BIODIVERSITY DESIGN GUIDELINES

TRAILS

7

Context

Trails provide residents and visitors opportunities to explore and enjoy the City's natural areas. Much of the City's trail system is intertwined with its Green Infrastructure Network, and act as important corridors for both people and wildlife. While these trails may be used for different purposes, from walking to biking to wildlife-viewing, it is important to consider the potential impacts of trails and trail use on biodiversity and how those impacts can be mitigated when trails are maintained, upgraded, or newly developed. These biodiversity design guidelines focus on nature trails; however, they can be applied to other types of trails and paths managed by the City.

Trails and trail use can change the landscape and cause disturbances to wildlife that may affect their behavior, physiology, reproduction and predation vulnerability. The zone of influence (the distance to which these effects may be experienced by wildlife) is dependent on a number of factors, including the species; the season (e.g., breeding season); the habitat; whether a species is feeding, breeding, or raising young; the weather; and the type and duration of disturbance(s). This zone of influence can extend from as little as a few meters from the trail to many hundreds of meters.[1] Being mindful of these issues in trail design, and limiting use depending on seasonal sensitivities, can help make trails more wildlife-friendly and minimize disturbance.

Elgin Heritage Park
Credit: Carla Stewart

Key Considerations:

- ☑ **Plan trails with wildlife in mind!** Avoid impacts to wildlife by anticipating how new trails and trail use might affect natural areas, the broader landscape, and the wildlife that uses the habitat. Consult a Qualified Environmental Professional (QEP) for information that can inform planning and design.
- ☑ Develop recreational greenways and trail corridors that support and complement the City's Green Infrastructure Network, where appropriate.
- ☑ Protect existing natural areas.
- ☑ Avoid creating new trails that will fragment habitats and create edge effects.
- ☑ Avoid locating trails in small, high quality habitat patches that act as important stepping stones for wildlife movement.[2]
- ☑ Design trail alignments that consider wildlife movement. Minimize the number of trail crossings along important wildlife corridors, such as riparian areas.
- ☑ Balance recreational opportunities with biodiversity goals by routing trails along habitat edges.
- ☑ Avoid trail development and/or decrease trail density in high sensitivity areas (e.g., sensitive habitats, steep slopes, wet areas, known locations of Species of Conservation Concern).
- ☑ Minimize the trail footprint and avoid unnecessary disturbances that will affect soil, native vegetation, and hydrology.
- ☑ Make human use of trails more predictable for wildlife. Reduce trail braiding, short-cutting, and unauthorized trail building by designing attractive and interesting trails that respond to natural demand lines for people, link to desirable destinations, and provide rest areas and viewpoints
- ☑ Reduce physical access to sensitive habitats.
- ☑ Consider seasonal trail closures and decommissioning trails in natural areas where human disturbance should be minimized for all or part of the year.
- ☑ Integrate technology such as trail counters and wildlife cameras to gain knowledge of natural assets and support adaptive management.
- ☑ Improve natural areas connectivity through targeted habitat restoration and enhancement that is tied to development of new trail infrastructure and trail decommissioning.
- ☑ Encourage citizen science and use of iNaturalist through trail network signage.
- ☑ Manage invasive species along trail edges.
- ☑ Prioritize low-impact engineering solutions.
- ☑ Consider the appropriateness of off-leash dog areas.
- ☑ Monitor areas becoming degraded due to human activities (e.g., off trail trampling, biking) and adaptively manage habitat along trail edges to mitigate such disturbances.

Relevant Surrey Documents:

- ☑ Biodiversity Conservation Strategy (2014)
- ☑ Official Community Plan (2013)
- ☑ Natural Areas Strategic Management Plan (2002)
  - o Access and Recreation Management Strategy (2002)
- ☑ Park Design Guidelines (2020)
- ☑ Parks Construction Documents (2017)
- ☑ Engineering Department Design Criteria Manual (2020)
- ☑ Greenways Plan (2012)
- ☑ Surrey Parks, Recreation and Culture Strategic Plan (2018-2027)

Cost Legend: Relative Cost: $ (low), $$ (medium), and $$$ (high).

Module linkages:

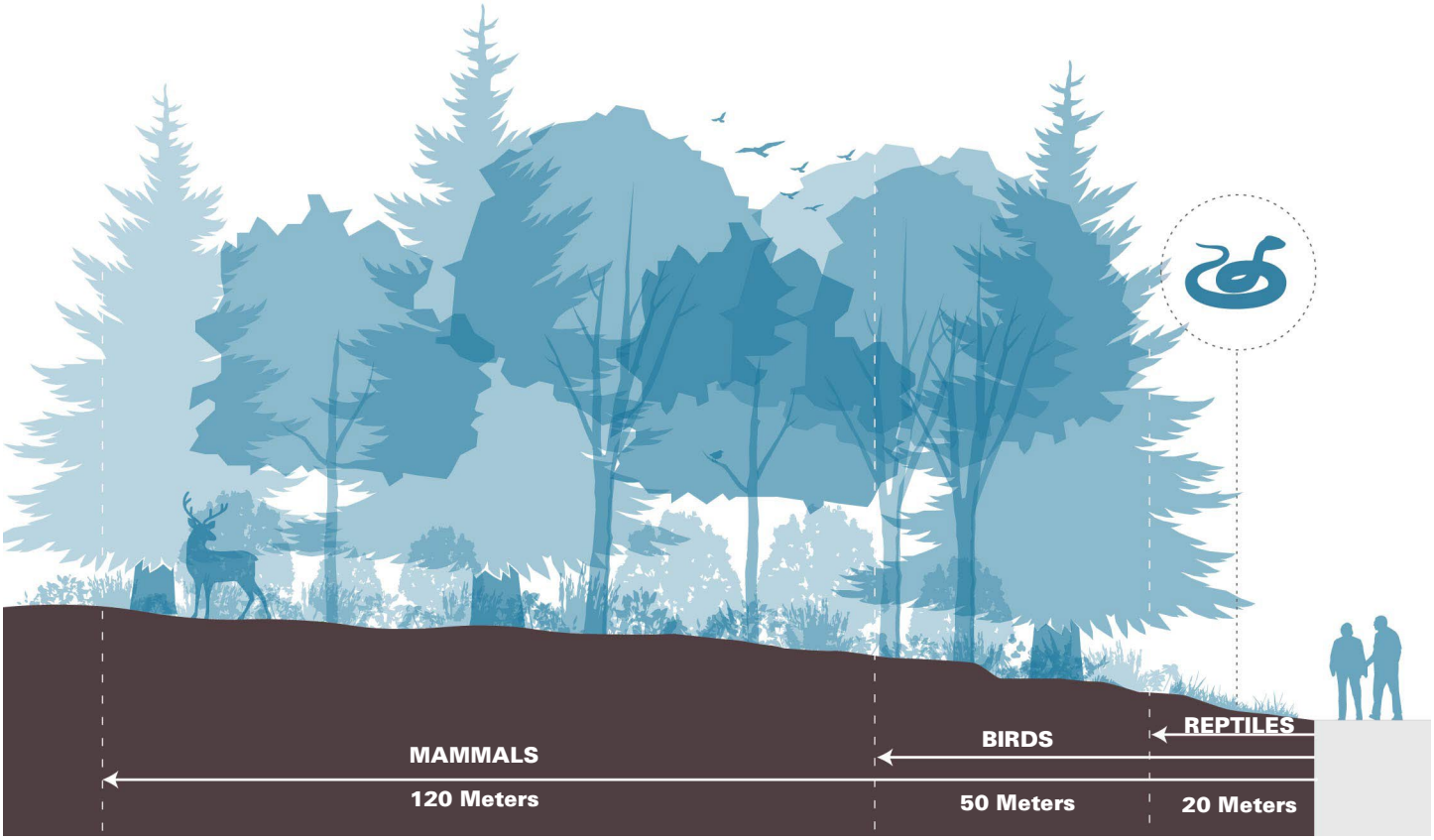


Fig. 1: Zone of Influence

Calculating a zone of influence

Generally, mammals are considered to be more tolerant of disturbance than birds or amphibians, but their Zone of Influence is larger. That is, mammals will generally become more alert or respond to human activity at further distances. Average zones of influence for mammals, birds, and reptiles have been calculated to be 120m, 50m, and 20m respectively. These distances should be considered a general guideline; other factors may warrant reduction or addition. For example, open habitats such as fields can reduce the Zone of Influence, whereas forested areas may increase it, due to differences in cover, visibility, and security.

When planning trails, overlay the zones of influence to determine how much undisturbed habitat remains for different species groups when proposing a trail alignment. Remember that these Zones of Influence are just an estimate, and that a more conservative approach may be required depending on existing conditions. A Qualified Environmental Professional should also be consulted to assess existing or proposed trails and flag potential wildlife/habitat conflicts.

7.1 TRAIL LOCATION

Overview

Wildlife-friendly engineering solutions balance accessibility and biodiversity through low-impact engineering. The intended use of the trail and the habitat characteristics of the area will determine the types of engineering solutions that are most appropriate for each project.

The zone of influence in which wildlife is affected by a disturbance can be highly variable. Studies have shown that even minimal presence of people can significantly alter behavior. For example, trail use (walking) was demonstrated to result in lower forest bird density and species richness, but that this change was influenced by the intensity of recreational use, the sensitivity of different bird species, and foraging behavior (e.g., whether on the ground or in the canopy).3 Trails and trail use can also result in direct loss of habitat and alterations to water, soil, and vegetation communities, which also affect biodiversity.

General Guidelines for Locating Trails:

1. Avoid locating trails in close proximity to riparian areas, wetlands, and other aquatic habitats. These habitats generally support a high diversity of species, many of which are sensitive to disturbance and/or are Species of Conservation Concern. These areas also provide important ecosystem services (e.g., flood protection) for people; maintaining intact, functional ecosystems maximizes the benefits that these natural assets can provide. Wetter areas also require more maintenance, so avoiding these habitats can reduce costs and avoid future management issues. Locate trails outside the Streamside Protection and Enhancement Area (SPEA) as defined under the BC Riparian Areas Protection Regulation (RAPR). Where possible, try to maintain a minimum vegetated buffer of 30m from the edge of a stream (e.g., watercourse, body of water, or wetland). Stream crossings may be permitted with a Notification or Change Approval under the provincial Water Sustainability Act; however, the number and length of crossings should be minimized. Establish sanctioned control points/view points to reduce disturbance within the SPEA.

2. Avoid sensitive habitats associated with Species of Conservation Concern. Habitat that supports Species of Conservation Concern (SCC) should be avoided to minimize disturbance, particularly in those areas where critical habitat features are known to support SCC for sensitive periods of their life cycle (e.g., breeding, hibernation, roosting, nesting, etc.). Sometimes, important habitat features that support SCC exist but are not known; taking a precautionary approach to avoid habitats associated with these features avoids unnecessary disturbance. Sensitive habitats and features may include vernal pools, wetlands, streams, wildlife trees, mature forest, and rock

bluffs. Human structures, such as old buildings, can also provide critical habitat for some species, and should also be considered when planning trail infrastructure.

3. Avoid natural areas with steep slopes. These areas are difficult to access and can provide important refuges for some species that may use this habitat. There is also a liability and economic factor to consider. Trails on steep slopes are subject to erosion and slumping and are more expensive to build and maintain.

4. Locate trails along edge interfaces. Edge habitats are considered areas of high biodiversity, which is often composed of more generalist species, which are more tolerant of disturbance. Locating trails along existing edges minimizes creation of new edges in undisturbed areas. This reduces negative effects to species that depend on interior habitats and are less tolerant of disturbance.[2] New trails that bisect natural areas may be considered where sensitive habitats will not be affected; however, a QEP should be consulted to inform planning and design. If possible, locate new trails in degraded areas where there are opportunities to restore natural areas and/or enhance connectivity.

What to Know: Some existing trails may have been developed without the needs of wildlife in mind. As our knowledge of local biodiversity increases, existing trails should be re-evaluated to determine if they are optimally located and meet management objectives for recreation and wildlife. Based on these assessments, existing trails can then be designated for upgrades, rerouting, or decommissioning.

Design Guidelines:

- ☑ Minimize the amount of disturbance when developing trails to reduce the zone of influence. Locate construction staging away from habitat areas
- ☑ Locate trails in areas along which vegetation can be used to visually and acoustically reduce the impacts of human presence on biodiversity in adjacent habitat. Plant barrier vegetation (e.g., salmonberry) along trail edges to help keep trail users on trails and limit disturbance in off-trail areas. Where possible, establish low growing plants within 1m of the trail to maintain sightlines and access.
- ☑ Integrate zigzag patterns and undulations into trails that bisect natural areas to minimize long sightlines that could result in more frequent disturbance to wildlife.
- ☑ Interesting, engaging trail experiences can deter off-trail activity. Design the trail to take advantage of topographic and biological variety. Use existing variations in the landscape such as ridge crests or the edge of benches versus long straight sections.
- ☑ Evaluate existing trails located in sensitive areas to determine if preferred alternate routes are viable.
- ☑ Decommission informal trails to minimize access and disturbance. Restore habitat to dissuade future use and improve natural connectivity.

- ☑ Avoid trail construction that results in small pools of water within and alongside the trail. These can act as "ecological traps" that amphibians will lay eggs in, only to

DID YOU KNOW?

Trail use can cause a variety of disturbance events that will affect wildlife in different ways. Even short periods of disturbance can have significant effects. Potential effects include:

- **Behaviour** – Disturbances may alter how wildlife feeds, rests, moves, or interacts.
- **Physiology** – Disturbances can cause stress and result in additional energy expenditures, which can be detrimental at certain times of the year (e.g., when food resources are limited or during adverse weather).
- **Reproduction** – Disturbances can affect reproductive success and the ability to raise young.
- **Predation** – Disturbances can result in wildlife fleeing and/or abandoning young, which increases the risk of predation.

Charles Richardson Nature Reserve
Credit: Pamela Zevit

have them dry up too early in the year, or where they can easily be disturbed by off trail humans and dogs.

Co-benefits of Trails:

- ☑ Provide recreation opportunities.
- ☑ Improve health and wellness.
- ☑ Provide carbon storage when the trail is integrated within the GIN.
- ☑ Provide refuge from the heat island effect if integrated within a conserved greenbelt or forest that may otherwise be developed.

FURTHER READING:

Trails for People and Wildlife.[3]
Planning Trails with Wildlife in Mind.[2]
Wildlife and Trails Checklist[5]

7.2 WILDLIFE FRIENDLY ENGINEERING

Overview

Wildlife-friendly engineering solutions balance accessibility and biodiversity through low-impact engineering. The intended use of the trail and the habitat characteristics will determine the types of engineering solutions that are most appropriate for each project.

Key Considerations:

- ☑ Consider alignment alternatives that will avoid the need for engineering solutions. Engineering solutions are most likely needed at stream crossings and through wetlands.
- ☑ Carefully choose locations for stream crossings to avoid impacts to mature trees and to minimize the number of crossings required.
- ☑ Use foot bridges instead of culverts wherever possible to minimize in-stream work and potential impacts to streams. Select crossing locations to minimize clear-span distances required for foot bridges.
- ☑ Consult a Qualified Environmental Professional to delineate environmentally sensitive areas (e.g., wetlands) and identify drainage patterns to guide trail alignment and design decisions.

7.2.1 TRAIL SURFACING

Soil is important in that it supports plant growth and a diversity of soil organisms, in addition to providing a variety of other benefits to people (e.g., rainwater absorption and filtration, flood prevention). Because trail construction can potentially alter soil structure and change drainage patterns, particularly in sensitive areas such as wetlands, there can be significant effects to biodiversity which must be considered. The City has different trail surfacing specifications depending on the type of trail; these Biodiversity Design Guidelines focus on retention of native soil.

Design Guidelines:

- ☑ Keep native soil in situ where possible.
- ☑ Maintain existing drainage patterns.
- ☑ Maximize permeability in trail surfaces. Choose porous surfacing materials (e.g., organics, mulch) or install elevated boardwalks in sensitive areas where soil compaction and drainage are concerns.
- ☑ Avoid potential for erosion by locating trails on existing grades (i.e., avoid sidecutting on slopes) and planting exposed surfaces.

Choosing the Right Tread Surfacing Materials:

- ☑ Will the tread material cause soil erosion or compaction?
- ☑ Will it cause root zone damage to existing trees?
- ☑ Will the surfacing negatively impact water quality or health of the ecosystem?
- ☑ Is it appropriate to use a natural material such as bark mulch or crushed rock?
- ☑ What is the right balance between biodiversity and accessibility?

42C Greenbelt, Surrey
Credit: City of Surrey

- ☑ Minimize the trail footprint and amount of ground and vegetation disturbance.
- ☑ Minimize ground compaction and rutting during trail construction and maintenance by working in dry conditions, limiting ground contact, and using low-impact machinery (e.g., tracked equipment; flotation tires), wherever possible. Use of geotextiles and organic mulch may be considered to disperse weight loads and minimize impacts to trees and soil.

7.2.2 FOOT BRIDGES

Foot bridges are a replacement for culverts and other engineered drainage systems that can cause ground and hydrologic disturbance in riparian, wetland, and aquatic habitats. By spanning from top of bank to top of bank, impacts to the stream channel and aquatic habitat can be avoided. Remember that trails should generally be routed to avoid environmentally sensitive areas and limit potential disturbance to wildlife.Foot bridges should be installed only where trail access is considered essential and based on an assessment by a Qualified Environmental Professional.

Design Guidelines:

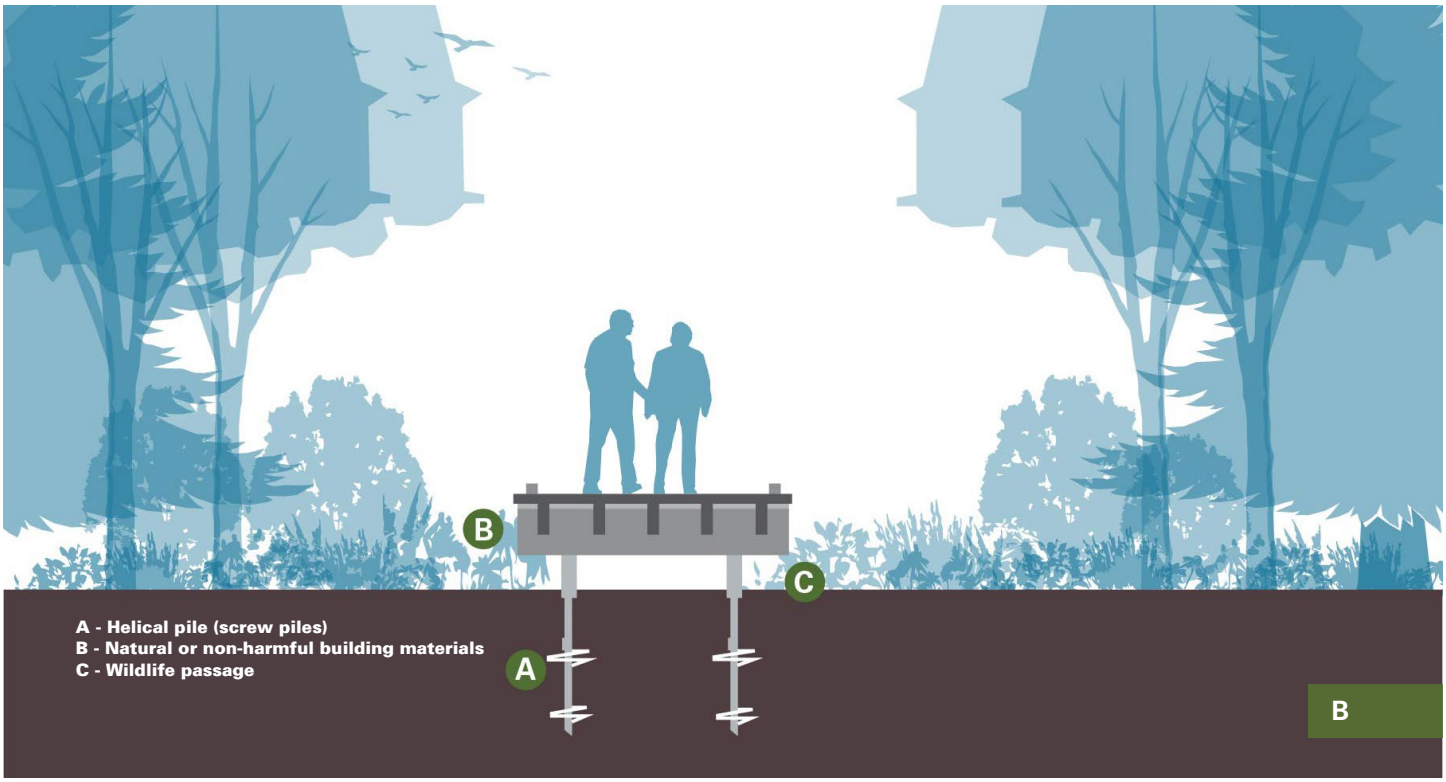
- ☑ Select building materials that will not negatively impact water quality. Natural materials like wood are best.
- ☑ Minimize the footprint through site-specific design, placement, and construction practices. Limit the amount of ground and vegetation disturbance to only what is necessary.
- ☑ Time construction within appropriate windows for fish, birds, and other species.
- ☑ Prefer clearspan bridges over pilings and culverts. If clearspan bridges are not an option, minimize pilings.
- ☑ Ensure that the height and placement of footbridges allows for wildlife passage and does not act as a barrier to movement. Sufficient freeboard should be provided to allow movement for terrestrial species adjacent to water. Bridge length should be increased and elevated benches constructed to allow passage of terrestrial wildlife during periods of highwater.
- ☑ Limit the amount of vegetation shading through appropriate design and placement.
- ☑ Minimize use of angular rocks or rip-rap and prefer smoother surface material instead. Large, angular rocks can trap and/or limit movement of amphibians.
- ☑ Retain existing habitat features (e.g., rocks and downed wood), where possible.

7.2.3 ELEVATED BOARDWALKS

Elevated boardwalks allow circulation through environmentally sensitive areas, often wetlands, with minimal disturbance to the habitat. Remember to avoid routing trails through environmentally sensitive areas as a first option; follow biodiversity design guidelines if access is required in these areas to protect wildlife, water quality, and other ecological functions.

Design Guidelines:

- ☑ Select building materials that will not negatively impact water quality and habitat health (natural materials like wood are best, but avoid unnecessary use of wood products treated with toxic chemicals).
- ☑ Use helical piles (screw piles) when building elevated boardwalks to minimize ground disturbance[7] and other potential impacts (e.g., leaching of wood preservative)[8] on the ecosystem.
- ☑ Maintain adequate freeboard to permit wildlife passage under and/or over boardwalk.
- ☑ Choose short, direct pathways that disturb the least amount of area.
- ☑ Avoid compacting soils and altering existing drainage patterns and water flow.



A - Fig. 2: Foot Bridge
B - Fig. 3: Elevated Boardwalk

CASE STUDY

Colebrook Park,

Surrey, BC

A new loop trail was constructed in Colebrook Park. Part of the trail required specific trail construction designs that addressed site-specific concerns within a sensitive forest wetland. These concerns included standing water, soil moisture, construction access, maintenance accessibility, and trail construction and maintenance costs. This habitat is also associated with Federal Species at Risk including Western Toad, Northern Red-legged Frog, and Olive-sided Flycatcher.

Control points were selected to avoid ecologically sensitive swamp habitat that would be prone to potential disturbance from pedestrian and dog traffic. Elevated, small-footprint boardwalks were constructed in wetter areas using galvanized groundscrews and pressure treated wood decking. The groundscrews require no excavation work and are specially designed to minimize disturbance to soil, vegetation, and hydrology. Drier portions of the trail alignment through immature coniferous forest were constructed to City of Surrey trail design standards.

Credit: Pamela Zevit

CASE STUDY

Blackie Spit,

Surrey, BC

A raised boardwalk was constructed in 2020 to provide improved beachfront access through a coastal sand ecosystem in Blackie Spit Park. A boardwalk was selected as the best approach due to the constraints of installing a gravel path on an environmentally sensitive coastal area that is prone to high tides and erosion. Coastal sand ecosystems are an interface between upland forest habitats and marine nearshore and intertidal zones. These unique ecosystems support a diversity of plant and wildlife species, and are particularly important for waterbirds and migratory songbirds. Blackie Spit is one of the top bird watching areas in Canada, with hundreds of species of birds recorded each year. Development and human activity has resulted in habitat loss and disturbance; Habitat preservation is important to protect rare plant communities and Provincial Species at Risk such as Silky Beach Pea (*Lathyrus littoralis*), Yellow Sand Verbena (*Abronia latifolia*), and Streaked Horned Lark (*Eremophila alpestris strigata ssp.*).

The boardwalk was designed and built by the City of Surrey in response to the request of the Crescent Beach Property Owner's Association for improved accessibility. Semiahmoo First Nation and environmental stewardship groups, including Friends of Semiahmoo Bay Society and White Rock Surrey Naturalists, were consulted. The final design featured a small footprint boardwalk that is 107m long, 1.5m wide, and ranges 0.15m to 0.25m above the ground. Like most modern boardwalks in the City of Surrey, the design featured environmentally friendly steel helical ground screws (1600mm in length and 76.10mm in diameter), which resulted in minimal ground disturbance. The boardwalk will protect existing natural areas by encouraging pedestrian and dog traffic to keep out of the environmentally sensitive area, while also providing future opportunities to restore this unique and sensitive ecosystem.

Credit: City of Surrey

7.2.5 TRAIL LIGHTING

Overview

Lighting should be sensitive to the surrounding environment, particularly in highly natural areas such as nature preserves and urban forests. Most parks are typically closed to the public after dusk, eliminating the need for lighting; however, multi-use pathways and other related infrastructure within and adjacent to parks and the City's Green Infrastructure Network may require biodiversity-sensitive lighting to minimize disturbance.

Key Considerations:

- ☑ Lighting should be considered on trails that are primarily used for commuting and transportation. Limited or no lighting is recommended on nature trails and on trails through sensitive environmental areas.
- ☑ If lighting must be provided, make sure that the level of light is appropriate.
- ☑ Avoid illuminating aquatic habitats.
- ☑ More light is not necessarily better and care must be employed to ensure that the light levels are right for the circumstances and commensurate with the risk and fear of crime.
- ☑ Lights that can be dimmed when less illumination is required should be used.
- ☑ When lighting is installed make sure it only illuminates the area it is intended for.
- ☑ Use long-wave (> 560 nm) light and avoid white LEDs with reduced or filtered blue, violet and ultraviolet wavelengths.[10]

Co-benefits:

- ☑ Reduces light pollution.
- ☑ Increases energy saving potential.
- ☑ Reduces Greenhouse Gas Emissions (GHGs).
- ☑ Increases visibility by reducing glare.
- ☑ Reduces exposure to night lighting which can decrease health risks and sleep disorders.

DARK-SKY PROGRAM

The Royal Astronomical Society of Canada (RASC) Dark-Sky Program identifies key locations to gaze at the stars; it also helps to educate the public about how poor outdoor lighting contributes to obscuring the stars in the night sky.[9] Dark-Sky Preserves have been established across Canada, including one in B.C. at McDonald Park east of Abbotsford.

FURTHER READING:

Guidelines for Outdoor Low Impact Lighting for RASC Dark-Sky Protection Programs.[9]

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