



RED ROCKS PARK

**Working towards a community-based
management plan**

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for the City of South Burlington
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Dedicated to Fred Sargent and the members of the city's original Natural Resources Committee, who had the vision and drive to secure Red Rocks as a park for the residents of South Burlington.

With thanks to the current members of the Red Rocks Committee, Tom Hubbard of South Burlington Recreation & Parks, the UVM advisory committee (Matt Kolan, Jeff Hughes & Walt Poleman), and the Field Naturalist/Ecological Planning Team AC.

TABLE OF CONTENTS

| | |
|--|-----------|
| SECTION 1: INTRODUCING RED ROCKS..... | 1 |
| Key management issues and objectives..... | 1 |
| Purpose of this document..... | 1 |
| Locator map..... | 2 |
| SECTION 2: PARK HISTORY..... | 3 |
| The first owners..... | 3 |
| The Hatch Estate..... | 4 |
| Tracing the ongoing history through air photos..... | 5 |
| Acquisition by South Burlington..... | 8 |
| SECTION 3: NATURAL RESOURCES..... | 10 |
| Geology..... | 10 |
| Soils..... | 13 |
| Hydrology..... | 15 |
| Natural communities..... | 16 |
| Wildlife..... | 21 |
| SECTION 4: MANAGEMENT CONCERNS..... | 22 |
| Invasive plants..... | 23 |
| Trails..... | 27 |
| Off-leash dog impacts..... | 32 |
| Forest health and management..... | 33 |
| Beach management..... | 35 |
| CWD easement..... | 36 |
| Parking area..... | 38 |
| Funding..... | 39 |
| Signage..... | 39 |
| Long-term conservation..... | 40 |
| SECTION 5: RECREATION & EDUCATION..... | 41 |
| SECTION 6: A DECISION-MAKER'S GUIDELINE..... | 43 |
| Values and goal-setting..... | 43 |
| Management limitations..... | 44 |
| Opportunities and key stakeholders..... | 45 |
| Managing people and encouraging compliance..... | 46 |
| Ongoing process..... | 47 |
| SECTION 7: SUMMARY OF MANAGEMENT ACTIONS..... | 48 |

| | |
|---|-----------|
| REFERENCES..... | 51 |
| FURTHER READING..... | 52 |
| APPENDICES..... | 53 |
| (1) Red Rocks from the air..... | 53 |
| (2) Current Park Trail Map..... | 54 |
| (3) Timeline: History of Red Rocks..... | 55 |
| (4) Plant Species List..... | 56 |
| (5) Animal Species List..... | 58 |



SECTION 1: INTRODUCING RED ROCKS

Red Rocks Park is a 100-acre community park and natural area in the city of South Burlington, Vermont. It was purchased by the City in 1970, having formerly served as the Hatch Family Estate since the late 1800s. The roads and lookouts created by the Hatch family now provide walking trails through maple-ash-hickory-oak forest and cedars perched atop red Monkton Quartzite cliffs. A city beach at the southeastern edge of the park provides 200 yards of waterfront access (the only public lake access in the city), and the Champlain Water District operates a pumping station with an adjacent 40-ft access easement at the western limit of the beach.

Red Rocks is one of four large natural areas in the South Burlington Parks network (the others are Wheeler Nature Park on Dorset Sreet, the Scott Property on Autumn Hill Road, and a recently acquired property south of Nowland Farm Road). Red Rocks occupies the westernmost corner of South Burlington (see Map 1). It is bordered by Lake Champlain to the south and west, Burlington to the north, and the Queen City Park neighborhood to the east. The park is accessed from Central Avenue.

The park is currently operated by the South Burlington Recreation & Parks Department and maintained by the Department of Public Works. Guidance and recommendations are provided by a seven-member committee of appointed city residents, many of whom reside in the Queen City Park neighborhood.

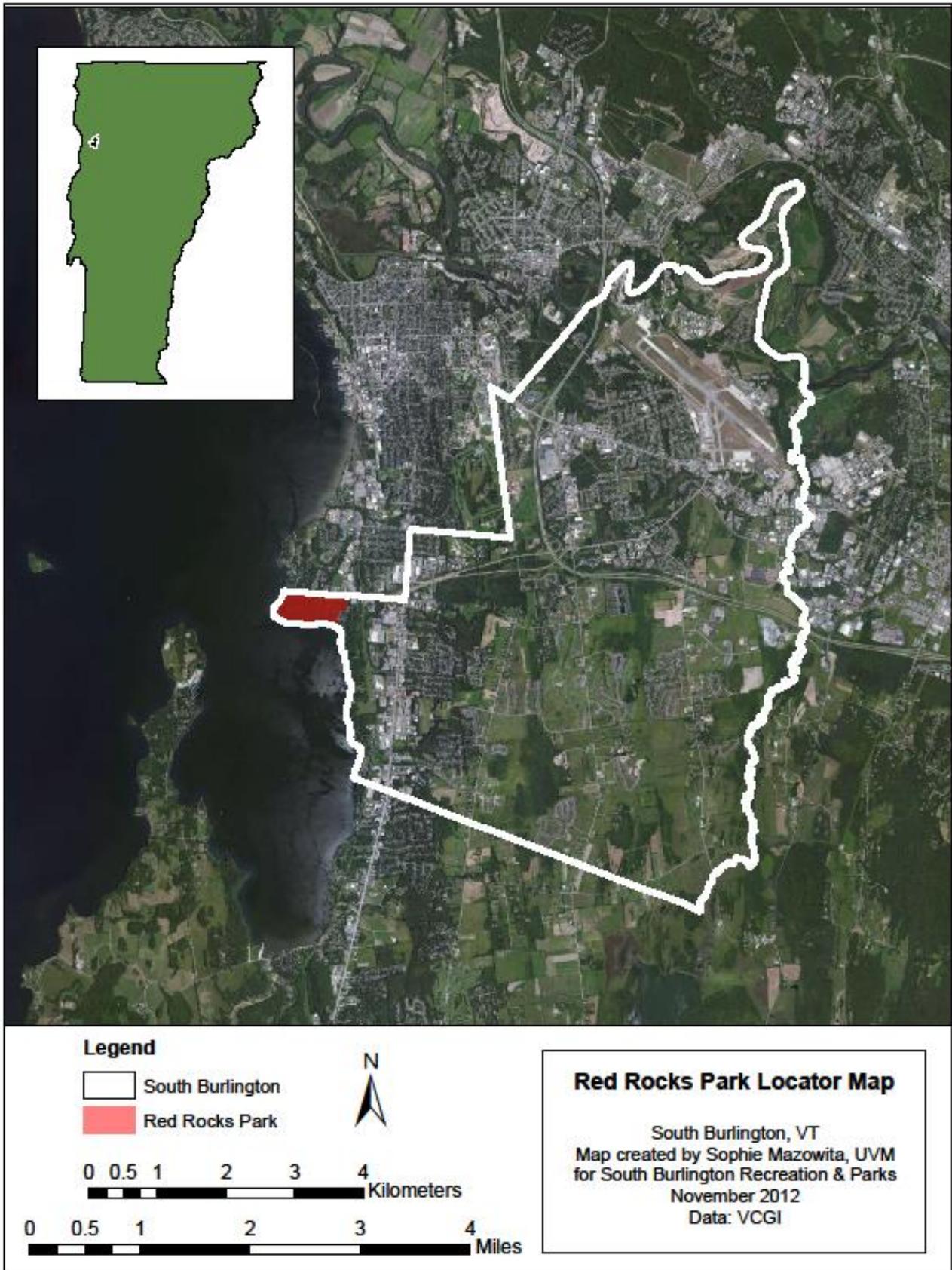
Key management issues and objectives

Red Rocks faces challenges posed by heavy recreational use by the public. Aquatic and terrestrial invasive species, off-leash dog impacts, unofficial trail use, forest health, and park signage are among the concerns of the park's management. The City seeks to provide a variety of recreational opportunities in Red Rocks Park while maintaining ecological integrity, minimizing usage impacts, and addressing threats and hazards.

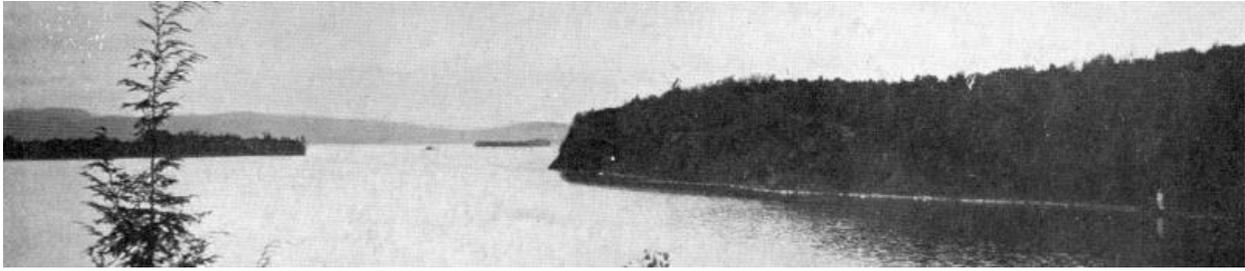
Purpose of this document

Despite ongoing management questions and concerns, this is the first synthesized natural resource assessment and management study for Red Rocks. Landscape architects made only an initial site assessment and recommendations in 1971.

This document is intended to serve as both a guide to the human and natural history of Red Rocks and as a guiding framework for making informed management decisions. It is written for park managers, park users, and the present and future stewards of Red Rocks Park.



Map 1



SECTION 2: PARK HISTORY

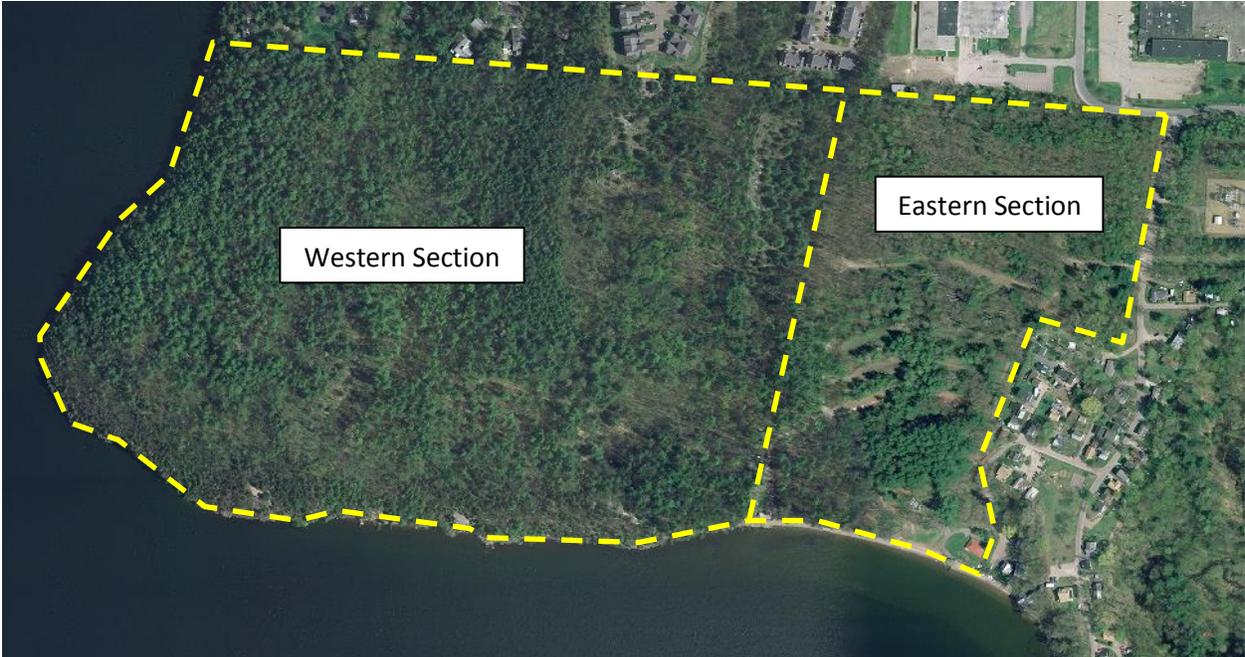
SUMMARY:

- Edward Hatch purchased Red Rocks and maintained it as a private estate starting in 1866
- Parts of the park were formerly used as pasture and woodlot
- The City of South Burlington purchased Red Rocks from the Hatch family in 1970

The first owners

When Red Rocks—the Hatch Estate—was purchased by the City of South Burlington, it came as a single large tract of land. Through the 19th century, however, it was divided up in various parcels between different landowners. In retracing the history of the land, it helps to divide the park into two large sections:

- (1) The eastern, “developed” section, from the Central Ave entrance to the north-south boundary where the hiking trails begin (this section includes the parking lots, picnic area, beach, CWD easement, and the northeastern loop walking trail).
- (2) The western, “natural” section, stretching from the north-south parking road/hiking trail boundary out to the far western tip of the park.



Map 2. Aerial view of Red Rocks showing the division between East and West sections of the park.

The western, now fully-wooded section of Red Rocks is first described in the Old Town of Burlington records as lot no. 163. The lot was drawn by Thomas Udell at a meeting of town proprietors in June 1798, when the first settlers of Burlington were dividing up their shares of the land in the form of 103-acre lots. The original lot was described based on its trees: “beginning at a pine standing on the lake shore,” thence 3 chains (a chain is 66 feet) east to an ash, then 25 chains north to a beech, and from there 46 chains west “to a cedar on the lake shore, thence southerly along the lake shore to the first bound.”

Between 1798 and the early 1800s, the ownership and land use history of the property is unknown. This was a time when much of Vermont was cleared for agriculture and timber, and Red Rocks was probably no exception. An 1836 article in the Burlington Free Press describes a 60-acre parcel called Red Rocks as “the Wood Lot of Ozias Buell.” Soon after this it was purchased by Joseph Harrington, who conveyed it to his son, Hiram Harrington, in 1844.

Edward Hatch bought this western section (or at least part of it) from Harrington in 1866; one portion was sold to his brother-in-law, Lucius Chittenden, that same year. Chittenden rose to fame as Register of the Treasury during the Lincoln administration. He owned a piece of Red Rocks for 25 years, but by 1891 the entirety of the western 70-acre parcel was in Edward Hatch’s possession.



The Hatch Estate

This acquisition coincided with a flurry of activity on the property. In August 1891, the Free Press announced that Hatch was finally making “improvements” to Red Rocks. Hatch enlisted Charles A. Murray to oversee the construction of a quarter-mile drive “forming a continuation of the road to Queen City Park.” Another road that “runs up a ledge” (most likely the eastern loop road towards the highest spot in the park) was also started at this time. These carriage roads were largely constructed from a bed of broken stone on the point, and they exist to this day as two and a half miles of hiking trails.

The carriage roads led to a Lookout House at the far western point of Red Rocks. This gazebo-like structure of white and red cedar, with a hemlock bark roof, was built in part by Hatch himself. He considered building a residential cottage, but this never came about. Pre-existing buildings on the property reportedly burned down and were never rebuilt.

The Life of Edward Hatch (1832-1909)

Edward Hatch was born in Norwich, Vermont on July 11, 1832 . He moved to Burlington when he was 5 years old. After amassing a fortune at the helm of the Wilcox & Gibbs sewing machine company, he took on management of the Lord & Taylor Department Store in New York.

Hatch spent his summers in Burlington, and he acquired Red Rocks between 1866 and 1907. He never lived on the property, instead taking up residence in the Hotel Vermont adjacent to City Hall Park. In the early 1890s he installed the Red Rocks carriage road system that persists to this day as a hiking trail network. He died in Burlington on September 9, 1909.

Hatch acquired the eastern section of Red Rocks just two years before his death. This parcel underwent many changes of ownership in the mid- to late 1800s: from Levi Underwood to John Kelly in 1860, to C. Cushman in 1864, to John Dickson in 1866, and then to Frank Converse in 1880. Frank and Abbie Converse leased summer cottages along the beach before they sold the land to Hatch in 1907. This different ownership history explains the difference in character between these two pieces of land—a difference that can still be felt and that likely influenced the layout of today's park. To the west lies the land set aside as Hatch's private woodland and carriage road system since 1866; to the east is a smaller parcel with a patchy ownership history and more recent evidence of forest clearing and agricultural use.

Tracing the ongoing history through air photos

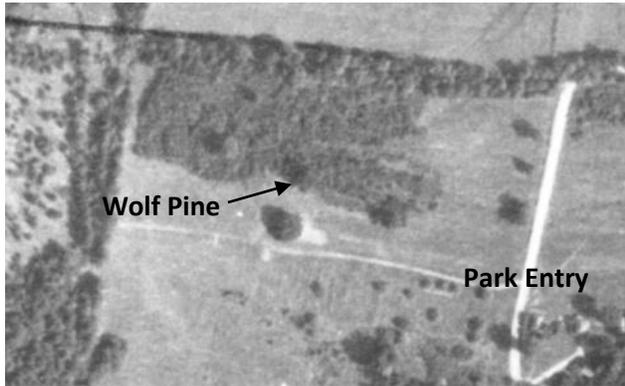
Local lore tells that Edward Hatch used Red Rocks as a summer resort from 1888 until his death in 1909. What happened after that?

The park stayed in the Hatch family, but it was relatively untended from 1910 until it became a public park in 1971. Untended did not mean unvisited—during this time, the park still served as a backyard for the residents of Queen City Park (a thriving summer spiritualist camp until 1930, before becoming a residential neighborhood). There is also evidence of both logging and farming during this time period.

Part of this evidence comes from historical air photos of the park, beginning in 1942:



The eastern section of the park is almost totally cleared—perhaps as pasture—in 1942, though trees are growing in to the north following agricultural abandonment. The opening in the forest to the west also stands out. It is being maintained as a clearing, the exact use unknown. This land sits adjacent to the western loop of the carriage road network, in an area of very fine-grained clay soils that retain a lot of moisture. Today it is filled in with dense growth of young trees suited to the area’s wetter soils.



Also very noticeable in the 1942 image are several large trees growing in the open near the park entry. One of these is the “wolf pine” that many visitors notice to the right of the road as they head into Red Rocks today. This old white pine is now surrounded by other growth, but its wide-spreading branches stand as evidence that the tree grew in open, sunny conditions. The term “wolf tree” could refer to the fact that the tree once stood like a lone wolf on the landscape.

The convoluted branches of the wolf tree provide another clue to this pine’s past. The multiple trunks and upturned branches are evidence of infestation by a tiny beetle called the white pine weevil. This insect lays its eggs only in the tips of white pine trees growing in full sun. Normally the top shoot of the tree would grow straight skyward, producing a single whorl of branches each year. When the weevil eggs hatch, however, the larvae kill this top shoot, and the side branches end up curving upwards to take over the role as the growing tip of the tree.



The next image from 1962 (see next page) shows several important changes:

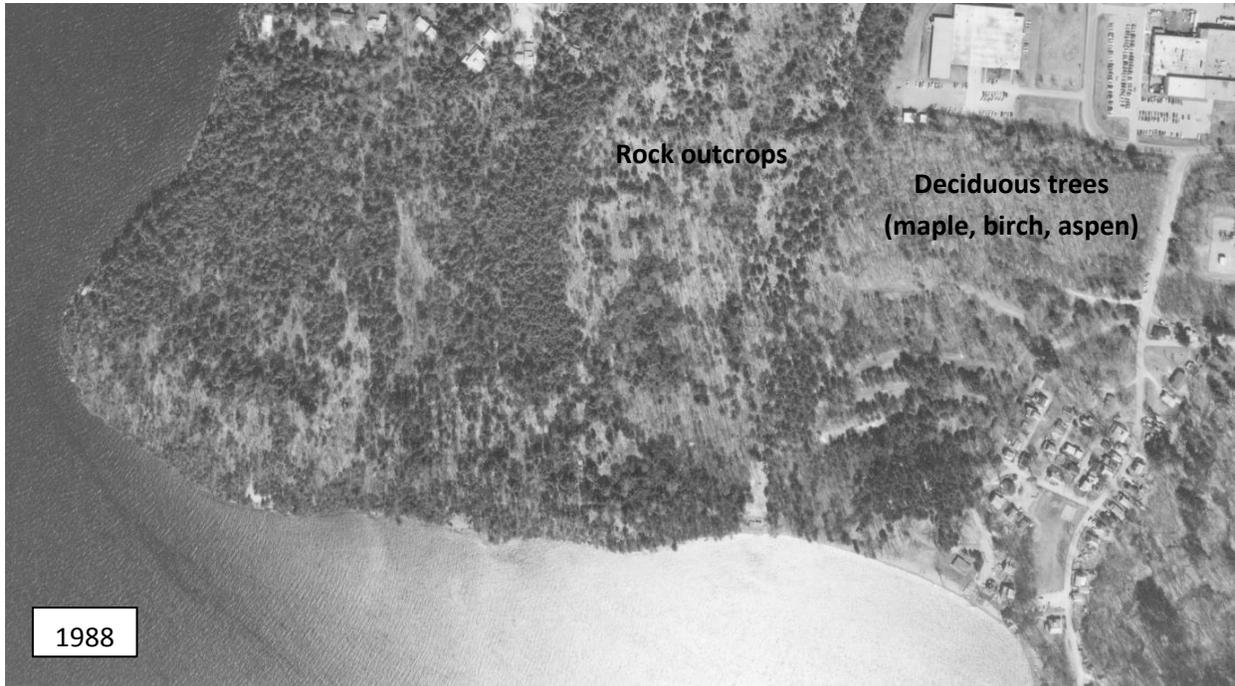
- New trees have already grown up all around the wolf pine; the park entry area and the western clearing are closing in.
- Rows of pine trees have been planted in what was the southernmost bit of the clearing in the eastern side of the park. Today these trees tower over the grassy picnic area between the parking lots and beach.

- There is the first hint of residential development at the top left corner of the image, just across the park boundary: South Cove Road is under construction.
- The open fields at the top right of the 1942 image have been filled in with industrial development, along the newly build Industrial Parkway.



By the time of the next image, from 1974, the City had purchased the park and constructed parking lots in the eastern side. The cottages once present along the beach are razed, the bathhouse is under construction, and further housing development abuts the northwest edge of the park.





This last image is from 1988 (see Appendix 1 for a 2012 color air photo of Red Rocks). Parts of the park may look denuded of trees here, but that is mainly because many of the trees are missing their leaves; this photo was taken in April, before leaf-out. This reveals the pattern of deciduous vs. evergreen trees across the park. The northeastern corner where the wolf tree stands, for example, is now full of red maples (*Acer rubrum*) and other hardwoods; these show a paler gray color compared to the evergreen cedar and hemlock trees, for example, on the western shore of the park. Note the difference between the pale gray of the deciduous growth compared to the even paler areas of rock outcrop and bare soil.

The construction trend continues in 1988, with more houses showing up just across the northern limit of the park, which also happens to be the dividing line between Burlington and South Burlington. Could the development have continued southward into present-day Red Rocks, had it not been for this municipal boundary? Or for the Hatch Family keeping their estate intact?

Acquisition by South Burlington

The aerial photos above show a quick transition from field to forest to the parking pods of Red Rocks Park, but the transfer of ownership was not a quick process.

The industrial development first apparent in the 1962 image is an important part of the story; there was an interest in extending this development southwards, into the northeastern corner of Red



Red Rocks was once a more manicured landscape, as depicted on this 1908 postcard. This same carriage road now passes through full forest cover, the lawn replaced by fallen leaves.

Rocks, in the mid-1960s. The Hatch family petitioned the City to rezone the land as light industry (which would have raised the property value above its standing \$450,000 estimate).

Some City officials and local conservationists, on the other hand, were keen to keep Red Rocks as a park. In 1967, a technical team under the direction of UVM Professor Fred Sargent inventoried 16 South Burlington sites with natural resource potential. Red Rocks made the top of the list: "it is felt that no nature center in the county if not in the state can compare with Red Rocks." The report recommended the land for a nature center and picnic area and suggested that The Nature Conservancy could be interested, should the City not choose to acquire it as a public park.

Fred Sargent led the effort to purchase Red Rocks from the Hatch Family, with support from South Burlington residents who formed the city's original Natural Resources Committee. In May 1970 the property became available to the town at a cost of \$450,000. Thanks to a \$200,000 grant from the federal Land and Water Conservation Fund and \$152,000 from the state, the purchase was expected to cost the town only \$100,000 (or \$1000/acre). In June 1970, residents voted 1094 to 98 in favor of a bond to purchase the park at this price. They ended up paying even less because the Hatch family made a gift of \$50,000.

South Burlington officially took ownership of Red Rocks on October 5, 1970.



Robert Hatch (standing) turning over the deed to Red Rocks to (from left to right) Selectman C. Harry Behney, town treasurer Helen Paquin, and Natural Resources Committee chairperson Barbara Bull (Burlington Free Press 10/6/1970).



SECTION 3: NATURAL RESOURCES

SUMMARY:

- Red Rocks gets its name from the **iron-rich Monkton quartzite rocks** that underlie the park. These rocks are formed of sand that formed the shoreline of a shallow sea 500 million years ago, then was transformed by heat and pressure during the formation of the Green Mountains.
- The **soils of Red Rocks are mostly loams** (a mix of particle sizes) with a **shallow depth to bedrock** (under 2 ft in most locations, with many bedrock exposures).
- The park has several wetland areas, where either very fine soils or the shallow bedrock cause water to stay perched at or near the ground surface. These **wetland areas are the site of vernal pools** that are important to breeding frogs and salamanders in the spring.
- The Red Rocks forest houses a **diversity of plant communities**, including a **state-significant limestone bluff cedar-pine forest** at the southwestern cliff edge.
- The Red Rocks forest is a **mix of northern hardwood tree species including maples and beech, along with oaks and hickories** that favor more warm and dry conditions.
- The park hosts a diversity of wildlife, most notably 135 species of birds. Special habitat features include mature forest, fallen woody debris, standing snags, mast-producing acorn and hickory trees, and cliff ledges.
- The **Lake Champlain shoreline** is a key feature of Red Rocks and an **important corridor for wildlife** in South Burlington.

Geology

Bedrock geology

You need to reach much further back in time—long before Thomas Udell drew ownership rights to Red Rocks in 1798—to uncover the geological story that gives Red Rocks Park its name.

The park's namesake rocks are part of the Monkton Quartzite formation, which stretches in a band from Colchester down to Addison County. Many buildings around Burlington are made from this rock, and some of the most notable are on UVM's redstone campus. Their material came from the redstone quarry just east of Shelburne Road.

These rocks formed from sediments laid down 500 million years ago, in the early Cambrian period, on the floor of a warm, shallow tropical sea called the Iapetus Ocean. Due to the movement of tectonic plates, Vermont was situated near the equator at the time, and South Burlington was near the sandy beach and shallows at the edge of the continent. Over many millions of years, the sandy sediments deposited in the water there solidified into sandstone.



The pattern of rock, as seen from Lake Champlain, reveals layers of sediments that fell near the shore of an ocean 500 million years ago.

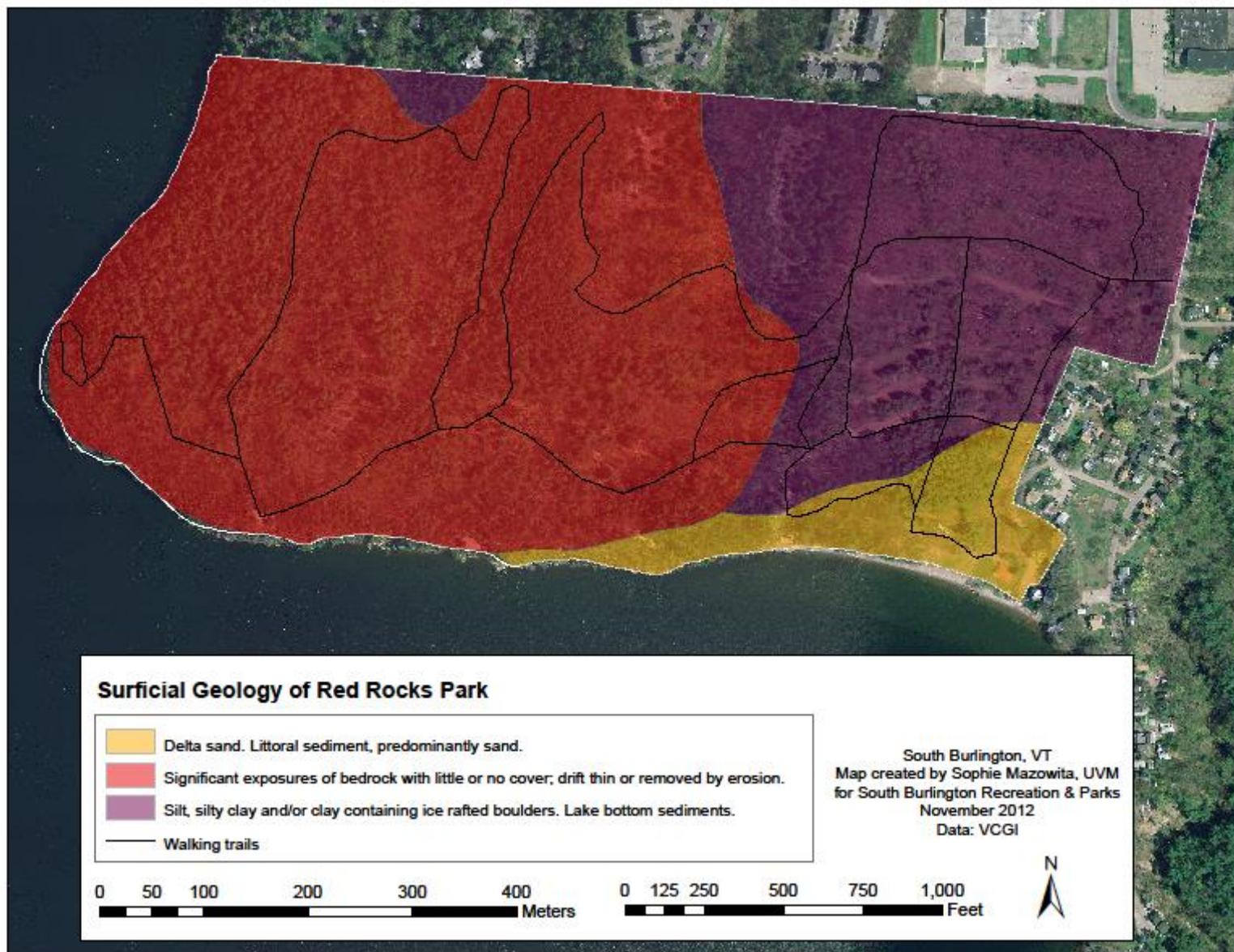
450 million years ago, more tectonic plate movements brought an island arc on a (very slow) collision course with Vermont. The resulting thrusting and folding of land

produced the Green Mountains, but more importantly here, it also made the Monkton quartzite: the heat and pressure of the mountain-building event (an orogeny) turned the sandstone into quartzite. This included reorienting of the quartz crystals and migration of some minerals into bands now seen as distinct layers in the rock. The red bands (and red rocks) have a higher amount of iron oxide.

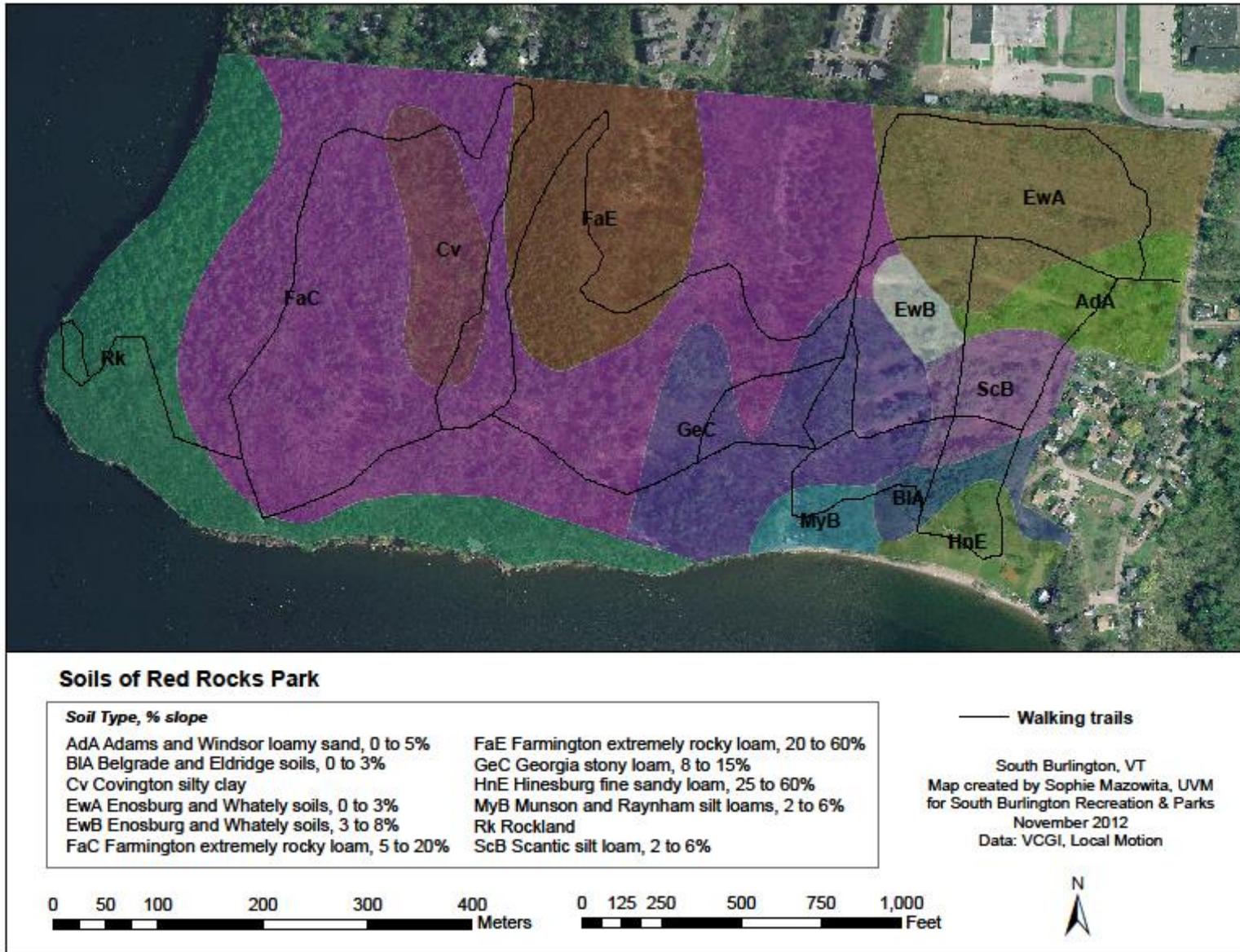
And then came the glaciers

Red Rocks continues to be shaped by the erosive forces of water and ice. The most dramatic of these forces were the glaciers that covered the park in a mile-high sheet of ice as recently as 13,000 years ago. This occurred when the climate was cooler and snow accumulated faster than it could melt.

When temperatures warmed and the glaciers receded, the area was covered by glacial Lake Vermont and then the Champlain Sea; Red Rocks sat below as much as 500 ft of water. Sediments deposited in these waters are the source of the delta sand and lake-bottom muds and clays that overlay the bedrock through much of Red Rocks (see Map 3, next page). In other parts of the park, erosive forces have exposed the underlying bedrock and glacial till (soils of mixed sediment sizes deposited by the retreating glaciers).



Map 3



Map 4

Soils

The soils of Red Rocks are the product of its bedrock, surficial deposits, the forces of weathering, and modifications by plants and animals—humans included. The park generally has nutrient-rich soils derived from the limestone in its rocks. The high calcium content and shallow depth of the soil have a strong influence on the park's vegetation.

The soils are generally characterized by a high windthrow potential, particularly wherever there is a shallow depth to bedrock or shallow depth to saturation. Soils are only slightly susceptible to erosion as a whole, but the areas of 20% or more slope are severely erodible. Devegetation greatly increases erosion risk.

The main soils in Red Rocks are pictured on Map 4 (previous page) and described below, in order of prevalence:

- ***Farmington extremely rocky loam:*** Loamy soils (a mix of sand, silt and clay) of only 10 to 20" depth. Somewhat excessively drained, low available water capacity, slight erosion hazard increases to severe where steeply sloped (FaE) or where vegetation is cleared. The shallow and steep soils pose many limitations to use besides forest. High windthrow potential due to low depth to bedrock.
- ***Covington clay:*** Poorly drained (hydric), highly fertile, fine-textured soils. High water table keeps the soils wet from fall through spring; water table is less than 12" below surface during wettest part of the year.
- ***Enosburg and Whately soils:*** Similar to Covington soil but with coarser, loamy texture. Poorly drained (hydric), water table within 12" of surface or ponded on surface.
- ***Rockland:*** 50 to 90% bare bedrock or less than 10" of soil over bedrock.
- ***Georgia stony loam:*** Deep, stony, moderately well drained soils. Perched water table 1.5 to 3 ft below surface from fall to spring.
- ***Adams and Windsor loamy sand:*** Deep, loose, excessively drained, sandy.
- ***Belgrade and Eldridge soils:*** Deep to bedrock, moderately well drained. Water table 1.5 to 3.5 ft below surface from late fall to spring.



The canopy gap created by the fall of a single oak tree. Red Rocks' trees are highly susceptible to windthrow due to the very shallow soils and high water table.



The high water table of the Covington clay soil is demonstrated by the ponded water where heavy machinery was backed onto the soil. Such equipment should be kept off these areas.

- **Scantic silt loam:** Deep, poorly drained with hydric areas, level to gently sloping. Low depth to water table; remain wet for significant periods after rains. In Red Rocks, modified by construction of parking area.
- **Hinesburg fine sandy loam:** Well drained, deep soils. The areas with this soil type at Red Rocks include high slopes (25 to 60%) and are thus highly susceptible to water erosion.
- **Munson and Raynham silt loam:** Deep to bedrock, somewhat poorly drained. Perched water table 0.5 to 2 ft below surface.

Hydrology

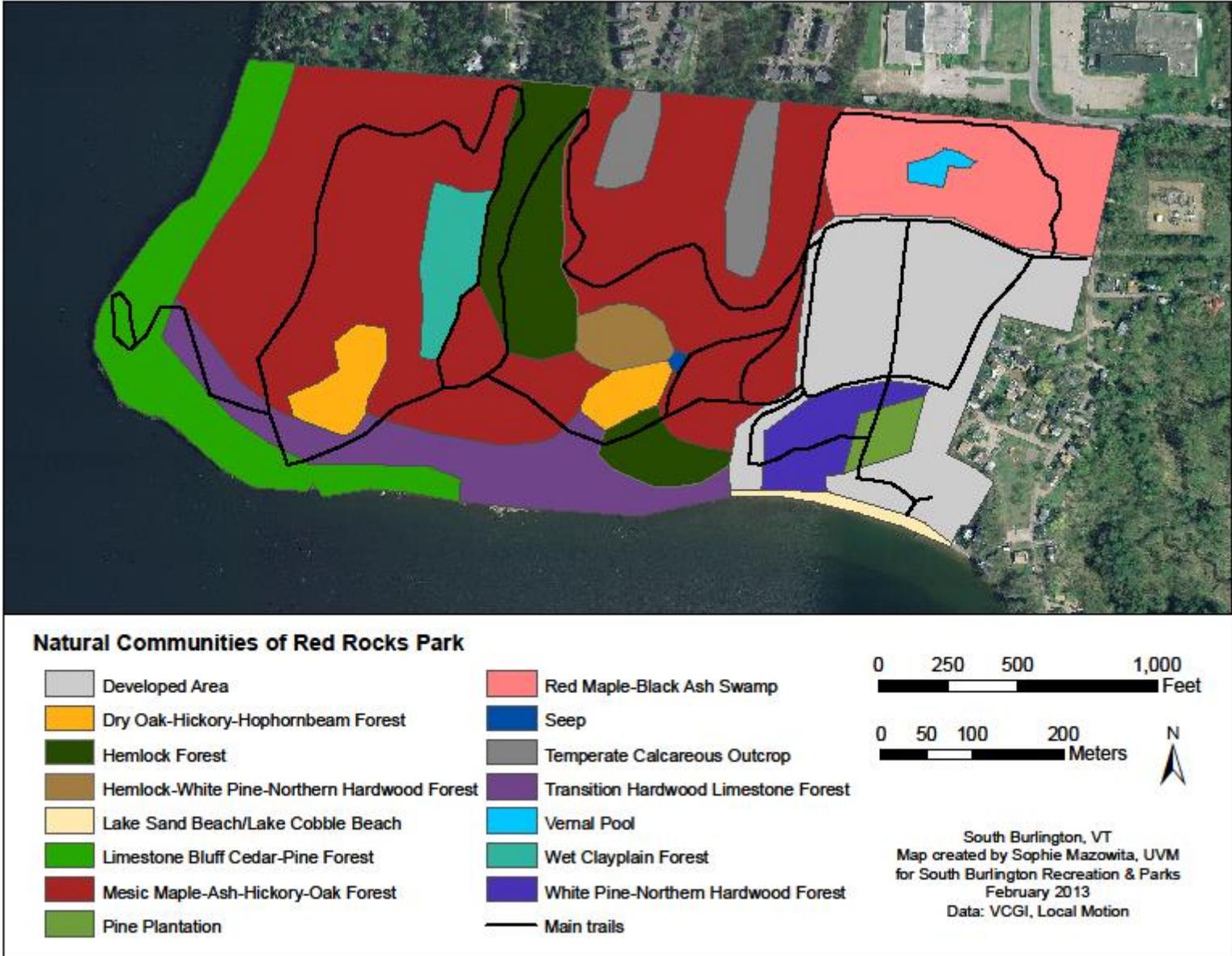
Red Rocks is situated on the shore of Lake Champlain, and the land drains into the lake by means of direct runoff and some channelling into first-order streams. There are no permanent surface waters within the park itself, but there are vernal pools and wetland areas at the locations on the map below. Boundaries should be confirmed by a full wetland delineation, which was beyond the scope of this report.



There is also a seep area alongside one section of trail, where the rock impedes the downward movement of water and it discharges at the ground surface. It crosses the path at this location and continues on the other side as a small stream which drains into a manmade fountain.



Map 5. Water features of Red Rocks Park. Note the shoreline of Lake Champlain that marks the southern and western boundaries of the park, wetlands indicated in pale blue, a seep shown in dark blue, and ephemeral streams.



Map 6

Natural Communities

A natural community is “an interacting assemblage of organisms, their physical environment, and the natural processes that affect them.” These communities are usually identified by their dominant vegetation, as groups of plants tend to grow in recognizable associations and patterns across the landscape. These groupings can vary, but they generally reflect the similar environmental needs of the plants of each community. There are 80 different natural community types recognized in Vermont.

In Vermont, natural communities are also specifically defined as those having minimal human alteration, able to develop under natural processes. When an area is significantly altered or only just beginning to regrow, the natural community identity of that location does not match what is visible on the ground, but rather indicates what that area *could* be. This takes an understanding of the underlying soils and how climate interacts with the the physical environment to create specific conditions for plant growth. One must ask, what *could* or *would have* been here?

The present-day vegetation (or lack thereof) can be classified under a different scheme: land cover type or forest cover type. The natural communities map for Red Rocks (Map 6, previous page) actually shows a combination of natural communities and present-day land cover, especially where substantial alterations have taken the land far from its “natural state” (the developed area around the parking lots is an example).

Natural community types and variants represented in Red Rocks:



Mesic maple-ash-hickory-oak forest: This is the most common plant community represented in Red Rocks. The forest canopy is a mixture of northern hardwood species including maples and beech alongside oaks and hickories that are more typical of the central hardwood forests south of Vermont. It is found here in Red Rocks because of the warm climate and somewhat dry conditions on this rocky piece of the Champlain Valley.



Transition hardwood limestone forest: This is a variant of the mesic maple-ash-hickory-oak forest, and it occurs nearer to the cliff edges of Red Rocks where bedrock is closer to the soil surface. The nutrient-laden rocks provide for a rich community of spring wildflowers here: large-flowered trillium, Dutchman’s breeches, blunt-lobed hepatica, and white baneberry are examples.

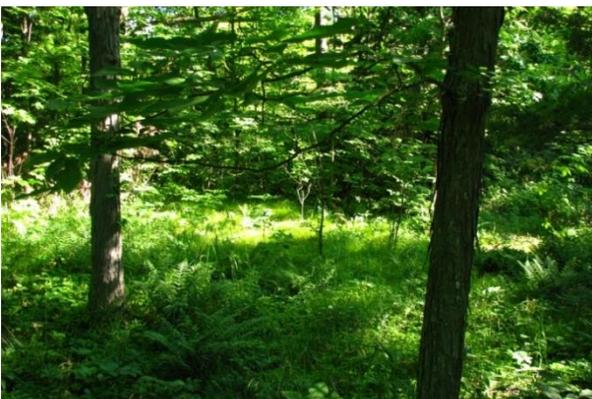


Limestone bluff cedar-pine forest: This community occupies a band along the top of the rocky bluffs at the south and west edges of Red Rocks, facing the lake. It is dominated by cedar trees that cling to the rocks. These trees may be centuries old, slowly growing on little to no soil. White pine, shagbark hickory, and hophornbeam are other common tree species here. This part of Red Rocks is also host to several state-listed rare plants (see Appendix 2). This is the typical plant community found on calcium-rich rocks on the headlands of Lake Champlain, but many of these areas in Vermont

have been lost to clearing and development. There are now only 21 quality examples of this natural community remaining in Vermont, totalling only 360 acres (Sorenson & Popp 2006). This low overall extent gives the community an S2 ranking, making the limestone bluffs of Red Rocks a state-significant natural community and a priority area for conservation. Unfortunately, the limestone bluff community in Red Rocks is one of the areas in the park that receives the most concentrated use and foot traffic, in large part from cliff jumpers looking to access the rocky bluffs. The result is a large concentration of ad hoc trails, vegetation trampling, littering, and colonization by invasive species in areas of disturbed soil.



Temperate calcareous cliff: This is not shown on the map, but this community occurs on the cliffs adjacent to the limestone bluffs and transition hardwood forest, wherever slopes exceed 60 degrees. These areas are sparsely vegetated, but small trees may grow on ledges or from cracks in the rock and the cliffs may support a rich diversity of herbs. **Transition hardwood talus woodland** may be present at the base of the cliffs, where pieces of rock have moved or fallen downslope from the cliffs above.



Dry oak-hickory-hophornbeam forest: Open, park-like forest with sparse shrubs. The ground layer is dominated by sedges. In Red Rocks, this natural community occurs upslope of the cliffside limestone bluffs and transition hardwood forest. It is limited in extent.



Temperate calcareous outcrop: Sparsely vegetated openings dominated by grasses, sedges, and moss. Occur towards the northern edge of Red Rocks, where bedrock is exposed. The rocky openings are ringed by pine and eastern redcedar trees.



Hemlock forest: Hemlocks are long-lived, shade-tolerant evergreen trees. This species is scattered throughout some of the other Red Rocks forest types, but it dominates the vegetation in two areas of the park that feature shallow soils and a steep cliff. In one of these areas, the hemlock forest grades into **white pine-northern hardwood forest** that is dominated by maple and pine trees. The hemlocks are very efficient at capturing light, making for very dark forest with few flowering plants at ground level.



Red maple-black ash swamp: This plant community occupies the northeastern corner of Red Rocks, where seasonal inundation favors red maple trees, which can tolerate saturated soil conditions. This land was cleared for agriculture through the 1940's and is now occupied by a young forest that includes early successional aspen and birch trees and white pine that regrew in the old fields. It is also highly impacted by non-native buckthorn and honeysuckle. The understory is rich in moisture-loving fern species including sensitive fern, cinnamon fern, and royal fern.



Vernal pools: The red maple swamp area is also the site of one or more vernal pools. Vernal pools form in forest depressions that fill with water during spring and fall, given sufficient rainfall and snowmelt. The temporary pools provide important breeding habitat for frogs and salamanders. The area mapped as **wet clayplain forest** on the natural communities map is another wetland area that likely holds vernal pools, though these require further mapping during a wet season. Prior to clearing and agricultural use, this area was likely the site of a clayplain forest of pine and oak trees on fine clay soils.



Seeps: There is one known seep area in Red Rocks, where bedrock impedes downward water movement and instead causes horizontal flow at the ground surface. Park visitors may recognize this area from the frequently flooded adjacent trail. The seep is dominated by spotted touch-me-not plants and clear of trees and shrubs in the immediate area. This seep forms the headwaters of a stream that drains to the lakeshore.



Lake sand beach and lake cobble beach: This is the shoreline community along the southern edge of the park. The public beach area features a sand beach that has been maintained by a supply of sediment from the mouth of nearby Potash Brook (south of Red Rocks on Shelburne Bay) and also human additions of sand. The sand beach grades into a cobble beach of larger rock fragments to the west, and this beach continues intermittently at the base of the cliffs to the far western point of the park.

Wildlife

The bird, mammal, reptile and amphibian species of Red Rocks are listed in Appendix 5. These lists include confirmed sightings as well as suspected presence in the case of some mammals, reptiles, and amphibians. Suspected presence is based on there being suitable habitat but no confirmed sightings to date.

Red Rocks includes the following notable wildlife habitat features:

- Rocky and sandy shoreline
- Intact mature forest
- Shrubby undergrowth
- Forest clearings
- Hemlock stands
- Rock crevices and ledges
- Vernal pools
- Woody debris (fallen trees and branches) on the forest floor
- Standing snags with nesting cavities and loose bark
- Large mast-producing trees (oaks and hickories)
- Cliffs

The intact forest of Red Rocks is particularly suited to a variety of birds; it serves as both a nesting location for summer residents and an important staging area for migrating species. The 135 species in the current Red Rocks bird list include 11 of the Vermont “Birder’s Dozen,” a set of species identified by Audubon Vermont as being high priorities for protection in northeastern US forests.

While the physical and biological habitat is suitable for a variety of species in Red Rocks, the fauna—particularly ground-nesting species—are strongly impacted by the presence of both people and dogs in the park. While off-leash dogs traveling off-trail may compound the problem, the mere presence of pets and people is enough to deter many species of mammals and birds.

See the separate document, “Wildlife of Red Rocks Park,” for more information about the inhabitants of the park and their habitat requirements.



A Common Raven nesting on the rocky cliffs at Red Rocks.



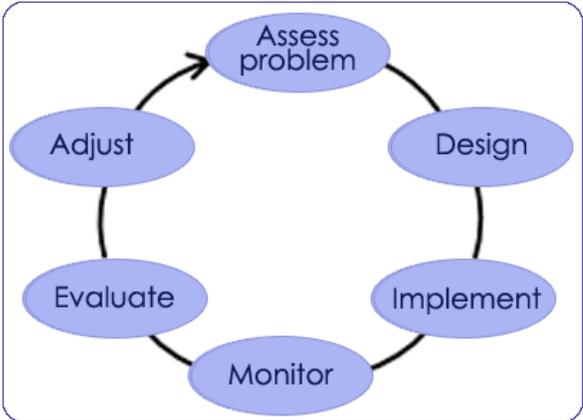
Deer scat found within the eastern loop trail of Red Rocks. Deer are scarce in Red Rocks compared to other local open spaces, likely due to the prolific presence of both people and dogs.



SECTION 4: MANAGEMENT CONCERNS

Management in the face of uncertainty

Red Rocks Park faces a host of management questions and concerns that do not have simple answers or solutions. Our knowledge of the natural world and how a natural area like Red Rocks functions will always be incomplete. The best that we can do as park managers and stewards is to implement solutions based on our current understanding of best practices, shaped by our goals for the park. It is important to monitor the results of these management actions, evaluate their success, and continually adjust as our scientific understanding and our own experience at Red rocks indicates. This is an “adaptive management” approach.



The Adaptive Management approach to problem-solving and land management.

Some principles to keep in mind in managing an area like Red Rocks:

- Think of management actions in terms of “small experiments” to test or evaluate possible management strategies.
- Monitor these experiments to assess how they meet goals.
- Consider new information as it emerges and adjust strategies (and goals) accordingly.

This section outlines some of the key management issues and questions at Red Rocks, some possible solutions, and recommended steps.

Section 6 provides additional management guidelines for decision-makers, and Section 7 summarizes recommendations into a list of management actions.

INVASIVE PLANTS

Overview

Much of Red Rocks is occupied by non-native invasive plant species (see Table 1, below), and their management should be a priority for park directors. Many conservation professionals sense a strong threat from invasive species and recommend complete removal as a best practice; however, a growing body of research is pointing to possible negative impacts from such heavy-handed invasive species control. Sound invasive species management should weigh the potential risks and benefits of such management actions on a case-by-case (or species-by-species) basis. First priority should be on preventing establishment of new invasive plants and containing their spread.



The wolf tree area. Notice the yellow-green understory composed entirely of invasive buckthorn, which holds onto its leaves after all the native trees have dropped theirs.

Impacts of Invasives

- Non-native species can quickly replace native vegetation in disturbed areas, leading to dominance of a few species throughout the ecosystem.
- This can lead to loss of a food source for local insects; many moths and butterflies, for example, rely exclusively on a particular species of native plant on which they lay their eggs and their caterpillars feed. Studies show that non-native species support a lower diversity of insects. This impact can be felt up the food chain, as these insects are a main food source for many birds.
- Other studies show more direct impacts to birds because some fruits of invasive plants have a lower nutritional value compared to native ones, but more research is required to confirm this.
- Some invasive plants cause changes in soil chemistry that can inhibit the growth of other plant species, with long-lasting effects. Garlic mustard is an example of this allelopathic behavior.

Present condition

Table 1. Invasive species inventory

| Species | Location and Abundance |
|---|---|
| Common and Glossy Buckthorn <i>Rhamnus cathartica</i> and <i>Frangula alnus</i> | Dominant understory shrub in parts of the limestone bluff cedar-pine community (particularly the cliff jumping area), the parking areas, the northeast corner of the park, and recently disturbed areas (e.g. windthrow gaps). Scattered patches and trees throughout the rest of the forest; absent only from heavily shaded areas, e.g. dense hemlock and cedar growth. |

| | |
|---|--|
| Shrub Honeysuckles <i>Lonicera sp.</i> | Small to large patches of variable density found throughout park, often alongside buckthorns (though less common). Particularly concentrated toward the east side of the park and along the southern lakeside trail to the main overlook points. |
| Japanese Barberry <i>Berberis thunbergii</i> | Individual plants and small patches found at low density throughout park. |
| Burning Bush or Winged Euonymus – PRIORITY SPECIES <i>Euonymus alatus</i> | Isolated plants along the entrance road and lakeside trail, with several plants concentrated along the far western (“turnabout”) overlook trail. |
| Norway Maple <i>Acer platanoides</i> | Scattered trees near the park entrance, along both sides of entry road, and near the high point of the E loop trail. Other scattered undetected infestations likely. |
| Periwinkle <i>Vinca minor</i> | Isolated dense patches at the top end of the western loop trail, encroaching in from nearby houses. Growing in thick mats. |
| Asiatic or Oriental Bittersweet – PRIORITY SPECIES <i>Celastrus orbiculatus</i> | Isolated patches and individual plants throughout park, at low density. |
| Garlic Mustard – PRIORITY SPECIES <i>Alliaria petiolata</i> | Growing in isolated patches, at the southeast corner of the parking loop road (near backyards of houses) and near the park entrance, to the north of the road just beyond the entry kiosk. |
| Purple Loosestrife – PRIORITY SPECIES <i>Lythrum salicaria</i> | Several isolated plants and patches along the shoreline, including the beach area by CWD and shallows to the west, plus around the point and north of the western loop trails. |
| Multiflora Rose – PRIORITY SPECIES <i>Rosa multiflora</i> | Isolated occurrences near western loop trail and around parking area. |
| Goutweed – PRIORITY SPECIES <i>Aegopodium podagraria</i> | Isolated occurrence along northern boundary of park. |
| Japanese Knotweed – PRIORITY SPECIES <i>Fallopia japonica</i> | One isolated occurrence just beyond the park boundary, near a condo development and adjacent network of side trails leading into the park. |

An identification guide and removal guidelines for Vermont’s invasive plants are available from The Nature Conservancy at www.vtinvasives.org

Invasive management history

The Nature Conservancy and student volunteers from UVM partnered for an invasive plant mapping day on October 15, 2012. This was followed by a removal day with students from Champlain College’s ‘Foundations of Ecology’ class on October 31, 2012. These students targeted buckthorn <4” diameter along the western loop trail. No other organized invasive plant removal has occurred to date.

Risks of invasives control: proceed with caution

Invasive species do alter the structure and function of ecosystems, but the exact mechanisms and causes are not entirely understood (Didham et al. 2005). Managers should proceed with caution in

proceeding with invasives management, as misguided removal efforts can easily lead to further spread. Complete removal often requires an intensive effort, including either repeated physical pulling or chemical treatment. The chemical herbicides are typically applied directly to cut stumps and reportedly break down quickly in the environment, but there are still risks of toxicity inherent in the use of any herbicide. Special care should be taken given Red Rocks' waterfront location and proximity to drinking water sources.

It is also important to keep in mind that invasive plants are a symptom of habitat disturbance rather than the root cause in and of themselves. These plants dominate in openings and areas of bare soil, such as along trails. They were originally introduced and are continually transported by people. The most dense growth of invasive buckthorn in Red Rocks, for example, occurs atop the cliffs where people have created side trails to access lookouts and cliff-jumping locations. Removal of these plants could simply open up the bare soil for regrowth of buckthorn from the seedbank that persists in the soil. Full removal would require a continued effort that could be both expensive and time-intensive.



Most of the green in this picture belongs to the leaves of non-native buckthorn trees which have invaded the cedar forest at the top of the Red Rocks cliffs. What would be the consequence of removing these plants from this sensitive environment?

Even though invasive species have a lower food value for native wildlife, they do still provide some cover and habitat value. Removing all non-native plants would mean removing much of the shrubby growth in Red Rocks, taking away cover from small and medium-sized birds and mammals. Removal efforts should consider what will replace the invasive plants. Such efforts may best be coupled with restoration plantings of native species.

Desired Condition

Given all the uncertainty and risks outlined above, is it wise to pursue any invasive removal in Red Rocks? The City does have the opportunity to limit the spread of certain invasive species that are only present in a small extent at one or two locations right now. This could be done at low risk and low cost and would prevent further loss of native biodiversity.

Management for more widespread and dominant invasives such as buckthorn and honeysuckle would require a much more time- and cost-intensive operation. The pros and cons of this approach should be considered further in consultation with park management and city residents. How important is it to

maintain native forest in Red Rocks, in the face of continued introductions of non-native species and disturbance from human use? This is not an easily answered question.

Park management should, at a minimum, aim to maintain the present level of ecosystem function by:

- (1) curbing the spread of invasive plant species by containing current populations and
- (2) preventing further infestations through an early detection-rapid response system

Management Options

- Early detection of invasive species
 - Fall and spring survey by park staff or volunteers.
- Control of small, isolated populations
 - Early detection and rapid response to isolated populations. Initial targets include garlic mustard, purple loosestrife, burning bush, Japanese knotweed, and goutweed.
- Protection of high-quality areas with few invasive species
 - No area of Red Rocks is completely untouched, but the interior of the loop trails (the areas furthest from side trails and human disturbance) could be prioritized for maintaining intact, native forest.
- Restoration of rare natural habitat types heavily impacted by invasive species
 - The limestone bluff cedar-pine forest is a state-significant rare natural community that could benefit from restoration, but it will require an intensive effort with uncertain results.
- Management of high-use areas that may be a source of further infestations.
 - Monitor the eastern, developed section and the park boundary for signs of new invasive species.

Park managers should monitor the effectiveness of any treatment methods pursued and adjust as appropriate.

Resources

- Partnership and support from The Nature Conservancy, UVM, Champlain College
- Department of Public Works certified herbicide applicators and chainsaw operators
 - *Note: no herbicide spraying within 150 feet of Queen City Park water source*
- Seasonal park gate staff could assist in management efforts and public outreach
- Grants may be available to support removal efforts

Public outreach and education

Public outreach and education will be central to any invasive species management effort.

- Articles, signs, letters to the editor and Front Porch Forum could notify the public of any invasive removal strategies and the reasoning behind such efforts- especially around sensitive issues such as herbicide use.
- A park pamphlet or signs could educate visitors about invasive plant issues and Identification.

TRAILS

Overview

The Red Rocks trail network includes 3.3 miles of official trails and access roads, based on the original carriage trail network constructed in 1891. These trails have been generally well maintained over the years. Areas in need of maintenance are outlined in Map 7, below. Some volunteers have been assisting in maintaining drainage ditches along the areas prone to flooding. Park staff should monitor trail condition and provide support where needed.



Map 7. Trail locations with issues of erosion or periodic flooding, requiring management attention.

Unofficial trails account for a further 4.3 miles of pathways through Red Rocks. There is a particularly dense network along the cliffs, especially west of the main southern lookout point and concentrated along the cliff-jumping area (cliff-jumping is not condoned by the City, and the jumping cliffs are considered an attractive nuisance). The creation and use of these ad hoc trails threatens the ecological integrity of Red Rocks.

Map 8 shows the distance from any point in the park to the nearest trail (official or unofficial). It illustrates that the farthest point in Red Rocks from any trail is just over 90 meters (approximately 300 feet), which has a strong implication for park wildlife. Every species has a “flushing distance” at which it will flee when approached by people (or other threats), causing stress and a disruption from regular activities of feeding, breeding, etc. For species like white-tailed deer, this flushing distance may exceed 300 feet, meaning there is no place in Red Rocks where that animal can feel safe from the presence of people.

The Issue

- More trails mean more wildlife disturbance, human-assisted spread of invasive species, vegetation trampling, and erosion.
- For soils, a little use causes most of the impact (trail compaction occurs rapidly with light use). Soil erosion is the most permanent and therefore most serious effect of trail expansion. Soil compaction recovery may take 6-18 years; erosion recovery may take centuries due to the long time it takes for new soil to form.
- Trail erosion risk exists wherever slopes exceed 9 degrees; especially severe above 18 degrees.
- For vegetation, it may take only 20 tramples to lose 50% of the vegetation on a given piece of land.
- Wildlife disturbance is related to the frequency of people passing by, and side trails may bring people closer to critical wildlife areas more often. Negative impacts on some breeding birds occur with forest trails as narrow as 1 to 3 meters; some birds stop nesting near trails and others avoid the trail areas altogether (Jordan 2000).

Trail Best Management Practices (BMPs)

- Conduct a seasonal walk-through to identify trail hazards and assess extent of off-trail use
- Respond to downed trees as needed
- Post signs to notify park users of trail closures for rehabilitation purposes
- Consider establishing select informal trails as “official” in order to concentrate impact and avoid excessive proliferation.
- Emphasize the contrast between trail and offtrail zones to avoid expansion of the impact zone (e.g. line the sides of the trail with stones, keep the trail very smooth-surfaced relative to the adjacent land).
- Install barriers to control movement of people—thorny shrubs can be particularly effective. Shrubs and trees are the best options for near houses.
- Plant grass-like plants (grasses and sedges) to revegetate areas where continued trampling is likely, as they are most resistant.

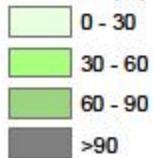


Examples of Red Rocks ad hoc trails

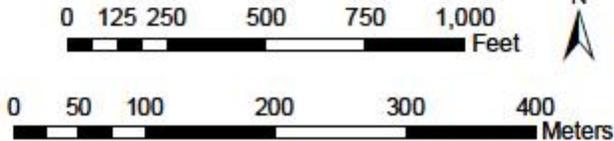


Red Rocks Park: Distance from Trails and Sidetrails

Distance (m)



— Main trails
 □ Park boundary



South Burlington, VT
 Map created by Sophie Mazowita, UVM
 for South Burlington Recreation & Parks
 December 2012
 Data: VCGI, Local Motion

Map 8

Trail Closures and Openings

Table 2. Recommendations for opening and closing recreational trails

| | |
|---|---|
| <p>Which trails are recommended for opening?</p> <ul style="list-style-type: none"> ➤ Heavily trafficked trails that connect to the local community and serve as an alternate park entry ➤ Heavily trafficked trails that lead to particular destinations (e.g., the wolf tree, the 76er lookout) ➤ Trails that are already as wide, well-used and maintained as the “official” ones but have not been marked on the map as such ➤ Key shortcut trails between loops | <p>Which trails are recommended for closure?</p> <ul style="list-style-type: none"> ➤ Trails going down steep slopes (erosion issues) ➤ Dense sidetrail networks (close the network with the possibility of centralizing traffic on one path) ➤ Trails going through sensitive habitat ➤ Trails that are minimally used or impacted, with good potential for revegetation and masking of the walked path |
| <p>Why?</p> <ul style="list-style-type: none"> ➤ Concentrate use on these official trails to draw use away from other ad hoc trails ➤ The heavily used spur trails are already impacted ➤ Trail closure not a viable option due to heavy use | <p>Why?</p> <ul style="list-style-type: none"> ➤ Steep slopes are subject to erosion (soil loss, siltation and pollution of water) ➤ Seldom-used trails stand a good chance of successful closure and restoration |
| <p>How to open trails</p> <ul style="list-style-type: none"> ➤ Mark edges of trail ➤ Reroute or reorient the trail as needed to give it a low grade and decrease erosion risk ➤ Add trail signage ➤ Indicate the trail on official park maps | <p>How to close trails/discourage use</p> <ul style="list-style-type: none"> ➤ Place logs and other debris across trail ➤ Use tools to scuff up the trail, break up earth to make it look unused ➤ Place notices of “area closed for restoration” (shown to deter 90% of visitors) |

Notes on the selected trails:

- The cliff-jumping area would be a prime area for closure given the intense disturbance and the presence of the sensitive limestone bluff cedar-pine forest there, but this would be very difficult to enforce given the high traffic.
 - Managers could consider closing off certain sections with signage indicating a restoration area (“Please help the plants- restoration area-stay on designated trails”).
 - They might also consider designating an official trail along the length of the cliff, from the main south-facing lookout towards the turnabout loop at the far western lookout point. The goal here would be to concentrate use along the official trail and prevent further spreading of this trail network. This could pose liability issues, however.
- There is also a well-travelled network leading from the eastern loop, up towards the Austin Dr neighborhood; this area is also densely populated with invasive species, e.g. the only Japanese knotweed occurrence in the area is right here on the park doorstep. This trail is recommended for official opening so as to concentrate use and acknowledge this alternative entryway into the park.

Summary: Trails

| |
|---|
| <p>PROBLEMS</p> <ul style="list-style-type: none">➤ Ad hoc trails increase wildlife disturbance, human-assisted spread of invasive species, vegetation trampling, and erosion.➤ Red Rocks has 4.3 miles of unofficial side trails. |
| <p>OBJECTIVES</p> <ul style="list-style-type: none">➤ Minimize disturbance to soils, vegetation, and wildlife➤ Provide an enjoyable recreational trail network to suit a variety of park users and purposes. |
| <p>OPTIONS</p> <ul style="list-style-type: none">➤ Close all ad hoc trails and maintain a strict policy of staying on designated official trails only by means of signage, fines, etc.➤ Rotate trail closures through sensitive areas to allow for recovery➤ Where there are many ad hoc trails, concentrate use onto a single “official” one➤ Do not enforce any trail restrictions and allow dispersed use across whole park |
| <p>RECOMMENDATIONS</p> <ul style="list-style-type: none">➤ Protect key wildlife areas from roads and trails➤ Use positive signage (e.g., with wording about restoration areas and sensitive vegetation) to indicate trail closures➤ Maintain the carriage road network as the central, official trail network➤ Continue annual maintenance and inspection of the trail network➤ Revegetate closed trails with resistant vegetation➤ Consider modifications to official trail network as outlined in Table 2, above; reassess yearly |



Left: Grass is the most resistant vegetation to trampling; it helps to secure soil against erosion. Above: One of the main, wide trails forming part of the original carriage trail network in Red Rocks. These trails reach up to 4 m width.

OFF-LEASH DOG IMPACTS



Overview

Red Rocks is a popular destination for dog walkers. A “Leash Law” is in effect within park boundaries, requiring that all dog owners must keep their pet on a leash (max. 6 ft length) at all times. Dogs are also entirely prohibited at the public beach and in the water at Red Rocks. Failure to comply with the “Leash Law” can result in a civil penalty charge of up to \$100 per day.

Many park users ignore these laws; one survey showed a 12% compliance rate. Some park users abide by an “unofficial understanding” that dogs can be let off-leash during certain times of day, outside of peak hours. Enforcement presence is limited to nonexistent, so there is little deterrent to anyone breaking the law.

Off-leash dogs create the potential for negative dog-dog and human-dog interactions as well as impacts to wildlife, vegetation, and water quality. One study showed that the presence of off-leash dogs affects animals like deer, rabbits, and small mammals (chipmunks, squirrels, and mice); deer activity was lower within 100 m of trails and small mammal activity declined within at least 50 m of trails used by dogs (Lenth et al. 2008). Only a small area of Red Rocks is more than 50 m from a trail, and no place in the park is 100 m away from a trail. Even after dogs have left the park, certain carnivores may avoid areas that have been scent-marked by dogs, while others may increase surveillance along dog-marked trails.

As dog-walkers are among the primary and most regular users of Red Rocks, it is of high priority to explore solutions that fulfill the needs of dog owners, maintain ecosystem health, and allow for safe and enjoyable visits for all park users.

Summary: Off-Leash Dog Impacts

PROBLEMS

- Park visitors may be frightened or threatened if approached by off-leash dogs, which detracts from their park experience
- People and pets risk injury from aggressive dogs
- Dogs may trample vegetation and disturb wildlife off-trail, including ground-nesting birds and animal dens
- Owners may fail to pick up dog poop deposited off-trail; this fecal matter may contaminate Lake Champlain

OBJECTIVES

- Safety and satisfaction of all park users, dog-owners and otherwise
- Minimized disturbance of wildlife
- Clean water

OPTIONS

- Designate certain areas of the park where off-leash dogs are allowed
- Designate certain times of day when off-leash dogs are permitted (or, conversely, designate hours when leashes are required and allow off-leash dogs otherwise)
- Modify leash laws according to the seasons, in consideration of critical dates for nesting/breeding wildlife (see example below)
- Enforce leash laws and issue fines to encourage compliance
- Create separate, enclosed areas for off-leash dogs
- Institute a no-dog (nature reserve) policy for Red Rocks and enforce this
- Fence environmentally sensitive areas to reduce impacts from roaming dogs

RECOMMENDATIONS

- Educate dog owners so that they are aware of the reasoning for leash restrictions
- Explore options for designating off-leash and on-leash times and trial this approach during the 2013 operating season
- Cite only irresponsible dog owners

Considering the seasons:

March through July are critical months for breeding wildlife; many young mammals are born in late March, and most birds nest from late April to July. These are months when it would be most critical to keep dogs on leash so as to minimize wildlife disturbance, particularly to ground-nesting birds. Another suggested on-leash period would be during times of significant snow pack, when mammals are on a tight energy budget. Other times could be designated off-leash times of the year, from a wildlife perspective.

FOREST HEALTH & MANAGEMENT

Overview

The Red Rocks forest is primarily a mesic maple-ash-hickory-oak forest, including a mixture of northern woods species with more southerly elements that take advantage of the dry, warm cliffs in these lowlands of the Champlain Valley. Eastern hemlocks occupy some of the wetter, darker, and older growth areas of the forest, and along the cliffs the forest transitions towards a cedar-dominated limestone bluff community.

Red Rocks is largely (if not all) secondary forest; it was managed as a woodlot in the 1800s, and has since been used for pasture and more recent logging operations. There were also several fires of unknown extent and intensity in Red Rocks' past, the largest of which is currently labeled as "The Burn" on park maps. A few stretches of forest may, however, have escaped the axe of European settlers. One hemlock—of only 12" diameter—fell across a trail and was sawed open to reveal over 210 years of growth rings! The tree had been slowly growing on the shallow soils along a rocky ridge, between two sections of trail. There is reason to suspect that other nearby hemlocks could be of similar age, left for their low-quality lumber and because they weren't in the way of pasture land, perched as they were on the steep and rocky terrain.

The Red Rocks forest is presently managed passively; trees are felled if they pose a threat to park users (e.g. snags hanging over a trail), but otherwise the forest is left "as-is."

Certain practices should be taken into consideration to ensure the healthy regeneration of the forest and the optimization of recreation and conservation opportunities.

Recognizing that Red Rocks is a well-loved and well-used public park, the forest management options below do not consider any harvesting or felling of trees beyond the ones that come down on the trails. With public consultation and buy-in, however, park managers might choose to release certain trees that provide valuable wildlife habitat or seed tree values by an individual tree selection. This would mean cutting other trees around the selected valuable trees, with the goal of improving the growth of the selected trees. The County Forester or other natural resource professional should be consulted before proceeding with any such work, which is not recommended at this time.

Forest Best Management Practices (BMPs)

- Leave both large and small woody debris for provision of wildlife habitat and recycling of forest nutrients.
 - Small mammals rely on the cover provided by coarse and fine woody debris.
 - Fallen trees serve as germination sites for many plants, including tree seedlings.
 - Felled trees cleared off trails could be piled off-trail rather than immediately alongside it.
- Leave snags and cavity trees standing; these provide habitat for many animals, such as woodpeckers, owls, squirrels, raccoons, and bats.
 - Aim for 4 to 6 large snag or cavity trees per acre; one should exceed 21" diameter at breast height (DBH) and the rest should exceed 15" DBH.
- Maintain important mast trees, such as oaks and hickories, for wildlife.
- Monitor forest for signs of natural regeneration.
 - Manage for non-native invasive species to release native species.
- Maintain forested buffers around sensitive habitats, especially wetlands and vernal pools (a 50-foot buffer is currently regulated around all designated wetlands).



Woody debris left at the side of the trail provides important habitat for small mammals including rabbits, chipmunks, squirrels, voles, and mice.

Pruning and View Corridors

Red Rocks has several lookouts across Lake Champlain and Shelburne Bay. These were once much more open, and the trees present could be pruned to restore historical viewpoints, with the following considerations:

- The old-growth cedars of the limestone bluff community should be left as-is.
- Trees should be pruned rather than removed to open views; exposed soil would be an easy target for colonization by invasive species (which could impact native vegetation and very quickly impede the views again).
- South Burlington’s Development Review Board regulates all land within 150 feet of the lakeshore. Land is to be left in an “undisturbed, naturally vegetated condition” unless otherwise approved.
- Park users should be notified before any such work takes place, especially in such a public location.



Present-day views impeded by tree growth.

BEACH MANAGEMENT

Overview

Red Rocks contains South Burlington’s only public beach access, a 200-yard stretch of waterfront at the southeastern corner of the park. The beach at Red Rocks has been closed on several occasions due to high levels of blue-green algae or bacteria from the outlet of Potash Brook, which drains into Lake Champlain just south of Red Rocks beach. Zebra mussels and Eurasian milfoil (both aquatic invasives) also pose problems for beachgoers, and the beach sands are frequently washed away by high water levels, rain events, and wave action.

A full assessment of aquatic management strategies is beyond the scope of this report, but further research should look to solutions and case studies for managing for these invasive species and maintaining beach quality. There is potential for these management efforts to be very time and labor-intensive. It would be useful to examine the public perceptions of the beach area and gauge the interest in investing time and resources in its management relative to other areas of Red Rocks Park.



Zebra mussels growing in the shallows on the Red Rocks shore (left) and a blue-green algae bloom (right).

CHAMPLAIN WATER DISTRICT (CWD) EASEMENT

The intake for the Champlain Water District was sited at Red Rocks in 1970, and the system came online in 1971. The CWD is Vermont's largest regional public water supplier, serving 12 municipal systems in Chittenden County, and this is their only intake location. A second intake line was recently added in response to increasing demand; it was located offshore of the far western point of Red Rocks.



The CWD holds a 40-ft wide easement through the eastern (developed) section of Red Rocks, starting just south of the main park entry and running in a diagonal towards their pump station at the west end of the Red Rocks beach. They also own the land immediately surrounding the pump house.

Some park users have expressed concern at the management of the CWD easement and the lack of communication about changes to park infrastructure, yet CWD managers have expressed a willingness to manage their infrastructure with minimal impact to the park. They also must invest a certain portion of their upgrade costs into landscaping, and they are willing to target some of this funding at the discretion of City management. Some of these funds went towards construction of a viewing deck, guardrail and plantings (visible in the picture above) in recent years.

CWD staff walk the easement line and brush-hog/mow every summer. Repairs are mainly done manhole to manhole; mowing is done to maintain access to these. Projects and repairs have increased

in frequency in recent years; they used to be more sporadic. The slope down to the water, east of the pumping station, was cleared for machinery access 10 to 15 years ago. It was rip-rapped to hold the soil back, but is currently experiencing erosion (likely compounded by frequent passage of people and dogs).

Summary: CWD Easement

| |
|--|
| <p>PROBLEMS</p> <ul style="list-style-type: none"> ➤ Conflict between what city residents perceive as best for the park and the needs of CWD to maintain their water supply line ➤ Erosion |
| <p>OBJECTIVES</p> <ul style="list-style-type: none"> ➤ Recognizing that resiting of the CWD intake is currently unrealistic, continued operation of the CWD water supply with minimal impact to the ecological and aesthetic values of the park ➤ Understanding between park users and the CWD about the reasons for any work they do in the park |
| <p>OPTIONS</p> <ul style="list-style-type: none"> ➤ Suggest easement management options to the CWD that will maximize wildlife habitat value and minimize aesthetic impact ➤ Recommend use for the CWD landscaping funds that will align with other park management goals and projects ➤ Accept that the CWD owns the pump house land and rights to the easement and leave them to manage it |
| <p>RECOMMENDATIONS</p> <ul style="list-style-type: none"> • Communicate a suggested policy to the CWD: <ul style="list-style-type: none"> ○ Maintain vegetation to the greatest extent possible, i.e. remove larger trees and shrubs growing into the easement (ones that would delay emergency manhole access) but retain all herbaceous growth for wildlife and aesthetic benefits. Remove only what’s directly around manholes for access as needed. ○ Notify local residents and park users (via signage on park notice boards) of any changes—with advance notice—and explain the reasons for any changes (e.g. placement of new pipes and outlets, widening of roads, removal of vegetation, etc.) ○ Manage erosion of the slope next to the pump house with plantings. Install barriers or signs to prevent people from walking on the area as needed. • Communicate ideas for use of landscaping funds <ul style="list-style-type: none"> ○ Erosion prevention ○ Beach management ○ Trail maintenance |

PARKING AREA

Red Rocks is officially open for a seven-week period from the end of June through mid-August. At this time, visitors are asked to drive into the park and pay an entrance fee (either a day use fee or season pass) for access. Outside of this seven-week period, visitors can park in the area outside the park gate, free of charge.

Many visitors ignore the 'No Parking' signs installed during the seven-week operating season and enter the park without payment. While an assessment of the full range of parking options is beyond the scope of this report, the City should place this assessment and implementation of long-term solutions at the top of its priority list. This will require an interdepartmental effort and should incorporate public input.

Summary: Parking Area

| |
|--|
| PROBLEMS <ul style="list-style-type: none">➤ Park users are confused about where to park/disregard parking regulations➤ Little incentive to park within park boundaries when a free option exists just outside, with inconsistent enforcement (ticketing)➤ City loses revenue stream from illegally parked vehicles➤ A substantial amount of park acreage is dedicated to parking, which could otherwise provide wildlife habitat and recreational benefits |
| OBJECTIVES <ul style="list-style-type: none">➤ Revenue stream for city to fund park operations➤ Straightforward parking option for park users; no confusion about where/when to park |
| OPTIONS <ul style="list-style-type: none">➤ Increase parking enforcement to ensure compliance during summer season➤ Reorganize parking area➤ Shared use of privately-owned company parking lots on Industrial Parkway➤ Accept that some users will continue to park without paying and pursue other sources of revenue➤ Install donation boxes or another parking fee collection system in outer lot to remind people to pay➤ Require payment year-round for consistency |
| RECOMMENDATIONS <ul style="list-style-type: none">➤ Consult with key stakeholders and residents during a public forum for ideas to restructure parking➤ Use positive messaging asking people to contribute towards park upkeep or restoration when they are spending money to access Red Rocks, rather than letting them simply view it as a fee to park their car |

FUNDING

Currently the only revenue stream for the park comes from summer operating season parking permits, which is supplemented with funding from the City's operating budget. Several park users have expressed a willingness to donate funds towards park upkeep and programming. The City should explore different options for fundraising and developing a sustainable funding stream for park projects. Several of the recommendations outlined in this report will require a substantial financial commitment.

SIGNAGE

A separate 2010 report outlined recommendations for installation of directional and interpretive signage in Red Rocks Park, and in 2012 a signage subcommittee of the Red Rocks Committee was discussing future needs. There are currently 25 signs installed in the park: 3 of these indicate no biking, 6 indicate the dog leash law, and 3 warn about cliff jumping. The only publicly visible park map is part of the single interpretive panel installed at the park entrance. A new park entrance sign will be installed in 2013.



Example of one of the unclear park intersections, at the four-way crossroads junction of the two main loop trails.

City emergency staff have also proposed 29 emergency signs (small reflective markers for emergency vehicle directions) to install along all major park trails. A decision about acceptable level of signage, considering both upfront and maintenance costs, should be a top priority.

Summary: Signage

| |
|---|
| PROBLEMS <ul style="list-style-type: none">➤ Many park users—especially but not limited to first-time users—get disoriented in the park➤ There is no central notice board (outside of the summer operating season when the gate house attendants hand out maps and takes fees) to deliver park announcements and list policies➤ Signs can detract from the wilderness experience of park users |
| OBJECTIVES <ul style="list-style-type: none">➤ Striking a balance between enough signs to ensure safety and orientation of park users, while still maintaining elements of a wilderness/nature experience➤ Effective delivery of park messaging (including city ordinances, park events, park interpretation) |
| OPTIONS <ul style="list-style-type: none">➤ Install all possible signs as outlined➤ Explore alternatives to sign boards and the 29 proposed emergency signs |
| RECOMMENDATIONS <ul style="list-style-type: none">➤ Begin experimenting with handing out different maps or posting ...<i>(next page)</i> |

- different temporary signs for the 2014 operating season
- Proceed with long-term funding for installation of directional signs at key park intersections, as outlined in the separate consultant report
- Employ positive messaging on park signs
- Install a park bulletin board at the main entrance
- Consider interpretive pamphlets as an alternative to interpretive signs



Map 9. Recommended locations for directional/wayfinding signage (square markers) and a bulletin board at the park entry (star).

LONG-TERM CONSERVATION

Since Red Rocks was purchased in part with federal funding, the park cannot be sold or converted from park use without appropriate equivalent replacement. Several regulations at the federal and city level grant additional protection to wetlands and the 50 feet of adjacent land and the 150 feet nearest the Lake Champlain shoreline (see Management Limitations, page 44, for a list). Operations within 98 feet of the shoreline also must meet US Army Corps of Engineers (USACE) approval.

This means Red Rocks is unlikely to be converted from its current use, and water features have additional protection. However, there is still potential for park use and management activities that could damage the ecological integrity of the park. The City should look to formalize forest management policies that ensure long-term protection of Red Rocks' natural resources.



SECTION 5: RECREATION & EDUCATION

Recreation

Red Rocks attracts both local South Burlington and Burlington residents, plus tourists from farther afield, with its diversity of recreational options. The South Burlington Recreation & Parks Department strives to provide fulfilling leisure time activities for all residents, and while increasing recreational use and activities is a laudable goal, several of these uses can conflict with one another and also with provision of wildlife habitat. The City should consider how to prioritize these conflicting uses. Where is the balance between quantity of recreational use (maximizing the number of citizens served) and preserving the quality of the recreational experience?

Some of the most popular uses of the park are also illegal and pose issues for liability. The City does not condone cliff-jumping in Red Rocks but also realizes that access to the cliffs cannot be controlled.

Current uses

- Walking, hiking, running, jogging, dog-walking
- Winter cross-country skiing and snowshoeing
- Swimming from beach, rocks, and cliffs
- Kayaking (boats available through kayak club)
- Bird-watching and nature appreciation
- Nature connection
- Outdoor sketching and painting
- Picnicking
- Relaxation and restorative uses
- Illegal uses: camping, bonfires, cliff-jumping

Opportunities

- Nature play area
- Use of retired parking areas in eastern section
- Moorings



One of the abandoned parking pods that provides open, grassy habitat and could serve as a nature play area or picnic area.

Education

Red Rocks has great potential as an outdoor classroom destination for local school groups, and it also offers all visitors a chance to explore and learn about nature in an urban setting. Envisioning Red Rocks as an outdoor classroom and for various education uses has implications for park visitation numbers, sense of crowdedness, trail impacts, and more. These issues could be discussed within a broader dialogue about long-term visions for the park and who could be using it.

A UVM undergraduate study in Spring 2013 investigated educational opportunities in the park. These students surveyed teachers at Orchard School and found that the majority of educators would consider using Red Rocks as a field trip destination. The UVM team prepared lesson plans on park wildlife, geology, and orienteering which will be made available online.

Current uses

- College classes
- K-12 use as a nature center is limited/nonexistent; some use for gym classes, cross-country meets
- Week-long "Governor's Institute" for high school students (based out of UVM) focused on Red Rocks several years ago
- Public guided walks
- Summer nature camps scheduled for 2013
- Red Rocks Nature Club monthly gathering and stewardship group

Opportunities

- Nature education center for public and for institutions
- Place-based education for school groups: benefit of students accessing a forest within their own city boundaries (learning in their own backyard)
- Stewardship opportunities
- Modeling Red Rocks as a community forest
- More connections with local schools and colleges

Considerations

- Staffing
- Building/physical location
- Equipment
- Funding
- Materials to encourage educational use
- Implications for visitor traffic, types of visitors



SECTION 6: A DECISION-MAKER'S GUIDELINE

Consider the following in proceeding with park management decisions:

- Park values, priorities, and goal-setting through an inclusive planning process
- Constraints to management options
- Opportunities for community involvement and the community players
- Means for encouraging public buy-in and park compliance
- Park management and planning as an ongoing process

VALUES AND GOAL-SETTING

To the best extent possible, park managers should consider the ideas and values of the residents of South Burlington, and the larger population of Red Rocks Park users, in moving forward with management actions for Red Rocks Park. Community values of Red Rocks will be explored in greater detail through an inclusive community consultation and outreach process.

For example:

What's a bigger priority at Red Rocks:

- (1) Beach access
- (2) "Natural"-state forest (maintaining native vegetation)
- (3) Educational use (school groups)
- (4) Maintaining and/or promoting wildlife habitat
- (5) Dog park
- (6) Promoting a solitude experience

In ranking these priorities, it would be wise to consider the role of Red Rocks within the larger parks network. Are there other places for people to exercise dogs or have an outdoor classroom? What can Red Rocks provide that other parks cannot?

MANAGEMENT LIMITATIONS

Keep the following management limitations and current park regulations should be kept in mind when considering actions in Red Rocks. Some could be changed more easily through City process (e.g., the dog leash law), while others fall outside of City control (e.g., the CWD easement) .

- USACE regulates any work, structures or fill that take place beyond (lakeward of) the 98' elevation
- The Champlain Water District owns the land immediately surrounding the pumping station at the west end of the beach. They also have access and management rights to the 30-foot wide easement that runs diagonally from the park entrance area to the pumping station.

Development Review Board regulations that apply to Red Rocks:

- All land within 150 ft horizontal distance of the high water elevation of Lake Champlain (defined as 102 ft above sea level) is subject to surface water buffer standards, which states that “all lands within [the] required stream buffer... shall be left in an undisturbed, naturally vegetated condition.” The main concern is maintenance of a vegetated buffer for erosion control.
- Wetlands and the 50 ft of land adjacent are also regulated.

City ordinances that apply to Red Rocks :

- Dogs: all dog owners must have their dogs on a leash (max. 6 feet) at all times within Red Rocks Park boundaries. Dogs are entirely prohibited at the public beach and in the water at Red Rocks. Safety is listed as the primary reason for the law, along with protection of “ecologically sensitive areas, including wildlife, rare wildflowers, wetlands, nesting, and other plants, flora, and fauna.” Failure to comply can result in a civil penalty charge, up to \$100 per day. Overseen by the Animal Control Officer. Dog owners looking to let their dog off-leash can visit Farrell Park, Overlook Park, Jaycee Park, Szymanski Park, and the Community Dog Park.
- Park Conduct Ordinance (see the City of South Burlington website for the complete document). Park rules include:
 - No picking of trees, shrubs, flowers, ferns or other plants within park boundaries.
 - No removal of stones, rocks, birds, or animals shall be removed.
 - No removal of bark from trees or cutting and removal of firewood.
 - Axes, hatchets, shovels, chain saws, picks, handsaws, and all other tools used to dig, cut or build are prohibited.
 - No glass containers are permitted within Park boundaries.
 - No person shall disturb the peace, endanger the public safety, use obscene or profane language or prevent the use of City parks by others.
 - Drinking of alcoholic beverages in City parks is strictly forbidden, except by special permit.
 - It is unlawful to post bills, cut, deface, write upon, remove or destroy any tree, shrub, rock, signs, buildings, tables, benches, fireplaces, grills or other structures or equipment, facilities or park property, or appurtenances whatsoever.

OPPORTUNITIES AND KEY PLAYERS

Current park management

- South Burlington Recreation & Parks oversees park operations
- The Red Rocks Committee of seven appointed city residents provides recommendations and communicates park needs to City Council
- The Department of Public Works is responsible for park maintenance

Current community connections

- UVM NR 206 class is researching educational opportunities in Red Rocks and preparing lesson plans and interpretive materials
- UVM Field Naturalist Program collaborated in preparation of this management study
- The Nature Conservancy provides support for invasive species management
- Champlain College 'Foundations of Ecology' class participated in invasive species management
- The Red Rocks Nature Club (volunteer-driven) meets monthly for a nature hike and stewardship activities

Opportunities for community participation and volunteer recruitment

The following user groups and stakeholders should be considered for volunteer recruitment and community engagement:

- K-12 and college students; partnerships with specific class groups and teachers; graduate student or senior undergraduate studies
- Ongoing partnership with Champlain College Foundations of Ecology and UVM NR 206
- Local neighborhood stewards (from Queen City Park and the condos along the northern park boundary)
- Individual volunteers from the larger South Burlington & Burlington community who come out to publicly-advertized work days and outreach events
- Corporate groups from South Burlington & Burlington (team-building activities and opportunities to give back to the community)
- Local businesses/companies: Burton, Edlund, Rhino Foods, etc.
- Vermont Youth Conservation Corps

Other opportunities and considerations

- External grants and funding
- Funding and stewardship oversight will require coordination and direction from a paid employee, intern, or very dedicated community volunteer

MANAGING PEOPLE AND ENCOURAGING COMPLIANCE

Options for restricting use (or encouraging desired use)

There are various means of limiting park user behavior:

- Time restrictions/seasonal limitations, e.g. off-leash dogs only permitted outside of bird breeding season
- Area/zoning limitations, e.g. no off-leash dogs in sensitive wildlife areas, walk only on designated trails
- Behavior allowances and prohibited activities (e.g. campfires, littering, etc.)
- Group size restrictions
- Suggestions vs. city ordinances

There are also various means for communicating park regulations to visitors: park signage, direct messages from staff, flyers, online information, etc. Presence of a uniformed ranger is often most effective at ensuring compliance with park rules (Swearingen & Johnson 1995). However, this comes at a higher cost to the visitor, both in terms of taxpayer dollars and the impact of this uniformed presence on the visitor experience.

Best Management Practices

- **Explain reasons for regulations** to improve visitor compliance: Clearly state the problem, what aggravates it, how a change in behavior will improve it. Make the suggestion reasonable.
- Be sure visitors understand **how they are expected to behave**.
- **Enforce regulations**- regulations are there for a reason, and furthermore, it's not fair to law-abiders if regulations are not enforced. If enforcement is impossible, better to just *ask* visitors to behave in a certain way; **regulate at the minimum level possible**.
- Written strategies often least effective but may help retention for those who are receptive to it
- Punishment-oriented strategies the most effective (if there's an enforcement presence), yet positive wording of regulations is favored by the majority (Winter et al. 2000)
- Personal (verbal) contact often facilitates initial receptiveness, but written guidelines may help retention
- Simplify messages: having 2 messages vs. 8 on a bulletin board results in the same knowledge gain (Cole, Hammond & McCool 1997)
- Focus the message: make it personal, tailor it to the audience. It will vary between user groups.
- Use positive wording and messages (and indicate reasons for restrictions) to encourage good behavior, rather than just listing limitations (e.g., "Habitat restoration area" vs. simply "No trespassing" or "Trail closed")

PARK MANAGEMENT AND PLANNING AS AN ONGOING PROCESS

A park management plan may be a static document, but the park management process is ever-evolving and a constant learning experience for all stakeholders involved (see back to page 22 for an introduction to the adaptive management process).

Management strategies should be adjusted in step with changes in our scientific understanding and with changes in our community values and priorities for the park. Now is the perfect time to join in this planning process.



SECTION 7: SUMMARY OF MANAGEMENT ACTIONS

| Management Action | Who/How? | Priority | Cost/Risk |
|---|---|----------|-----------|
| <i>Nonnative invasive plant management</i> | | | |
| 1. Hold work days to remove isolated populations of garlic mustard, purple loosestrife, burning bush, Japanese knotweed, and goutweed | Community or school volunteers. Led by trained staff or lead volunteer. | High | Low |
| 2. Survey in fall and spring to monitor for new occurrences | Community or school volunteers. Led by trained staff or lead volunteer. | High | Low |
| 3. Restore the limestone bluff cedar-pine forest | Intensive removal effort and restoration plantings with trained staff and volunteers. | High | High |
| 4. Remove buckthorn, honeysuckle, and all other invasives from interior of western loop trail and monitor for regrowth. | Community volunteers, monitored by staff or lead volunteer. | Moderate | Moderate |
| 5. Inform park users about invasive plants to control further introductions and spread. | Online and print materials prepared by staff/students/volunteers. | High | Low |
| <i>Trails</i> | | | |
| 6. Seasonal walk-through to identify trail hazards and assess extent of off-trail use. | Red Rocks Committee and/or community volunteers (ongoing). | Moderate | Low |
| 7. Close unofficial trails and post signs for rehabilitation, starting with high-impact side trails. | Park staff and/or community volunteers. | Moderate | Low |
| 8. Restore ad hoc trails to discourage further use | Staff and/or volunteers. Some equipment required to resurface trails. | Moderate | Moderate |
| 9. Open select side trails for official use to concentrate current ad hoc trail network | Staff and/or volunteers | Moderate | Low |
| <i>Off-leash dogs</i> | | | |
| 10. Trial on-leash/off-leash days or times for dog-walkers | Community discussion of options. Post signs, announce in local media. | High | Moderate |

| Management Action | Who/How? | Priority | Cost/Risk |
|--|---|-----------------|------------------|
| 11. Educate park users on reasons for leash laws | Online and print materials, signage at park | High | Moderate |
| Forest Health | | | |
| 12. Leave woody debris for provision of wildlife habitat | No action required. | High | Low |
| 13. Seek community input regarding opening of view corridors. | Community discussion of options. | Low | Moderate |
| CWD Easement | | | |
| 14. Ask that the CWD retain all herbaceous growth for wildlife and aesthetic benefits within their easement. Remove only what's directly around manholes for access as needed. | Park managers and CWD staff | High | Low |
| 15. Encourage CWD to notify local residents and park users with advance notice of any changes | Park managers and CWD staff | Moderate | Low |
| 16. Communicate with CWD on an annual basis (and more regularly as needed) to check in about easement management. | Park managers and CWD staff | Moderate | Low |
| 17. Restore eroding area next to pump house | DPW and/or CWD | High | Moderate |
| 18. Request that CWD landscaping funds towards beach maintenance | Park managers and CWD staff | Moderate | Low |
| Parking & Funding | | | |
| 19. Seek input for restructuring of parking system | Community discussion of options. | High | Moderate |
| 20. Explore new funding strategies <ul style="list-style-type: none"> a. Donations b. Grants c. Friends organization | Community discussion of options. Leadership from park staff or volunteers to trial options and oversee. | High | Moderate |
| Signage | | | |
| 21. Post temporary park maps (directional signage) for 2013 operating season. | Park staff or volunteers to print, post. Small material costs for temporary signs. | High | Low |
| 22. Proceed with long-term funding for installation of directional signs at key park intersections, as outlined in the separate consultant report. | Park managers and city budget. | High | High |
| 23. Install a park bulletin board at the main entrance. | Installation by staff or construction by a community group. | High | Moderate |
| 24. Discuss alternatives to current emergency signage proposal with city staff. | Park managers and/or open community forum. | High | Low |
| 25. Develop interpretive materials and make them available online and in print. | Student groups, local naturalists. | Moderate | Low |

| Management Action | Who/How? | Priority | Cost/Risk |
|---|--|-----------------|------------------|
| Easement 26. Discuss opportunities with LCLT and VLT | City staff (already initiated by City Planning department). | Moderate | Low |
| Recreation 27. Seek public input for new recreational opportunities and values | Community discussion of options. | Low | Low |
| Education 28. Provide educational and interpretive resources to school and public groups. Make them available online and in print. a. Lesson plans b. Expanded park website/online interpretive material c. Pamphlets | Park staff, college groups/class projects, local naturalists. Ongoing work with UVM NR206 class. Requires oversight from a city contact. | Moderate | Moderate |
| 29. Increase opportunities for public engagement in park stewardship a. Trail maintenance b. Invasive species monitoring c. Vernal pool surveys and delineation d. Amphibian surveys e. Park wildlife census/"Bioblitz" f. Community wildlife sightings portal g. Park clean-up h. Forest health monitoring | Leadership from staff or a dedicated community volunteer. Red Rocks Nature Club (ongoing). School groups, local workplaces, neighbors. | High | Moderate |
| General 30. Hold a community visioning process to set park values and goals. | Scheduled for April 2013 in conjunction with this study. | High | Low |



REFERENCES

History

- Burlington Free Press, 12/30/1836
- Burlington Weekly Free Press, 8/14/1891, "Red Rocks: Improvements now being made there by Edward P. Hatch"
- City of South Burlington and Town of Burlington land records
- County Forester Files at Vermont ANR (personal correspondence of Bill Hall)

Natural Resources

- *Written in Stone* by Chet Raymo & Maureen E. Raymo
- "Glacial Geology of the Burlington and Colchester 7.5' Quadrangles, Northern Vermont" by Stephen F. Wright
- NRCS Web Soil Survey
- Soil Survey of Chittenden County Vermont.
- *Wetland, Woodland, Wildland* (2003) by Elizabeth H. Thompson and Eric R. Sorenson
- *New England Wildlife: Habitat, Natural History, and Distribution* (2000) by Richard M. DeGraaf and Mariko Yamasaki
- "Limestone Bluff Cedar-Pine Forests of Vermont: A Statewide Inventory" (2006) by Eric Sorenson and Robert Popp.

Management Concerns

- Bayfield, N.G. and Bathe, G.M. (1982) Experimental closure of footpaths in a woodland national nature reserve in Scotland. *Biological Conservation* 22: 229-237.
- Didham, R., Tylianakis, J., Hutchison, M., Ewers, R., and Gemmill, N. (2005). Are invasive species the drivers of ecological change? *Trends in Ecology and Evolution*, 20: 470-474.

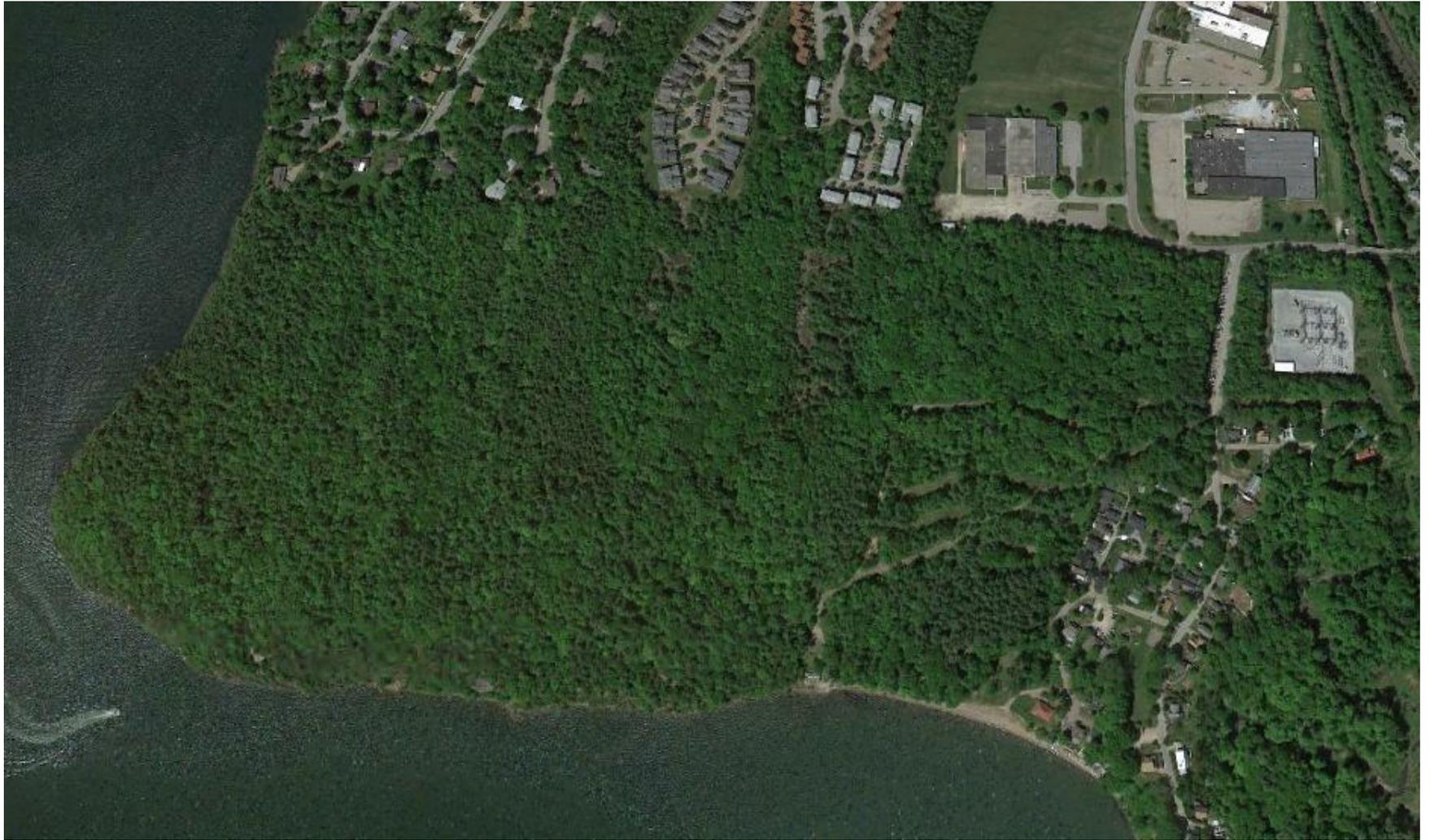
- *Technical Guide to Forest Wildlife Habitat Management in New England* (2007) by Richard M. DeGraaf et al.
- *Forest Bird Habitat Assessment: A Guide to Integrating Bird Habitat Data into a Vermont Forest Inventory* (2011) from Audubon Vermont.
- Jordan, M. (2000). Ecological impacts of recreational use of trails: a literature review. The Nature Conservancy, Cold Spring Harbor, New York.
- Lenth, B.E., Knight, R.L., and Brennan, M.E. (2008) The effects of dogs on wildlife communities. *Natural Areas Journal* 28(3): 218-227.
- Swearingen, T.C. and Johnson, D.R. 1995. Visitors' responses to uniformed park employees. *Journal of Park and Recreation Administration* 13(1): 73-85.
- *Town Forest Health Checklist: A Town Forest Steward's Guide to Forest Health Assessment.* David Brynn, Vermont Family Forests.
- VTInvasives.org (The Nature Conservancy website)
- *With People in Mind: Design and Management of Everyday Nature* (1998) by Rachel Kaplan et al.
- *Wildland Recreation*
- Winter, P.L., Sagarin, B.J., Rhoads, K., Barrett, D.W., and Cialdini, R.B. (2000) Choosing to encourage or discourage: perceived effectiveness of prescriptive versus proscriptive messages. *Environmental Management* 26(6): 589-594.

FURTHER READING

- *Reading the Forested Landscape* by Tom Wessels
- *Nature of Vermont* by Charles W. Johnson

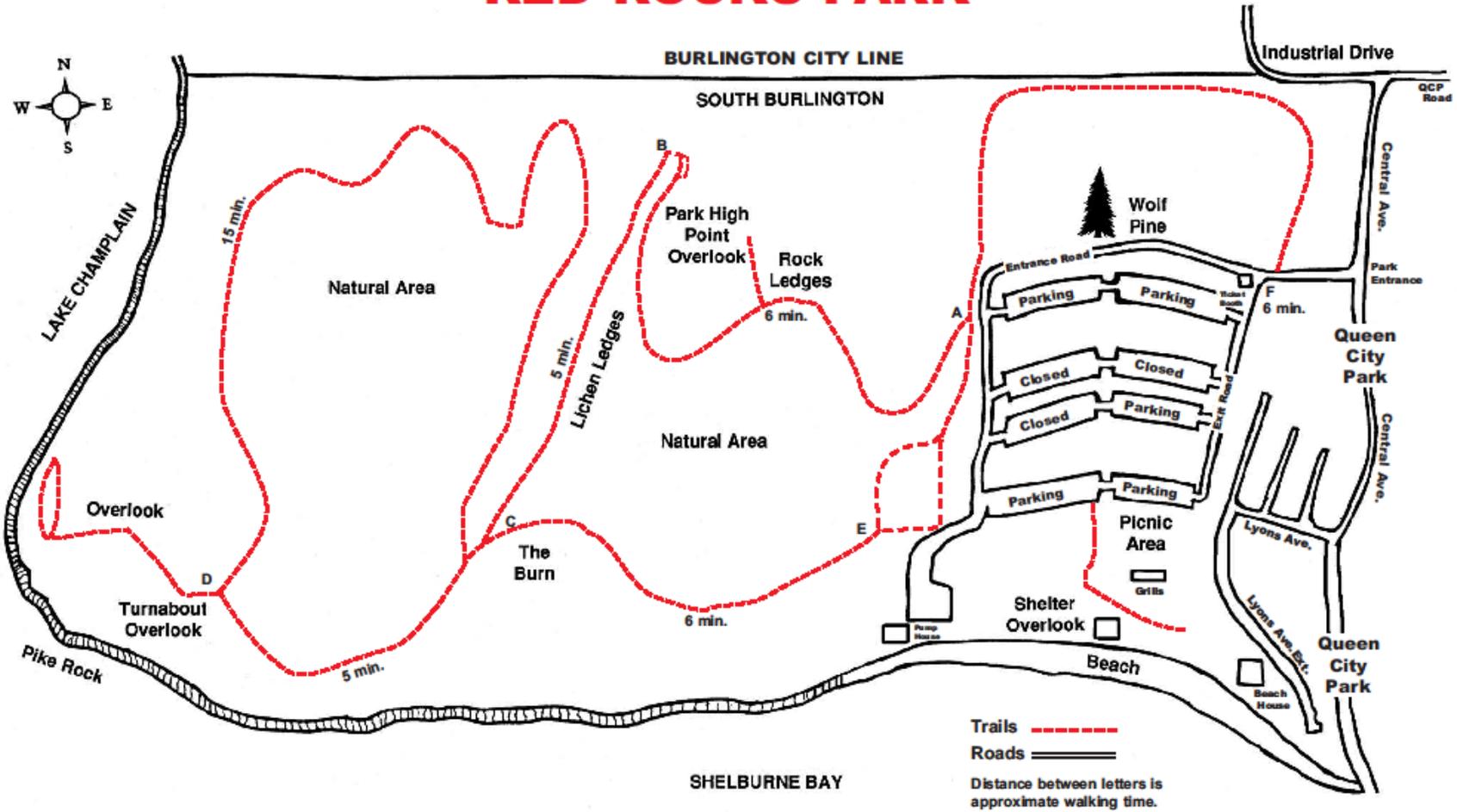


APPENDIX 1: Red Rocks from the air



APPENDIX 2: Current Park Trail Map

RED ROCKS PARK



APPENDIX 3: Timeline

The development of Red Rocks Park

1798: Red Rocks (lot no. 163 in the Old Town of Burlington) drawn by Thomas Udell.

1800-1850: The Wolf Pine begins growing.

1866: Edward Hatch acquires western portion of Red Rocks Park.

1891: Carriage roads constructed.

1907: Hatch purchases final, eastern piece of Red Rocks.

1909: Edward Hatch dies.

1960: South Burlington Master Plan shows Red Rocks as open space, recognizes need for community park.

1967: Red Rocks cited in town reports as exceptional natural and scenic lakefront property, greatly desired for city park system. A technical team led by UVM Professor Fred Sargent lists Red Rocks as one of 16 sites with natural resource potential.

1968: Sargent submits a proposed Conservation/Recreation Plan for South Burlington, endorsed by the South Burlington Natural Resources Committee. The committee lists reasons to acquire Red Rocks and attributes of the area. They draw up a rough plan for development of Red Rocks Park.

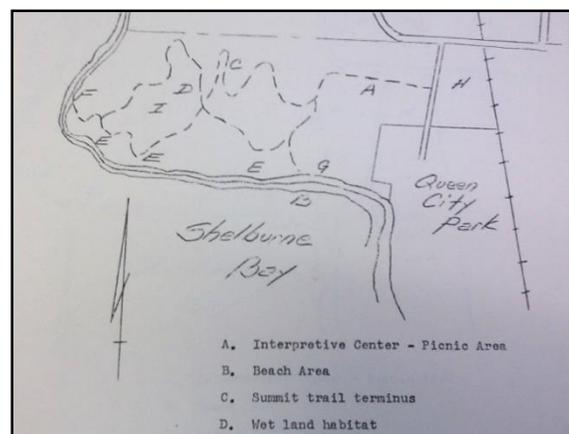
1969: The Conservation/Recreation Plan is accepted by the Planning Commission, and the Natural Resources Committee is charged with its implementation. The committee decides that lakefront property should have top priority. The updated South Burlington Master Plan again shows Red Rocks as open space.

1970: Red Rocks purchased by South Burlington after suddenly becoming available in early May for \$450,000. Residents vote 1094 to 98 in favor of purchase, and the city takes official ownership on October 5. Most of the purchase price comes from federal and state funds.

1974: \$25,000 bond issue passed to help fund park development.

1975: Bathhouse built, ordinance and fee system for park use written, entrance secured against motorized vehicles.

2013: Red Rocks management plan drafted.



1960s sketch outlining a proposed park at Red Rocks

APPENDIX 4: Plant Species List

Trees

- *Acer negundo*, Boxelder
- *Acer pennsylvanicum*, Striped maple
- *Acer platanoides*, Norway maple
- *Acer rubrum*, Red maple
- *Acer saccharum*, Sugar maple
- *Betula allegheniensis*, Yellow birch
- *Betula papyrifera*, Paper birch
- *Betula populifolia*, Gray birch
- *Carya cordiformis*, Bitternut hickory
- *Carya ovata*, Shagbark hickory
- *Carpinus caroliniana*, Musclemwood
- *Fagus grandifolia*, American beech
- *Fraxinus americana*, White ash
- *Hamamelis virginiana*, Witch hazel
- *Juniperus virginiana*, Eastern red cedar
- *Malus sp.*, Apple
- *Ostrya virginiana*, Hophornbeam (Ironwood)
- *Pinus resinosa*, Red pine
- *Pinus strobus*, White pine
- *Populus deltoides*, Cottonwood
- *Populus grandidentata*, Large-toothed aspen
- *Populus tremuloides*, Trembling aspen
- *Prunus serotina*, Black cherry
- *Quercus alba*, White oak
- *Quercus rubra*, Red oak
- *Rhus typhina*, Staghorn sumac
- *Robinia pseudoacacia*, Black locust
- *Sambucus racemosa*, Red elderberry
- *Taxus canadensis*, Canada yew
- *Thuja occidentalis*, Northern white cedar
- *Tilia americana*, Basswood (Linden)
- *Tsuga canadensis*, Eastern hemlock
- *Ulmus americana*, American elm

State-listed rare plants

- Water Hemp, *Amaranthus tuberculatus*, S1
- Canada Milk-vetch, *Astragalus canadensis*, S2
- Tall Cinquefoil, *Drymocallis arguta*, S3
- Houghton's Cyperus, *Cyperus houghtonii*, S2
- Ram's-Head Lady's-slipper, *Cypripedium arietinum*, S2
- Needle-spine Rose, *Rosa acicularis*, S1
- Small Skullcap, *Scutellaria parvula* var. *parvula*, S2
- Marsh Vetchling, *Lathyrus palustris*, S2
- Snowberry, *Symphoricarpos albus* var. *albus*, S3
- Rock Spikemoss, *Selaginella rupestris*, S3
- Four-leaved Milkweed, *Asclepias quadrifolia*, S3
- Blunt-leaved Woodsia, *Woodsia obtusa*, S3



Four-leaved milkweed, an uncommon Vermont plant, in flower at Red Rocks.

State rank significance:

S1 = Very rare (Critically imperiled): At very high risk of extinction or extirpation due to extreme rarity (often 5 or fewer populations or occurrences), very steep declines, or other factors.

S2 = Rare (Imperiled): At high risk of extinction or extirpation due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.

S3 = Uncommon (Vulnerable): Moderate risk of extinction/extirpation due to restricted range, relatively few populations or occurrences (often 80 or fewer), recent and widespread declines, or other factors.

APPENDIX 5: Animal Species List

The lists here are based on a combination of confirmed sightings and suspected presence based on the variety of habitats in Red Rocks.

Birds

This list includes all bird species sighted at or from Red Rocks, based on records from Vermont eBird. Birds are listed in taxonomic order.

Breeding season records (eBird) are in bold

**Species confirmed during this study italicized*

Vermont birder's dozen birds underlined

Canada Goose

Wood Duck

American Black Duck

Mallard

Bufflehead

Common Goldeneye

Common Merganser

Red-breasted Merganser

Red-throated Loon

Common Loon

Double-crested Cormorant

Great Blue Heron

**Turkey Vulture*

Osprey

Bald Eagle

Northern Harrier

Sharp-shinned Hawk

**Cooper's Hawk*

Accipiter sp.

Broad-winged Hawk

Red-tailed Hawk

Merlin

Killdeer

Spotted Sandpiper

Bonaparte's Gull

***Ring-billed Gull**

***Herring Gull**

Great Black-backed Gull

Caspian Tern

Common Tern

Sterna sp.

Rock Pigeon

Mourning Dove

Great Horned Owl

Chimney Swift

Ruby-throated Hummingbird

Belted Kingfisher

Red-bellied Woodpecker

Yellow-bellied Sapsucker

Downy Woodpecker

**Hairy Woodpecker*

**Northern Flicker*

**Pileated Woodpecker*

**Eastern Wood-Pewee*

Least Flycatcher

Empidonax sp.

***Eastern Phoebe**

***Great Crested Flycatcher**

Eastern Kingbird

Northern Shrike

Yellow-throated Vireo

Cassin's Vireo

Blue-headed Vireo

Warbling Vireo

Philadelphia Vireo

***Red-eyed Vireo**

**Blue Jay*

***American Crow**

**Fish Crow*

***Common Raven**

Northern Rough-winged Swallow

Tree Swallow

Barn Swallow

***Black-capped Chickadee**

Tufted Titmouse

Red-breasted Nuthatch

**White-breasted Nuthatch*

Brown Creeper

Carolina Wren

House Wren

***Winter Wren**

Blue-gray Gnatcatcher

Golden-crowned Kinglet

Ruby-crowned Kinglet

Veery

Gray-cheeked Thrush

Swainson's Thrush

Hermit Thrush

Wood Thrush

**American Robin*

Gray Catbird

European Starling

Bohemian Waxwing

***Cedar Waxwing**

Snow Bunting

***Ovenbird**

Northern Waterthrush
Golden-winged Warbler
Black-and-white Warbler
Tennessee Warbler
Orange-crowned Warbler
Nashville Warbler
Mourning Warbler
Common Yellowthroat
American Redstart
Cape May Warbler
Cerulean Warbler
Northern Parula
Magnolia Warbler
Bay-breasted Warbler
Blackburnian Warbler
Yellow Warbler
Chestnut-sided Warbler

Blackpoll Warbler
Black-throated Blue Warbler
Palm Warbler
***Pine Warbler**
***Yellow-rumped Warbler**
Yellow-throated Warbler
Black-throated Green Warbler
Canada Warbler
Wilson's Warbler
Eastern Towhee
***Chipping Sparrow**
Field Sparrow
Savannah Sparrow
Fox Sparrow
Song Sparrow
Lincoln's Sparrow
White-throated Sparrow

White-crowned Sparrow
***Dark-eyed Junco**
***Scarlet Tanager**
***Northern Cardinal**
Rose-breasted Grosbeak
Indigo Bunting
Red-winged Blackbird
***Common Grackle**
Brown-headed Cowbird
Baltimore Oriole
Purple Finch
House Finch
Red Crossbill
Pine Siskin
***American Goldfinch**
House Sparrow

Reptiles & Amphibians

Confirmed

Milk snake
Garter snake
Gray treefrog
Spring peeper

Suspected

Red-backed salamander
Wood frog
American toad
Spotted salamander

Mammals

Confirmed

Virginia opossum
Mink
White-tailed deer
Eastern cottontail
Gray squirrel
Red squirrel
Eastern chipmunk
Moose
Raccoon
Red fox
Gray fox
Striped skunk
Ermine (short-tailed weasel)
Myotis bats

Suspected

Big brown bat
Southern red-backed vole
Northern flying squirrel
Southern flying squirrel
Short-tailed shrew
Long-tailed weasel
Woodland jumping mouse
Deer mouse

