorganisms, insects, small mammals, and birds.
    - Sterilizes underlying soil, resulting in soil quality and nutrient reductions that may also affect adjacent tree health.
- The industry-promoted perceived benefits of artificial turf relative to grass (lower cost, reduced water use, and elimination of pesticides/fertilizers) do not include a full profile of the costs and benefits associated with its use (i.e., the environmental impacts (rainwater, heat, biodiversity), life cycle costs, recycling challenges).
- Specific Action Areas to help ensure artificial turf use on private property does not undermine the City of Vancouver's goals and objectives related to sustainable rainwater management, urban heat mitigation, biodiversity enhancement, and other climate adaptation challenges include:
    - **Supplemental research and evidence building** (e.g., water quantity and quality impacts from runoff).
    - **Education and outreach** (e.g., internal and external educational resources).
    - **Policy and regulatory alignment** (e.g., position statement, bylaw and policy review, clarifying and strengthening existing regulations, new polices or regulations, suitably resourced enforcement program).
    - **Supporting tools** (e.g., requiring identification of proposed artificial turf on design drawings, location tracker, and adaptive management monitoring).
- To the best of our knowledge, regulations which limit artificial turf use on private property are not common in municipalities in British Columbia. The City of Vancouver has an opportunity to demonstrate leadership in the sustainable management of this product.

While this study offers an extensive review of the literature, expert insights, and case study research, the limitations of this study are as follows:

- Little is known about how much artificial turf is being used on private properties in the City of Vancouver. Without understanding the magnitude of the issue, it is difficult to describe the current level of risk. Nevertheless, proliferation of the product on private property is likely to undermine the City of Vancouver's goals and objectives related to sustainable rainwater management, urban heat mitigation, biodiversity enhancement, and other climate adaptation challenges.
- Artificial turf on private properties is not the focus of current academic research. Almost all the published literature has focused on artificial turf products used on sports fields. Given some differences in products used on sports fields and private applications, we were careful in the interpretation and extrapolation of research findings.
- The presence of chemical contaminants in artificial turf is a known hazard, but how much contaminant leaches into the environment (exposure) is less understood, especially for non-infill systems.
- It would be useful to obtain lessons learned from other municipalities regulating artificial turf on private property in the lower mainland of British Columbia. Given the limited municipal response to enquiries, this information is not available to supplement this report.

7. Appendix

A1. City of Vancouver Interview Questions

Interview Purpose: To 1) determine (if possible) the relative magnitude of artificial turf use in the city (i.e., area occupied by artificial turf on parks, streets and boulevards, and private property), 2) understand the department specific policies/ policy approaches relating to artificial turf, and 3) obtain application information sources and any lessons learned.

BACKGROUND, USE, AND TRENDS

1. What areas of the city does your department oversee, and what is your role within the department?
2. How and where is artificial turf used within your department's jurisdiction?
3. Are there any trends in artificial turf installations (e.g., increasing, decreasing, stable)?
4. Who are the main artificial turf suppliers in the city? What types are used, what infill materials are common, and what is the typical lifespan of artificial turf?
5. Does your department track the extent of artificial turf use (e.g., total area or number of installations)? If not, do you know of any resources that might provide this information?
6. How is artificial turf perceived by your department?

DEPARTMENT POLICIES AND LEGISLATION

7. Does your department have any policies regulating artificial turf use (e.g., bylaws/permits, strategies, policies, design guidelines)? If so, what are the specifics of the policies (e.g., allowable turf use, restrictions, or limitations)?
    - Are there guidelines or review processes in place for artificial turf proposals in development plans?
8. What is the rationale behind these policies?
9. When were the policies established, and where can they be accessed?

DEVELOPMENT, IMPLEMENTATION, AND MONITORING

10. Who were the key interest holders involved in developing artificial turf policies (e.g., public, industry, advocacy groups)?
11. Who were the key decision makers involved (e.g., senior staff, council, others)?
12. Can you briefly outline the implementation process?
13. How have the public (e.g., residents and businesses) responded to artificial turf policies?
14. How do you monitor compliance and how effective have these mechanisms been in practice?
15. Have there been any enforcement challenges or adaptative management since implementation?
16. If no policy exists, is there interest in developing one? What challenges may arise in doing so?
17. What are the most significant lessons your department has learned about managing artificial turf use?

RESOURCES AND ADDITIONAL INSIGHTS

18. Has your department conducted or reviewed any studies on artificial turf, and if so, can you share the findings?
19. Are you aware of any municipalities with artificial turf regulations?
20. What are the potential impacts of artificial turf on the city's climate adaptation strategies, specifically urban heat, biodiversity, and rainwater management?
21. Are there any relevant resources (e.g., municipal documents, white papers, case studies) you would recommend?

A2. Subject Matter Expert Interview Questions

BACKGROUND, LIFE CYCLE

1. Can you tell us about your background and any work you have conducted on artificial turf?
2. Can you describe the life cycle of artificial turf (from cradle to grave) and the high-level environmental impacts of artificial turf throughout its life cycle.
3. Do artificial turf products differ between applications (i.e., recreational fields vs private installations)? Do the lifespans of artificial turf differ between applications?
4. At the end of life, can artificial turf be recycled in North America, or do they often end up in landfills?

IMPACTS TO BIODIVERSITY, WATER, URBAN HEAT

5. How will installing artificial turf in place of natural landscapes affect aquatic and terrestrial biodiversity?
6. What are the ecological hazards posed by the different artificial turf products (i.e., infill, plastic turf blades)?
7. What are some of the unknowns regarding artificial turf and its impacts on biodiversity?
8. Is artificial turf permeable, and how does its permeability compare to natural grass?
9. How can artificial turf impact nearby water quality?
10. The City of Vancouver is striving to improve rainwater management; how may the application of artificial turf impede this objective?
11. Another objective the City of Vancouver is working on is the mitigation of urban heat; how will installing artificial turf alter the urban heat island effect?
12. How will the impacts from artificial turf to urban heat affect biodiversity and/or rainwater management?

EXPERT INSIGHTS

13. From the lens of climate change impacts (i.e., increased frequency and intensity of extreme weather events, increased temperatures), what are the risks of installing artificial turf?
14. Do we have enough evidence from research at this time to support artificial turf restrictions, regulations, or outright bans?
15. Are you aware of any jurisdictions currently regulating artificial turf in public or private spaces?
16. Do you have any resources on any of the topics discussed today that you can share with us, or any other experts in the field we should reach out to?

A3. Case Study Interview Questions

The purpose of this interview is to connect with leading jurisdictions to inform the City of Vancouver's internal recommendations for artificial turf management. We are specifically interested in understanding your jurisdiction's:

i) Climate adaptation strategies.

ii) Allowable artificial turf use, rationale for any limitations, and mechanisms to limit use.

iii) Lessons learned in developing and implementing any use restrictions with reference to interest holder and decision-maker involvement, implementation, and progress reporting.

CLIMATE ADAPTATION STRATEGIES

1. Can you describe how your jurisdiction's climate strategies address urban heat, biodiversity, and rainwater management?
2. How does artificial turf factor into or conflict with these strategies?

ARTIFICIAL TURF USE AND POLICY APPROACH

3. Has your municipality conducted any research or reviewed any assessments on the impacts of artificial turf? If so, what were the key findings?
4. How and where is artificial turf used within your jurisdiction?
5. Does your municipality have any policies regulating artificial turf use (e.g., bylaws/permits, strategies, policies, design guidelines)? If so, what are the specifics of the policies (e.g., allowable turf use, restrictions, or limitations)?
    - Are there guidelines or review processes in place for artificial turf proposals in development plans?
6. What is the rationale behind these policies?
7. When were the policies established, and where can they be accessed?

DEVELOPMENT, IMPLEMENTATION, AND PROGRESS REPORTING

8. Who were the key interest holders involved in developing artificial turf policies (e.g., public, industry, advocacy groups)?
9. Who were the key decision makers involved (e.g., senior staff, council, others)?

10. Can you briefly outline the implementation process?
11. How have the public (e.g., residents and businesses) responded to artificial turf policies?
12. How do you monitor compliance and how effective have these mechanisms been in practice?
13. Have there been any enforcement challenges or adaptative management since implementation?
14. Is there any progress reporting for this policy? Have any measurable impacts been observed with respect to biodiversity, urban heat, and/or rainwater management?

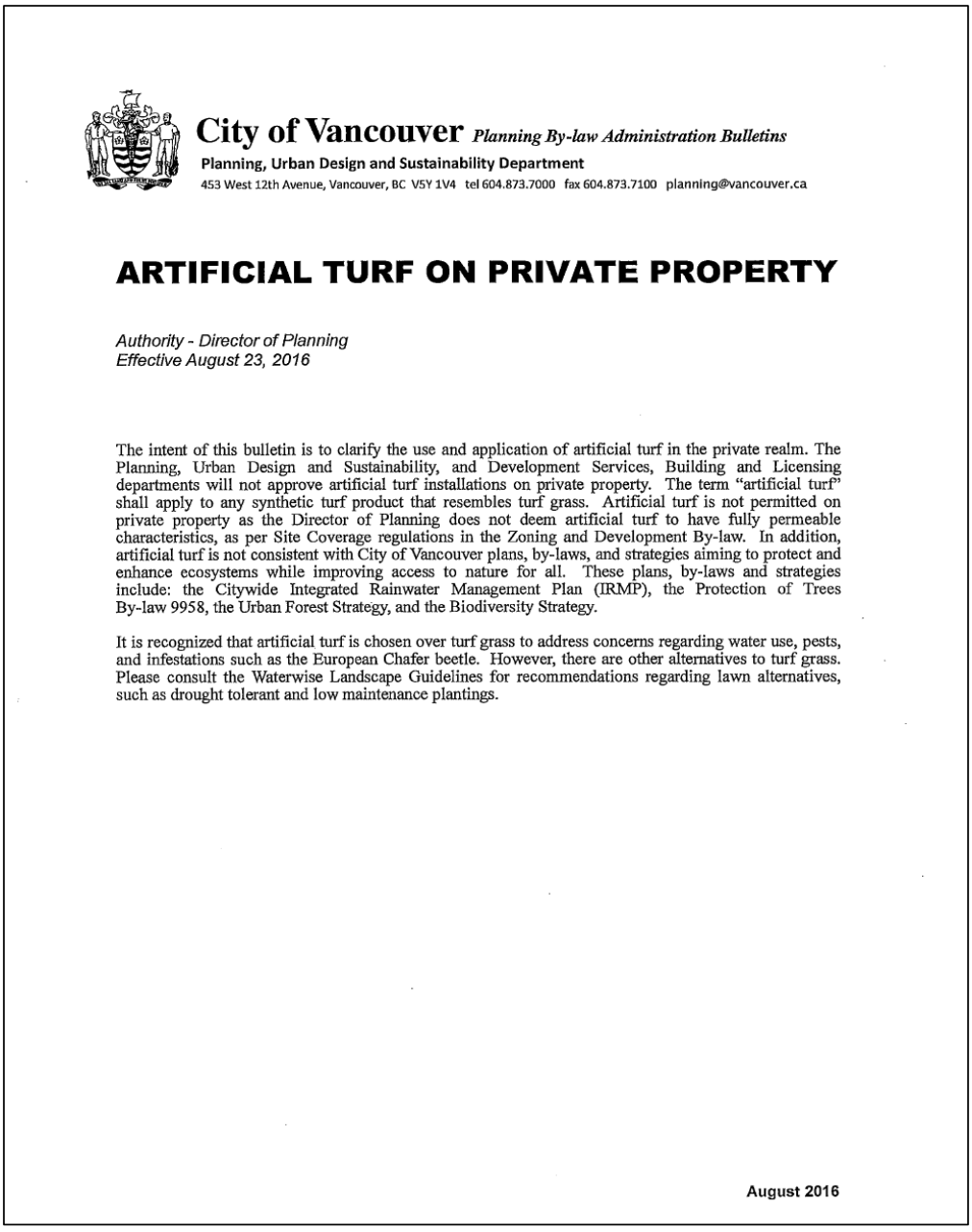
LESSONS LEARNED

15. What are the most significant lessons your jurisdiction has learned about managing artificial turf use?
16. Confidently, are there any future planning directions being considered regarding artificial turf management and/or its role in your municipality's climate adaptation strategies?

OTHER RESOURCES

17. Are you aware of other municipalities with artificial turf bans or regulations?
18. Are there any relevant resources you would recommend for us to review for our project?

A4. City of Vancouver, BC: 2016 Bulletin (Prohibiting Artificial Turf)



City of Vancouver *Planning By-law Administration Bulletins*

Planning, Urban Design and Sustainability Department
453 West 12th Avenue, Vancouver, BC V5Y 1V4 tel 604.873.7000 fax 604.873.7100 planning@vancouver.ca

ARTIFICIAL TURF ON PRIVATE PROPERTY

Authority - Director of Planning
Effective August 23, 2016

The intent of this bulletin is to clarify the use and application of artificial turf in the private realm. The Planning, Urban Design and Sustainability, and Development Services, Building and Licensing departments will not approve artificial turf installations on private property. The term "artificial turf" shall apply to any synthetic turf product that resembles turf grass. Artificial turf is not permitted on private property as the Director of Planning does not deem artificial turf to have fully permeable characteristics, as per Site Coverage regulations in the Zoning and Development By-law. In addition, artificial turf is not consistent with City of Vancouver plans, by-laws, and strategies aiming to protect and enhance ecosystems while improving access to nature for all. These plans, by-laws and strategies include: the Citywide Integrated Rainwater Management Plan (IRMP), the Protection of Trees By-law 9958, the Urban Forest Strategy, and the Biodiversity Strategy.

It is recognized that artificial turf is chosen over turf grass to address concerns regarding water use, pests, and infestations such as the European Chafer beetle. However, there are other alternatives to turf grass. Please consult the Waterwise Landscape Guidelines for recommendations regarding lawn alternatives, such as drought tolerant and low maintenance plantings.

August 2016

A5. City of Langford, BC: Subdivision and Development Servicing Bylaw No. 1000 (Section 14.2.9 Artificial Turf Product Specifications)

Schedule 14 Boulevard Landscape Standards

14.2.9. Turf Grass Seeding/Sodding and Artificial Turf. (Bylaw No. 1669)

14.2.9.3. Any approved application of artificial turf must be in accordance [with] Schedule 11, details L3(a), L3(b), L3(c), L3(d), and L4(b) for artificial turf installation specifications.

14.2.9.3.1 Artificial turf product specifications shall comply with Table 14-2.

Table 14-2 – Artificial Turf Product Specification (Bylaw 1817)

Physical Property	Physical Characteristics
Pile Fiber Type	Polyethylene "U" Shape Cross Section
Thatch Fiber Type	Polyethylene
Fabric Width	15 feet
Pile Fiber Height	1 ½" – 1 5/8"
Thatch Fiber height	1" +/- 15 %
Pile Fiber Colour	Field Green / Olive Green or similar
Thatch Colour	Tan / Brown or similar
Tuft Gauge	3/8" – ½"
Tuft Bind	>7 lbs
Stitch Rate	Compliant with ASTM D5893
Grab Tear Strength	Compliant with ASTM 5034
Yarn Breaking Strength	Compliant with ASTM D2256
Backing Weight	Minimum 24 oz
Pile Fiber Weight	Minimum 45 oz
Water Permeability	Minimum 28" of rainfall per hour / sq yd
Recommended Infill	1.5 – 2 lbs per sq foot 20/40 Tan Silica Sand (Target Products)
Warranty Period	Minimum 10 years

14.2.9.3.2 All [glued] turf to turf connections is to be by Nordod or X-GF. (Bylaw 1817)

14.2.9.3.3 All glued turf to concrete abutment connections is to be by PL Premium Adhesive. (Bylaw 1817)

14.2.9.3.4 For Artificial turf plastic wood nailer board refer to Approved Product List and Schedule 11, details L3(a), L3(b), L3(c), L3(d), and L4(b).

A6. City of Langford, BC: Amendment to Bylaw No. 1000 (Removing the Requirement for Mandatory Artificial Turf)

City of Langford

Staff Report to Sustainable Development Advisory Committee

DATE: Monday, June 12, 2023
DEPARTMENT: Parks, Recreation and Facilities, and Engineering
SUBJECT: Omnibus Amendments to Subdivision and Development Servicing Bylaw No. 1000, Bylaw No. 2103

BACKGROUND:

The Purpose of this report is to provide background information to the proposed Subdivision and Development Servicing Bylaw, Amendment No. 24, 2023 (Omnibus) Bylaw No. 2103.

The bylaw amendments in this omnibus are being proposed to provide additional clarity for staff and developers, modernize and amend drawing details to reflect industry standards, and update development requirements to reflect Council direction provided to staff at the June 5th Council meeting regarding dust. As this omnibus contains multiple amendments that are ready to be implemented, staff recommend that any further direction from Council regarding additional amendments be included in a future omnibus amendment. Staff believe the amendments proposed in this bylaw will positively contribute to future development.

COMMENTARY:

Amendments proposed by the Parks, Recreation and Facilities Department include but are not limited to the following:

- Adding definitions to provide clarity for staff and developers;
- Increasing the boulevard tree planting ratio (1 per 15m to 1 per 12m) and cash-in-lieu compensation ($1100 to $1750);
- Updating and adding additional irrigation drawing, planting and parks related details (see attached drawing list);
- Removing the requirement for mandatory artificial turf to allow for increased flexibility in boulevard treatments;
- Updating landscape architect requirements for drawing submissions;
- Aligning Construction Acceptance Landscaping (CA-L) and Final Acceptance Landscaping (F-AL) approval and warranty processes with the industry standard;

Langford.ca
t 250.478.7882
e administration@langford.ca
2nd Floor, 877 Goldstream Avenue
Langford, BC V9B 2X8

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A7: City of Toronto, Ontario: Bylaw No. 569-2013 (Section 10.5.50.10 Landscaping)

(1) Front Yard Landscaping for Certain Types of Residential Buildings

In the Residential Zone category, on a **lot** with a **detached house**, **semi-detached house**, **duplex**, **triplex**, **fourplex** or **townhouse**, the following **front yard landscaping** regulations apply:

(A) for **lots** with a **lot frontage** less than 6.0 metres, or a **townhouse dwelling unit** less than 6.0 metres wide, the **front yard**, excluding a permitted **driveway** or permitted parking pad must be **landscaping**; [By-law: 1429-2017]

(B) for **lots** with a **lot frontage** of 6.0 metres to less than 15.0 metres, or a **townhouse dwelling unit** at least 6.0 metres wide, a minimum of 50% of the **front yard** must be **landscaping**;

(C) for **lots** with a **lot frontage** of 15.0 metres or greater, a minimum of 60% of the **front yard** must be **landscaping**; and

(D) a minimum of 75% of the **front yard landscaping** required in (A), (B), and (C) above, must be **soft landscaping**, and if a **lot** does not have a permitted **driveway** in the **front yard,** a minimum of 75% of the **front yard** must be **soft landscaping**. [By-law: 1675-2013]

(2) Side Yard Landscaping for Certain Types of Residential Buildings on Corner Lots

In the Residential Zone category, a **corner lot** with a **detached house**, **semi-detached house**, **duplex**, **triplex**, **fourplex** or **townhouse** must have:

(A) a minimum of 60% of the **side yard** abutting a **street** for **landscaping**; and

(B) a minimum of 75% of the **side yard landscaping** required in (A), above, must be **soft landscaping**.

(3) Rear Yard Soft Landscaping for Residential Buildings Other Than an Apartment Building

In the Residential Zone category, a **lot** with a **residential building**, other than an **apartment building**, must have:

(A) a minimum of 50% of the **rear yard** for **soft landscaping**, if the **lot frontage** is greater than 6.0 metres; and

(B) a minimum of 25% of the **rear yard** for **soft landscaping**, if the **lot frontage** is 6.0 metres or less.

(4) Landscaping Requirement for an Apartment Building

In the Residential Zone category, a **lot** with an **apartment building** must have:

(A) a minimum of 50% of the area of the **lot** for **landscaping**; and

(B) a minimum of 50% of the **landscaping** area required in (A), above, must be **soft landscaping**.

(5) Landscaping Requirement for an Apartment Building Abutting Another Residential Lot

In the Residential Zone category, a **lot** with an **apartment building** must have a minimum 1.5 metre wide strip of **soft landscaping** along any part of a **lot line** abutting another **lot** in the Residential Zone category.

(6) Landscaping Exclusion for Permitted Encroachments

In the Residential Zone category, the calculation of **landscaping** or **soft landscaping** regulation 10.5.50.10(1), (2), (3) and (4), excludes the area of the required minimum **building setback** covered by any part of a **building** or **structure** which is permitted to encroach into a required minimum **building setback** by Clause 10.5.40.60.

(7) Swimming Pools or Similar Ancillary Structures Containing Water Deemed to be Soft Landscaping for Specified Regulations

In the Residential Zone category, for the calculation of **soft landscaping** required by regulation 10.5.50.10(3) and (4), the area of **soft landscaping** includes the water surface area of outdoor swimming pools or other **ancillary structures** used to hold water, such as fountains or artificial ponds.

10.5.60 Ancillary Buildings and Structures

10.5.60.1 General

(1) Application of this Article

The regulations in Article 10.5.60 apply to **ancillary buildings** or **structures** in the Residential Zone category, if they are **ancillary** to **dwelling units** or **residential buildings**.

Any addition or extension to a **lawfully existing building** referred to in regulation 15.5.40.81(1) must comply with the minimum separation distance between **main walls** required by this By-law or be authorized by a Section 45 Planning Act minor variance.

(3) Permitted Separation from Other Zones for Lawfully Existing Buildings

In the Residential Apartment Zone category, if the **lawful** separation distance between a **lawfully existing apartment building** and a **lot** in an RD or RS zone is less than the required minimum separation distance required by this By-law, that **lawful** separation distance is the minimum separation distance between that **lawfully existing apartment building** and that **lot**.

(4) Additions to Lawfully Existing Buildings - Separation from Other Zones

Any addition or extension to a **lawfully existing apartment building** referred to in regulation 15.5.40.81(3) must comply with the required minimum separation distance from a **lot** in an RD or RS zone required by this By-law or be authorized by a Section 45 Planning Act minor variance.

15.5.50 Yards

15.5.50.10 Landscaping

(1) Landscaping Requirement for an Apartment Building

A **lot** in the Residential Apartment Zone category must have:

(A) a minimum of 50% of the area of the **lot** for **landscaping**; and

(B) a minimum of 50% of the **landscaping** area required in (A), above, must be **soft landscaping**.

(2) Landscaping Requirement for an Apartment Building Abutting a Lot in the Residential Zone Category

A **lot** in the Residential Apartment Zone category must have a minimum 1.5 metre wide strip of land for **soft landscaping** along any part of a **lot line** abutting a **lot** in the Residential Zone category.

(3) Landscaping Exclusion for Permitted Encroachments

In the Residential Apartment Zone category, the calculation of **landscaping** or **soft landscaping** required by regulation 15.5.50.10(1) excludes the area of a required minimum **building setback** covered by any part of a **building** or **structure** which is permitted to encroach into a required minimum **building setback** by Clause 15.5.40.60.

(4) Swimming Pools or Similar Ancillary Structures Containing Water Deemed to be Soft Landscaping for Specified Regulations

In the Residential Apartment Zone category, for the calculation of **soft landscaping** required by regulation 15.5.50.10(1), the area of **soft landscaping** may include the water surface area of an outdoor swimming pool or other **ancillary structure** used to hold water, such as fountains or artificial ponds.

15.5.60 Ancillary Buildings and Structures

15.5.60.1 General

(1) Application of this Article

The regulations in Article 15.5.60 apply to **ancillary buildings** or **structures** in the Residential Apartment Zone category, if they are **ancillary** to **dwelling units** or **residential buildings**.

(2) Living Accommodation in Ancillary Buildings

An **ancillary building** in the Residential Apartment Zone category may not be used for living accommodation.

(3) Food or Sanitary Facilities in Ancillary Buildings

An **ancillary building** in the Residential Apartment Zone category may have:

(A) food preparation facilities and sanitary facilities if the **ancillary building** or **structure** is for indoor **amenity space** required by this By-law; or

(B) either food preparation facilities or sanitary facilities, but not both, if the **ancillary building** or **structure** is for any other purpose.

A8: City of Millbrae, California: Synthetic Grass and Artificial Turf Ordinance (Chapter 8.65)

City of Millbrae Municipal Code Title 8, Chapter 8.65, "City of Millbrae Synthetic Grass and Artificial Turf Ordinance,"

as adopted by City Council on October 24, 2023

8.65.010 Title

This chapter shall be known as the "City of Millbrae Synthetic Grass and Artificial Turf Ordinance."

8.65.020 Purpose

The purpose of this chapter is to protect and enhance the health, safety and general welfare of residents and to protect the water quality of our watercourses, water bodies and wetlands in a manner pursuant to and consistent with the state and federal regulations and permits, including the Clean Water Act.

A. Eliminating the discharge of debris from synthetic grass and artificial turf products, such as plastic blades, crumb rubber, nylon and other synthetic components, into stormwater runoff;

B. Improve the absorption and retention of storm water through the use of natural drought-tolerant landscaping using living plant material;

C. Eliminating solid waste generated by the disposal of synthetic grass and artificial turf products;

D. Improving public health and safety by removing exposure to potential environmental carcinogens found in synthetic grass and artificial turf products.

8.65.030 Definitions

A. Definitions. As used in this section, the following definition will apply:

1. "Synthetic Grass" and "Artificial Turf" is synthetic or artificial non-organic material that simulates the appearance of organic sod, grass, or lawn ground cover, and includes outdoor plastic carpeting. Synthetic grass and artificial turf does not include painted natural organic grass or sod.

2. “Subgrade” is the native ground underneath a synthetic grass and artificial turf installation. Subgrade does not include concrete, pavers or impermeable hardscape.

8.65.040 Prohibition

The use and installation of synthetic grass and artificial turf landscaping material is prohibited within the city.

8.65.050 Existing Synthetic Grass and Artificial Turf Installations

A. Existing synthetic grass and artificial turf legally installed prior to January 1, 2024, is permitted to remain under the following conditions:

1. Synthetic grass and artificial turf installations must be maintained pursuant to its manufacturer’s maintenance schedule, in an attractive and clean condition, and must not contain holes, tears, stains, discoloration, seam separations, lifted surfaces, loose or separated nap and netting, buckling, heat degradation, or excessive wear.

2. Existing installations must remain taught and flush with subgrade.

3. Existing installations must allow permeability of storm water.

4. Adjacent hardscape, ground cover and natural landscaped areas must be kept free of residual debris from synthetic grass and artificial turf such as plastic blades, netting and crumb rubber.

B. The parking of vehicles on synthetic grass and artificial turf is prohibited.

C. Synthetic grass and artificial turf installations damaged or destroyed, by any means, to the extent of thirty-five (35%) percent of its replacement cost new, must be removed and replaced with water-efficient natural landscaping.

D. Existing synthetic grass and artificial turf installations must be removed and replaced with water-efficient natural landscaping once they are unable to be maintained as required by this section.

E. Failure to comply with the provisions of this section is an unlawful property nuisance and may be abated by the city pursuant to MMC Chapter 6.25.

A9: City of San Fernando, California: Educational Resource for Lawn Replacement

A10: Definitions

Albedo: the proportion of solar energy reflected by the surface. Lighter surfaces have higher albedos and lower temperatures compared to darker coloured surfaces.

Artificial turf: human-made surface replicating natural grass, made from synthetic materials.

Biodiversity: the variety of life in the world or in a particular habitat or ecosystem.

Benthic: the ecological region at the lowest level of a body of water. This includes the sediment (or soil) and the area just below the sediment surface.

Beta diversity: refers to the difference in species composition between ecosystems. It quantifies how species diversity changes from one habitat to another, providing insights into the spatial patterns of biodiversity. Beta diversity is related to alpha diversity (diversity within a local site) and gamma diversity (total diversity across a region).

Carcinogens: agents (such as chemicals) that can cause cancer.

Chemical leaching: the movement of chemicals (e.g., from soil, pavement, or products (artificial turf)) into water or soil through percolating water.

Climate mitigation: actions taken to reduce or prevent the emission of greenhouse gases into the atmosphere or to enhance the capacity of natural systems to absorb these gases, thus lessening the impacts of climate change.

Climate adaptation: the process of adjusting to actual or expected climate and its effects.

Combined Sewer Overflows (CSOs): events that occur when the upstream combined sewage and stormwater pipes exceed capacity during heavy rainfall events, causing release of untreated discharge into water bodies.

Crumb rubber: recycled rubber granules made from shredded car tires, commonly used as infill in artificial turf.

Ecological connectivity: the degree to which landscapes allow movement and interactions between organisms, which supports gene flow and ecological resilience.

Endocrine disruptors: chemicals which interfere with hormone systems.

Evapotranspiration: the process where water moves from the Earth's surface into the atmosphere through evaporation and transpiration.

Green Rainwater Infrastructure (GRI): rainwater management systems that commonly utilize living components to mimic natural drainage and provide other benefits such as reducing urban heat, creating habitat, improving air quality, enhancing aesthetics, and complementing amenity spaces. Examples include green roofs, rain gardens, bioswales, and permeable pavements.

Heavy metals: a group of metallic chemical elements (often used industrially) that typically have a high atomic weight, high density, and are toxic to organisms at low concentrations. Examples include copper, zinc, lead, mercury, and arsenic.

Mutagens: agents that cause genetic mutations in DNA.

Microplastics: pieces of plastic typically <5 mm in size. Microplastics can be manufactured in this size fraction or as a result of the breakdown of larger plastic objects.

Neurotoxins: agents that damage the nervous system.

Nutrients: substances like nitrogen and phosphorus which are essential for organism growth and reproduction but can cause ecological imbalances when they are overly abundant.

Polymer: large molecules composed of repeated subunits (monomers) which form plastics and synthetic materials.

PFAS (per- and polyfluoroalkyl substances): a group of man-made chemicals that have been widely used in various industrial and consumer products since the 1950s due to their water, grease, and stain-resistant properties. They are persistent, bioaccumulative, and termed “forever chemicals”.

Rainwater infiltration: the process by which rainwater filters into the soil, replenishing groundwater.

Rainwater management: the planning and implementation of systems to capture, store, or manage rainwater to reduce flooding, recharge groundwater, and conserve water.

Surface runoff: the unconfined flow of water across the ground, also known as overland flow. It occurs when the ground is saturated or when surfaces are impervious (like roads or roofs) and prevents infiltration.

Urban heat island effect: the phenomenon where urban areas are significantly warmer than their surrounding rural areas. This temperature difference is primarily caused by human activities and the built environment, which absorbs and retains more solar radiation than natural landscapes.

Urban heat mitigation: Strategies designed to reduce the excessive heat accumulation from the urban heat island effect.

Water cycle: the continuous movement of water within the Earth and the atmosphere.

Water quality: the chemical, physical, and biological characteristics of water; can be affected by combined sewer outflows, surface runoff, and chemical leaching.

Water quantity: the measure of the volume, flow, or quantity of water; can be affected by combined sewer outflows, rainwater infiltration, surface runoff, rainwater management, and green rainwater infrastructure.

Whole effluent toxicity: the aggregate toxic effect of wastewater discharge on aquatic organisms, measured by exposing sensitive organisms to the effluent and observing their growth, survival, and reproduction.

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