City of Richmond

Report to Committee

To:	Parks, Recreation and Cultural Services Committee	**Date:**	June 29, 2026
From:	Elizabeth Ayers General Manager, Parks, Recreation and Culture	**File:**	06-2345-20-NPAR1/Vol 01
Re:	**Richmond Nature Park Study – Findings and Next Steps**		

Staff Recommendation

That the report titled "Richmond Nature Park Study – Findings and Next Steps", from the General Manager, Parks, Recreation and Culture, dated June 29, 2026, be received for information.

Executive Summary

The Richmond Nature Park (the Nature Park) represents a unique, threatened bog ecosystem that is significant within the City and region. Remnant bog sites such as the Nature Park play a crucial role in the City achieving its sustainability and climate adaptation goals, including those outlined in the Council-endorsed Community Energy and Emissions Plan 2050.

From 2021 to 2023, a City-led comprehensive hydrogeological and biophysical study (the Study) was initiated in response to longstanding and emergent site challenges that have been compounded by adjacent roadworks and climate change, including those related to hydrology, wildfires, and invasive plant species. It sought to update findings from the 2008 Lulu Island Bog report, improve understanding of the transitional bog ecosystem, provide recommendations to conserve, enhance, and restore the ecosystem in the face of climate change, establish focus areas for potential restoration pilot projects, and identify a path forward to mitigate challenges related to hydrology, wildfire risk, and invasive plant species. The results of the Study indicate that challenges related to anthropogenic and climate change effects and the establishment of invasive plant species are leading to the Nature Park transitioning from open, shrub-dominated bog to conifer forest.

While small-scale bog restoration initiatives have been undertaken at the Nature Park to date, the findings of the Study demonstrate that a coordinated, collaborative approach with a dedicated funding source will be essential to ensure successful long-term outcomes. A capital submission to support bog restoration measures will be prepared and submitted for Council consideration as part of a future budget process. It will include a detailed scope of work, budget, and operating budget impact (OBI). With approval, the budget would be used to implement pilot projects that seek to restore and enhance the bog ecosystem, improve hydrogeological conditions, reduce wildfire risk, and manage invasive plant species.

Staff Report

Origin

The purpose of this report is to provide an overview of findings from the Nature Park hydrogeological and biophysical assessment and outline opportunities for bog restoration measures.

This report supports Council's Strategic Plan 2022–2026 Focus Area #5 A Leader in Environmental Sustainability:

> *Leadership in environmental sustainability through innovative, sustainable and proactive solutions that mitigate climate change and other environmental impacts.*

Background

Ecological Relevance of Richmond Nature Park and Bog Ecosystems

The 212-acre (86-hectare) Nature Park encompasses a range of habitats, from bog wetland to small patches of open water wetland, and conifer-dominated to mixed-species (deciduous and coniferous) forest. Although all the habitats at the Nature Park are ecologically significant, the bog ecosystem was a primary reason for setting the area aside as a park site. The park supports a remnant of the historic Lulu Island Bog, which has been designated as a red-listed ecosystem by the BC Conservation Data Centre.

Bogs are unique wetlands characterized by deep organic peat soils and vegetation dominated by *Sphagnum* mosses. The Nature Park began as a raised bog, an ecosystem that is wholly dependent upon precipitation for water. Groundwater in a raised peat bog is a result of local precipitation, which percolates through and is contained within the mounded peat. Groundwater also has a mounded surface and maintains a radial flow from the centre to the margin. In an intact bog, the *Sphagnum* peat soils create this unique ecological condition such that groundwater of the perpetually saturated soil is not in contact with mineral soil, which results in nutrient poor, acidic groundwater and soils. These soils support unique plant species that are adapted to survive in this relatively inhospitable ecosystem while excluding species that require upland and/or nutrient-available mineral soils.

Bogs provide a host of invaluable ecosystem services, such as:

- Hydrological functions, including water absorption and flood control;
- Habitat functions, including the provision of habitat for a diversity of native, unique, and potentially rare species; and
- Climate functions, including carbon fixation and sequestration, and fire control.

Bogs and similar peatland ecosystems serve as significant carbon sinks; while they cover only three per cent of the Earth's surface, they store approximately 30 per cent of the Earth's land-based carbon. On a global scale, bog ecosystems are integral to the carbon cycle and climate regulation. On a local scale, remnant bog sites such as the Garden City Lands and the

Nature Park also provide important ecological functions, including habitat support, hydrological regulation, and biodiversity value. In Richmond, these sites contribute to the City's sustainability, climate adaptation, and ecological management objectives, including those outlined in the Council-endorsed Community Energy and Emissions Plan 2050 and the Ecological Network Management Strategy.

Although the Nature Park has been set aside for conservation since 1970, it has not been immune to external pressures, including drainage-related impacts from the development and expansion of adjacent roadways and ditches, climate-related changes such as altered temperatures and precipitation, and the encroachment of invasive plants. These disturbances have led to modified ecological communities that are distinct from those set aside for conservation over 50 years ago.

Historical Peatland Distribution

The Lower Mainland contains several historical peatlands, including preserved sites such as Burns Bog in Delta and Camosun Bog in Vancouver – refer to Figure 1. In Richmond, Lulu Island originally contained two expansive peatland areas: the Greater Lulu Island Bog and Lesser Lulu Island Bog. The Nature Park is situated within the former Greater Lulu Island Bog – refer to Figure 2, with the Nature Park outlined in red. Figure 3 provides an aerial view of the Nature Park with surrounding context, and property lines in red.

Figure 1 – Historical Peatlands of the Lower Mainland (source: Hebda et al. 2000)

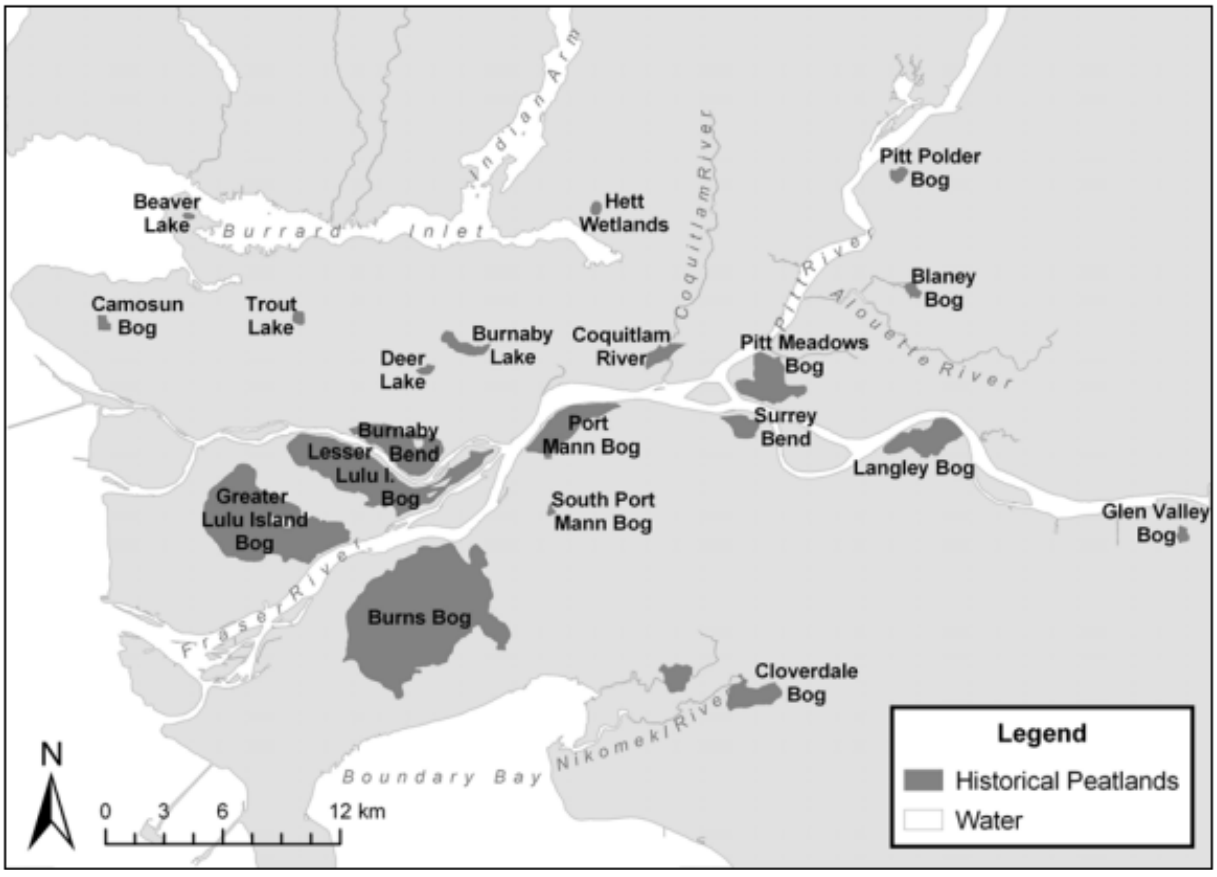

Figure 2 – Historical Vegetation of Lulu Island (source: North 1989)

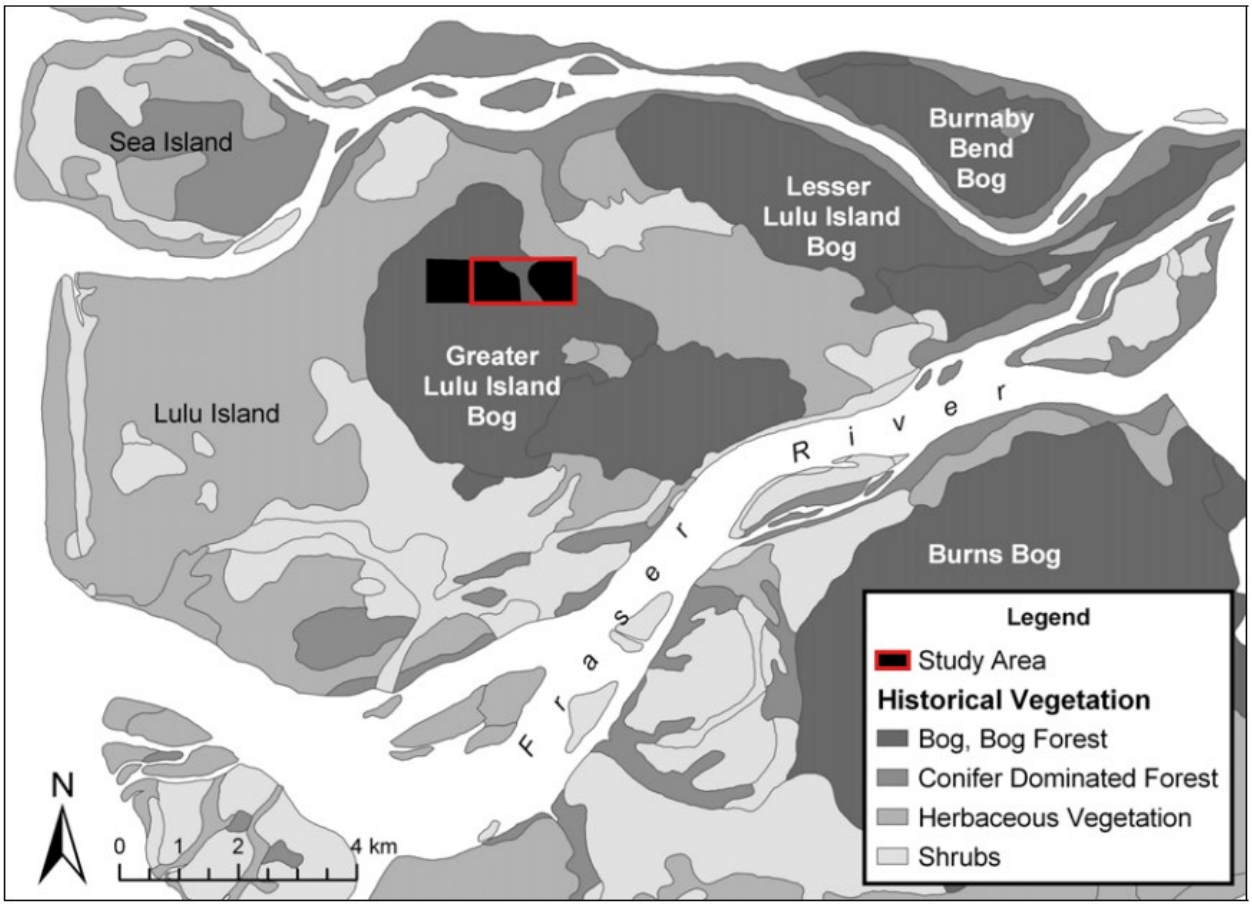

Figure 3 – Aerial Map of the Nature Park

A Biophysical Inventory and Evaluation of the Lulu Island Bog (2008)

In 2008, a comprehensive report titled *A Biophysical Inventory and Evaluation of the Lulu Island Bog* (the Lulu Island Bog report) was produced by editors Neil Davis and Rose Klinkenberg. A project of the Richmond Nature Park Society Ecology Committee, the report summarized findings from a 2001 to 2008 study period that evaluated the Nature Park and Department of National Defence (DND) property to the west. Exploring its significance as a natural area and contributor to regional biodiversity, the intent of this study was to document flora, fauna, and vegetation cover types present in the bog, thus enabling informed comparisons with earlier inventory work, and provide a baseline for monitoring and responding to future changes.

Analysis

Hydrogeological and Biophysical Assessment (2023)

In 2021, the City procured the services of a Qualified Environmental Professional (QEP) to undertake a comprehensive hydrogeological and biophysical study of the Nature Park. The Study was initiated in response to longstanding and emergent site challenges that have been compounded by Ministry of Transportation and Transit roadworks, including grading and drainage modifications, and climate change. These include issues related to hydrology, wildfire occurrences and heightened risk, and the spread of invasive plants which have reduced sightlines and adversely affected native bog species.

The Study also serves as an update to the 2008 Lulu Island Bog report by documenting the current hydrogeological status, i.e., distribution, movement, and quality of groundwater, and completing a biophysical inventory, i.e., observation and assessment of biological and physical characteristics, including ecosystem and habitat mapping. The Study was conducted between 2021 and 2023 to account for seasonal variability and provide the most complete picture possible. The Nature Park Society was engaged over the course of the Study, with regular updates provided by Parks Programs staff. Refer to Attachment 1 for an executive summary of the Study and its findings.

Project Objectives

The key objectives of the Study were to improve understanding of the transitional bog ecosystem, including how it has changed since the 2008 study was completed, provide recommendations to conserve, enhance, and restore the ecosystem in the face of climate change, establish focus areas for potential restoration pilot projects, and identify a path forward to mitigate challenges related to hydrology, wildfire risk, and invasive plant species.

Project Focus Areas and Methods

The Study identified a range of focus areas including water, vegetation, wildlife, and ecosystem mapping that necessitated deployment of a diverse range of methodologies. The investigation focused on water included the installation of monitoring wells, ground and surface water sampling, and a study of bog chemistry. Vegetation was studied by way of a rare plant survey and invasive species study, and wildlife was documented via desktop and field studies, the latter including environmental DNA (eDNA) sampling, automated recording unit (ARU) surveying,

and bat detector recording. The ecosystem mapping component employed desktop and field reviews as well as drone flights to identify distinct ecological communities, areas of interest, e.g., those determined to warrant further study and/or interventions, and habitat suitability for wildlife species of concern.

Project Findings

The Study's findings were comprehensive and informative. It was determined that water losses are occurring, both through evaporation and the ground layer, and that a significant lowering of the peat aquifer level is occurring during summer months. While it is anticipated that the increasing presence of invasive plant species and effects of climate change will exacerbate the overall drying of the site, areas of intact *Sphagnum* mosses and other bog indicator species provide opportunities for restoration. In terms of water quality, the central portion of the site indicated water chemistry reminiscent of a typical bog environment, while the perimeter reflected non-bog/transitional conditions.

While no rare plants were identified, several bog indicator species, including *Sphagnum* mosses, bog rosemary, western bog laurel, labrador tea, and cloudberry, were present. Fifteen invasive species were identified, with two of the most impactful being highbush blueberry and European birch. Highbush blueberry is a horticultural escapee that forms dense thickets with the capacity to obstruct light from reaching the ground and species of mosses and herbaceous plants. European birch is a fast-growing deciduous tree that opportunistically invades wetlands such as bogs. This species forms extensive root networks that can have a disproportionate impact on bog ecosystems through its effective uptake of water and nutrients, contributing to drying of the bog through high rates of evapotranspiration.

The wildlife community at the Nature Park was determined to be largely unchanged since the 2008 Lulu Island Bog study. Most species of birds, reptiles, amphibians, fish, and dragonflies reported in 2008 were confirmed to still be present, with much of the data obtained through recorded eBird and iNaturalist observations. Newly detected at-risk species include peregrine falcon, purple martin, black-crowned night-heron, and blue dasher dragonfly.

The ecosystem mapping component of the Study revealed that ecological communities are transitioning from open, shrub-dominated bogs to conifer forest. Eight areas of interest were identified and mapped, including an area where invasive plant management and bog restoration measures are being actively conducted, areas with well-preserved bog ecosystem features, and an area affected by fire in 2021. Maps were prepared to indicate habitat suitability and recovery potential for two species of concern: barn owl and little brown myotis (little brown bat).

Recommendations

The Study affirmed that the bog ecosystem is experiencing synergistic pressures, including those related to anthropogenic and climate change effects and the establishment of invasive plants, that are adversely affecting site hydrogeology. As such, it is anticipated that a sustained, multifaceted approach to restoration will be necessary to conserve and restore areas of bog habitat while addressing challenges related to hydrology, wildfire risk, and invasive plant species. Given the local and regional significance of the Nature Park from educational, ecological, and nature-based

experience standpoints, an approach guided by restoration is essential to ensure it continues to provide these services. A threefold rationale for bog restoration is outlined below:

- To restore an ecologically significant bog habitat that is designated as a threatened ecosystem;
- To reduce fire risk by minimizing fuel load and increasing soil moisture; and
- To improve sightlines and increase accessibility for users, maintenance and fire response activities by removing dense highbush blueberry.

As suggested by the above rationale, bog restoration efforts are anticipated to result in mutually beneficial holistic outcomes. For example, managing invasive plant species and improving site hydrogeology has the potential to improve bog ecosystem health while concurrently reducing wildlife risk. Table 1 provides examples of bog restoration opportunities sorted by category.

Table 1 – Bog Restoration Opportunities

Restoration Category	**Example Opportunity**
Ecological Restoration	• Establish long-term ecological monitoring to inform restoration planning, assess ecosystem response, measure outcomes, and support adaptive management.
Hydrogeological Restoration	• Identify and seal breaches in the silty clay strata below the peat layer to reduce water loss and improve bog hydrology.
Vegetation Restoration	• Actively increase populations of native, desirable plants in areas where invasive species have been removed and in areas of disturbance.
Wildlife Restoration	• Improve habitat suitability by removing invasive trees, retaining open water habitats, and installing nest/roost boxes.
Fire Management	• Develop a site-specific fire management plan in collaboration with Richmond Fire-Rescue that incorporates best practices for prevention, control, and post-fire recovery.

Ecological monitoring will be a vital component of future work to assess the effectiveness of restoration activities, document successional changes, and assess ecological responses to local conditions. Three forms of monitoring are recommended: survey-based monitoring, drone camera monitoring, and long-term monitoring plots.

Presentation to Advisory Committee on the Environment (ACE)

On April 8, 2026, an overview of the Study, findings and next steps were presented to the Advisory Committee on the Environment (ACE). The presentation was positively received, with

the committee sharing a few comments and questions pertaining to opportunities for collaboration and the importance of fire management over the long term. The committee was advised that they would be kept informed of updates and future initiatives related to bog restoration.

Next Steps

While bog restoration initiatives have been undertaken at the Nature Park, efforts to date have been small in scale. Broader restoration is now warranted given the potential benefits for ecosystem health, hydrogeological function, wildfire risk reduction, and invasive plant species management. Advancing this work will require a coordinated approach and dedicated funding to support both implementation and the long-term viability of the bog ecosystem.

A capital submission to support bog restoration measures will be prepared and submitted for Council consideration as part of a future budget process. The capital submission will include a detailed scope of work, budget figure, and associated OBI. With Council approval, this budget would be used to implement pilot projects that seek to restore and enhance the bog ecosystem, improve hydrogeological conditions, reduce wildfire risk, and manage invasive plants.

Opportunities to develop a fire management plan in collaboration with Richmond Fire-Rescue will also be explored. As potential bog restoration measures will require a holistic, interdisciplinary approach, future planning and implementation will be informed by relevant subject matter expertise and cross-departmental input. The Richmond Nature Park Society will continue to be meaningfully engaged throughout this work.

Budgetary Implications

There are no budgetary implications at this time. As noted in the Next Steps section of this report, a capital submission and associated OBI will be submitted for Council consideration during a future budget process.

Conclusion

For over 50 years, the Nature Park has provided formative nature-based experiences, unique educational and interpretive opportunities, and regionally significant ecosystem services. A remnant of the Greater Lulu Island Bog, the Nature Park has faced challenges related to anthropogenic and climate change effects, as well as the establishment of invasive plant species.

The results of the 2023 hydrogeological and biophysical study offer insight into the effects these factors have had on the Nature Park's bog ecosystem, and affirm these synergistic pressures are adversely affecting site hydrogeology, which in turn undermines the long-term viability of the bog. Given the local and regional significance of the Nature Park from educational, ecological, and nature-based experience standpoints, an approach guided by restoration is essential to ensure it continues to provide these services.

In order to conserve and restore areas of bog habitat while addressing challenges related to hydrology, wildfire risk, and invasive plant species, it is anticipated that a sustained, multifaceted

approach to restoration will be necessary. Next steps will include the preparation of a capital submission to support bog restoration measures, to be submitted as part of a future budget process.

Bog restoration efforts are anticipated to result in mutually beneficial holistic outcomes, including carbon sequestration, invasive plant and fire management, and enhanced ecosystem services, while allowing the Nature Park to continue offering educational and nature-based experiences that are unique within the region.

Respectfully submitted,

Todd Gross, Director, Parks Services

Report Contributors

This report was prepared by Kevin Fraser, Research Planner 2, and reviewed by Climate and Environment, and Fire-Rescue.

Endorsed by Serena Lusk, CAO

Att. 1: Richmond Nature Park Hydrogeological and Biophysical Assessment – Executive Summary

Executive Summary

The Richmond Nature Park (RNP or 'the park') is an 86-hectare (ha) natural area characterized by forested bog and upland forest, located on Lulu Island in central Richmond, B.C. The park is home to a Nature House and has a long tradition of educational nature programming for public and school groups. The park is bordered by roadways, a railway, and is divided into west and east halves by Highway 99 and Number 5 Road.

The RNP encompasses a range of habitats, from bog wetland to small patches of open water wetland, and from conifer-dominated to mixed-species (deciduous and coniferous) forest. Although all the habitats at the RNP are ecologically important, it was initially the bog ecosystem that was the reason for setting the area aside as park.

The RNP began as a raised bog, an ecosystem that is wholly dependent upon precipitation for water. Groundwater in a raised peat bog is a result of local precipitation, which percolates through and is contained within the mounded peat. Groundwater also has a mounded surface and maintains a radial flow from the centre to the margin of the bog. In an intact bog, the Sphagnum peat soils create this unique ecological condition such that groundwater of the perpetually saturated soil is not in contact with mineral soil, which results in nutrient-poor, acidic groundwater and soils. These soils support unique plant species that are adapted to survive in relatively inhospitable ecosystems while excluding species that require upland and/or nutrient-available mineral soils.

As a bog, the RNP provides multiple ecological services, most notably:

- Hydrological function (e.g. water absorption, flood control and slow release of water during dry periods).
- Habitat function (e.g. provide habitat for diversity of native, unique and possibly rare species).
- Climate function (e.g. carbon fixation and sequestration).

Although the park has been set aside for conservation since 1970, it has not been immune to external pressures from disturbances such as roads and ditches, climate-related changes such as altered temperatures and precipitation and the encroachment of invasive plants. These disturbances have led to modified ecological communities from those set aside for protection over fifty years ago.

Overarching goals of this report are threefold:

1. To investigate and document the current biophysical and hydrogeological status of the RNP.
2. To synthesize the hydrogeological status with the above-ground biophysical state.
3. To provide recommendations to preserve and, where possible, restore patches of what remains of the unique bog ecosystem.

Water

This investigation of groundwater and surface water at the park included installation of three multi-level groundwater monitoring well nests and eight shallow wells, as well as four ditch sample locations. Unfortunately, the wells installed at the eastern portion of the park (RNP East) were vandalized before they were able to yield water level or chemistry data. The four ditch sample locations, and shallow wells at the western part of the park (RNP West), were sampled for chemical analysis. Year-long continuous water level monitoring was conducted at seven well locations at RNP West.

Drilling at RNP West revealed approximately 1.7 metres (m) of peat, underlain by 4 m of silty clay, which was underlain by sand.

Water chemistry results indicate that the water type in the central part of RNP West has remained as bog conditions, while near the margins of the bog, the water chemistry indicates variable bog to non-bog conditions and, in the Nature House pond and park ditches the water is considered to be non-bog or transitional.

There is significant lowering of the peat aquifer level during summer months. This drying is corroborated by the hydrogeological flow calculations and water balance model, which yield similar results. The estimated groundwater discharge rates (losses) is 41% of recharge rate estimated by the water balance model. The differences between the calculated groundwater discharge and water balance model are attributed to uncertainty in the constituent variables, the most significant of which are considered to be hydraulic conductivity and evapotranspiration rate.

Groundwater was measured at a depth of 0.4 m in the wet season (April 2022) and 1.1 m in the dry season (October 2022); the peat had a saturated thickness of 1.4 m in the wet season and 0.7 m in the dry season. Groundwater appears to have a mounded shape and flows radially to the margins of RNP West, as is typical of a healthy raised peat bog. Groundwater also flows downward into the aquifer throughout the year. Estimates of aquifer permeability and gradient indicate that downward flow accounts for 98% of the losses of peat aquifer storage as compared to lateral water losses, including losses into perimeter ditches.

The predicted effects of climate change, including longer, hotter, drier summers, are expected to stress the raised bog ecosystem and the thin saturated peat groundwater system that the bog relies on. Drier conditions may also present a fire hazard. The potential risks of low water levels, particularly in the dry season, are anticipated to be:

- Loss of bog soil structure leading to an irreversible collapse of raised bog ecosystem
- Decomposition of peat leading to release of greenhouse gases
- Complete drying of the peat aquifer leading large-scale death of vegetation
- Increased likelihood of fire leading to use of a potentially scarce water resource in the dry season to fight fire, with potential for fire fighting efforts that may be deleterious to bog health
- Altered recreational and educational public use.

Biophysical

RNP is located within the Coastal Douglas-fir moist maritime (CDFmm) biogeoclimatic subzone (Green and Klinka 1994). According to the BC Biogeoclimatic ecosystem classification system ecosystem description that best fits the ecological communities found at the RNP is the *Pinus contorta – Sphagnum,* or the Lodgepole Pine (*aka* shore pine) – Peat Mosses ecological community, which has been designated as a red-listed ecosystem by the Conservation Data Centre (BC CDC 2012).

The RNP forest is a transitional ecological community that ranges from typical bog ecological community that has been invaded by horticultural blueberry to conifer-dominated forest where soils have been mixed due to anthropogenic activities such as road building (Hwy 99 and No. 5 Road). Park-specific ecosystem mapping was completed in 2022 for the RNP following a methodology modified from the standardized provincial ecological mapping method called Terrestrial Ecosystem Mapping (TEM) (RIC 1998).

The mapping was further refined to highlight "Areas of Interest", which are areas that were deemed by the ecologists to be of special ecological interest for various reasons such as higher restoration potential, high risk of invasive plant spread, historical anthropogenic alterations (i.e. fires) and/or candidate locations for long-term ecological monitoring. Two drone flights were conducted to capture imagery to inform the Areas of Interest. Since these areas could have potential management implications, their mapping will help RNP managers prioritize the allocation of resources and efforts.

Rare plant surveys were conducted to try to locate previously-documented populations of the Blue-listed Vancouver Island beggarticks (*Bidens amplissima*) but no populations were re-detected. There was, however, a population of a similar, albeit non-native, plant species, three-parted beggarticks (*Bidens tripartita*), found in a location where *B. amplissima* had previously been documented.

The RNP is home to many non-native plant species, some of which are considered invasive while others are simply introduced plant species which have naturalized in the region but that don't pose a threat to the local ecology. The most abundant and deleterious invasive plants in the park are highbush blueberry and European birch. Recommendations for managing invasive plants are summarized in in this report and a project-specific, stand-alone Invasive Plant Management Plan is provided as an appendix to the report (see **Appendix F**).

The vegetation in a bog habitat is defined by plant species that are unique to systems with low pH and low nutrients. A list of these bog-related species observed within the RNP is compiled along with guidelines for propagation and translocation into restoration areas and is provided as an appendix to the report (see **Appendix I**).

Wildlife usage at the RNP was documented through a range of methods including targeted surveys, Environmental DNA (eDNA) analysis and reviewing occurrences reported through Citizen Science initiatives. eDNA sampling was conducted in aquatic features of RNP to determine the presence of aquatic species such as fish and amphibians in open water habitats in the park.

Wildlife documented through the review of the citizen science programs eBird and iNaturalist included birds, mammals, amphibians and insects. A lengthy list of wildlife species was generated and cross-referenced with previously-documented species to ascertain whether or not species have been re-detected or are newly detected. This full list of wildlife species is provided as an appendix (see **Appendix G**). Approximately 85% of the bird species detected in 2008 have been redetected. Although some of the butterfly species reported in 2008 have not been re-detected since, there have been many new species of dragonflies, bees and spiders detected in RNP.

Targeted wildlife field surveys consisted of walking bat recording transects using handheld bat detectors as well as through installation of a remote bat detector that was deployed at the canal/ditch on the east side of RNP West on two separate occasions, each for 9 days, one in summer 2021 and the other in spring 2022. Four bat species were confirmed as recorded by the ARU (with many more calls unconfirmed). The four confirmed species were the silver-haired bat (*Lasionycteris noctivagans*), the big brown bat (*Eptesicus fuscus*), Californian myotis and the federally Endangered and provincially Blue-listed little brown myotis (*Myotis lucifugus*). The walking transects recorded four confirmed species: big brown bat, Californian myotis, little brown myotis and the Blue-listed Yuma myotis (*Myotis yumanensis*).

A remote recorded survey for vocalizing birds, was conducted using an Automatic Recording Unit (ARU), deployed at the Nature House pond in July 2022. Several bird species were recorded (Table 4.14) as well as two amphibians: Pacific treefrog (*Pseudacris regilla*) and the invasive green frog (*Lithobates clamitans*). No American bitterns were documented.

Fire Management

Although we have not conducted site-specific studies pertaining to fire as this is beyond the scope of this project, we do recommend a fire management plan for the RNP that includes measures for prevention, control and monitoring that considers ecological principles. Recommendations for fire management include prevention measures such as reducing fuel load by removing invasive shrub and tree species, and increasing soil moisture through decreased evapotranspiration. We also recommend including in the fire control/response plan the consideration of the fire-retardant types (both water and chemicals) as they will likely have an impact on the water chemistry of the site should they be deployed. As fire is part of a bog's natural disturbance regime, and since multiple fires have occurred recently in the RNP, (2021 and 2023), we recommend monitoring the site of the fire to observe post-fire responses in the ecosystem (e.g. vegetation regrowth, soil moisture, wildlife usage etc.).

Restoration

The RNP as a provincially red-listed ecological community and one of the few remaining remnants of the Lulu Island Bog, is ecologically important both locally and regionally. Although some areas the RNP are transitioning from a bog ecosystem towards a forested ecosystem (particularly where the mineral and organic soil layers have been mixed, near the No. 5 Road and Hwy 99), there still remains large areas within the park which retain both bog soil and water quality features and have potential for restoration. These areas will benefit from restoration activities such as vegetation and water management as well as artificial wildlife habitat structures.

The rationale for seeking to restore portions of the RNP West are threefold.

1. Restore an ecologically important bog habitat that is designated as a Red-listed ecosystem.
2. Reduce fire risk via minimizing fuel load and increasing soil moisture.
3. Improve sight-lines along trails by removing dense highbush blueberry.

Since the bog is experiencing multiple, synergistic pressures such as invasive plants and changes to hydrology due primarily to climatic effects from prolonged dry periods and higher temperatures during summer months, multiple interventions will be necessary to restore areas of the bog habitat. Recommended restoration activities include a combination of hydrological measures to address the soil drying as well as vegetation restoration measures to reduce evapotranspiration and afforestation of the bog. Ideally, the intended outcome for the park would be to reverse the trend of afforestation.

Restoration activities include removing invasive shrubs and trees, replanting native vegetation and enhancing soil and groundwater levels for a longer period of the year.

We recommend initiating restoration efforts in small trial areas and subsequently expanding areas where restoration efforts are deemed successful, while adaptively adjusting the methods where necessary. A good example of a restoration activity with incremental expansion has already been initiated along the Quaking Trail where highbush blueberry shrubs have been cut and covered with landscape textile and native vegetation has been successfully re-colonizing the site. This habitat restoration also benefits birds such as common nighthawk and barn owl and bats such as little brown myotis, who prefer open habitat with low vegetation for foraging, and nesting. Installation of nest boxes and bat roosts will also promote the use of the RNP by desirable wildlife.

Since groundwater flow has been deemed to move slowly across the horizontal plane, it is likely possible to manage groundwater in the peat aquifer to allow for localized restoration efforts involving water levels in priority areas. Considering that most of the water losses occur at the top and bottom of the peat, restoration and monitoring efforts that aim to enhance water levels at the top and bottom of the peat seem likely to have the greatest effect.

In general, water levels may be enhanced through increasing inputs or reducing outputs of water. Some ideas for water level enhancement are suggested in the **Restoration and Monitoring** section of this report.

Some additional future projects to better understand the ecological system at RNP include an elevation survey of the bottom of ponds at Richmond Nature House (near MW21-02) and the linear ponds on the margins of the highway to evaluate if there may be a breach in the silty clay unit that may be a preferential downward flow pathway.

Since restoration efforts can be labour-intensive, we recommend establishing volunteer work parties, led by one or more City of Richmond staff. There may already be precedents for using volunteer labour to perform restoration work in City of Richmond parks, but if not, examples of effective volunteer programs also exist elsewhere in British Columbia, such as invasive plant removals at Saanich Parks on Vancouver Island and native plant propagations at Maplewood Flats native plant nursery as well as other natural area management organizations such as Stream Keepers.

Monitoring

Ecological monitoring allows managers to track the effectiveness of restoration practices as well as tracking the status of stochastic events (such as fires) on habitat features, soil, water etc. while providing a basis from which to compare to other similar areas, such as the DND Richmond Training Facility and Burns Bog in Delta.

Baseline hydrological monitoring was initiated in this project and can be continued by reinstating the transducers in the monitoring wells. We recommend extending the hydrological monitoring program to include measuring evapotranspiration (through lysimeter installations) and surface runoff to improve the conceptual water balance and to evaluate performance of pilot-scale vegetative restoration.

We recommend continued monitoring of hydrological test locations at RNP West to improve the temporal relevance and expand the spatial confidence of inputs to the water balance since water inputs and output change on an annual basis.

Ecological monitoring is useful for several reasons and in various situations:

- To track effectiveness of restoration activities, where possible, starting with baseline/pre-activity.
- To document successional changes in ecological parameters following stochastic natural system re-sets (such as fire) or anthropogenic/planned physical activities that may have indirect effects on an area (such as road building or other disturbance)
- To document ecological responses to local conditions, such as climate, experienced in a reference area (i.e., area that isn't subjected to active restoration efforts).

Types of ecological monitoring utilized for this project included survey-based monitoring, drone camera monitoring and initialization of long-term monitoring plots.

The RNP is easily accessible to naturalists, scientists, students and park visitors, making it an ideal place to collaborate on long-term monitoring projects with academics, citizen scientists and/or volunteers. The RNP could serve as a natural laboratory/training facility where university students and youth from local First Nations communities, can learn invaluable skills and techniques in the field of environmental science, from setting up and managing water monitoring wells/piezometers to calculating carbon capture and respiration, tracking evapotranspiration, and monitoring for vegetation, bats, birds, amphibians, insects and other animals.

Acknowledgments

The project was a collaborative effort and came together through the assistance of many people. Ausenco would like to acknowledge the contributions of the following individuals:

- Nicole Tennant from Cascara Environmental Ltd. for completing the Terrestrial Ecosystem Mapping (TEM).
- Rich Kenny and Kris Bauder from the Richmond Nature Park Nature House for providing guidance and historical knowledge of the RNP.
- Markus Merkens from Metro Vancouver for providing information about bog vegetation ecology at the Burns Bog.
- Sarah Howie from City of Delta for providing information on bog hydrology at the Burns Bog.
- Dr. Sophie Wilkinson from SFU School of Resource and Environmental Management (REM) for insight into bog fire ecology.
- Edmund Strachan from Ausenco for contributing technical advice on bog restoration.