



Spring 2021 | The City of Providence

PESTICIDE AND CHEMICAL FREE MANAGEMENT PRACTICES



PROVIDENCE
PARKS + RECREATION
play · relax · explore



SUSTAINPVD
CITY OF PROVIDENCE | MAYOR JORGE O. ELORZA

Acknowledgements

This document was prepared by Samatha Kronyak of the Audubon Society of Rhode Island with support from the City of Providence's Office of Sustainability, Healthy Communities Office, and Parks Department. It was funded by a grant from Healthy Babies Bright Futures.

The Audubon Society of Rhode Island, established in 1897, is an independent, not-for-profit environmental organization. Audubon's mission is to protect birds, other wildlife and their habitats through conservation, education and advocacy for the benefit of people and all other life. Audubon protects nearly 10,000 acres of wildlife habitat, reaches over 20,000 students each year with environmental education programs, and has advocated for strong environmental protection for over 100 years.

Healthy Babies Bright Futures (HBBF) is an alliance of nonprofit organizations, scientists and donors that designs and implements outcomes-based programs to measurably reduce babies' exposures to toxic chemicals in the first 1,000 days of development. We bring together the strongest and latest science, data analysis, critical thinking, performance measurement, campaign talent, communications skills and commitment to collaboration. We deploy those assets across all of our work.

(Cover, clockwise from top) Vegetated bioswale photo courtesy of the Stormwater Innovation Center, Roger Williams Park satellite image courtesy of Google Maps, Edible Forest Garden photo courtesy of Lee Ann Freitas, Fagnoli Park photo courtesy of Providence Parks Department, Tree pruning photo courtesy of Doug Still. (This page) Edible Forest Garden photo courtesy of Lee Ann Freitas

Contents

6	Urban Parks: Benefits and Threats
7	Benefits of Urban Parks
7	Environmental Health Benefits
8	Mental Health and Community Benefits
10	Threats to Urban Parks
10	Chemical Heavy Land and Water Management
12	Toxins in Playground Equipment
14	Best Management Practices in Providence Parks and Beyond
15	Best Practices for Land Management
15	Integrated Pest Management (IPM)
19	Organic Land Management (OLM)
22	Best Practices for Water Management
22	Structural Methods (Green Infrastructure) of Stormwater Management
24	Non-Structural Methods of Stormwater Management
26	Management of Ambient Lakes and Ponds
28	Best Practices for Design and Maintenance of Public Parks and Playgrounds
28	Safe Playground Materials
30	“Greening” of Playgrounds and Public Parks
32	Chemical-Free Turf Fields
34	Urban Forests
36	Community Partnerships
37	Workforce Development
38	Best Management Practices Summary Chart
44	Appendix 1: Health Information Related to Mothers and Children
45	Appendix 2: Relevant Legislation, Rules and Regulations
46	Appendix 3: The Central Park Conservancy Turf Management Plan
47	Appendix 4: Additional Resources
48	Works Cited

Executive Summary

Urban parks have profound benefits to the physical and mental health of residents of all ages and contribute significantly to the overall health of the environment. The safety of the nation's urban parks is threatened by chemical-heavy land management practices, including the use of toxic pesticides and the over-application of fertilizers that are carried as runoff into our nation's waterways. In urban environments, where parks see high levels of use, the possibility of elevated levels of exposure to toxins can be a threat to the health of visitors. The City of Providence's Parks department has gone to great lengths to minimize such exposure by reducing, and in many cases, eliminating the use of toxins.

Burnside Park.
Photo courtesy of GoProvidence.com

The intention of this document is to compile sustainable practices in urban parks so that the Parks Department can institutionalize and expand their best management practices. Documenting this work helps inform future management decisions as Providence continues to develop state-of-the-art practices that reduce or eliminate the need for harmful pesticides and chemicals.

The Providence Parks Department is continually taking steps towards a chemical-free future and currently utilizes several environmentally preferable methods of management. The department does not use pesticides as a regular part of their treatment plan for any parks or playgrounds in the City. They are only used sparingly as a last resort option. In the case of the Roger Williams Botanical Center, no pesticides are used and Integrated Pest Management techniques have been implemented with great success. Materials for renovations and upgrades to Providence parks and playgrounds are sourced from companies that focus on recyclable, natural and non-toxic materials. This work is done in collaboration with over 50 park friends groups, conservancies, and neighborhood associations. In the future, management of the turf fields within Roger Williams Park will be dictated by a comprehensive turf management plan that emphasizes soil health and maintenance of fields based on their level and type of use.

The Providence Parks Department, including the Botanical Center and the Forestry Division, continue to make environmentally preferable choices to the extent they are able to while working within the confines of budget, staffing and feasibility. Based on research that included extensive interviews of Parks Department staff, as well as best practices from across the county, the below recommendations will help build on this foundation.

Recommendations



1) Continue to minimize pesticide use on all land owned by the City and codify such practices

Although used infrequently and minimally, the Parks Department does use pesticides when deemed necessary. The City keeps an inventory of what pesticides, including herbicides, insecticides and rodenticides, are used in the City and when and where they have been applied. Integrated Pest Management should be the primary method of pest control used by the Parks Department, with pesticide training focusing primarily on IPM techniques.

The City should also ensure all lands owned by the City adhere to Environmentally Preferable Practices of the Parks Department. Triggs Golf Course is one

example of a property for which the City acts as a landlord. The golf course is not required to adhere to the same practices as the Parks Department. It is unknown to what extent chemicals are being applied on the property. The City should consider including such standards in future leases or other agreements with those responsible for managing City-owned land.

The Botanical Center is an excellent example of the success of a no-pesticide policy and can serve as a model for the rest of the Parks Department as they continue to move towards more integrated pest management and organic land management techniques. Additional training on pollinators and beneficial insects would also be a useful addition to the Parks Department's training. The use of pesticides, even if infrequent, undermines the ability of beneficial insects to naturally control pests.



2) Minimize chemicals used in ponds

The lakes and ponds in Roger Williams Park are routinely treated with herbicides that make the water unsafe for humans and wildlife alike. Non-chemical means of controlling algae and aquatic weeds in the park should continue to be explored. Mechanical removal of weeds and the use of Galerucella beetles to control for purple loosestrife have both been mentioned and should be explored further.



3) Reduce the use of synthetic fertilizers on private and other non-City owned property

The Parks Department leads by example, managing its green spaces without the use of synthetic fertilizers. The City should take steps to promote the reduction of the use of synthetic fertilizers citywide. For example, a "Chemical Free" lawn campaign could help reduce the use of synthetic fertilizers by homeowners. Nutrient heavy fertilizer runoff affecting Rhode Island's waterways and making its way to the ocean is a substantial threat to residents and wildlife. New Jersey's Fertilizer Law restricts the time of year that residents can apply fertilizer containing Nitrogen and Phosphorous,

something similar can be considered for Rhode Island. Restricting the use of these types of fertilizers will reduce the likelihood of polluting nutrients reaching waterways.



4) Ensure the safety of all playgrounds in the City

The Providence Parks Department executes a near continuous schedule of upgrades and repairs to its parks. New playground equipment is sourced from companies that value environmentally friendly and safe materials and practices. The example set by the Providence Parks Department should be extrapolated to include all outdoor recreational, educational and food production space owned by the City, holding every natural space to the same high standard. Schools will benefit from certification of School or City staff as playground safety inspectors.



5) Promote community education and outreach

The Providence Parks Department is on the cutting edge of implementing environmentally friendly practices. Providence Parks should showcase their best management practices to the public. Spreading information about the steps Providence Parks is taking to minimize the use of pesticides should be done to increase awareness and encourage more residents and other landowners to eliminate the use of pesticides on their properties. Innovative best management practices such as the weed-eating goats at the Botanical Center can be highlighted on social media, peaking the public's interest for non-chemical techniques as well as recruiting much needed volunteers for the program.

A "Chemical Free" homeowner campaign can be a creative way to engage the public in adopting Best Management Practices on their own property. Homeowners who do not treat their lawns with pesticides and synthetic fertilizers are able to display signs that their property is chemical free, bringing awareness to the neighborhood and reducing the number of residents using lawn chemicals.



URBAN PARKS: BENEFITS AND THREATS

Over 80% of Americans now live in cities.¹ In this rapidly urbanizing world, humans are increasingly disconnected from the natural environment. This makes urban parks critical to accessing the physical and mental health benefits of spending time outdoors and connecting with nature. Most standard park management practices nationwide threaten the safety and health benefits of urban parks by using chemical-heavy land and water management practices and toxic building materials. Such practices are not only a threat to the parks, but they pose dangers to the people who use these spaces, especially young children and mothers. They also have cascading impacts on the broader environment, such as polluting our waterways and threatening key species like pollinators.

Photo courtesy of the Stormwater Innovation Center

Benefits of Urban Parks

Why do urban parks matter?

Access to urban parks can greatly increase the quality of life for city residents as well as support the local economy and environment.



Environmental Health Benefits

Urban green spaces reduce the impacts of climate change and urban pollution by providing air, water and soil purification, noise reduction and city cooling. Access to city parks encourages regular physical activity and protects residents from excessive heat and pollutants, fostering good health and wellbeing. Of the roughly 180,000 residents in the city of Providence², 98% of the city's population lives within a 10 minute walk of a park and 10% of the land in Providence is public park space. The abundance and accessibility of public park space in the city helps ensure all residents have access to their benefits.

1) Increased Physical Activity

Creation of, or better access to, places for physical activity such as urban parks, combined with informational outreach, resulted in a 48.4 percent increase in the frequency of physical activity among adult residents.³ Regular physical activity has the potential to reduce or prevent obesity and other chronic diseases such as diabetes, heart disease and respiratory illness, as well as encouraging a healthy and active lifestyle. Green spaces have also been linked to overall lower mortality and disease.⁴

2) Cooling Urban Areas

Trees and plants help cool the environment, making urban parks and green spaces an effective tool to reduce the "urban heat island effect," a phenomenon where the temperature inside cities is significantly higher than surrounding rural areas. The urban heat island effect leads to an increase in heat related illnesses, higher air pollution and greenhouse gas emissions, as well as higher energy costs. Urban

green areas can increase the amount of shade, reflecting radiation from the sun, and decrease the amount of pavement, thereby reducing heat retention and providing a cooling effect.⁵ The cooling effect of one tree is up to 3.6.⁶

3) Improve Air Quality

Trees and vegetation filter air contaminants. The presence of trees and green spaces in residential areas has been linked to lower exposure rates to air pollution in residents.⁶ A study done by The Nature Conservancy estimates that particulate matter in the air will result in around 6.2 million deaths each year by 2050.⁶ The presence of trees and green space not only benefits the environment, but has the potential to cut down on respiratory and other illnesses among the population, leading to a cleaner and healthier city. The average reduction of particulates near a tree was between 7% and 24%.⁴



Green spaces
have also been
linked to overall

lower

mortality
and disease⁴

4) Protection from Harmful Radiation

Excessive exposure to ultraviolet (UV) radiation can result in skin cancer. Tree leaves can absorb about 95% of ambient UV radiation, making urban parks and city trees effective tools in protecting the community and reducing the occurrence of skin cancer in residents.⁷

5) Reduce Stormwater Runoff

The high percentage of impervious surfaces found in urban areas result in a large amount of runoff from rainfall events. Urban stormwater runoff can carry contaminants such as chemicals, oil, animal waste and plastic through cities and into water bodies, creating health and environmental hazards. Stormwater management structures as well as natural structures like plants and trees can be an effective tool to help remedy this problem by redirecting runoff, cleaning stormwater and re-purposing it, reducing overflow events and preventing contamination of surface waters.

Mental Health and Community Benefits

Regular contact with nature has been proven to decrease stress and depression as well as increase mental wellbeing. The presence of urban parks and green spaces increases community engagement, reduces crime and increases the local economy by creating jobs and attracting businesses and residents.



There is a

33%

higher chance of diagnosed depression in neighborhoods with a low percentage of green space⁸

1) Provide Quiet Places for Mental Well-Being

Urban parks provide space for community members to find a reprieve from city noise, busy streets, and the overstimulation of city living, all of which can lead to chronic mental fatigue. According to the National Recreation and Park Association, individuals in greener neighborhoods report higher life satisfaction and there is a 33% higher chance of diagnosed depression in neighborhoods with a low percentage of green space.⁸ For more information on the beneficial effects of parks on mothers and young children see Appendix 1.

2) Build Community

The Trust for Public Land found that residents of neighborhoods with more green spaces benefit from stronger social ties and better community development, and neighborhoods with shared green spaces like community gardens show more stability over time and lose fewer residents.³

3) Support the Local Economy

The presence of urban parks and green spaces can also increase the local economy by attracting residents and businesses and increasing property value.



The average reduction of particulates near a tree was between

7% and 24%⁴

Threats to Urban Parks

What factors are threatening the safety, development, and management of urban parks?

Park management practices can threaten the safety and health benefits of urban parks by using chemical-heavy pesticide and fertilizer treatments. Individuals may be unnecessarily exposed to toxins that have been applied directly to the surface of plants and the ground, drifted from nearby fields that have been treated, or are leaching from dangerous building materials.

Chemical Heavy Land and Water Management

The use of pesticides (herbicides, insecticides, rodenticides, and fungicides) to maintain parks, playgrounds and other green spaces exposes humans to harmful toxins. This is especially true in high-traffic areas like city parks where exposure rates can be much higher and more frequent. According to the EPA's "Pesticide Industry Sales and Usage 2008-2012 Estimates," over 1 billion pounds of pesticides are used annually in the U.S., with 11% being used for non-agricultural purposes in places like homes, parks, playing fields and playgrounds. For more information on pesticide use legislation in Rhode Island see Appendix 2.



1 billion

pounds of pesticides are used annually in the U.S., with 11% being used for non-agricultural purposes in places like homes, parks, playing fields and playgrounds.

1) Effects on Human Health

The most common pesticides used on playing fields are glyphosate, 2-4,D, and neonicotinoid insecticides.⁹ In 2015, both glyphosate and 2-4,D were classified as human cancer-causing agents by the World Health Organization, and have also been linked to disruption of the endocrine system.¹⁰ For more information on how pesticide exposure effects children and the reproductive system see Appendix 1. There are a number of potential exposure points between pesticide use and at-risk populations. Pesticide drift can threaten communities near agricultural areas, contaminating areas far beyond the application site. Landscapers, farmers and laborers working in areas that have been treated are also at risk for major pesticide exposure due to touching residue left on plants or soil, or due to pesticide drift. Pets are also at risk for pesticide exposure. Dogs have a 70% higher chance of developing canine lymphoma after being exposed to herbicide treated lawns.¹¹

2) Effects on Wildlife

Neonicotinoids, a type of potent neurotoxin, are the most widely used insecticides in the world. They are believed to be a major contributor to the decline



672

million birds are exposed to pesticides annually, and around 10% of these birds will die from the exposure.¹²



1

single kernel of corn coated in a neonicotinoid is enough to kill a songbird.¹²



Since 2006, honeybee populations have decreased

29-36%

a year, with many researchers linking pesticide exposure to honey bee population decline and colony collapse disorder.¹³

of pollinators and other beneficial insects and have had detrimental effects on bird, bat and amphibian populations. They have high water solubility and there is a high likelihood of these chemicals leaching into the soil as well as surface water and ground-water sources where they can lead to off-target contamination.¹²

Non-human mammals are most commonly affected by pesticide exposure indirectly through water contamination and runoff or as the result of consuming prey that has been contaminated or exposed to pesticides. Rodenticides can lead to poisoning and death of owls, cats, dogs, weasels and countless other mammal species through secondary poisoning. Pesticide runoff can negatively affect aquatic species including dolphins, seals and whales.

3) Effects on Water

Pesticides and fertilizers have impacts that reach far beyond their application site. Pesticides can drift from the area they were initially sprayed, be lost to accidental spillage, or move through the soil into groundwater.¹⁴ Synthetic fertilizers are prone to leaching through the soil and being carried as runoff where they commonly wind up polluting groundwater and nearby waterways.

Fertilizers are an often overlooked source of chemical input in our public parks and playing fields. Although neither are toxic, both inorganic and organic fertilizers can pose a threat to health and the environment if used incorrectly.¹⁶ When they enter water bodies, fertilizers can cause naturally occurring algae to grow in abundance, causing algal blooms. Some algal blooms contain toxic cyanobacteria. In fresh water, algal blooms are generally caused by an excess of phosphorus, while in estuarine and ocean water, nitrogen is the problem pollutant.



Pesticides were found in one or more water samples from every stream sampled, more than

90%

of the time.¹⁵



Toxins in Playground Equipment

Common materials used to construct playground equipment and playground surfacing may leach toxins into the environment and onto children's hands and bodies where they can easily be ingested or absorbed. Toxins that have more recently been banned for use in playground equipment may remain present in playgrounds with older equipment.

1) Rubber Playground Surfacing

The use of recycled tires to surface playgrounds and athletic fields is increasingly popular and is used to make rubber tiles, poured-in-place surfacing, loose rubber mulch and synthetic turf fill. From 2005-2015 the amount of ground tires used in U.S. playgrounds rose from 19,000 to around 225,000 tons.¹⁷

The crumb rubber filling used in artificial turf fields may contain unsafe levels of toxic compounds including heavy metals such as lead and zinc, as well as polycyclic aromatic hydrocarbons (which are known human neurotoxins), and Benzene (a carcinogen). These compounds can easily be ingested, inhaled through vaporization or come into contact with the surface of the skin. Some polycyclic aromatic hydrocarbons vaporize even at room temperature, making them much more likely to be inhaled.¹⁸

2) Lead Paint on Equipment

Lead is listed in the top 10 "chemicals of major health concern" by the World Health Organization and according to the CDC there is no safe amount of lead that children can ingest. For more information on the risks of heavy metal exposure in young children and pregnant mothers see Appendix 1.

On playgrounds that have not been maintained regularly or upgraded, lead paint may still remain and can deteriorate into toxic paint chips and dust that can be easily ingested or inhaled. Lead from

external sources, such as older houses nearby that are coated in lead paint, may linger in the soil. Testing by the U.S. Consumer Product Safety Commission concluded that many school grounds and public playgrounds contain metal and wood equipment that present a lead paint poisoning threat.¹⁹

3) Pressure-Treated Wood

Wood used to construct playground equipment is often pressure treated with toxic chemicals and preservatives to prevent damage from insects, mold, and other fungus. This can pose a serious health threat to children and families touching and playing on these treated wood surfaces.

One of the most common chemicals used to treat wood is an Arsenic compound, Chromated Copper Arsenate (CCA).²⁰ Arsenic is a known carcinogen and Chromated Copper Arsenate continually leeches arsenic to the surface of the wood where it is easily absorbed through the skin or through hand-to-mouth contact.²¹ In 2004 CCA was banned from use on playground wood, however many playgrounds still have older structures in place that were constructed with chemically treated wood and it remains an issue of concern.²¹

Wood chips used as ground cover and mulch in parks and playgrounds may also be of health concern if the original wood source is not known. Chipping or mulch that was made from recycled wood may have originated from chemically treated wood.



From 2005-2015 the amount of ground tires used in U.S. playgrounds rose from 19,000 to around

225,000

tons.¹⁷



BEST MANAGEMENT PRACTICES IN PROVIDENCE PARKS AND BEYOND

The need to balance effectively managing public parks and limiting environmental and human health impacts has led to the development of Best Management Practices, or BMPs. Cities and towns across the country are using BMPs to maintain municipal lands in a way that supports their community's needs while limiting exposure to toxins, heavy metals, and other pollutants. Cost and feasibility of practices must always be taken into account. A best management practice for a community may not always be a complete elimination of the "bad" management practice, but a mix between conventional and environmentally preferable options, or simply taking steps to minimize use of traditional chemical heavy methods.

Best Practices for Land Management

Many communities are effectively controlling pests and weeds and maintaining attractive lawns, fields and landscaping by using Best Management Practices (BMPs) to minimize the effects of toxins on the environment and human health. Integrated Pest Management and Organic Land Management methods are considered to be the most environmentally preferable options when it comes to land management.



Integrated Pest Management (IPM)

Integrated Pest Management is a method of pest control utilizing least-risk and low-impact options with the goal of more closely mimicking natural processes. Integrated Pest Management is an umbrella term that may include any number of low-toxicity/non-toxic techniques. Traditional chemical pesticides can be a part of an Integrated Pest Management plan but are considered a last resort. When they are necessary, they are used carefully and minimally to reduce impacts on human health and the environment.

1) Prevention

Prevention is a critical first step in an effective Integrated Pest Management program. Prevention works by eliminating conditions that attract pests, including standing water, cracks in walls, food crumbs and overgrown vegetation. Monitoring areas and being familiar with common pests and vulnerable areas are important steps in developing appropriate management actions. A threshold level should be established and action should only be taken if a maximum threshold for pest infestation is reached. These steps are critical in determining if action should be taken and reducing the need for pesticide treatments.

Best Practices

- Monitor the spaces for threshold levels on a routine basis and scout for potential pests. Monitoring is an integral part of the IPM program of the Botanical Center. Once a threshold has been met at the Botanical Center, a 'knock down'

method of removing pest problems enacted before biological controls are introduced.

- Prevent pests inside and around buildings by eliminating conditions that attract pests and removing unhealthy or infected plants.

2) Biological Control

The use of beneficial insects or other microorganisms to manage pests is known as Biological Control and it can be highly effective for reducing the need for pesticides and supporting a healthy environment. Pest populations can be reduced by introducing natural predators into the environment to control populations of destructive or invasive insect pests or weeds. Eliminating the use of pesticides can also support existing populations of beneficial insects.

Best Practices

- Several biocontrol controls are used at the Botanical Center. The Center introduces beneficial insects to manage pest insects that are scientifically lab tested for safe use and approved by the USDA for use as a biologic control. When possible, the Center uses insects native to New England such as green lacewing, (*Chrysopa* sp.) and the convergent lady beetle, (*Hippodamia* sp.). Other insects, such as the mealybug destroyer, (*Cryptolaemus* sp.), is used to control specific pest species. The Botanical Center includes biological controls as part of the annual IPM budget and releases beneficial insects on a monthly basis.

- Nematodes are an important component of soil microfauna. They predate harmful grubs and larvae. Beneficial nematodes such as the *Steinernema* sp. are part of the biological control program at the Center and are applied to the soil to control whitefly. Beneficial nematodes can be applied directly to the soil, where they predate harmful grubs and larvae. Beneficial nematodes are applied to the soil in the flavor lab gardens of the Botanical Center to control for whitefly.
- Soil microfauna are important aspects of biological control. A common bacteria, *Bacillus* mosquito, black fly and fungus gnat larvae. *Bacillus thuringiensis* subspecies *israelensis* (Bti) is commonly sprayed aerially over bodies of water that are prime habitat for mosquito larvae, killing the larvae and successfully controlling mosquito populations.

3) Cultural Control

Cultural controls are physical actions taken to make the environment less desirable to pests thereby reducing their populations. Removing weeds, maintaining healthy plants and creating habitat for beneficial insects are all methods used to reduce pests without the use of chemical pesticides.

Best Practices

- Mechanical controls such as hand pulling weeds is one method used by the Botanical Center to control invasive plant species. Mulch is also used for weed suppression.
- Grazing animals as weed control.
- Maintain healthy plants: Healthy plants are less susceptible to disease and insect damage and native species are always preferable over non-native.

LEADING BY EXAMPLE

Roger Williams Park Botanical Center

Roger Williams Park Botanical Center is an exemplar for Integrated Pest Management within the Providence Parks system and the department aims to extrapolate their practices to the rest of Roger Williams Park.

Pesticides are used very rarely to treat plants in the Botanical Center. Instead, the Botanical Center has implemented a successful biocontrol program for managing insect pests without the use of toxic chemicals. Biological controls are defined more in depth on the previous page, under “2) Biological Control.” The biological control program relies on the release of beneficial insects to control populations of damaging pests, eliminating the need for pesticides. Director Lee Ann Freitas also maintains three goats that are housed at the, Botanical Center which are used as an innovative and chemical-free approach to weed and invasive plant control throughout Roger Williams Park.



The Botanical Center encourages a “natural is beautiful” mentality, encouraging visitors to accept the presence of insect pests (which are important food for beneficial insects) and to find beauty in the natural order of things. *Photo courtesy of Lee Ann Freitas*



Three goats are stationed at the Botanical Center gardens and are used as natural weed control by being allowed to graze, primarily in and around Roger Williams Park. The goats were also brought to the Waterman Street dog park in 2019 to reduce weed cover.

Photo courtesy of Lee Ann Freitas

4) Low-Toxicity Insecticides

Good integrated pest management programs use preventative, biological and cultural controls whenever possible; however there may be times when these methods are not enough on their own to control pests. In these cases, the lowest toxicity treatment is advised. Low-toxicity insecticides are often of biological origin derived from botanical chemical compounds. Soaps and microbes are also often considered low toxicity pesticides. It is important to note that all pesticides, including those considered low-toxicity and/or organic can have negative impacts to beneficial insects. When not used as directed, all pesticides can be harmful.

Best Practices

- Insecticidal soaps work on soft bodied insects and can pose a threat to pollinators when being applied; however once dry they leave no harmful residue.²² The Botanical Center's IPM routine includes a soap and water mixture that is sprayed

on plants affected by pests. A home-made soap and water mixture retains the insect control benefits while eliminating the risk of any additives that may pose a threat to beneficial insects and pollinators.

- Botanical insecticides are naturally occurring toxins derived from plants.²² The Botanical Center's IPM routine includes neem spray, which is a botanical insecticide derived from the neem tree. According to the University of Connecticut's Home and Garden Education Center, the active ingredient found in Neem oil (Azadirachtin) "has a very low toxicity to humans and animals although it is slightly toxic to fish and aquatic animals. It is of low toxicity to pollinators".²²
- Kaolin Clay is made up of finely ground clay particles that are mixed with water and applied to a plant's surface in a slurry. This natural insect repellent does not pose a health threat to bees but may disrupt movement and foraging of beneficial insects.²²

5) Conventional Pesticides

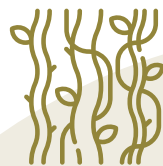
Conventional synthetic pesticides are always a last resort option in Integrated Pest Management and special care should be taken to minimize impacts to the environment and risks to health.

There is very little use of chemical treatments by the Parks Department and pesticides are not a part of the regular maintenance routine. Since 2017, Roundup (glyphosate) has been used three times with hand application. Once was to prevent Poison Ivy creep from reaching a children's play area, once to remove poison ivy from around a tree, and once to treat a pathway at a waterpark where hand weeding of this path would have destroyed the ground surfacing. Other instances of chemical treatments include:

- Preen herbicide is used as a preventative in some cases.
- Preen herbicide is used by the Botanical Center only on outdoor gravel pathways where it is not possible to hand pull weeds or manage the weed cover with other means.

- Treflan herbicide is applied to all fields when they are first installed by the contractor. Treflan is applied by the contractor, not the Parks Department.
- Beech and Hemlock trees outside the Botanical Center have been treated with pesticides in last case scenarios to preserve old, valuable and aesthetically important trees that are more susceptible to stress, disease and insect infestation.

The Rhode Island Department of Environmental Management (RIDEM) may aerial or target spray for mosquito control when there is an elevated risk for human disease. The pesticide used is Anvil 10+10 (Sumithrin), a synthetic pyrethroid (natural pyrethrins come from the chrysanthemum flower). While this pesticide is non-carcinogenic with low toxicity to humans, it is highly toxic to bees and other insects, fish and amphibians.⁴⁹ It is not known to what extent RIDEM manages for mosquitos in and around Providence Parks.



The University of Rhode Island (URI) has spearheaded several insect biocontrol projects.⁴⁸

These releases were not done specifically in any Providence Park but there is the potential that they have traveled to and are at work in Providence Parks, as many of the targeted invasive species are present in Providence. In 2017, URI received a permit to release a species of moth that acts as a biological control agent of swallow-worts. Releases were made in RI and MA in 2018. Data is currently being collected on the effectiveness of the release. In 2018, URI released 5,000 weevils to act as a biological control agent of mile-a-minute vine. In the same year, URI released 2,100 weevils that act as a biocontrol of knapweed. In both cases it is too early to know if the programs are successful.



The Edible Forest Garden at the Botanical Center includes native trees, shrubs and groundcover that produce food that can be enjoyed by humans and wildlife. This site is managed organically. *Photos courtesy of Lee Ann Freitas*



Organic Land Management (OLM)

Organic Land Management treats the ecosystem as a whole by reducing inputs of excess chemicals and water while enhancing biodiversity, soil health and natural biological cycles. It utilizes non-toxic, organic and low-impact methods similar to Integrated Pest Management. Unlike Integrated Pest Management, Organic Land Management does not allow for the use of traditional chemical pesticides or synthetic fertilizers and instead relies entirely on non-toxic methods of pest control.

1) “Right Plant, Right Place”

Planting the best native species with the optimal soil conditions for a given environment will help reduce the need for irrigation, fertilization and pesticides. The Providence Parks Department is implementing a plan to grow its own landscaping and decorative vegetation at Roger Williams Park. There are two greenhouses that were recently repaired in order to be used as a space where the park can buy seeds and cuttings and grow their own plants on-site. The park grew its own poinsettias for Christmas in

2019. Three gardens located at the Botanical Center are maintained organically by URI Master Gardeners and BC volunteers; native pollinator-friendly plants are included.

Multi-functional plants are not only ornamental, but also provide food for pollinators or humans, and habitat for beneficial insects and other wildlife.

2) Pest Control

Pest control under organic land management standards includes non-chemical Integrated Pest Management techniques such as prevention, low-toxicity insecticides and biological controls. Monitoring pest populations and disrupting reproduction by eliminating favorable conditions are key steps in ensuring pests are managed without the use of pesticides. In organic land management, the focus is on managing populations of pests rather than eliminating them, and ensuring a healthy, balanced ecosystem that can thrive without the use of pesticide treatments.

Organic land management can also include mechanical weed control including hand pulling and using grazing animals. The Botanical Center uses mechanical weed control as their primary method. The grazing goats are also housed at the botanical center and used primarily in Roger Williams Park; there is a desire to expand the goat grazing program in the future if more volunteers are recruited.

Best Practices

- Maintaining thick ground cover of turf, landscape plants, or mulch.
- Non-chemical IPM techniques such as scouting and biocontrol.

3) Soil Health and Fertilization

Both conventional and organic land management methods use fertilizers that have the potential to cause harm if used incorrectly; therefore it is essential to avoid over-application which can harm the soil and lead to runoff. Maintaining healthy soil reduces unnecessary use of fertilizers and pesticides and increases water retention. According to the Natural Resources Defense Council, “each 1 percent increase in soil organic matter helps soil hold 20,000 gallons more water per acre.”²³

Organic fertilizers like alfalfa, bone, and blood meal benefit both the target plant and soil health as a whole, and result in plants that thrive in the long-term. In partnership with the Master Gardeners, seaweed was added to the vegetable gardening demonstration garden (located in the Botanical Center) before and after the growing season to assure soil health and act as a sustainable method of fertilizer.

Best Practices

- Testing soil for pH, nutrient levels and organic matter content.
- Mechanical aeration can remedy compacted soil and increase grass growth.

- Good quality organic compost can help build communities of beneficial microorganisms in the soil.
- Leaving grass clippings in place will recycle nitrogen into the soil.

4) Water Conservation

A major component of Organic Land Management is the protection and conservation of water resources. Being mindful to conserve existing water supplies by reducing the need for excessive or unnecessary irrigation is key to successful water conservation. Great care should also be taken to protect existing water bodies from pollutants, including runoff that may carry toxins and high nutrient loads that are the result of the overuse of fertilizers. These pollutants can have harmful effects on waterways, making them unsafe for both humans and wildlife.

Best Practices

- Native plants grown in healthy, aerated soil will need drastically less water.
- Watering or irrigating early in the day can help prevent unnecessary water loss due to evaporation.
- Adding mulch around established plants and mowing grass “high” not only prevents weeds, but can also help to retain moisture.
- Irrigation systems must meet water efficiency standards and can be fitted with weather sensors to avoid irrigating in wet conditions and to adapt to changing temperature.

LEADING BY EXAMPLE



Composting Landscaping Waste in Providence Parks

The Parks Department is exploring options for expanding composting at Roger Williams Park and beyond. Currently, the first flush of leaves at Roger Williams Park every year is composted on-site, but additional space is needed for the rest of the season; the remaining leaves are taken to Rhode Island Resource Recovery. And while the Botanical Center collects organic matter for compost, this is also sent to Rhode Island Resource Recovery. The Parks Department hopes to revitalize and expand the composting area in order to use it to recycle landscaping waste into usable compost. The area will also be connected to water (watering 3 or 4 times a year) to allow for the faster creation of usable compost. In addition, the Roger Williams Park Zoo is working to build a compost facility that will be used by all of Roger Williams Park. This facility will compost animal manure from the zoo, vegetation and lawn trimmings, and horse manure from the Roger Williams Park mounted command.



Water Conservation in Roger Williams Park

All irrigation systems in Roger Williams Park are outfitted with rain sensors. In addition, hillsides in Roger Williams Park are not being mowed in an effort to help reduce runoff. The duff or “leaf” layer is sometimes left on the hillsides to also aid in runoff reduction, retaining soil nutrients and increasing habitat for pollinators. The Parks Department is striving for a combination of leaf mowing and better composting in the future.



Organically-Managed Community Gardens in Providence Parks

There are twelve (12) community gardens located in City parks. Pesticides are not permitted in any of these gardens and there is a community-gardener-in-residence who works with gardeners to provide assistance and support. The community garden located in the Roger Williams Park Botanical Center is maintained organically without the use of pesticides or herbicides. This includes a demonstration garden maintained in partnership with URI Master Gardeners. Over the 2018-2019 winter, two large garden beds in the display garden were left intact to provide natural habitat and ground cover for overwintering wildlife and insects and to provide seeds for the birds. The Roger Williams Park Produce Donation Garden, also in partnership with the URI Master Gardeners, utilizes techniques like compost amendment, scouting for pests and neem oil for pest control. Invasive species are not permitted to be planted as a food source. Pollinator plants are added to the garden to create a beneficial insect habitat.

Best Practices for Water Management

In a world that is increasingly threatened by extreme weather events such as heat waves, drought and floods,²⁴ making the most of natural rainfall events while placing controls for overflow and flooding are important best management practices. Protecting and preserving already existing natural water features are critical in maintaining a healthy water supply and well-balanced ecosystem.



Structural Methods (Green Infrastructure) of Stormwater Management

Structural methods of stormwater control are human-made features that are designed to treat stormwater runoff by filtration through plants, soil and other natural features which can infiltrate excess stormwater into the ground. Cities have a higher percentage of impermeable surfaces which leads to high amounts of runoff during a rainfall or storm event, making structural stormwater features an invaluable addition to communities wishing to protect and manage their water resources.

The Parks Department has become a leader in the state for installing and managing green infrastructure. Roger Williams Park is currently home to 36 structural controls for stormwater management. Most recently, the Parks Department helped establish the Providence Stormwater Innovation Center, which was created in a partnership between the Providence Parks Department, The Green Infrastructure Coalition, the Audubon Society of Rhode Island and The Nature Conservancy. The Center is located in Roger Williams Park and highlights the innovative work that the Parks Department and its partners



Two vegetated bioswales located in Roger Williams Park. Photos courtesy of the Stormwater Innovation Center

are doing to manage stormwater. The Center will also serve as a teaching and research facility. The Center's website features descriptions, photos, a map of stormwater structures, their locations and a spreadsheet with technical details.

Best Practices

- Bioswales allow water to flow through them, rather than pooling, and slowly filter into the sub-soil. They decrease sedimentation and the level of pollutants reaching waterways.
- Rain gardens or bioretention gardens can be planted in depressed areas in the landscape where runoff and stormwater naturally collect. Rain gardens can be planted with native vegetation to enhance habitat. There are several rain gardens in Roger Williams Park, as well as many other neighborhood parks, such as Woonasquatucket Adventure Park, Riverside Park, and Peace and Plenty Park. Many of these include interpretive signage.



Rain gardens are an example of bioretention, they work by allowing stormwater to pool on the surface and slowly infiltrate into the ground. These photos show two rain gardens located in Roger Williams Park. *Photos courtesy of the Stormwater Innovation Center*

- Infiltration basins receive and infiltrate stormwater through soil, storing runoff and allowing it to slowly filter and permeate into the ground.
- Tree box filters integrate street trees with stormwater treatment structures. The Providence Parks Department has partnered with Rhode Island DEM and the Woonasquatucket River Watershed Council to install tree filters on the Pleasant Valley Parkway. These tree box filters will provide shade, cooling and stormwater treatment, all while beautifying city streets and preventing pollutants from reaching the river.
- Permeable surfaces allow water to pass into the soil underneath, infiltrating water rather than allowing it to become runoff. Blackstone Boulevard is the most heavily used walking path in Providence. In fall of 2019, the Parks Department revitalized the northernmost section of Blackstone Boulevard with a permeable surface to help prevent erosion and runoff. Continued renovations are scheduled for 2020.



Infiltration basins use the natural filtration properties of soil to treat and infiltrate stormwater. *Photos courtesy of the Stormwater Innovation Center*

- Redirecting downspouts from gutters and rooftops bound for a storm drain towards a permeable area is a simple and cost friendly green infrastructure practice that can naturally infiltrate rainfall and prevent runoff.
- Rain barrels (above ground) and cisterns (below ground) can be used to collect rainfall which can then be used to water turf, landscaping or gardens.



Blackstone Boulevard walking path. *Photo courtesy of Blackstone Parks Conservancy*

Non-Structural Methods of Stormwater Management

Non-structural methods of stormwater management preserve existing water features and protect natural systems and infiltration areas. The Parks Department has made non-structural stormwater practices a key component of their management by striving to protect natural systems, incorporating landscape features such as buffers, managing leaf litter, and reducing the amount of impermeable surface present. The implementation of innovative techniques, such as keeping grass long on hillsides, speaks to the Parks Department's integration of stormwater management techniques into their broader management plans.

Best Practices

- Preserving natural infiltration areas can include restoring and maintaining natural buffer zones along waterways and wetlands or skipping the grass cutting on hillsides. These techniques hold soil in place, prevent runoff from reaching nearby sources of water, and allow for thick vegetation to grow naturally, aiding in infiltration. The Parks Department does not cut grass on the hillsides in Roger Williams Park, Mashapaug Park, Blackstone Park and parts of North Burial Ground in an effort to reduce runoff. Buffer plantings are in place in Roger Williams Park and many neighborhood parks.

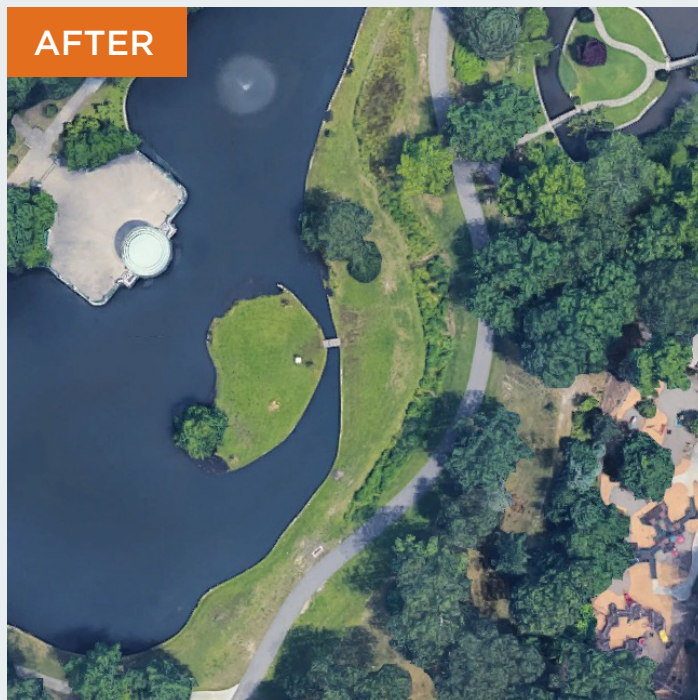


Buffer plantings in Roger Williams Park prevent pollutants from reaching the water and deter geese from lingering on the banks and entering the water.

Photos courtesy of the Stormwater Innovation Center

- Removing pavement decreases runoff and prevents pollutants from flowing into waterways. Pavement has been removed near Cunliff Pond and Elm Lake. Paved structures called flumes were installed to divert stormwater runoff to a bioretention area.
- Substituting native vegetation in place of non-native species decreases fertilizer and water needs while restoring the native landscape.
- Decaying organic matter such as leaf litter contributes significantly to nutrient loads of Phosphorus in urban stormwater.²⁵ Performing

regular street sweeping and cleaning leaf catchments reduce the amount of litter, debris and pollutants entering stormwater systems through runoff. Street sweeping is done by the Department of Public Works in Roger Williams Park and across Providence several times a year (at least four). This keeps leaf litter off the street, reduces the amount of nutrient-rich runoff, and helps keep leaf catchment basins from becoming overloaded.



These photos show the before and after results of pavement removal in Roger Williams Park. Removing pavement reduces runoff and prevents pollutants, including geese waste, from flowing into waterways and making the lakes unsafe for visitors and wildlife. A two lane road was reduced to just a bike and walking path in order to reduce the amount of pavement.

Photos courtesy of the Stormwater Innovation Center





Geese at Roger Williams Park. Photo courtesy of Providence Parks Department

Management of Ambient Lakes and Ponds

Maintaining healthy, clean water in ambient lakes and ponds involves managing both water quality and the watershed as a whole. Some of the most common goals of lake and pond management include ensuring ambient water bodies are free from invasive aquatic species, are protected from runoff entering the water body, and are not suffering from nutrient pollution. Before any management is done, a lake and watershed study should always be conducted to better understand inlet and outlet flow, potential pollution sources, and any erosion or sedimentation concerns. A study should also include any plant and animal species present, including native and invasive fish and aquatic plants.

Best Practices

- **Managing water quality (including water Phosphorus and Nitrogen levels, dissolved oxygen levels, temperature, sedimentation) through physical techniques include:**

- Aeration and circulation to move water and add oxygen.

- Dredging to remove sediment, which can alter the flow of water and add excessive nutrients.
- **Protecting the entire watershed by including runoff control structures to prevent pollution and erosion.**
- **Understanding populations of aquatic wildlife present in order to control invasive fish, algae and aquatic plants that may be detrimental to the health of the lake or pond. Best practices in control of aquatic invasive species include:**
 - Less-toxic herbicide controls such as barley straw which act as a natural inhibitor to algae growth.
 - Physical removal. The Providence Parks Department is considering harvesting invasive aquatic weeds instead of treating them with herbicides, utilizing these weeds as “green” matter to be added to compost.
 - Insect biocontrols. The Parks Department has plans to release a biological control beetle (*galerucella* sp.) in Polo Lake within RWP in

LEADING BY EXAMPLE



Geese Control in Roger Williams Park

The Providence Parks Department partners with the U.S. Department of Agriculture (USDA) to control populations of Canada geese in Roger Williams Park. Geese populations increase the amount of nutrient runoff flowing into water bodies at the park as a result of geese waste. This nutrient runoff contributes to algae overgrowth in the ponds.

Educational signage alerts park-goers to the harms of feeding ducks and geese. Buffer plantings are used to limit geese access to the shoreline. The goal is to reduce the use of the Park system by Canada geese. However, the removal of geese populations has become a last resort measure.

Employees from USDA studied the population of resident geese at Roger Williams Park and recommended that some be removed. They returned eight or nine times over the course of 2019 and removed geese. Geese that could not be relocated due to poor health were exterminated. USDA determined that the geese were too sick to be used for food.

Based on the success of the program, the Parks Department intends to explore other sites for treatment. North Burial Ground will likely be the next site to manage geese populations.

order to control Purple Loosestrife. These beetles were previously released in RWP Zoo several years ago and continue to work as insect biocontrol in the Zoo.

- Managing geese populations in order to reduce excessive nutrient inputs into lakes and ponds due to runoff of geese waste.

Roger Williams Park has 100+ acres of lakes and roughly 79 acres of that water is being actively managed for invasive aquatic vegetation and algae. A majority of the lakes being treated have been receiving ongoing, continuous management for invasive aquatic species since 2012. Cunliff Lake, the Japanese Garden, Elm Lake, Willow Lake, Roosevelt Lake and Edgewood Lake are being treated for invasive species including Curlyleaf Pondweed, Waterweed, Fanwort, Waterlilies, Water Chestnut, filamentous algae and microscopic algae.

In addition to implementing the best practices listed above, the Parks Department also applies herbicide and algaecide treatments to quickly and temporarily control severe nuisances, such as algal blooms, that are threatening the safety of the lake or pond for

humans and wildlife. Herbicide treatments are applied to control aquatic invasive plants in the lakes of Roger Williams Park yearly between May and October. The chemical herbicides used range from low to high toxicity for aquatic invertebrates and fish. As with herbicides used for land management, these aquatic chemical treatments can pose a health threat to humans and pets and may temporarily make the water unsafe for recreation.

Copper based algaecides are used to manage the filamentous and microscopic algae in the lakes of Roger Williams Park. Copper is an effective treatment for algae, however it can be toxic to fish and aquatic invertebrates, and large scale die-offs of algae can deplete oxygen levels in water bodies to dangerous levels. While the treatment kills algae, it does nothing to address the underlying problems that are causing the algal blooms (excessive nutrients). Common algaecides are broad spectrum and not only kill algae but many other plants and animals. Repeated treatment is necessary, and when applied repeatedly, chemicals and metals such as copper may build up in sediments and in the bodies of fish.

Best Practices for Design and Maintenance of Public Parks and Playgrounds

Maintaining safety standards in playground equipment, reducing the use of toxic chemicals in public spaces and increasing greenery in parks and on city streets are some examples of BMPs being used to create and maintain healthy and safe public parks.



Safe Playground Materials

The use of sustainably sourced and eco-friendly natural materials and recycled high quality plastics in playground construction drastically reduces children and families potential for toxic exposure. The three main companies used to source playground equipment for the Providence Parks Department are Landscape Structures, Game Time and Kompan. These companies have various practices to ensure playground materials in Providence are safe and healthy.

Best Practices

- High Density Polyethylene (HDPE) is a high quality, easily recyclable plastic, making it more sustainable than other types of plastic.²⁶ HDPE plastic is not known to actively leach any toxins,²⁷ making it a safe and environmentally friendly choice for playgrounds and public parks. Kompan's durable plastic building materials are made from high quality, recycled HDPE (which is also recyclable after use).
- Naturally rot- and insect- resistant woods like robinia (black locust), western red cedar, and redwood²⁸ can be used to build reliable fencing and benches for public parks and equipment in playgrounds. By opting for naturally resistant wood varieties, the need for chemical wood treatment is eliminated and the level of toxic exposure in playgrounds is reduced. Kompan builds with robinia wood, a naturally resistant wood that does not need chemical treatment. Kompan's wood is harvested sustainably and responsibly.
- Engineered wood fiber (EWF) is becoming a popular choice for playground surfacing due to its affordability, safety and attractive natural appearance. Engineered Wood Fiber mulch is the most common ground cover for playgrounds maintained by Providence Parks; it is a safer and more economical option that is non-toxic.
- Building with sustainably sourced, recycled materials and/or end-of-life recycling are great ways to reduce the environmental impact of playground equipment. Landscape Structures utilizes child safe and environmentally preferable materials such as recycled anodized aluminum, bamboo panels (a renewable and sustainable resource), fabric that protects children from UV rays, cast concrete, galvanized steel, recycled plastic lumber and stabilized HDPE marine-grade plastic. Kompan recycles all manufacturing waste. Game Time also uses low-impact materials that

LEADING BY EXAMPLE

Providence Playground Upgrades and Renovations

In 2019, 23 upgrades and renovations were completed on Providence playgrounds and parks. This includes new natural robinia wood playgrounds at Veazie Street School Connector Park and Fagnoli Park, a new artificial turf field at Donigian Park and field improvements at Mt. Pleasant Little League Fields and Playground. At least 25 renovation and upgrade projects are scheduled to be completed in 2020. This includes a new artificial turf playing field at Bucklin Park, continued renovations at Fagnoli Park and many playground upgrades, pathway upgrades and field renovations. These projects are included in the City's Capital Improvement Plan.



Natural robinia wood playground at Veazie Street School Connector Park. *Photo courtesy of Providence Parks Department*

are responsibly sourced. More than 93% of the materials used to construct their products are recycled. Their recycled plastic lumber, aluminum and other plastic products are designed to be recyclable at the end of their life cycle. All of their products meet American Society for Testing and Materials and Consumer Product Safety Commission standards.

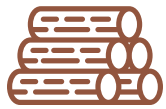
- Lead hazard assessments, including inspecting for lead paint on older equipment or nearby structures, as well as testing for unsafe levels of lead in the soil. In Providence Parks, lead testing is done when capital improvements are made to a playground. Remediation steps are taken to ensure safety of the playground, regardless of whether lead was found to be present or not. For example, Bucklin Park was not found to have harmful levels of lead present, but had 12 inches of soil excavated and removed in 2019. A thick layer of Engineered Wood Fiber (EWF) mulch was then placed down to create a barrier between old soil and the surface of the playground.
- Playgrounds and parks should be regularly inspected by a Certified Playground Safety Inspector, and any damaged, unsafe or out-of-date equipment should be replaced. As of 2019, the

Providence Parks Department has five Certified Playground Safety Inspectors.

- Playgrounds and parks require regular maintenance to keep them safe and in good condition. A new tablet-based maintenance system has been implemented for use by the Parks Department. This system allows Parks Department crews to log their completed tasks in real time; it also allows individuals to log requests through the program for maintenance of specific items or areas within the parks. It is hoped that this system will allow the Parks Department to better track completion of maintenance over the long-term in the parks and may be used in the implementation of the upcoming turf management plan.

“Greening” of Playgrounds and Public Parks

Including natural elements like robinia wood and vegetation in a playgrounds design encourages social and imaginative play and exploration in children and creates a space that is attractive to a diverse group of individuals. Exposure to nature in places like public parks and playgrounds can improve psychological health and increase social ties within a community. It has been proven that in children with Attention Deficit Disorder, the “greener” the child’s play area the less likely they are to suffer severe symptoms and the more likely they are to be able to concentrate.³ This makes “green” playgrounds a wonderful tool for schools to engage young students, helping them focus while in the classroom and allowing them to develop physically and socially while on the playground.



Fagnoli Park exemplifies the use of natural materials (in this case robinia wood) to create play structures. This “naturalized” style of playground lends itself to open ended, imaginative play that allows children to develop physical, social and creative skills. *Photo courtesy of Providence Parks Department*

Best Practices

- Naturalized playgrounds include plant life, greenery and natural elements, with these plants managed in a way that reduces the use of chemical fertilizers and toxic pesticides.
- Vegetative barriers are areas of trees, shrubs or other plants used as a barrier against air and noise pollution, runoff, pesticide drift and soil erosion.
- Multi-use playgrounds can be used for multiple purposes by a range of age groups, maximizing the potential of valuable urban space and providing areas that can be used in all seasons.
- Food forests or “edible parks” are a way to incorporate multi-functional vegetation into a design. This concept provides cities with the environmental benefits of green spaces while also introducing edible plants into the landscape that produce food for the community and wildlife.





Joslin Playground exemplifies a multi-use playground design. The playground serves as a waterpark in the summertime, with spray features and a spray pad ground surfacing. The addition of a bridge, climbing boulders and a shade sail make this playground usable in all seasons, even when the water features are turned off from fall through spring.

Photo courtesy of Providence Parks Department



The Edible Forest Garden at the Botanical Center includes native trees, shrubs and groundcover that produce food that can be enjoyed by humans and wildlife. This site is managed organically. *Photos courtesy of Lee Ann Freitas*



New artificial turf field at Donigian Park.
Photo courtesy of Providence Parks Department

Chemical-Free Turf Fields

Organically managed natural turf fields are the most environmentally and health friendly option for sports fields.



Best Practices

- Organically managed natural turf fields can use heavy mowing, over-seeding and fertilization to prevent weeds and ensure healthy turf that can resist pests and disease.
- Manage turf fields in a way that takes into account type of turf, use of turf and the specific needs of that area. This can help reduce the need for additional water and chemical input such as pesticides and fertilizers. 10-10-10 Fertilizer is used by the Parks Department as a starter for seeding of turf and occasionally as a supplemental treatment for established turf fields. Only fields that already have irrigation installed are treated with fertilizer, as fertilizer needs to be watered in, otherwise it will do harm to the grass. Non-irrigated fields receive no fertilizer treatments.
- Utilize organic land management techniques to move towards a turf maintenance routine that minimizes chemical input. The Parks Department is moving towards non-chemical turf management techniques such as more frequent mowing of athletic fields and building up the soil in order to develop healthier turf that will naturally crowd out weeds and be more resistant to disease. Grass areas at Burnside and Biltmore parks received extra mowings in 2019 to encourage full growth without necessarily needing more applications of fertilizer.
- Alternative synthetic turf fillers are non-toxic and allergen free and may be safer options than traditional crumb rubber, which can release toxins that can be harmful to human health and the environment. Envirofill is made from acrylic coated sand. Safe Shell is made from U.S. grown walnut shells and is compostable. Envirofill turf filler has been used by Providence Parks in place of traditional crumb rubber (which can be a carcinogen) in at least one newly installed turf field.

UPCOMING IN THE PARKS DEPARTMENT

Turf Management Plan

The Deputy Superintendent of the Providence Parks Department, Brian Byrnes, is spearheading the development and implementation of a turf program based on New York City's turf management plan for Central Park. For an overview of the Central Park Conservancy's Turf Management Plan, see Appendix 3.

The Providence Parks Department Turf Management Plan will be an upcoming project in 2020 and will split Roger Williams Park into zones based on specific turf types and their requirements. All athletic fields, the area in front of the casino in Roger Williams Park where there is irrigation installed, and the fields at Neutaconkanut will all be included in the zoning for this plan.

Urban Forests

Optimal urban tree canopy cover will vary from city to city and should take into account climate, desired ecosystem services, feasibility, land use patterns and local preferences. Trees provide natural cooling, air and water filtration, opportunities for recreation and beautification of city streets. Urban forests should be managed in a way that maximizes environmental and health benefits to residents as well as ensuring the health of the tree canopy.

Best Practices

- Canopy cover can be measured and used as a way to calculate the environmental footprint of urban trees (such as carbon sequestering, heat reduction and the filtration of air pollutants and water). Data provided from Providence's Open Data Portal documents a net gain of 214 trees in 2017 and a net gain of 21 trees in 2018. The City has a goal to increase the annual net gain in trees to 200 by December 2020. Tree inventories were completed for Providence's urban forest in 2006 and 2017. Types of trees present, amount of each variety of tree and environmental benefits of the forest were all measured. In 2013, an assessment was conducted that determined the structure, function and value of Providence's urban forest. The study used iTree Eco to analyze trees in 250 plots throughout Providence and calculate land use and types of trees present. An Urban Tree Canopy study was conducted in 2007 that determined the City as a whole has 23% canopy cover. Another UTC study using 2018 imagery determined the City's canopy cover grew to 25%.
- Preserving large sections of intact wooded areas helps create green corridors, which is important for habitat, as well as recreation. Sensitive areas such as upstream watersheds and wetlands should also be protected.²⁹
- Plant trees in neighborhoods to ensure there is a net gain in the urban canopy cover. Tree planting programs should place priority on planting in low canopy neighborhoods.
- Urban forests should be managed in a way that protects the health of the canopy, enhances diversity of tree species and reduces or eliminates the use of chemical pesticides and fertilizers. The Providence Forestry Division does not routinely use any pesticides to treat trees in Providence. Pesticides are used rarely as a preventative measure, usually for older, valuable trees. The large sycamore outside of the Betsey Williams Cottage in RWP is an example of this. In the past it has been treated with a fungicide to control anthracnose, a foliar disease that causes the tree to drop its leaves in the spring.



Program Highlight

Neighborhood tree plantings with the Providence Neighborhood Planting Program (PNPP) occur every spring and fall, and strive to plant approximately 500 trees per year. The PNPP program also ensures tree biodiversity is being maintained through the planting of a wide array of species.



In 2019, PNPP volunteers planted 541 trees including 55 different species through 30 neighborhood plantings across 19 Providence neighborhoods. *Photos courtesy of Doug Still*

LEADING BY EXAMPLE

Pruning Providence’s Urban Forest

Since 2016, the Forestry Division has adopted a block pruning program that breaks Providence up into sections and runs on a 10-year cycle. This means that 10% of the trees (~2,500) are pruned each year. Systematic tree pruning ensures a healthy tree canopy and public safety. This block pruning program ensures the City is able to maintain the long-term health of Providence’s Urban Tree canopy and maximize cooling and pollutant filtering benefits for residents.



Photo courtesy of Doug Still



Ash tree *Photo courtesy of GardeningKnowHow.com*



**Emerald Ash Borer:
A growing threat to Providence’s urban forest**

Ash Trees account for 7% of the street trees in Providence (~1,700) and the Forestry Division will need to employ pesticides to prevent wide-scale destruction and loss of trees due to the Emerald Ash Borer. According to the Providence 2014 Urban Forest Report, Emerald Ash Borer has the potential to cause at least \$25 million dollars in damage and tree loss. Providence’s Forestry Division has treated 230 ash trees for Emerald Ash Borer in 2020 and approximately 600 more trees will be treated in 2021. They were treated with TreeAzin, whose ingredient is Azadirachtin, which is a tree injection and is a “least hazardous” option. The main ingredient of TreeAzin is azadirachtin, which comes from neem seeds and works by targeting Emerald Ash Borer larvae. These 800+ trees will continue to be treated every two years for the foreseeable future. If a private property owner wishes to hire an arborist to treat a City-owned tree they must first receive a permit from the Forestry Division.



Community Partnerships

Community partnerships combine the interests of the City and its residents, leading to collaborations in which urban parks continue to be cared for over time and are held to the highest standards of management. By working with local parks' friends groups, improvements and renovations are made to directly support the wants and needs of the community. Collaboration between community partners and the Parks Department encourages communication between the city and residents, allowing residents to take part in maintaining their local park and providing additional support to the Parks Department through fundraising and planning events.

Providence's Community Partners

- **Neutaconkanut Hill Conservancy:** Neutaconkanut Hill is the largest forested area in Providence at 88 acres of woodland habitat. The Conservancy was formed in 2005 and maintains Neutaconkanut Hill in partnership with Providence Parks. The Parks Department maintains the "lower" Neutaconkanut area that includes baseball fields and a playground. In 2019, the Parks Department renovated 65-70% of the forested trail, put in signage and added a sitting area.
- **Blackstone Parks Conservancy** manages Blackstone Boulevard and Blackstone Park Conservation District in conjunction with Providence Parks and the Department of Public Works. Blackstone Boulevard is a 1.6 mile long 100 ft wide median. It is the most heavily used walking path in Providence. In fall of 2019, the Parks Department revitalized the northernmost section of Blackstone Boulevard with a permeable surface to help prevent erosion and runoff. Additional path revitalization is scheduled for 2020.

Blackstone Park Conservation District is a 45-acre natural woodland that includes two ponds, an open meadow and acts as a green buffer, preventing runoff from the city streets into the

Seekonk River. The area also acts as a wildlife corridor and in 2003 was rezoned as a conservation district.

In 2019 the Conservancy created a map to be shared with the Parks Department to ensure recently planted native plants were not mowed down. Meetings are held in the spring time between the Parks Department and the Conservancy.

Partnerships with other organizations and volunteers work to remove invasive species by hand, pull weeds, maintain trails, add wood chips to stabilize hillsides and reduce runoff, plant native vegetation and install signs.

- **The Partnership for Providence Parks** works to create and support friends groups for many parks and playgrounds across Providence. The group is financially supported by the Parks Department and provides assistance and support to Parks "Friends of" groups across the City. Partners of Providence Parks work to engage with community members, plan programming and fundraise. Friends groups are NOT involved in maintenance of their associated playground or park.

It is the Parks Department's preference that parks or playgrounds receiving capital improvements have an existing friends group supporting it, although not all do. Friends groups may emerge once a project is complete or during the process of improvements being made.

The Parks Department actively engages friends groups when they are planning an upgrade or renovation to their playground, asking what they would like their park to look like and include. In this way, the City is truly serving the needs and wants of community members while also ensuring there is a group in place to maintain and continue growing the park or playground into a safe hub of neighborhood activity after the work of the Parks Department is completed.

- **The Roger Williams Park Conservancy** was created in 2016 and works as a partner to the Providence Parks Department. The Conservancy acts as a steward of Roger Williams Park, creating and offering programs for the public, fundraising resources and ensuring the park remains a fun and safe place for the community to enjoy.



Workforce Development

Ongoing workforce development is essential for ensuring employees have the skills and knowledge to implement new management techniques. By training employees in best management practices and environmentally preferable methods, the Parks Department can ensure its workers are comfortable with any changes and understand why environmentally preferable practices may be introduced in place of more traditional methods. By providing continuous training opportunities, the Parks Department is able to maintain a workforce where every employee has in-depth knowledge of at least one topic.

Best Practices

Providence Parks Academy

The Providence Parks Department provides workforce training for their staff through “Providence Parks Academy.” Maintenance crews are required to take all relevant classes. After the completion of those classes, each staff member will select at least one specialized area for further study so all staff become experts in one specialized trade and one general trade. The following classes were offered as a part of the Providence Parks Academy 2018 Course Book:

- **The “Lead Safe” Program** certifies individuals who work on pre-1978 housing or child-occupied facilities in the US.
- **Playground Safety Maintenance** trains maintenance crew employees to identify park safety hazards and techniques for repair. Maintenance workers responsible for mowing city parks and playgrounds were trained to conduct “walk-throughs” while they are on the job and scan for hazards. This maximizes the Parks Department’s ability to monitor playground safety and utilizes the presence of maintenance staff to not only do their assigned job (mowing) but also to assess the conditions of the parks they are visiting on a regular basis.

- **Best Practices in Field Renovations** trains participants to identify the methods and materials used in revitalizing grass playing fields.
- **Best Practices in Snow Removal** teaches participants the best methods, materials and equipment for removing snow from public areas.

Turf Management Training

Turf trainings are increasing in frequency (with several occurring during 2019 and one occurring in February of 2020). These trainings will be based on least-risk management methods that aim to reduce the need for synthetic fertilizers and the use of pesticides. All management staff participated in training on best land management practices with Kathy Connelly.

Certified Pesticide Applicators

All certified pesticide applicators attend training provided through the University of Rhode Island’s Pesticide Safety Education Program. Currently one staff member in the Providence Parks Maintenance Division is certified as a pesticide applicator specific to turf and parks. There are two certified pesticide applicators in the Forestry Division. The Parks Department is hoping to have five certified in the future. These certified applicators will be trained to identify fungal pests so that the correct measures are taken to bring the grass back to health, ideally without the use of pesticides (two examples of this are “watering out” fungus growth in grass, and treating with fertilizer to help grow out the fungus instead of treating with fungicide).

Best Management Practices

SUMMARY CHART

	Providence Parks Department - Current Practices	Providence Parks Department - Future Practices	Best Practice Recommendations for Private Property Owners	Programs in Other Cities
Integrated Pest Management	<ul style="list-style-type: none"> • Providence Parks Department does not use insecticides or herbicides as a part of their regular maintenance routine • Insect biological controls are being used in Roger Williams Botanical Center • Low-toxicity pest control options, such as botanically derived neem spray, are used in the Botanical Gardens when necessary • Scouting and removal of damaged plants are done in the Botanical Gardens to naturally control pests 	<ul style="list-style-type: none"> • Continue to use non-chemical methods of pest management • Emphasize Integrated Pest Management techniques, such as scouting, in future trainings • Use the Botanical Center’s comprehensive Integrated Pest Management plan and no-pesticide policy as a model for the rest of Providence Parks 	<ul style="list-style-type: none"> • Prevent pest infestations by scouting and monitoring around the home and garden, be familiar with common beneficial insects • Protect populations of beneficial insects by reducing or eliminating the use of pesticides and chemical treatments on private property • Accept the presence of some insects around the home and garden 	<ul style="list-style-type: none"> • Marblehead, Massachusetts Organic Pest Management Policy and Regulations • Boulder, Colorado’s Integrated Pest Management Plan • University of California’s Roadmap for Integrated Pest Management • Irvine, California’s Integrated Pest Management Policy
Pesticide Application	<ul style="list-style-type: none"> • All certified pesticide applicators attend training provided through the University of Rhode Island’s Pesticide Safety Education Program • Currently there is 1 certified pesticide applicator in the Providence Parks Maintenance Division and 2 in the Forest Division 	<ul style="list-style-type: none"> • Providence Parks Department hopes to have 5 certified pesticide applicators in the future, they will be trained in Integrated Pest Management techniques such as scouting and identification of pests • Further reduce or completely eliminate pesticide use by the Providence Parks Department 	<ul style="list-style-type: none"> • Go “pesticide free” on lawns and gardens to protect pollinators, the environment and members of the household (including pets) • Pesticides should only be used as a last resort option and least-toxic options are preferable • Neonicotinoid insecticides should not be used in order to protect populations of native pollinators and birds 	<ul style="list-style-type: none"> • Oregon State University’s “How to Protect Bee Poisoning from Pesticides” cellphone app • Maryland’s Pollinator Protection Act • Salt Lake City, Utah’s Pesticide Free Salt Lake City Initiative • Penn State Center for Pollinator Research’s Pennsylvania Pollinator Protection Plan and Pollinator Garden Certification

	Providence Parks Department - Current Practices	Providence Parks Department - Future Practices	Best Practice Recommendations for Private Property Owners	Programs in Other Cities
<h3>Organic Land Management</h3>	<ul style="list-style-type: none"> The Roger Williams Botanical Gardens do not use pesticides and rely on a comprehensive Integrated Pest Management program Providence Parks Department does not routinely use pesticides as a part of its maintenance routine Providence Parks Department is moving towards a turf management plan that will include zoning turf areas and reducing chemical input (fertilizers and herbicides) for management of natural turf The first flush of leaves at Roger Williams Park is collected and brought to a compost pile in the park Three goats that are stationed at the Botanical Center are used for weed control primarily in and around Roger Williams Park 	<ul style="list-style-type: none"> Implement a Central Park Conservancy style turf management plan throughout Providence's parks in order to manage turf more efficiently and with less chemical input Prioritize best management practices that reduce the need for chemical fertilizers and reduce or eliminate the use of pesticides Allow leaf litter to remain in some areas to support pollinators and other wildlife while returning nutrients to the landscape Reduce mowing on hillsides to reduce runoff Expand and revitalize the Providence Parks composting program Recruit more volunteers to help with the goats in order for them to be used as mechanical weed control more often 	<ul style="list-style-type: none"> Pull weeds by hand Go "chemical free" on lawns by eliminating herbicide and insecticide use and reducing or eliminating use of synthetic fertilizers Maintain a healthy lawn and garden through the use of organic compost and a thick cover of vegetation, this will reduce the need for chemical pesticides and fertilizers Compost yard and garden waste Allow some leaf litter to remain and let grass grow higher to retain water and crowd out weeds Utilize native plant species Reduce the use of irrigation and excess watering 	<ul style="list-style-type: none"> Tempe Arizona's Sustainable Tempe plan The Rose Kennedy Greenway managed organically by the Greenway Conservancy, Boston Central Park Conservancy's Turf Management Plan Boulder, Colorado's Healthy Parks = Healthy People campaign

	Providence Parks Department - Current Practices	Providence Parks Department - Future Practices	Best Practice Recommendations for Private Property Owners	Programs in Other Cities
Urban Forestry	<ul style="list-style-type: none"> • Providence Parks Forestry Division does not routinely use pesticides, they are only used as preventative treatments for older, valuable trees that may be vulnerable • Fertilizers are not applied to trees planted by the Forestry Division • A block pruning program operates in Providence on a 10 year cycle, insuring a healthy tree canopy and public safety • Tree inventories have been completed to assess the health of Providence's Urban Forest and the environmental and economical benefits it provides to the City • Monitor Emerald Ash Borer and choose least-harmful options when managing for this pest and protecting the health of Providence's Urban Forest 	<ul style="list-style-type: none"> • Strive for increased neighborhood tree plantings in order to meet the Office of Sustainability's goal of an annual net gain of 200 trees by December 2020 • Create a long term plan for the management of the Emerald Ash Borer infestation 	<ul style="list-style-type: none"> • Native tree and shrub species should be used when landscaping private property • Homeowners should not treat trees with pesticides • Homeowners can learn to scout for the Emerald Ash Borer on any trees located on their property and plan to remove or responsibly treat any infested trees, this can help slow the spread of Emerald Ash Borer through Providence's Urban Forest 	<ul style="list-style-type: none"> • Tempe, Arizona Urban Forest Master Plan • Oxford, Ohio's Urban Forestry Plan and Emerald Ash Borer Management Plan • Boulder, Colorado's Urban Forest Strategic Plan • Boulder, Colorado's Emerald Ash Borer and Private Land Owners Resources

Water Management	Providence Parks Department - Current Practices	Providence Parks Department - Future Practices	Best Practice Recommendations for Private Property Owners	Programs in Other Cities
	<ul style="list-style-type: none"> Green Infrastructure such as bioswales, rain gardens and removal of pavement have all been implemented in Roger Williams Park and other Providence parks to treat pollution from stormwater runoff Roger Williams Park partners with the USDA to remove geese from the park, limiting the amount of nutrient runoff entering waterways Roger Williams Park has put signs in place educating the public about the role geese play in increasing nutrient runoff into the parks lakes and ponds Lake management in RWP 	<ul style="list-style-type: none"> Continue implementing green infrastructure to manage stormwater runoff Continue to implement strategies to minimize nutrient runoff from animals and fertilizer and stormwater Explore and implement practical non-chemical management for invasive aquatic vegetation, mechanical removal and use of a biocontrol beetle for purple loosestrife are possible options being considered 	<ul style="list-style-type: none"> Reduce or eliminate the use of synthetic fertilizers on lawns and gardens and eliminate the use of phosphorous heavy fertilizers in an effort to decrease runoff related to algal blooms Pick up pet waste to reduce nutrient runoff Consider rain barrels for collecting runoff from roofs, driveways and other impermeable areas Plant vegetation in areas where runoff is high Plant native species that do not need excessive fertilization or watering 	<ul style="list-style-type: none"> Philadelphia, Pennsylvania's Green City, Clean Waters Plan North Carolina's Mills River Integrated Watershed Management Plan and Source Water Protection Plan New Jersey Highlands Water Protection and Planning Council's Lake Management Plan Guidance New Jersey's Healthy Lawns, Healthy Water Fertilizer Law

	Providence Parks Department - Current Practices	Providence Parks Department - Future Practices	Best Practice Recommendations for Private Property Owners	Programs in Other Cities
<h3>Playground Safety and Design</h3>	<ul style="list-style-type: none"> • There were 23 renovations and upgrades completed in Providence Parks and Playgrounds in 2019 and at least 25 are slated for 2020 • All upgraded playground equipment is sourced from companies that value safe, non-toxic and environmentally conscious materials • Engineered Wood Fiber mulch and naturally insect repellent Robinia wood are being used in the creation of new playgrounds • Playgrounds are constructed in a more natural way, incorporating natural materials and shapes to allow for open ended imaginative play • If high levels of lead are detected during a major renovation, the soil is remediated and covered with engineered wood fiber mulch • Many Providence Playgrounds have a “friends of” group organized through Partners for Providence Parks, these friends groups can fundraise and organize events. They frequently collaborate with the Providence Parks Department. 	<ul style="list-style-type: none"> • Continue using only environmentally friendly and non-toxic materials when renovating and upgrading playgrounds • Move away from potentially harmful crumb rubber as a synthetic turf infill and towards less toxic options such as envirofill • Continue to provide trainings on playground best management practices to employees of the Parks Department 	<ul style="list-style-type: none"> • Keep children from playing in soil near older buildings that may be contaminated by lead chips or dust • Community members can join a “friends of” group for their local playground • Residents should continue to advocate for the use of non-toxic and environmentally preferable materials in all playground upgrades and renovations 	<ul style="list-style-type: none"> • Sustainable Tempe's Health Impact Project will inform playground and park sustainability guidelines • Vermont League of Cities and Towns, Guidance for Safe Playgrounds • New York City Parks, Plan for Sustainable Practices within NYC Parks • New York City Parks, Community Parks Initiative • Boulder, Colorado's Healthy Parks = Healthy People campaign

	Providence Parks Department - Current Practices	Providence Parks Department - Future Practices	Best Practice Recommendations for Private Property Owners	Programs in Other Cities
<p>Workforce Trainings</p>	<ul style="list-style-type: none"> • The Providence Parks Academy offers courses in lead safety, playground safety maintenance, best practices in field renovations and best practices in snow removal for Parks staff • Maintenance workers who mow and remove trash from Providence Parks have been trained to also conduct “walk-throughs” and scan for hazards while they are performing their duties • Certified Pesticide Applicators are certified through the University of Rhode Island’s Pesticide Safety Education Program and are introduced to Integrated Pest Management methods 	<ul style="list-style-type: none"> • Provide trainings that emphasize Integrated Pest Management and organic management techniques, making these methods the go-to way of managing public parks, playgrounds and green spaces in Providence • Continue to increase turf management trainings in order for Providence Parks to move towards a less chemical heavy maintenance routine 	<ul style="list-style-type: none"> • Property owners should be encouraged to participate in pesticide-free and organic land management trainings • Become familiar with the University of Rhode Island’s Integrated Pest Management online portal and utilize it as a resource for researching and implementing Integrated Pest Management and Organic Land Management techniques on private property 	<ul style="list-style-type: none"> • Tempe, Arizona’s CapaCities training which brought together stakeholders, city officials, students, professors and the public to address climate change in Tempe

APPENDIX 1

Health Information Related to Mothers and Children

Green Spaces and Health Effects for Pregnant Mothers and Young Children

Higher neighborhood greenness has been linked to positive effects for pregnant mothers, and led to a reduced risk of low birth weight in newborn babies.³³

It has been proven that childhood exposure to green spaces resulted in a reduced risk of developing psychiatric disorders (such as depression, anxiety and substance abuse) during adolescence and adulthood, with those spending the most time in nature experiencing greater mental health benefits.³⁴ By ensuring easy and safe access to urban parks for young residents, cities can positively affect the mental health of their residents from youth through adulthood.

There is a proven positive correlation between time spent in green space and cognitive development in 7- to 10-year-old schoolchildren, with a potential factor being the reduction in exposure to air pollution due to proximity to plants in urban parks.³⁵

Pesticide Exposure and Children

In a 2018 study in which 1,000 adults with children were surveyed, 69% of parents were concerned with lessening pesticide exposure from food. However almost the same amount (67%) of parents did not consider pesticide exposure from parks, playgrounds and sports fields to be of concern.³⁸ Infants and children are especially at risk of pesticide toxicity due to their lowered ability to absorb, metabolize and excrete dangerous compounds. The immune systems of infants and young children are not fully formed and may make them less able to protect them from pesticide exposure. Exposure to toxins such as pesticides can permanently prevent normal maturation and can also have negative effects on behavioral development such as cognitive ability and fine motor skills.³⁹

Pesticide Exposure and Effects on Reproductive Health

Endocrine disruption has been linked to reproductive issues such as infertility, low birth weight, low sperm count, birth defects and miscarriage, as well as certain types of hormone related cancers such as breast, testicular and prostate cancer.⁴⁰

Risks of Heavy Metal Exposure to Pregnant Mothers and Young Children

Lead exposure is extremely dangerous to pregnant mothers as it readily crosses through the placenta and into the fetal brain. High levels of lead during pregnancy has been connected to hypertension, spontaneous abortion, low birth weight and impaired neurodevelopment.⁴¹ Prolonged exposure to lead has been connected to behavioral and learning problems, brain and nervous system damage, hearing problems and slowed growth.¹⁹

Compared to adults, children absorb 40-90% more ingested heavy metals like arsenic.⁴² The levels of exposure to arsenic from playground equipment are generally not significant enough to contribute to serious illness.⁴³ However, arsenic exposure during development has been associated with altered neurodevelopment including lower IQ and decreased motor function as well as disruption of organ system development which can lead to chronic illness later in life.⁴²

APPENDIX 2

Relevant Legislation, Rules and Regulations

Background Information on Pesticide Use Legislation in Rhode Island

The Rhode Island Pesticide Control Act (23-25-9), known as RIPCA, is in place to regulate labeling, distribution and sale, registration, storage, transportation, use and safe application of pesticides in the state of Rhode Island.

- All pesticides in the state of Rhode Island must be registered. As of 2018, The Department of Agriculture estimates they register and collect fees from ~9000 pesticide products in Rhode Island.³⁷
- The Division of Agriculture's Pesticides Unit certifies and licenses commercial pesticide applicators for all pesticides, and certifies private applicators for restricted-use or state limited-use pesticides. Rhode Island DEM's Pesticide Safety and IPM training program is run in conjunction with The University of Rhode Island. Prior to being licensed or certified applicants are required to attend a two day core training with an exam at the conclusion of the second day. Applicants that are applying for commercial certification must attend additional training and testing in their specialty area. Commercial and private applicators must recertify every 5 years.
- RIPCA includes regulations for restricting the use of hazardous pesticide applications in schools and calls for the implementation of Integrated Pest Management (Section 23-25-37).
- Schools are required to provide the parents or guardian of every student with a copy of their pesticide application policy as well as a description of any applications made the previous year. Alerts prior to any pesticide treatment must be received at least 24 hours in advance.
- Pesticides can not be applied on the property while children are present, during school hours or while after school activities are taking place.
- Rhode Island's Rules and Regulations Relating to Pesticides (250-RICR-40-15-2) was created

to ensure the enforcement of RIPCA to protect public health and avoid degradation of the environment.

- The posting of signs alerting community members to the application of pesticides are required of commercial applicators. Homeowners and managers of public recreation facilities are required to leave the signs in place for 48 hours after the application.
- Pesticide application on agricultural lands shall be performed in such a way that pesticide drift to adjacent lands does not occur. Pesticide applications to lands near or adjacent to public water supplies will be made in such a way that pesticide drift or flow into water supplies does not occur.
- Pesticide applications to any surface waters of the state for the control of aquatic pests or any other reason is not permitted unless approved by the Director.

Playground Safety Regulations

- The Consumer Product Safety Commission (CPSC) produces a public playground safety handbook, which can be consulted for current guidelines for playground safety.
- ASTM International developed manufacturing standards for the development of the safest public use playground equipment, surfacing and fencing possible.
- The International Play Equipment Manufacturers Association (IPEMA) offers a voluntary certification program which validates a product is compliant to ASTM standards.
- When designing a new playground or park, purchasing equipment that meets the above standards ensures the equipment will be up to the most current safety standards.
- A Certified Playground Safety Inspector should inspect individual playgrounds periodically in order to assure continued compliance with safety standards and to look for any serious damage or hazards present.

APPENDIX 3

The Central Park Conservancy Turf Management Plan

This plan exemplifies coordinated efforts to effectively manage turf utilizing a wide array of organic and integrated pest management techniques suitable to the specific needs of Central Park. In 2013 the Conservancy launched the Institute for Urban Parks, which along with the Center for Urban Park Management, works to educate and share what the CPC has learned over 35 years of innovative park management. This system has proven extremely successful in effectively allocating the finite resources of the Central Park Conservancy, preventing over-treatment and managing use and access of fields lawns within the park, accounting for periods of “rest” where certain fields may be closed.

Guiding Values

Preservation, Long Term Planning, Communicating with the Public, Minimizing the Impact of Turf Care on Natural Ecosystems

Goal

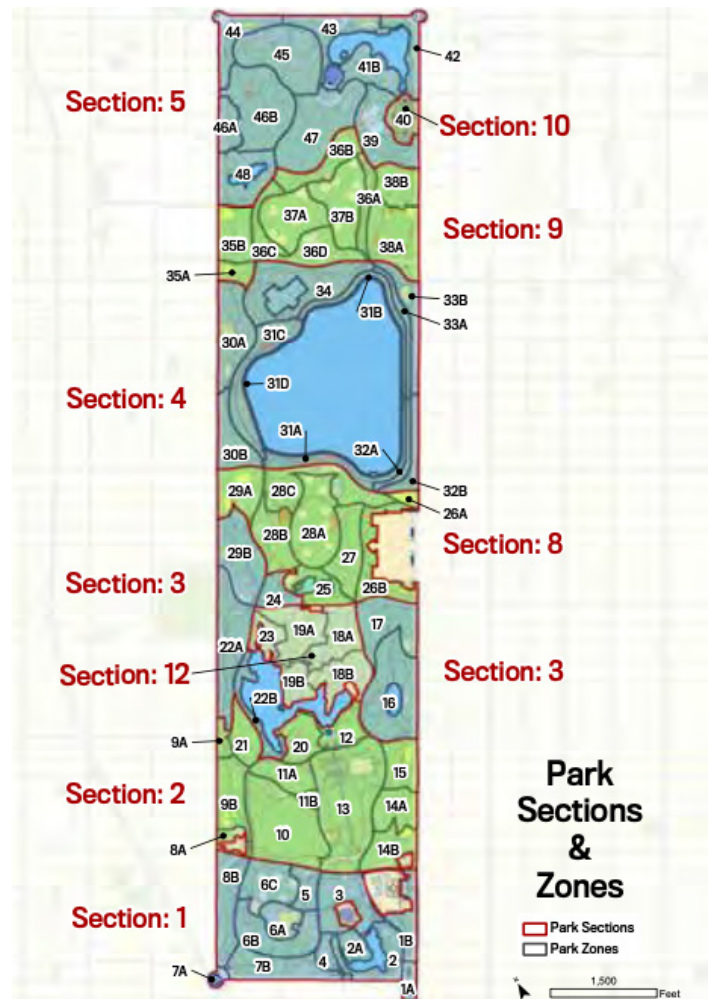
Restoring, enhancing and managing Central Park in partnership with the public, while developing long-term planning and consistent management practices.

Techniques

Zoning, signage, effectively communicating with the public, routinely closing fields for “recovery”, extensive internal training programs, soil health monitoring, mowing, aeration, over-seeding, IPM

This plan adopts a “zoning” technique that breaks the park into 49 zones and 9 sections, assigning employees to zones that reflect their area of expertise. This management technique holds employees accountable while allowing workers to become specialists in their area- resulting in employees that are better able to make decisions about BMPs regarding their zone and better communication between employees and managers.

A comprehensive lawn categorization system was implemented in 1997, areas are designated as “A”, “B”, “C”, or “D” lawns depending on the level of treatment and maintenance required. This system prioritizes the amount of maintenance and care needed by each specific area of the park.



APPENDIX 4

Additional Resources

Helpful resources consulted for information on Integrated Pest Management, Organic Land Management and Water Management:

Integrated Pest Management Resources

- IPM Institute of North America
- Cornell College of Agriculture and Life Sciences
- University of Connecticut Extension and Plant Science Department
- The Association of Natural Biocontrol Procedures (ANBP)
- University of California Agriculture and Natural Resources Statewide Integrated Pest Management Plan

Organic Land Management Resources

- NOFA Standards for Organic Lawn Care
- Rutgers Organic Land Care Best Management Practices Manual
- The Central Park Conservancy Turf Care Handbook
- Town of Marblehead, MA Organic Pest Management Policy for Turf and Landscape
- Central Park Conservancy Turf Care Handbook
- The Organic Materials Review Institute (OMRI)

Water Management Resources

- National Recreation and Park Association Green Infrastructure Resource Guide
- Green Infrastructure Implementation Strategy for the Town of Franklin, Massachusetts

Works Cited

1. "U.S. Cities Factsheet." *Center for Sustainable Systems, University of Michigan*, 2019. css.umich.edu/factsheets/us-cities-factsheet
2. "QuickFacts, Providence Rhode Island." *United States Census Bureau*. www.census.gov/quickfacts/providencecityrhodeisland
3. Gies, Erica. "The Health Benefits of Parks; How Parks Help Keep Americans and Their Communities Fit and Healthy." *The Trust for Public Land*, 2006: pp. 6-18.
4. Zhang, Liqing, Tan PY, Diehl J. "A Conceptual Framework for Studying Urban Green Spaces Effects on Health." *Journal of Urban Ecology*, vol. 3.1 (2017). NCBI.
5. "Heat Island Effect." *United States Environmental Protection Agency*. www.epa.gov/heat-islands
6. McDonald, Rob et al. "Planting Healthy Air; A Global Analysis of the Role of Urban Trees in Addressing Particulate Matter Pollution and Extreme Heat." *The Nature Conservancy*, 2016.
7. Nowak, David, Heisler G. "Air Quality Effects of Urban Trees and Parks." *National Recreation and Park Association*, 2010.
8. "Parks and Improved Mental Health and Quality of Life." *National Recreation and Parks Association*, 2015. www.nrpa.org/our-work/Three-Pillars/health-wellness/ParksandHealth/fact-sheets/parks-improved-mental-health-quality-life
9. "Pesticides 101." *Stonyfield Organic*. www.stonyfield.com/playfree/pesticides-101
10. "Health Effects of Pesticides." *Stonyfield Organic*. www.stonyfield.com/playfree/health-effects-of-pesticides
11. "Pets, Pollinators and Pesticides." *Stonyfield Organic*. www.stonyfield.com/playfree/playfree-pets-pollinators-and-pesticides
12. Mineau, Pierre, Palmer C. "The Impact of the Nation's Most Widely Used Insecticides on Birds." *American Bird Conservancy*, 2013. abcbirds.org/wp-content/uploads/2015/05/Neonic_FINAL.pdf
13. "Environmental Impacts." *Pesticide Action Network North America*. www.panna.org/resources/environmental-impacts
14. "Impacts of Pesticides on the Environment." *Pesticide Action Network; UK*, 2017. www.pan-uk.org/our-environment
15. Gillom, Robert J., Barbash J, Crawford C, et al. "The Quality of Our Nation's Waters; Pesticides in the Nation's Streams and Ground Water, 1992-2001." *U.S. Geological Survey; National Water-Quality Assessment Program*, 2007.
16. "NOFA Standards for Organic Land Care; Practices for Design and Maintenance of Ecological Landscapes. 6th Edition." *NOFA Organic Land Care Program*, 2017.
17. Almansour, Khaled, Arisco NJ, Woo MK, et al. "Playground Lead Levels in Rubber, Soil, Sand and Mulch Surfaces in Boston." *PLOS ONE*, vol. 14.4 (2019).
18. Perkins, Alaina, et al. "Evaluation of Potential Carcinogenicity of Organic Chemicals in Synthetic Turf Crumb Rubber." *Environmental Research*, vol. 169 (2019): pp. 163-172. NCBI.
19. "CPSC Staff Recommendations for Identifying and Controlling Lead Paint on Public Playground Equipment." *Consumer Product Safety Commission*, 1996. www.cpsc.gov/s3fs-public/cpscleadpaint.pdf?BNwUqHMTEbObWAev3XktQYO62iwZ60ji
20. "Pressure-Treated Wood Use in Playground Equipment." *Massachusetts Department of Public Health, Bureau of Environmental Health*. www.mass.gov/service-details/pressure-treated-wood-use-in-playground-equipment
21. Steingraber, Sandra. "Late Lessons From Pressure-Treated Wood Part 1." *Center For Environmental Health*. www.ceh.org/legacy/storage/documents/Arsenic_in_Play_Structures/LATE_LESSONS_FROM_PRESSURE_Treated_Wood-_pdf_hyperlink.pdf
22. "Insecticides: Low Toxicity Options." *UConn College of Agriculture, Health and Natural Resources; Home and Garden Education Center*, 2017. www.ladybug.uconn.edu/FactSheets/insecticides--low-toxicity-options_29_183943864.pdf

23. Bryant, Lara. "Organic Matter Can Improve Your Soil's Water Holding Capacity." Natural Resources Defense Council, 2015. www.nrdc.org/experts/lara-bryant/organic-matter-can-improve-your-soils-water-holding-capacity
24. "Extreme Weather." National Climate Assessment, U.S. Global Change Research Program. <https://nca2014.globalchange.gov/highlights/report-findings/extreme-weather>
25. Selbig, William. "Evaluation of Leaf Removal as a Means to Reduce Nutrient Concentrations and Loads in Urban Stormwater." *U.S. Geological Survey. Science of the Total Environment*, vol. 571 (2016): pp. 124-133.
26. "How Recreation Plastic is Used in Playground Equipment." *A&C Plastics, Inc.* www.acplasticsinc.com/informationcenter/r/recreation-plastic-in-playground-equipment
27. Galic, Bojana. "Are Your Plastic Water Bottles and Meal Prep Containers Safe to Use?" *Livestrong*, 2019. www.livestrong.com/article/158674-which-plastic-containers-can-i-safely-use
28. Highley, T. L. "Comparative Durability of Untreated Wood in Use Above Ground." USDA Forest Service. *International Biodeterioration and Biodegradation*, vol. 35.5 (1995): pp. 409-419.
29. Leff, Michael. "The Sustainable Urban Forest; A Step-by-Step Approach." *U.S. Forest Service Department of Agriculture*, 2016.
30. "Providence's Urban Forest: Structure, Effects and Values. iTree Ecosystem Analysis 2014." *City of Providence Forestry Division*, 2014.
31. "PVD Tree Plan; Community, Climate and Health." *Providence Neighborhood Planting Program*, 2019.
32. "City of Providence Climate Justice Plan." *Sustain PVD, The City of Providence*, 2019.
33. Dadvand, Payam et al. "Surrounding Greenness and Exposure to Air Pollution During Pregnancy: An Analysis of Personal Monitoring Data." *The National Institute of Environmental Health Sciences*, vol. 120.9 (2012): pp. 1286-1290. JSTOR.
34. Engemann, Kristine, et al. "Residential Green Space in Childhood is Associated with Lower Risk of Psychiatric Disorders from Adolescence into Adulthood." *Proceedings of the National Academy of Sciences of the United States of America*, vol. 116.11 (2019): pp. 5188-5193.
35. Dadvand, Payam, et al. "Green Spaces and Cognitive Development in Primary Schoolchildren." *Proceedings of the National Academy of Sciences of the United States of America*, vol. 112.26 (2015): pp. 7937-7942. JSTOR.
36. Cicilline, David, McMahon R, Still D. "State of Providence's Urban Forest." *City of Providence Forestry Division*, 2008.
37. "Special Legislative Commission to Study Pesticide Control Regulations; Findings and Recommendations." *Rhode Island Senate*, 2018.
38. "StonyFIELDS Organic Play Free Initiative." *Stonyfield Organic*. www.stonyfield.com/playfree
39. "Pesticides in the Diets of Infants and Children." *National Research Council (US) Committee on Pesticides in the Diets of Infants and Children*, 1993. NCBI.
40. Mnif, Wissem et al. "Effect of Endocrine Disruptor Pesticides: A Review." *International Journal of Environmental Research and Public Health*, vol. 8.6 (2011): pp. 2265-2303. NCBI.
41. "Lead screening during pregnancy and lactation." *American College of Obstetricians and Gynecologists*, Number 533 (2012) pp. 416-20.
42. Del Rio, Michelle, Alvarez J, Mayorga T, et al. "A Comparison of Arsenic Exposure in Young Children and Home Water Arsenic in Two Rural West Texas Communities." *BMC Public Health*, vol. 17.1 (2017). NCBI.
43. Lew, Kristi, Acker J, Gabos S, Lee X.C. "Biomonitoring of Arsenic in Urine and Saliva of Children Playing on Playgrounds Constructed from Chromated Copper Arsenate-Treated Wood." *Environmental Science and Technology*, vol. 44.10 (2010): pp. 3986-3991. ACS Publications.