Fundamentals for Thermal Comfort and Safety:

Designing Climate-Ready Playgrounds

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NPPAS
NATIONAL PROGRAM FOR PLAY AREA SAFETY

PlaygroundSafety.org

Prepared for
Standards Council of Canada and Health Canada

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Contents

Transforming Children's Playgrounds

Photo Courtesy City of Toronto

Children are drawn to playgrounds, yet they are often places we take for granted. Playgrounds — which can be located at child care centres, schools, cities and towns, community housing, and other public venues — are places where children can play freely, thereby helping develop skills and abilities for life. Toward the end of the 20th century, as more and more play areas were being developed, concern about the safety of children's play emerged. Initiatives began to keep children safe from acute injuries from trips and falls.

Today, all regions of Canada are experiencing environmental, social, and economic impacts of climate change. Extreme heat is a leading cause of illness and death from weather-related hazards in Canada. Playgrounds are often in areas that have significantly higher temperatures than their surrounding areas due to human changes to the built environment.

Playground design decisions have led to choosing climbing, sliding, and swinging equipment that maximizes fun and injury prevention. Yet, many playground designs have overlooked thermal considerations for climate, sun intensity, and extreme weather. Scientific evidence shows that overly hot playgrounds can impact the amount of time children spend being physically active at a playground — and children's lives and well-being are increasingly at risk. **As the climate continues to warm and extreme weather events become more frequent, it is imperative that we prioritize thermal comfort and safety in playground design to safeguard children's health and well-being.**

Climate Factors

Thermal comfort relates to being satisfied with environmental conditions. For instance, if a child is too hot or too cold, then play and learning behaviours are affected. When uncomfortable thermal conditions occur, children become less active, disengaged and even avoid using the playground altogether, reducing time spent being physically and socially active.

The design of a playground shapes its microclimate — affecting how hot, cold, humid, or breezy the space feels — and determines which plants and landscaping elements will flourish. Understanding climate factors are essential because they can directly affect how comfortable, safe, usable, and sustainable playgrounds are — especially as climate conditions become more extreme.

TEMPERATURE

This simply means how hot or cold the air around a child feels. Extremely high and low temperatures can make a child feel uncomfortable. The temperature of the playground — air temperature, surface temperature, and equipment temperature — can have an effect on physical activity and behaviour.

HUMIDITY

This is the amount of moisture in the air. Humidex is used to express a “feels like” temperature.

SUNLIGHT (SOLAR RADIATION)

Solar radiation is the energy released by the sun that travels to the earth's surface. When children get sunlight, their bodies will naturally produce vitamin D. However, it doesn't take much time in the sun to produce adequate amounts of vitamin D, and too much sun exposure can have negative impacts. Radiant temperature is increased with solar exposure and emitted radiation from nearby surfaces.

RECOMMENDED PRECAUTIONS BASED ON LEVELS OF ULTRAVIOLET (UV) RADIATION*

LOW	MODERATE	HIGH	VERY HIGH & EXTREME
UV Index of 1–2 *If child burns easily, sunscreen recommended.*	**UV Index of 3–5** *Sunscreen, hats and sunglasses recommended.*	**UV Index of 6–7** *Play in shaded areas. Wear hats, sunscreen and sunglasses. Establish limits to sun by seeking shade or rescheduling to other times of day with a lower UV index.*	**UV Index of 8+** *Play in shaded areas. Take extra precautions. Avoid sun during times of peak UV exposure (midday).*

**Adapted from UV and Sun Exposure Guidelines Derived from US EPA (2004) A Guide to the UV Index*

ALBEDO

Albedo refers to how much sunlight a surface reflects. Light-coloured surfaces like snow, sand, and tan have a high albedo, meaning they reflect most sunlight. Darker surfaces — like asphalt, darker rubber — have a low albedo and absorb more heat. When materials absorb heat, it leads to warming.

WIND FLOW

The wind flow is how fast or slow the air moves. Stagnant air on hot days is uncomfortable. A low breeze can be pleasant, but the high winds can make it feel colder in the cold seasons.

PERSONAL CHARACTERISTICS

Personal characteristics of thermal comfort refer to clothing, brim hats, drinking water, sunscreen, and the extent of physical activity.

Working together, we can increase the ability of playgrounds to withstand and adapt to the challenges posed by climate change.

Photo courtesy of Earthscape Play

ABOUT THIS GUIDEBOOK

Whether it is adding a landscaping feature, repositioning playground amenities, renovation, or new construction, this guidebook shares the fundamentals of thermal comfort and safety for climate-ready playgrounds.

The information is applicable for planners, educators, directors, owners and operators (such as child care and school facilities; municipalities and parks; and community housing), designers, landscape architects, playground equipment and surfacing installers, insurance agencies, civic organizations, parents, grandparents, community members, and other youth organizations.

The guidebook highlights challenges and describes the effects that climate has on playgrounds. It provides useful considerations, including four phases to help designers improve a playground's microclimate. An emphasis is placed on helping playground design planning committees navigate using climate data, conduct site assessments, implement modifications, maintain the playground, and evaluate outcomes.

CHAPTER

1

Challenges

What are the challenges?

CHALLENGE 1 Extreme Weather Conditions

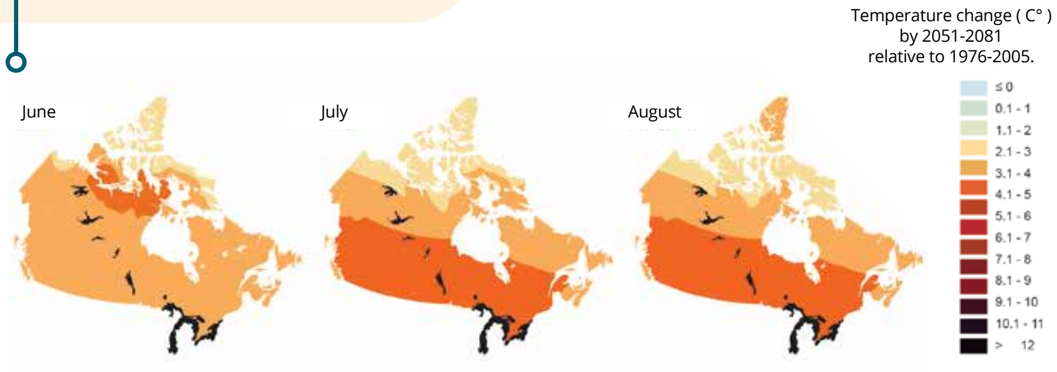
Canada's climate is changing. All regions of Canada are experiencing increases in both average temperatures and record-breaking heatwaves.

Children may be more vulnerable than adults from heat-health impacts for various reasons, including physical, physiological, behavioural, and environmental factors that can influence the ability to regulate body temperature (Notley, et al. 2020). UNICEF reports that by 2050, nearly 2.2 billion children worldwide will be exposed to frequent heat waves, making proactive measures essential.

A recent study found that extreme weather and microclimate conditions have not received as much priority in playground designs and design standards as other safety factors (Kennedy, Olsen, & Vanos, 2020). As playgrounds are reconstructed or newly built, the microclimate conditions at the local site are essential to keep children safe.

The map below shows summertime temperature changes by 2051-2081 across Canada. You can learn more about the illustration and extreme weather conditions and playgrounds in *Thermally Comfortable Playgrounds: A review of literature and survey of experts* (Kennedy, Olsen, & Vanos, 2020).

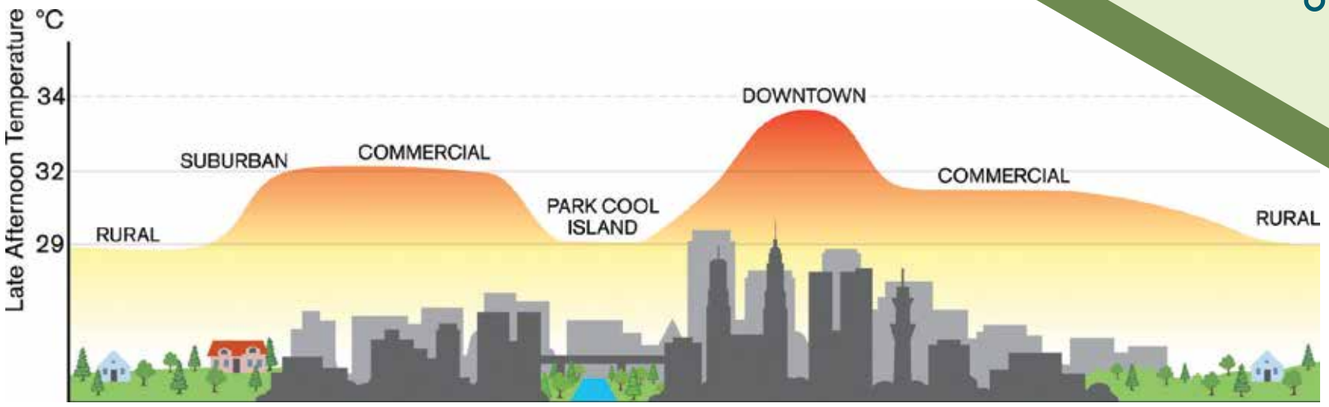
Reprinted from Kennedy et al. (2020). Image created by graphic artist at the Julie Ann Wrigley Global Institute of Sustainability, Arizona State University.



CHALLENGE 2

Micro Heat Islands

Playgrounds located in communities of any size — including villages, towns and cities — are often surrounded by dark-coloured paved surfaces like roads, parking lots, pathways, and playing courts which absorb heat during the day and radiate the heat into the air at night. They then become micro heat islands where they are hotter than nearby areas due to the way surfaces absorb and hold heat.



This is an illustration of how built environments shape temperature variation across a city. Rural areas and green and water space (identified as park cool island) often have lower temperatures. Hottest areas exist in more highlighted buildings in downtown, commercial, and suburban areas. Reprinted Kennedy et al. (2020). Image created from a graphic artist at the Julie Ann Wrigley Global Institute of Sustainability. Arizona State University.

CHALLENGE 3

Continuity and Trajectory

PAST

Public playgrounds for children have existed since 1800s.

PRESENT

Historical influences have prioritized minimizing serious acute injuries by providing technical requirements for the design, construction, installation, and inspection of playground equipment and surfacing.

FUTURE

New and upgraded playgrounds should not only be designed to reduce serious acute injuries, but also to be safe from changes in climate.

***Read More** from Thermally Comfortable Playgrounds: A review of literature and survey of experts*

Climate Ready Playgrounds

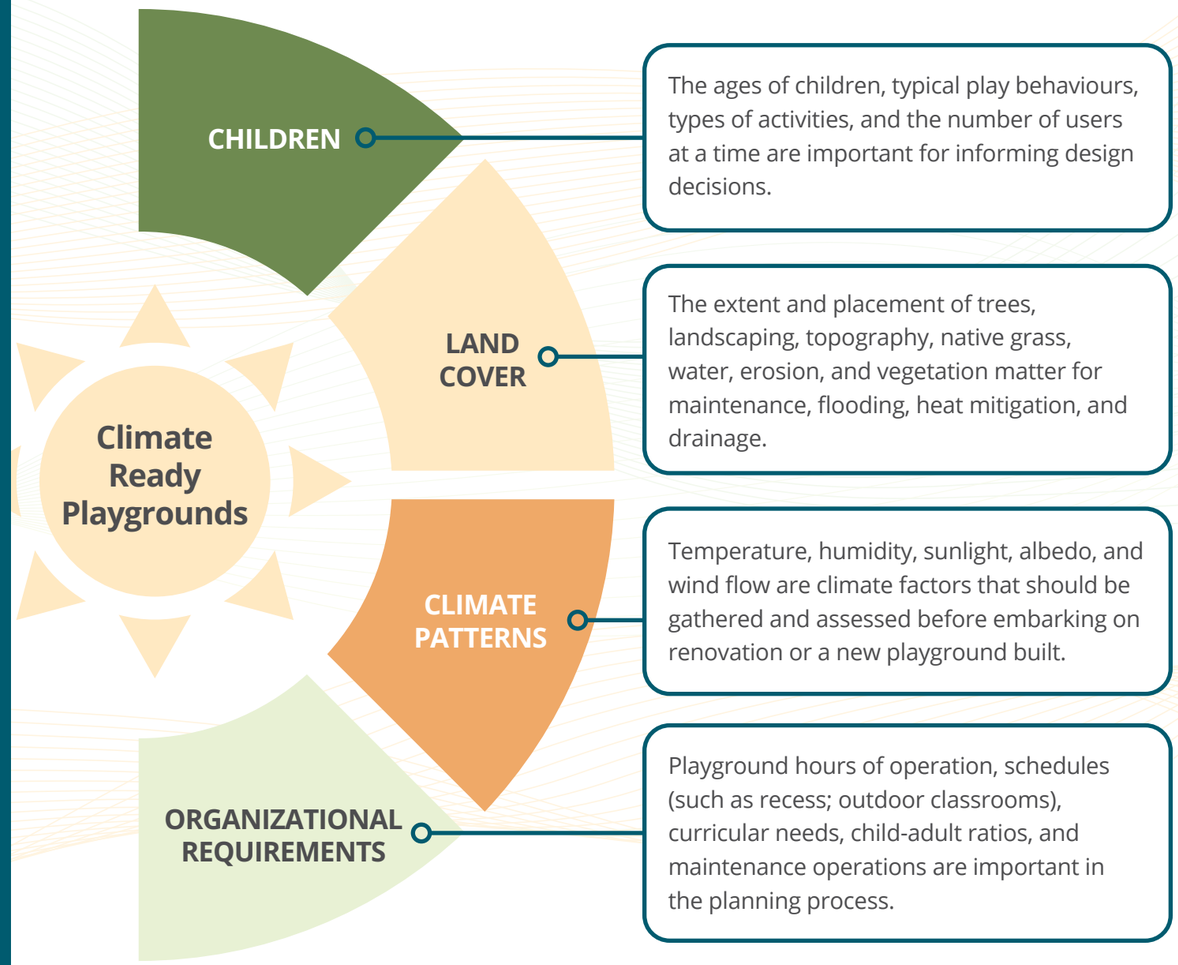
CHAPTER

2

Climate Ready Playgrounds

Addressing Challenges

Every playground has unique circumstances. To improve thermal comfort, it is vital to make a distinction between playgrounds that already exist versus a new playground that may be built. Addressing the challenges involves a process where decisions need to focus on the children, the land coverage, local climate patterns, and organization requirements.



Phases for Designing Comfortable Playgrounds

Since the 1990s, researchers affiliated with the National Program for Play Area Safety (NPPAS) have been leading workshops for planning play sites for children. The phases are symbolic of the process that have been used in *Building Playgrounds: A Guide to the Planning Process* (2008) and *S.A.F.E. Play Areas: Creation, Maintenance, and Renovation* (first printed in 2007 and revised in 2013 and 2017). **As urban populations continue to grow and as we experience an increase in the frequency and intensity of heat events and extreme weather patterns, the authors have updated their dynamic design process. The four simple phases that follow can be used to guide agencies through thermal comfort and safe playground design decisions.**

PHASE 1

Preparation

Establish the playground's purpose and needs. Discuss playground use, child behaviours, location, and funding needs **(See page 16)**.

PHASE 2

Pre-Design

Assess the playground site before embarking on design to help inform decisions **(See pages 18-27)**.

A Gather Seasonal Climate Patterns

- **Record Site-Specific Climate Details:** Air temperature, humidity, windflow, solar intensity, and precipitation.

B Conduct a Site and Landscape Analysis

- **Identity Existing Human Made Elements:** Buildings, shade structures, pathways, utility easements, parking lots, and roadways.
- **Identify Existing Natural Features:** Trees (mature and juvenile), vegetation, landscaping elements, water access, air movement, drainage, and soil type.

PHASE 3

Design with Considerations of Climate, Safety, Inclusion, and Thermal Comfort

Building on design guidance included in *Thermal Comfort and Playgrounds: A review of literature and survey of experts* incorporate design strategies for safety, inclusion, and thermal comfort **(See pages 28-51)**.

- **Design for Safety & Inclusion** Design considerations include site layout, appropriate/safe play components, accessibility, fall area protection, supervision, and maintenance.
  - **General Layout** Follow all safety, accessibility, and injury prevention guidelines. Follow all relevant provincial and organizational guidelines for public locations and playgrounds.
  - **Surfacing** Integrate landscaping and greening elements. Select materials that can sustain extreme weather conditions, especially avoiding equipment and surface materials that absorb and radiate heat.
- **Design for Thermal Comfort** Gather information on seasonal weather patterns, popular play periods of day, hot/humid conditions, and peak time for sun intensity.
  - **Shading** Orientate equipment and materials in the right direction to receive maximum benefit from shade.
  - **Airflow** Use weather records to help determine where the winds typically blow from in the different seasons. Consider orientating playground equipment to allow air flow during the warm season.

PHASE 4

Implementation and Evaluation

Have supervision and maintenance plans been developed, reviewed and operationalized for the on-going safety of children and care of the playground landscape and equipment? **(See pages 52-53)**.

PHASE 1 Preparation

FORM A COMMITTEE

Playgrounds for children should be planned by a group of individuals rather than a single planner. The more people that are involved in the preparation phase, the greater the diversity of thinking occurs. It is suggested that a committee of six to ten people be formed. If more individuals want to be involved, the use of steering groups should be established. Project steering groups may include staff, Board of Directors, child development specialist(s), someone who is involved with maintenance, teachers, an administrator, a parent, individuals who are knowledgeable about children's health and safety, landscape architect, and representatives from the neighbourhood.

ESTABLISH NEEDS AND GOALS

The committee should establish needs and goals at the beginning of the planning process. An open and inclusive engagement process fosters collaboration, encourages thoughtful decision-making, and builds consensus — even when viewpoints differ. By embracing a range of voices, the committee will be better positioned to make sound financial choices and develop climate solutions for the playground's owner and operator. The following questions can be discussed by the committee.

Questions

1. Who will be the primary users of the space: preschool children, school-age children, or families with multiple ages of children?
2. What is the purpose of the area: passive/active play; physical, emotional, social and/or intellectual development; multi-generational play?
3. What season(s) will the playground be mostly used?
4. What time(s) of the day will it be mostly used?

GATHER INFORMATION AND RESOURCES

Gather input (such as surveys, forums, public meetings) from children, users, and neighbours for design preferences, landscaping and planting ideas, and safety concerns. It is worth the time to gather reliable information. Resources are available which offers different insights into microclimate considerations, as well as purchasing decisions to help with design decisions for safe, clean, and healthy products. Some information is helpful, while some may be biased. It's important to discuss all information and considerations.

VISIT NEIGHBOURING PLAYGROUNDS

Take photos, observe, and ask questions to better understand how other playgrounds are being used and to gain design inspiration.

Consider involving children in the planning!

PHASE 2 Pre-Design

Achieving optimal thermal comfort and safety within a playground requires an understanding of various climate factors. The pre-design is all about knowing and documenting the exact details of the local playground site. This phase includes a dual-stage process. Step A involves gathering seasonal climate information from the playground's geographical region. Step B includes completing an analysis onsite to study the playground's topography, landscaping, and site amenities.

Step A: Seasonal Climate Information

The microclimate of a playground is subject to the users (popular seasons and time of day) and effects of the climate. **Climate** is often referred to as the "personality" of a location, while the **weather** is like its "mood." Climate can be variable from season to season, day to day, and hour to hour.

As described in chapter 1, thermal comfort is influenced by a combination of air temperature, radiant temperature, humidity, and wind speed. Relative humidity increases as the air temperature decreases. Locations with high humidity are less comfortable in the summer. Some areas in Canada are more humid (like the Great Lakes region) than others (the Prairies are much dryer).

SUNLIGHT

It is essential to understand how much sunlight (and sun exposure) a playground site receives throughout the year. This involves studying the sun's location and trajectory, sun intensity, sun duration, sun path, and sun angles. At the local playground site, look for surrounding buildings or structures which may cast shade during different seasons. A playground site with limited sun exposure in colder months could be less comfortable compared to a playground location that receives ample sunlight.

RESOURCES AND TOOLS

- ***SunCalc*** provides the length of a shadow at a given time for the location, based on the height of a building, tree, or other object https://www.suncalc.org/
- ***Canada Weather Stats*** offers sunlight intensity, sunrise/sunset, and UV forecast. Consider reviewing "More solar data and Photovoltaic." The "irradiance" value tells you the sun's intensity, which is the total power of incoming radiation hitting the surface of the earth. https://www.weatherstats.ca/
- ***Canadian Climate Normals*** gives temperature and precipitation information and tables for your location of interest. https://climate.weather.gc.ca/climate_normals/index_e.html

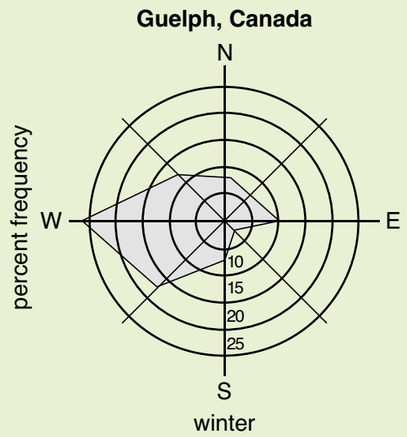
WIND DIRECTION

Wind can significantly affect thermal comfort, especially in the colder months. Understanding the prevailing wind speed and direction throughout the year at the site will help in orientating the play equipment and amenities. Coniferous trees, landscaping, and other amenities (washrooms or shelters) can be designed to block strong winter winds.

With wildfire smoke becoming more frequent and intense, especially in vulnerable regions, considering air quality for health and emotional safety is important. Wind data can help guide decisions for the plantings of vegetation. Dense, fire-resistant plantings (like deciduous trees) can act as a windbreak and reduce airborne particulates. The design planning phase can help ensure appropriate channeling of ventilation in the warmer months and guide decisions for clean air infrastructure.

A wind rose is a graphic tool used by meteorologists to give a view of how wind speed and direction are typically distributed at a location. If you want to know the average wind speeds and directions for your playground location follow these 4 steps.

- **STEP 1:** Go to **https://www.weatherstats.ca/**
- **STEP 2:** Go to “Change Location” on the right-hand side, and type in or select your location.
- **STEP 3:** Click on “Charts” at the top, find “Wind speed” on the left and "Montly data" or "Quarterly data seasonal" at the top, and click "go."
- **STEP 4:** Select the radio button “10x - most” to see the last 10 years of averages.



This wind rose is of a winter season. It shows that in Guelph, Ontario, the winds blow predominantly from the west in the winter (up to just over 25% of the time). Designers would want to consider blocking cold westerly winter winds. (From Brown and Gillespie, 1995).

Designers should focus on where the wind normally blows from, not where it is blowing towards.

RESOURCES AND TOOLS

- ***ClimateData.com*** provides high-resolution climate data to help decisions makers build a more resilient Canada. It offers future climate projections and historical data through a data portal to assist with the development and implementation of climate change adaptation plans. https://climatedata.ca/
- ***Canadian Urban Environmental Health Research Consortium*** develops and delivers environmental data to support health research across the country. The data, information, tools, and programs offer a variety of topics in environmental exposures, health, and inequities in cities across Canada. https://canue.ca/
- ***Tree Canada*** provides information, programs, and guidance to planting and nurturing trees in rural and urban environments, in every province across the country. https://treecanada.ca/

ACTIVITY

This is an activity for playground planning committees. First document the playground site's location. Second predict the months (and time(s) of day) that the playground will have the most traffic. Third, record information on sunlight intensity and peak sun intensity. Fourth, document the averages of temperature, wind speed and direction, windchill, and humidex for the local playground site.

The climate averages can be used during Phase 3 to help guide decisions during the design phase. The climate information for months of interest can help planners make thoughtful decisions, such as the placement of playground equipment and play activities, plantings and landscaping, types of shelter and shade features, washrooms and drinking fountains, topography, drainage, and the type(s) of land cover.

Location: _____ Latitude: _____ Longitude: _____

MONTH(S) OF INTEREST	MAX SUNLIGHT INTENSITY	TIME OF MAX SUNLIGHT	AVERAGE TEMPERATURE	AVERAGE PRECIPITATION	AVERAGE WIND SPEED & DIRECTION	AVERAGE WINDCHILL	AVERAGE HUMIDEX
E.g., July							

Add more rows as needed.

Step B: Site and Landscape Analysis

Every playground site has its unique microclimate, influenced by factors such as topography, vegetation, and building footprints onsite and in the adjacent properties. Take time during this phase to visit and assess the local site for any topography concerns, such as the possibility of flooding or direct solar exposure to the playing surface. Closely examine any shade coverage to determine the extent of shade cast during different seasons.

Each playground site has unique features. Information about land cover, trees, and vegetation are described below.

LAND COVER

Thermal comfort of a playground site can be significantly impacted by the land cover and adjacent properties. Different materials, such as asphalt, grass, dirt, and concrete have distinct thermal properties that directly influence the temperature of the surroundings. Different soil types absorb and retain moisture. Clay soils, with their dense particles, retain heat and often stay warm into the evening. Sandy soils heat up quickly but also cool and drain rapidly. Loamy soils — a balanced mix of sand, silt, and clay — offer more stable temperatures. Documenting soil types provides valuable insight into site-specific heat retention, cooling behaviour, and long-term surface durability.

Urban areas with concrete and asphalt can contribute to the urban heat island effect. Playgrounds then become micro heat islands as temperatures are higher than in surrounding suburban or rural areas. This effect is due to the heat absorption and storage of heat within the surface.

TREES

Trees represent one of the most effective ways to keep play areas thermally comfortable. Mature trees provide shade! Deciduous trees provide shade in the summer while allowing sunlight, thus warmth, in the winter (see Design Strategy #1). They also reduce the direct impact of sunlight on the surface in the summer. Coniferous trees can block cold winds in the winter. Trees also release moisture through evapotranspiration, which can have a cooling effect through the air at the play area.

VEGETATION

Vegetation controls the flux of water vapor into the air through transpiration. Vegetation can help the soil and reduce temperatures. Areas covered in grass and vegetation absorb less heat in comparison and can provide a cooler and more comfortable environment in warmer seasons (see Design Strategy #2).

SHADE

Not all shade sources provide quality coverage. Thus, it is strongly recommended to complete a shade analysis at the playground site to evaluate existing shade coverage and identify areas needing improvement. Planners can assess the size of the area, exposure to the sun, and any existing natural or built shade. This includes recording the sun movement across different times of the day and throughout the year to determine peak exposure periods. Another factor to check is the condition of the existing built shade structure(s) and the health of trees.

Once existing shade has been recorded, planners can discuss how much shade coverage exists and whether it is sufficient. This involves visual observation. Advanced shading modeling tools are available but often are associated with a fee. Remember even if an area appears shaded or you see a shade sail, it may not be providing enough shade.

On-site at the play area,

- ✔ **Check the positioning of the shade structure**, determining if adjustments need to be made to enhance sun protection.
- ✔ **Examine if the surface materials would absorb and retain heat**, determining if adjustments need to be made to reduce direct sun exposure to those surface areas.
- ✔ **Look for signs of wear and tear** of existing built shade structures, including fading, tearing, or weakened anchor parts.
- ✔ **Check the health of trees on site**, making sure trees are healthy, in good condition, and providing appropriate shade coverage.

What to photograph?

At the playground site, take photos to document particular views, land cover, existing structures, orientation, and existing trees and landscape.

EXTENT OF SHADE, in the morning, midday, and later in the day. Deciduous trees allow for warmth in the fall and winter.

VIEWS from within the site at various angles, including buildings, surface types, fence lines, and materials.

ARCHITECTURAL FEATURES on adjacent properties, including streetscapes, tall buildings, and pathways.

NATURAL FEATURES including existing natural shade, vegetation, plants, native grass, berms, and hills.

MANUFACTURED ELEMENTS on the site, including power lines, pavilions, pathways and parking lots.

COMPLETE A SITE ANALYSIS TO RECORD FEATURES AT THE PLAYGROUND SITE AND ADJACENT PROPERTIES. Using a grid paper, observe and document the following:

- **Location, Pathways and Barriers**
  Take time to look at neighbouring land, boundaries, easements, roads, buildings, electrical and utility elements, open bodies of water, parking, and pedestrian and bicycle pathways. Examine adjacent property lines, such as parking lots with drop off and pick up zones, to determine if a protection barrier is needed.

- **Trees, Landscaping and Vegetation**
  Record the soil type, land grade, ground water, and drainage. Take note of trees, landscaping, and vegetation. Differentiating between a dead and dormant tree can make a difference for the safety of the users and property. Check for bugs, pests, parasites, and signs of diseases. Consider a snap/scratch test, check roots, and assess trunks and bark. If there is concern, it's time to schedule a tree risk assessment with an arborist or qualified professional.

- **Environmental and Health Impact**
  Children are vulnerable to certain environmental toxins and pollution because their bodies and brains are still developing. Identify possible environmental impacts, such as soil erosion and compaction, water pollution, air quality, land use and habitat loss, and noise and light pollution. Explore potential exposure sources such as airborne pollutants, pesticides, lead, bisphenols (BPA), Phthalates, and PFAS to identify and mitigate health risks to children.

- **Placement of Play Equipment and Activities**
  Record the amount of land coverage to be sure there is enough space to support intended activities. Native grass playing fields, climbing and swinging, and water play each require different amount of land size.

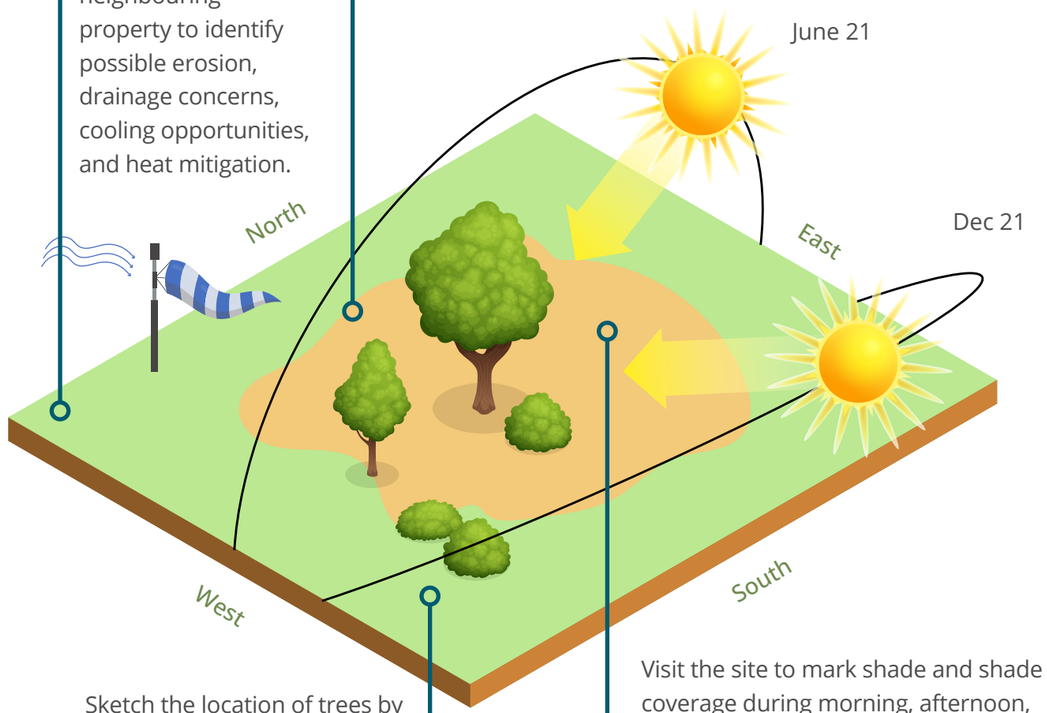
- **Placement of Amenities**
  Determine appropriate locations for washroom, drinking fountains, shelters (such as shade, picnic, classroom), benches and other seating places, trash disposal, and recycling.

- **Signage and Labels**
  Examine the entrance areas and playground equipment for warning and informational signs and labels (See Phase 4).

This image is an example of a local site for a future playground. During the pre-design phase, go to the site and walk around it to identify shade, wind direction, land cover, topography, adjacent property, and other elements highlighted in phase two. This image shows peak sun location in June and December. The blue wavy lines show common air flow in winter blowing from the north and northwest.

Record the surface types around the perimeter and neighbouring property to identify possible erosion, drainage concerns, cooling opportunities, and heat mitigation.

Make note where open and blocked areas for wind may exist, and on what side of the play area. Consider comparing on site findings to a wind rose. Wind roses give a view of how wind speed and direction are typically distributed by season.



Sketch the location of trees by identifying juvenile and mature trees and marking areas where greening and landscaping could occur.

Visit the site to mark shade and shade coverage during morning, afternoon, and evening play times to enhance coverage.

PHASE 3 Design

After working through phases 1 and 2, it is time to make design decisions. Identify the types of activities and play equipment which would be appropriate. Every decision — the selection of activities, play equipment, topography, types of surfaces, landscaping, amenities, traffic flow, and parking — will modify the microclimate in some way at the site.

Many playground designs have not incorporated considerations for impacts on the microclimate. Brown (2010) indicates "miroclimate is *the* most important consideration in designing and building outdoor spaces, yet it is also *the* most difficult and challenging area to understand and apply" (p. 19).

Playground planners can make strategic design decisions to prevent extremely hot and cold conditions that cause thermal injuries. For instance, different playground surfaces have varying levels of solar reflectivity or heat capacity, impacting their ability to absorb and retain heat. Understanding these properties in the design phase is crucial, particularly in mitigating the micro heat island playground effect and keeping children thermally comfortable and safe.

It is possible to make design changes to create a thermally comfortable and safer play experience!

Thermally responsive playground in Corner Brook, Newfoundland designed with natural shade and a porous surfacing.

DESIGN CHECKLIST

It's recommended to use a design checklist to help manage every step — from preparation to gathering climate information.

- ✔ Integrate and apply findings from *Phase 1: Preparation.*
- ✔ Incorporate findings from *Phase 2: Pre-Design* to make informed decisions, including placement of shade, material and colour selection, vegetation, windbreaks, and water access to dovetail with existing infrastructure.
- ✔ Draw a preliminary layout of the playground site. Begin by sketching out information and data gathered from your site visits and research, including sun patterns, climate information, wind flow, existing vegetation, and shade coverage (See Bubble Diagram on p. 30).

Think of a bubble diagram as the brainstorming phase of spatial design —messy, creative, and essential for getting the big picture (climate) right before diving into purchasing and details!

- ✔ Follow *Phase 3: Design* by incorporating the seven thermal comfort design strategies (See p. 36-51).
- ✔ Identify the location of boundaries, access points, and existing structures/features (trees, landscaping, and shade amenities).
- ✔ Identify surface materials (See *Design Strategy #5*).
- ✔ Select age-appropriate and sustainable materials suitable for the playground's microclimate (See *Design Strategy #6*).

BUBBLE DIAGRAM

Bubble diagrams are used in design — especially in architecture and landscape planning — because they offer a simple yet powerful way to visualize spatial relationships during early stages of the project. Each bubble represents a space or function (like a swing, outdoor shelter classroom area, tree, or open grass playing area).

The proximity and connections between bubbles show how spaces interact — like which play areas should be near shade, drinking locations, or how children might move through the space.

Using the bubble diagram can help identify potential layout issues or thermally uncomfortable locations before committing to a detailed plan, saving time and resource later. They make it easier for planners to explain ideas to stakeholders, designers, or clients by encouraging feedback and collaboration.

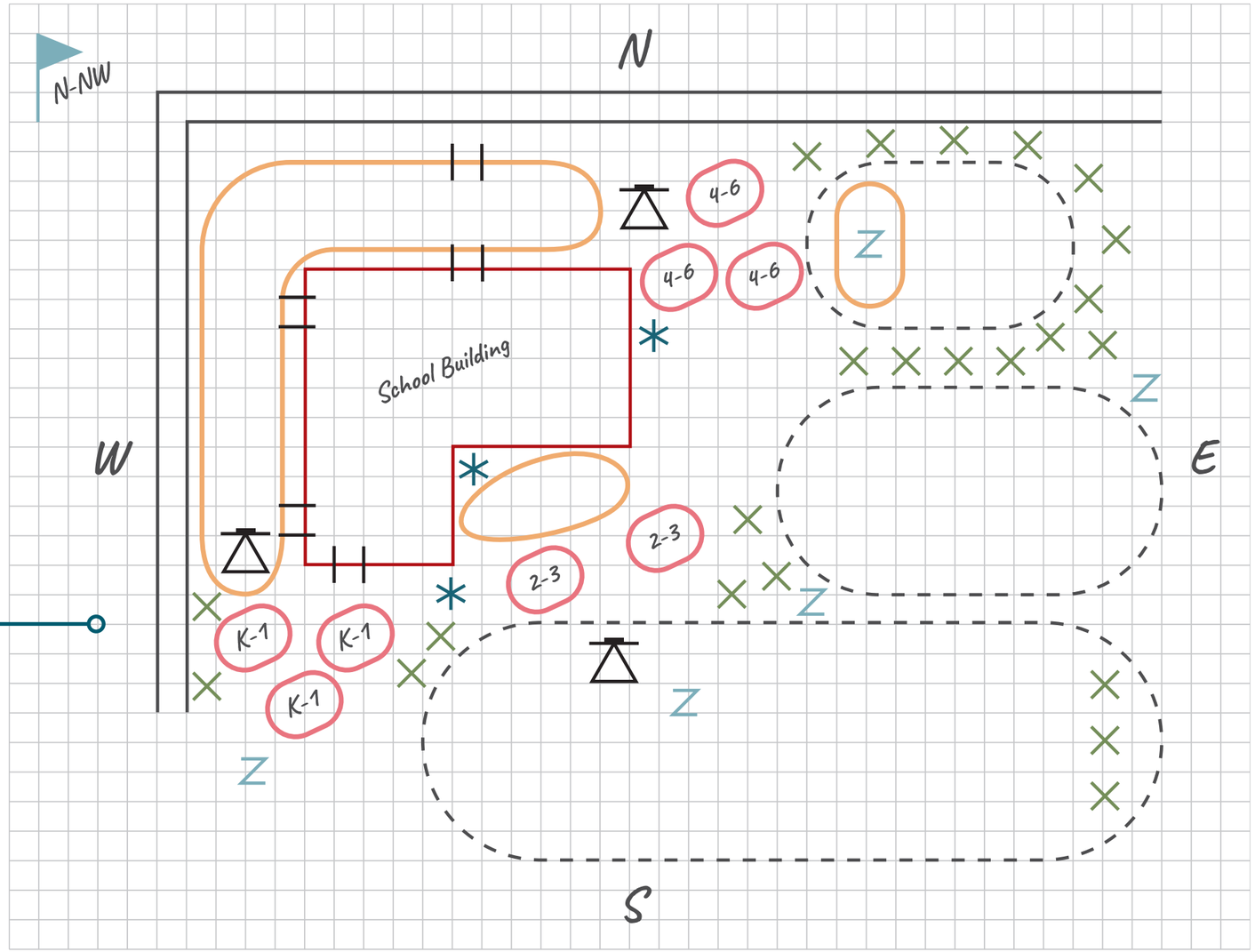
This simple illustration shows how various pieces of playground equipment and amenities fit together at a site.

This school playground site serves children ages five to twelve. Members of the planning committee have identified several parts of the playground site where outdoor learning and play can occur. The facility will be utilized year around, offering summer learning sessions and camps.

The winds are strong in the winter. A wind block is proposed along the north and northwest side. The outdoor learning and play times are designed to be positioned on the south and east. Water stations and shelters are included in the design, creating opportunities for extended outdoor learning and play. Drinking fountains and shelters offer cooling areas. Quality native grass, trees, and landscaping will offer safe and appropriate thermal comfort.

Location: _____ Popular play times: _____

Wind direction(s) and season(s): _____ Sun angles and available shade: _____



KEY

= Wind block	= Native tree species	= Native playing grass
= Water access	= Hard surface courts	= Supervision shaded zones
= Shade feature	= Play feature (stand-alone or composite)	

Principles for Incorporating Thermal Comfort and Safety into Playground Designs

APPLY AN INCLUSION, DIVERSITY, EQUITY, AND ACCESSIBILITY LENS

Playgrounds in lower-income areas often face challenges such as lack of funding, outdated equipment, and limited accessibility. A recent study explored disparities in play spaces across different socioeconomic neighbourhoods. Children from lower-income areas often have fewer well-maintained green and play spaces, which can impact children's physical and mental well-being (LeClair, 2024). Transportation barriers can also be a factor which limits children's access to safe and age-appropriate urban green spaces.

It is important within cities and communities to prioritize playgrounds in marginalized communities and organizations to strengthen inclusion, equity, safe, and thermally comfortable access. Well-designed playgrounds can serve as community hubs, fostering social interaction, physical activity, and cognitive development. Additionally, playgrounds designed with thermal comfort in mind — such as shaded areas, water access, and heat-resistant materials — help mitigate environmental challenges, making play equitable and safer in all types of weather conditions.

Accessibility is a fundamental aspect of inclusion and equity and ensures that the infrastructure is usable by everyone, including individuals with all types of disabilities. By developing accessible playground infrastructure, people of varying abilities can access thermally comfortable playgrounds. Accessible playgrounds provide physical access to interactive play opportunities, washrooms, shade, and water features, promoting social inclusion, allowing all children to interact and thrive together.

Photo courtesy of Earthscape Play

FOCUS ON THE CHILDREN

When it comes to playgrounds, one size does not fit the needs and behaviours of all children. This principle, by focusing on the children, encourages a comprehensive understanding of the children and how they are likely to use the space. Start by identifying the ages of the children, maximum number of users at a time, and the types of activities desired. Consider when the children will be using the playground. For instance, playgrounds that are adjacent to sports fields have different peak use periods than child care centres and schools. Knowledge of these factors may suggest different design decisions regarding playground equipment, landscaping, types of materials for the land coverage, and playground amenities.

IMPLEMENT A COLLABORATIVE APPROACH

A child care centre has significantly different operations than a school facility. Implement a collaborative approach in the playground planning processes taking into consideration schedules of playground operation, curricular needs, hours of operations, staff, and special circumstances.

IDENTIFY ACTIVE AND PASSIVE ACTIVITIES FOR ALL SEASONS OF PLAY

When designing playgrounds, think about including a variety of play activities that match the age of the children who will likely use the space. Active areas — climbing, swinging, running, and other physical play — often need more room. Passive areas — such as locations for socializing, crafts, sitting, gardens, or reading — are also important for children's development. Designing adaptable spaces, like turning a summer garden into a winter snowman-wonderland, allows for lively, year-round playground use.

UNDERSTAND THE LOCAL MICROCLIMATE

The microclimate at the local site is an important consideration in designing and building playgrounds, yet it is also the most difficult and challenging consideration to understand and apply in outdoor spaces. The good news is that we can improve (or modify) the microclimate — even in hot and dry areas — to make it thermally comfortable for children and all playground visitors.

*Playground designs can prevent **extremely hot conditions** that cause thermal discomfort to children and other playground users, often due to intense sunlight, low windflow, high humidity, and high air temperatures. Designs can also prevent **extremely cold conditions**, such as high winds with low temperatures. Tips for playground design for warm and cold seasons are presented below.*

WARM SEASON

To improve thermal comfort at playgrounds in the warm season, consider reducing solar radiation and allowing for air flow.

DESIGN TIPS:

- ✔ Create plenty of shade to reduce sun exposure.
- ✔ Select sites with thick vegetated tree canopies where feasible.
- ✔ Plant trees to reduce south sun exposure during peak times of day.
- ✔ Orientate shade structures to reduce sun exposure for shading.
- ✔ Take advantage of already-existing buildings to benefit from morning or afternoon shade.
- ✔ Place playground equipment on the north side for early afternoon shade.
- ✔ Vegetation and landscaping surrounding the perimeter can help with cooling.
- ✔ Grass and porous surfaces around the perimeter of the playground can cool down the area.
- ✔ Light surfacing colours can lower the absorption of heat.
- ✔ Caution with bright and reflective colours, such as white, and sand. The reflection can cause sunburn and be uncomfortable on the eyes.

Photo courtesy of Earthscape Play

WINTER SEASON

There are two important design considerations in the cold season that can be partially controlled through design: radiation and wind.

DESIGN TIPS:

- ✔ Create wind breaks to protect play areas from cold blasts.
- ✔ Use deciduous trees to allow sun in winter but provide shade in summer.
- ✔ Use wind roses or weather radials to understand wind patterns.
- ✔ Ground vegetation (like hedges, evergreens, and coniferous trees) can help block strong winds and snow drifts.
- ✔ Buildings and shelters can be utilized for wind protection.
- ✔ Design vertical shade features to the west or northwest to help with blocking cold westerly winds.
- ✔ Orientate playground equipment strategically to maximize thermal comfort.

DESIGN STRATEGY #1

Shade

Playgrounds with shade create more thermally comfortable play. Apply solar findings from 2A (See p. 19) for the use of shade especially in locations that quickly heat up or absorb heat. Intercepting sunlight by shade is an effective way to reduce the intensity of solar radiation.

This design strategy can be achieved by including shade to reduce the amount of solar radiation arriving at the surface. If it is not possible to intercept the solar radiation through shade, consider the type and albedo (reflectivity) of the surface to reduce heating.

Shade sails over playground equipment are generally a great addition, offering a mix of comfort and visual appeal. That said, be sure the sail casts enough shade over the play equipment. Durability of shade, proper installation, and maintenance are key to choosing the right type of shade structure. Poorly tensioned sails or low-quality material can tear, sag, or even become safety hazards in high wind.

EXAMPLES

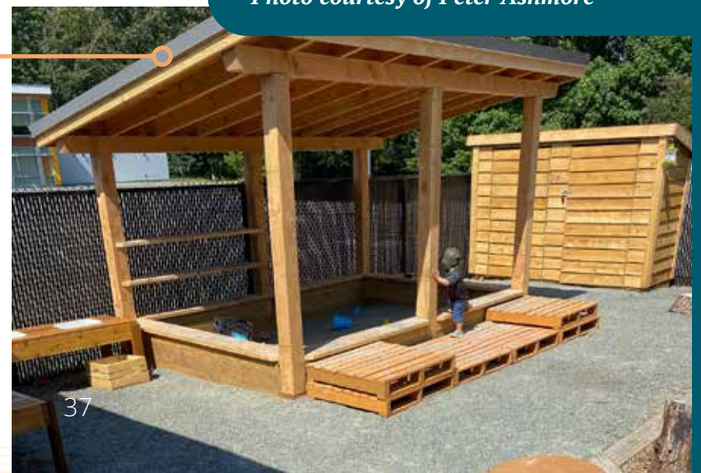
Multi-story buildings, courtyards, and building design features can block the sun.

They also can protect children and adults from the north and northwest cold wind during the Canadian winter season.

Type and placement of shade structures are important in the planning decision stage.

Be sure to orientate shade so that it reduces solar radiation at popular time(s) of day.

Photo courtesy of Peter Ashmore



This is an example of a roof over a sand play area at a childcare centre for infants and toddlers at the Lake Trail Childcare Centre in Courtenay, British Columbia. The roof's design was intended to provide shade and shelter to extend learning and play in rain, mist, and snow.

EFFECTIVELY PLANNING SHADE ACROSS SEASONS FOR THE LOCAL SITE

Use a variety of tree types, suitable for the local site.

Incorporate tree canopy in the design.

Orientate shade decisions to reduce sun intensity based on popular play times.

Trees require water, maintenance, and time to grow.

Review the *Shade Lookbook: A Guide to Designing Sun Safety*

Mature and large canopy trees provide maximum shading and allow cooling air flow to be present at the child's height.

This park site strategically placed the equipment to receive the summer shading angles. Shading angles are critical for summer.

Public Playground in Corner Brook, Newfoundland providing excellent wind block for cold winter months and summer shade. Coniferous trees provide vertical shade to help block cold winter winds.

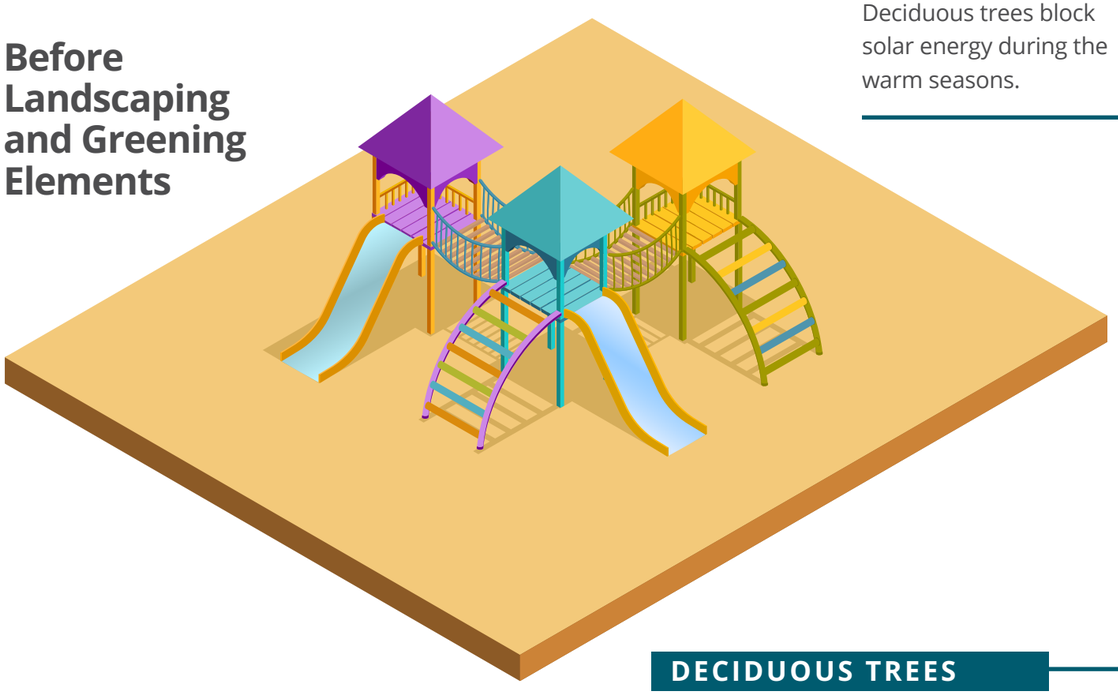
Deciduous trees are great for summer and fall shade. They will lose their leaves in the late fall, which allows important warmth from the sun during the winter months.

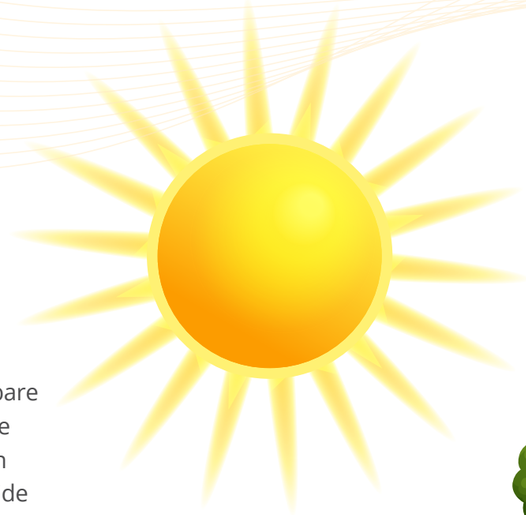
DESIGN STRATEGY #2

Landscaping and Vegetation

Often times, playground equipment is located in the middle of an open bare space with no tree or shrub plantings. Sometimes, the most cost-effective way of improving an existing play area is to plant vegetation. Planting can provide shade, landscape texture, colour, scent, encourage wildlife, provide protection from wind, and help reduce soil erosion.

Before Landscaping and Greening Elements





After Landscaping and Greening Elements

Deciduous trees block solar energy during the warm seasons.

DECIDUOUS TREES

Deciduous trees are most effective for shading on the south and southwest side of a playground to provide shading through the hottest part of the day.

GROUND-VEGETATION

Grass, shrubs, and native plants provide cooling.

Grass surrounding the perimeter of the playground area can help lower surface temperature.

CHOOSE PLANTS THAT ARE

- ✔ Fast growing
- ✔ Easy to maintain
- ✔ Resilient
- ✔ Native

AVOID PLANTS THAT ARE

- ✗ Thorny, prickly, or sharp
- ✗ That are known to irritate skin
- ✗ Poisonous or toxic

A Success Story

The Bay of Fundy lies between Canada's Nova Scotia and New Brunswick provinces. It's known for extremely high ocean tides and dry lands. The Fundy Discovery Site was a project of the Municipality of Colchester in partnership with the Town of Truro. It features a thermally comfortable musical play area for all ages to enjoy. The playground design capitalized on the existing mature trees and also added new landscaping features and vegetation. The design maximized the land cover, capturing the ocean tides breeze. The play equipment was strategically positioned to have shade during peak play periods.

Photo courtesy of Percussion Play | Cobequid Consulting Ltd

DESIGN STRATEGY #3

Air Circulation and Wind Breaks

WARM SEASON

Some of the most thermally uncomfortable warm days are those with stagnant and humid air.

Winds in the mid-latitudes are normally from the west. Yet, often times, during long heat waves, the winds are from the south. Play areas surrounded by tall buildings can often block air movement allowing for a cooling breeze in the warm season.

This school yard has no landscaping or planting elements. The land coverage has limited opportunity to cool during extreme periods of high temperatures. There are no shaded areas or water access points to help cool playing conditions.

COLD SEASON

The coldest winter winds in Canadian cities often blow from northerly and westerly directions.

WINDBREAKS

- Control snowdrifts
- Slow the air flow to protect from harsh winds
- Provide shade in early or later parts of the day

DESIGN STRATEGY #4

Water

Water plays a *quietly powerful* role in thermal comfort. Its unique physical properties help regulate temperature in ways that are both immediate and long-lasting. Here's how water positively helps thermal comfort:

Hydration and Visitor Experience

Provide drinking fountains to help children and visitors stay hydrated. Water, misting systems, and splash pads are a great opportunity for play, socialization, and cooling off.

Evaporative Cooling

When water evaporates, it draws heat from the surrounding air and surfaces. This process lowers ambient temperatures, especially in dry or breezy conditions.

Material Interaction

Water affects how **soil and surface materials** behave thermally. Moist soils retain heat differently than dry ones. Compacted and waterlogged soils may help reduce airflow and increase surface heat. Permeable surfaces that allow water infiltration tend to stay cooler than impervious ones.

Microclimate Regulation

Water features can cool adjacent surfaces through evaporation and shading. They support vegetation and native plantings which adds further to cooling through transpiration.

Photo courtesy of the City of Toronto

QUESTIONS TO CONSIDER:

- What is the purpose of the water?
- How much water will be consumed by people or vegetation?
- What is the water source?
- Can the water be recycled?
- Is it a suitable quality for drinking?

When playground equipment is near splash pads or water play areas, post warning labels to inform users to wear shoes.

SAFETY

Water play can provide hours of enjoyment and a place to cool off. If including water in the design of a playground, remember safety. Drowning can happen in as little as one inch of water.

There is no one solution to prevent water play drowning. **Active supervision, safe design, proper education, and warning labels** are required to ensure children are safe in and around water.

DESIGN STRATEGY #5

Ground and Play Surface

Understanding the characteristics of ground and play surfaces — including land coverage — is essential from ecological, planning, and safety perspectives. *Research consistently shows that most playground injuries are caused by falls, and that certain surface materials can retain heat that pose serious concern. Thoughtful surface selection and regular maintenance are essential to reducing the risk and severity of these health risks.*

Not all materials respond to climate conditions uniformly: some may freeze, retain moisture, become slippery, absorb heat, or even be displaced by wind. Additionally, wildlife, pests, and invasive grasses can compromise surface integrity and increase maintenance demands, posing risks to accessibility and safety.

The following are considerations that capture the interplay between the site surface conditions, material behaviour, and child safety:

1 GREENING THE SURROUNDING SITE

Understanding the ratio of impervious (e.g., asphalt) to pervious (e.g., grass or mulch) surfaces supports sustainable playground design, effective drainage planning, and stormwater management. Features such as tree canopy coverage, soil health, and native vegetation around play equipment contribute meaningfully to the site's microclimate.

Vegetation cools the surrounding air through evapotranspiration, helping to reduce surface temperatures and improve comfort. In open or exposed areas, planting coniferous trees or installing windbreaks can help control the displacement of loose-fill surfacing materials. Strategic planting around parking lots, pathways, seating zones, and property edges can enhance thermal comfort and environmental quality.

Newly planted trees and vegetation at Coulson Public School in Milton, Ontario.

Photo courtesy of Cam Collyer, Evergreen

2 SAFETY AND COMPLIANCE

"Playground equipment at 450 mm in height shall meet standards for fall protection" (CSA Z614-20). Not all playground surfacing materials have the same shock-absorbing characteristics to protect a child's fall. Two types of materials are available for under and around playground equipment: loose-fill (such as engineered wood fiber, pea gravel, or sand) and unitary (such as poured-in-place rubber or artificial turf) (CSA Z614). When selecting playground unitary surfaces, such as artificial turf or unitary rubber surfaces, avoid black or very dark surfaces which easily absorb and retain heat.

3 BE RESPONSIVE TO EXTREME WEATHER CONDITIONS

All materials on earth's surface are heated by the sun's solar energy, which then heats the air. Some surfaces, such as sand, snow, and ice reflect more sunlight than other surfaces. Albedo refers to how much sunlight a surface reflects. In playgrounds, this matters a lot because it affects surface temperature and contributes to the urban heat island effect.

The concept of albedo relates to how much heat is absorbed. Designs should try to reduce the amount of solar radiation especially in hot summer months arriving at the ground and play surface. **Suggestions include additional shading as well as native plantings and landscaping throughout the playground.** Permeable surface materials and sources of shade are essential.

4 BE ACCESSIBLE

Providing opportunities for children of all abilities to play is a design factor. The Canadian Standards Association has an informational annex available (Annex H, Ground Level Accessible Routes) for accessible designs. Inclusion, equity, and usability are important principles in playground design.

5 MAINTENANCE AND BUDGETING

Paved versus natural versus synthetic surfaces each demand different upkeep. A clear map of land coverage supports forecasting maintenance needs and associated costs. Without proper maintenance, fall protection will decrease. For clay or poorly drained soils, there should be drainage tiles to an outlet. Trees, plantings, and vegetation need water and care.

DESIGN STRATEGY #6

Smart Materials and Products Conducive to Safety Year-Round

Playground equipment varies in size, weight, height, and shape. Materials commonly used are plastic, wood, steel, aluminum, and metals like nickel and stainless steel. Select play materials, surface materials, and amenities with low thermal storage and low heat conductivity.

Light-coloured materials can minimize the absorption of heat. However, be cautious with bright or reflective colours, such as white and shiny metal surfaces and sand. They can increase potential of sunburn and may cause discomfort due to glaring. Obtain documentation from the manufacturer to explore options for quality performance application for your local site.

Be sure materials are appropriate and healthy for children

- ✔ Chemical-resistant
- ✔ Corrosion-resistant
- ✔ Structural integrity
- ✔ UV-resistant
- ✔ Heat-reducing
- ✔ Light-coloured materials to minimize heat absorption

DESIGN STRATEGY #7

Placement of Surfaces and Equipment

Decisions on where and how surfaces and equipment are placed must aim to maximize thermal comfort and safety.

The equipment was positioned to receive maximum shade benefit for the popular summer play times.

Position slide beds north to reduce intense sun exposure. Try to orientate slides and larger equipment away from the direct sun exposure as much as possible.

Young children naturally gravitate to shaded areas. Trees, landscaping, and shade structures can help improve thermal comfort at sand play areas.

This child care centre located loose parts and play materials to the large shaded area.

PHASE 4 Implementation and Evaluation

The final phase includes developing a maintenance strategy, promoting supervision, and posting instructional visuals and signage for users. Maintenance includes all the work necessary to keep the play area clean, safe, and operating efficiently. Supervisors should monitor the playground environment and the children's play patterns for safety and to intervene in dangerous situations. Signage is also important, especially for supervision, age-appropriateness of equipment, removing strangulation hazards (such as removing bike helmets and drawstrings), and checking the temperature of the play equipment prior to use.

MAINTENANCE TIPS

Post signs and warning labels.

Care for the trees and landscaping.

Monitor the play equipment for worn, broken, and loose parts.

Clear the garbage and address other maintenance needs.

A final step is to evaluate both the end product and process.

- Are children using the area as expected?
- Does the play space reflect the planning goals?

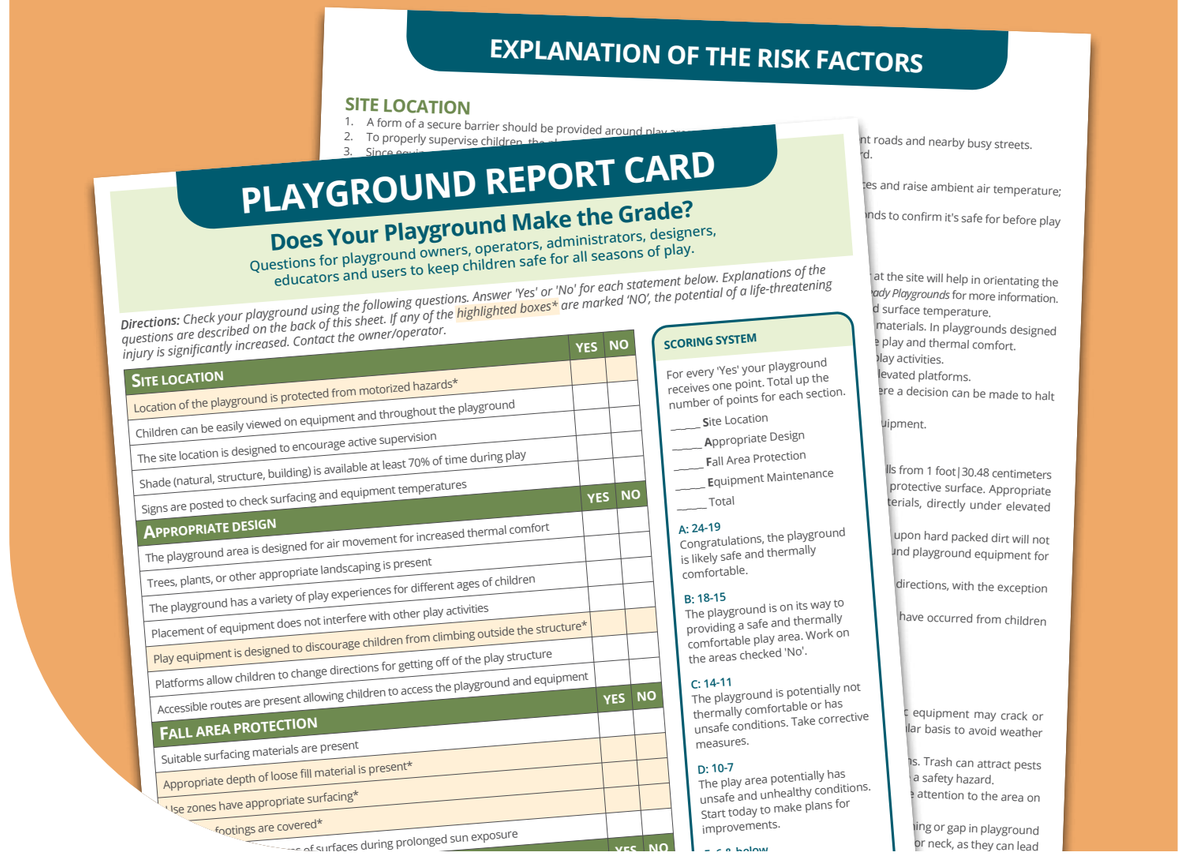
Developing maintenance policies and plans can extend the life of the equipment. Follow maintenance guidance from the manufacturer.

Informing users about extreme heat advisories or temperature thresholds is recommended. **Alerts** could include digital displays to keep viewers informed. Show real-time heat index and hydration reminders during hours when the playground is open. Consider integrating policies for heat-resilient playground operation, such as a digital localized alerts with tips like "play in shade between 12-4 PM," "stay hydrated," or "take breaks." Post signs to inform playground users to check temperature of surface materials through a quick touch test.

CHAPTER

3

Does Your Playground Make the Grade?


EXPLANATION OF THE RISK FACTORS

SITE LOCATION

1. A form of a secure barrier should be provided around play
2. To properly supervise children, the
3. Since

PLAYGROUND REPORT CARD

Does Your Playground Make the Grade?

Questions for playground owners, operators, administrators, designers, educators and users to keep children safe for all seasons of play.

Directions: *Check your playground using the following questions. Answer 'Yes' or 'No' for each statement below. Explanations of the questions are described on the back of this sheet. If any of the highlighted boxes* are marked 'NO', the potential of a life-threatening injury is significantly increased. Contact the owner/operator.*

	YES	NO
SITE LOCATION		
Location of the playground is protected from motorized hazards*		
Children can be easily viewed on equipment and throughout the playground		
The site location is designed to encourage active supervision		
Shade (natural, structure, building) is available at least 70% of time during play		
Signs are posted to check surfacing and equipment temperatures		
APPROPRIATE DESIGN	YES	NO
The playground area is designed for air movement for increased thermal comfort		
Trees, plants, or other appropriate landscaping is present		
The playground has a variety of play experiences for different ages of children		
Placement of equipment does not interfere with other play activities		
Play equipment is designed to discourage children from climbing outside the structure*		
Platforms allow children to change directions for getting off of the play structure		
Accessible routes are present allowing children to access the playground and equipment		
FALL AREA PROTECTION	YES	NO
Suitable surfacing materials are present		
Appropriate depth of loose fill material is present*		
Use zones have appropriate surfacing*		
footings are covered*		
of surfaces during prolonged sun exposure	YES	NO

SCORING SYSTEM

For every 'Yes' your playground receives one point. Total up the number of points for each section.

_____ Site Location
_____ Appropriate Design
_____ Fall Area Protection
_____ Equipment Maintenance
_____ Total

A: 24-19
Congratulations, the playground is likely safe and thermally comfortable.

B: 18-15
The playground is on its way to providing a safe and thermally comfortable play area. Work on the areas checked 'No'.

C: 14-11
The playground is potentially not thermally comfortable or has unsafe conditions. Take corrective measures.

D: 10-7
The play area potentially has unsafe and unhealthy conditions. Start today to make plans for improvements.

The National Program for Play Area Safety's (NPPAS) *Playground Report Card* is a structured evaluation tool that can be used to assess various aspects of the health and safety of a playground. It helps identify possible playground risks and hazards. The *Playground Report Card* originated in 1997 when researchers affiliated with NPPAS released the *National Action Plan for the Prevention of Playground Injuries* and assessed over 3,000 playgrounds. Validated through stakeholder input, expert review, and real-world application, this checklist ensures comprehensive safety measures. It was revised in 2001 and 2012.

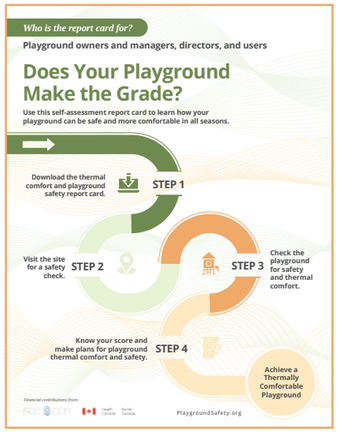
With the recent information on playground safety and climate changes, the researchers have updated the Playground Report Card in 2025.

Does your playground make the grade? Use these questions for keeping children safe, protecting children from the sun, and preventing playground injuries for all seasons of play.

CHAPTER

4

Infographics and Sources



Does Your Playground Make the Grade?

This infographic highlights four simple steps for completing a playground assessment. It provides access to NPPAS's *Playground Report Card*, including information about the playground *Site Location, Appropriate Design, Fall Area Protection, and Equipment* and *Environment* maintenance. The infographic is designed to help playground owners and operators, directors, and users check their playgrounds for safety and advocate for improvements.

Why Design for Thermal Comfort at Playgrounds?

This infographic presents a visual summary of integrating thermal comfort considerations at playgrounds. It features a seven practical ideas to guide planning decisions making it an effective communication tool for stakeholders, planners, landscape architects, and design teams.

Stay Cool While Playing

This child-friendly playground safety infographic uses bright colours, simple icons, and playful illustrations to teach essential ideas for children and adults to stay cool while playing at playgrounds.

DOWNLOAD INFOGRAPHICS

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NPPAS

NATIONAL PROGRAM FOR PLAY AREA SAFETY

PlaygroundSafety.org

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