Our Mission is to Provide Quality Public Services in a Fiscally Responsible Manner While Preserving the City's Open Space Character

NOTICE OF MEETING

City of Lake Elmo Park Commission
3800 Laverne Avenue North
May 20, 2019 6:30 PM

AGENDA

1. Pledge of Allegiance
2. Approve Agenda
3. Approve Minutes
    a) March 18, 2019
    b) April Meeting Canceled
4. Sunfish Lake Bike Trail Proposal
5. 2020-2024 Parks Commission Capital Improvement Plan (CIP)
6. Buckthorn Removal Grant
7. Sunfish Lake Nature Center Patio Addition
8. June 2019 Meeting Agenda
9. Communication
10. Adjourn

****Note: Every effort will be made to accommodate person or persons that need special considerations to attend this meeting due to a health condition or disability. Please contact the Lake Elmo City Clerk if you are in need of special accommodations.*

MINUTES

City of Lake Elmo Parks Commission
March 18, 2019

Members Present: Commissioners Olinger, Schumacker, Weeks, & Zeno. Mayek arrived late.
Members Absent: Commissioners Ames, & Nightingale
Staff Present: Public Works Lead Worker Colemer, City Planner Prchal

The meeting was called to order by Chair Weeks at 6:30 PM.

Approval of Agenda

Weeks made a suggestion to amend the agenda item 5 to Park Naming Policy as it is described in the report and attached documents and add 3b - Public Comment to the agenda after the Approval of Minutes. Zeno made a motion to approve the amended agenda, Schumacker seconded the motion. Motion passed.

Approval of Minutes

Motion by Olinger to approve the February minutes, seconded by Schumacker. Motion passed, Zeno abstained.

Public Comment

George Johnson stated he has been part of the Nature Center board and buckthorn removal in the past but has since resigned and is not here to speak on behalf of the Nature Center. He said he is here speaking as a citizen on his own belief that he does not think mountain biking belongs in the park and will harm the park. He asked what the hurry is to add mountain biking to Sunfish Lake Park before completing the Reid Park trails and surveying the residents.

Johnson stated that there has been two plans completed to restore Sun Fish Lake Park in 2011 and 2017 and he would like to see the restoration take place. He said he found a company called Stantec that creates proposals to the DNR to get funding for parks. All of the paperwork would be completed by Stantec. The City would have to agree to a $10,000 investment or 10 percent in order to get the project constructed. With the funding the City could plant the species they want into the park, especially now that the buckthorn has been removed.

Linda Keller 4594 Lilac Lane N, member of St. Paul Audubon. She stated that animals need large tracks of land that has not been carved up by human activity in order to survive and believes mountain biking trails will carve up the park.

Judith Blackford 9765 45th St N stated that the erodible soils in the park have been researched by the DNR and Washington County and ordinances were made to protect this park. She stated that through clerical errors and technicalities the ordinances were emitted and now promises of no mountain biking are being asked to be broken. She asked the Commission members to research the topic and to make a decision on integrity.

Susan Dunn, 110818 Upper 33rd Street, is in favor of preserving Sunfish Lake Park. She is concerned that once damage has been done to the park it cannot be undone. She would also like the Parks Commission contacts updated.

Susan Saffle, 11180 50th Street N, Sunfish Lake Park has been called it a high quality hardwood forest. The intact forests are becoming more of a rarity in central Minnesota. The DNR promotes low-impact walking trails. She is concerned about safety, injury, and liability as a nurse. Would like to attend the meeting with the MN Land Trust.

Jeff Moris, 9876 Tapestry Road, was around when the park was created and aware of the original ordinances to protect the park. His family has mountain bikes and his property has egress to the park and would never bike in the park. Concerned about safety.

Ann Bucheck, 2301 Legion Ave, asked if the Parks Commission received a copy of the Conservation Easement established by the MN Land Trust. She asked if there would be a report of the meeting. Wanted to know when, why, and how did the rules regarding biking in city parks change.

Playground Proposal for Wildflower and Village Preserve

Prchal stated that .7 acres of land was provided in-lieu of cash for parkland in the Wildflower & Village Preserve area. The city has $105,000 set aside for park improvements.

There were three proposals, St. Croix Recreation is the preferred choice since their bid is inclusive of grading, pea gravel, curbing, etc. Both other bids require the City to do that work separate from the bid costs.

Weeks asked if St. Croix Recreation is who did Savona or another park in the city. Colemer stated the have supplied equipment for Sanctuary. Additional questions around pea gravel and mulch, screening materials, and maintenance were discussed.

Weeks made a made a motion to approve the proposal from St. Croix Recreation, seconded by Mayek.

Olinger asked if this is Public Works and the residents' first choice. Prchal explained it was and that Inwood would be the next park for review and construction.

Motion passed unanimously.

Park Naming

Prchal presented the proposed policy.

Ann Bucheck, 2301 Legion Ave, asked if the public would be notified if parks would be changing names. She also asked if people would be notified of the parks naming. Weeks explained that most of the publication is online and the purpose is to have future parks to not be named for the development it is located near to prevent the confusion about who can use a park.

Zeno made a motion to add in a method to notify public. Mayek made a motion to adopt the Parks Naming Policy, Zeno seconded the motion.

Amended motion passed unanimously.

April Meeting Agenda
Parks Commission bylaws and policy

Communications
None

Meeting adjourned at 7:43 p.m.

Respectfully Submitted,
Tanya Nuss

STAFF REPORT

DATE: 5/20/2019
REGULAR

TO: Parks Commission
FROM: Ben Prchal, City Planner
AGENDA ITEM: Bike Trials within Sunfish Lake Park
REVIEWED BY: Kristina Handt, City Administrator

BACKGROUND:

The City of Lake Elmo Parks Commission and City Council approved a Capital Improvement expenditure of $120,000 for the development of bike trials in Sunfish Lake Park. Staff was then directed through the 2019 parks work plan to further explore trail development and gather information on what it would mean to build bike trails within the park. The Parks Commission had an opportunity to review a preliminary bike trail map at their January 23rd meeting. At that meeting they directed staff to focus on developing one trail that would be reasonable to present to them and to the Land Trust, who also has a level of authority over the park related to the conservation easement. A draft map was sent to the Land Trust to review, to which they provided feed back to the City. Staff took their comments and incorporated them into the other trail option as it was more in line with what the Trust saw as being acceptable. Since then, a new bike trail map has been developed which has been approved by the Land Trust. Staff recognizes that this map is different than what the Parks Commission had previously approved but would ask them to understand that it has met the expectations of the Land Trust. A Request for Proposal (RFP) was also prepared in tandem with the trail.

ISSUE BEFORE THE PARKS COMMISSION:

Does the Parks Commission support the proposed Trail Map and RFP for the Sunfish Lake Trail system?

PROPOSAL DETAILS/ANALYSIS:

The intent of this report is to cover a few of the key discussion points that came up at prior meetings as well as provide some relevant detail about the proposed bike trail map.

SOILS:

Staff researched the soil types that are throughout the park and have provided some information from the USDA Web Soil survey website (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx). After looking into the site in more detail the survey produced a map that would indicate the soils to range from somewhat limited to very limited in terms of their ability to develop trails. On the site you can search the soils capability for development by use, such as trails, off-road trails, camp grounds, home sites, etc. Staff ran two reports one for paths and trails and one for off road motorcycle trails. Staff ran both reports because the bike trails seemed to fit between the two use categories, both reports produced similar results. Beyond maintenance reasons, motorized vehicles will not be allowed on the trails. The section of soil that the trail will be going through is classified as somewhat limited for this use. The USDA classifies the "somewhat limited" soils as follows:

""Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected."

Staff believes that with the professional design, review of the Minnesota Land Trust, and design implementation of the final contractor the trails will be able to overcome the limiting factors of the soil.

HISTORY:

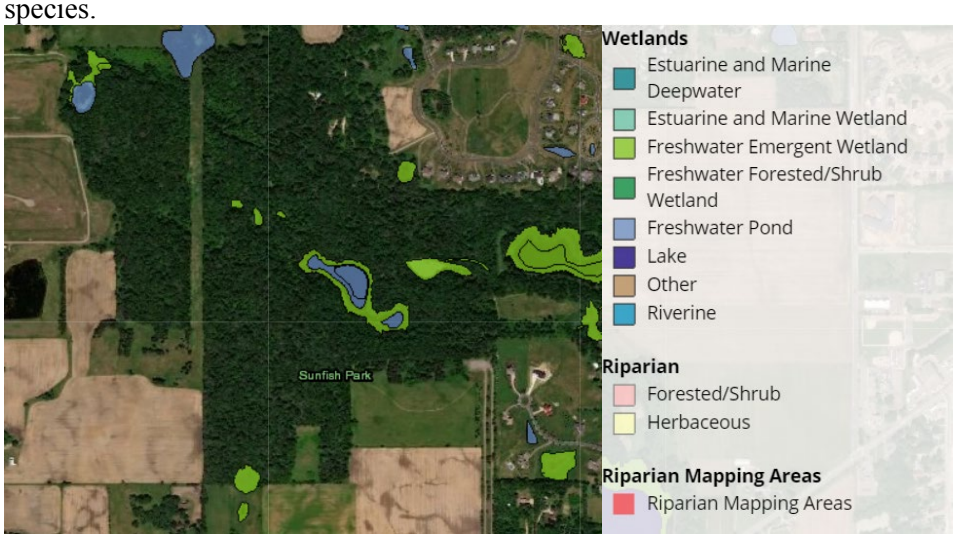
MN Historical Society:
Searching the Minnesota Historical Society website did not produce any information that was relevant to Sunfish Lake Park.

National Registry:
The National Registry for Historical Places also did not produce any information pertaining to Sunfish Lake Park.

Staff understands that the park does hold historical value to some residents. This is clearly outlined in the "History of Sunfish Lake Report" that was produced by residents of the City.

THREATENED OR ENDANGERED SPECIES:

MN DNR:
Using the Minnesota DNR website Staff performed a search of Lake Elmo (https://www.dnr.state.mn.us/rsg/index.html). There was only one species that came up as being threatened which was the Pugnose Shiner (fish). These fish are known to inhabit clear glacial lakes. The trail has limited exposure to the pond within the Park and if the fish are present in the pond it is not expected that the trail will impose detrimental effects to the fish. Also known to be in the park is the Blandings Turtle. The DNR lists the turtles habitat as being in prairie, floodplain forest, wet forest, steams and ponds. As you will see the trial has been moved out of the prairie to help mitigate the impact to other species.



US. Fish and Wildlife:
The search through this agency produced more results but instead of providing data specific to Lake Elmo it provided information state wide (https://ecos.fws.gov/ecp0/reports/species-listed-by-state-report?state=MN&status=listed). The search could suggest that there is habitat for the Rusty Patch Bumble Bee which is listed as endangered. Their habitat consists of grasslands. Keeping this in mind a trail route has been suggested which would mitigate interference with the existing grassland/prairie. Beyond that they also list Bush-clover as being a threatened species. The preferred habitat is considered to be tall grass parries. Similar to the bumble bee, the bike trail has been moved to help limit the potential exposure.

NEPA (National Environmental Protection Agency):
Staff also ran a report from the NEPA website, which is attached. There are some relevant categories that the report will provide for evaluating the site. Such as historic relevance, impaired *(does not meet quality standards)* waterbodies, or streams. Based on the produced report staff did not see anything that was not already known or posed substantial concern for further review.

Staff was unable to find substantial evidence proving that mountain bikers would cause more of a disturbance to the natural environment than other user groups. There is also a continual statement that mountain bikers produce more litter than hikers or other user groups. Again, there was not supporting evidence to prove that there was a direct correlation between activity and careless displacement of litter.

SUNFISH LAKE TRAIL PROPOSAL:

Aspects of the Trial:

Due to the potential for conflicts between user groups, the number of crossings was reduced. This is beneficial from two perspectives. It will help to reduce the potential for conflicts as well as prolong the riders' ability to focus on the trail without constantly being cautious of another crossing.

Number of Bike/Walking Trail Crossings

- 10 crossings

Estimated Trail Length

- 4 miles

The bike trails proposed for Sunfish Lake would be narrow trails called single-track. Once established, single-track trails average 18-24" in width, are not paved, reach a broad range of riders and are designed to flow through natural areas with gradual inclines and declines in topography. These single-track trails can be seen as similar to a narrow hiking path (not like the trails already existing) with the exception that bike trails would be closed to the public when saturated with water after a significant rainfall, melting snow or melting frost, and would remain closed until dry to avoid erosion and degradation of the trail surface. Modern trail design and construction uses sustainable trail building techniques. Single-track trails have been shown to have minimal impact on the environment, resist erosion through proper design, construction and maintenance, co-exist with the natural environment and blend with the surrounding area.

Impact on surrounding properties:

The park does not boarder a large number of residential properties. The majority of the homes are located to the North/ North East of the park with the rest being farm land or larger residential properties. The bike trail is generally kept internal to the site and Staff believes it would be difficult to see the proposed trail from the edges of the park. Staff does not anticipate bikers to cause more of a nuisance than other users within the park.

There is an established park entrance with a parking lot which is where we would expect most users to enter the park. Staff does expect the trail to receive active use but at this time believes the parking lot(s) to be adequate for users.

Impact to other users:

With the added amenity of bike trails, it is anticipated that the number of users in the park will increase. With the user type expected to vary, the majority of the proposed trail is designed to mitigate the speed at which a bike will cross a walking path. The design of the trail is predominately located in areas that do not have an established use, thus not now actively used. It is important that the park is safe and offer useful amenities for all residents and visitors. Where crossings are going to occur they will be established in a way that will force bike riders to slow their speed to safely cross the walking trail. Clearing brush near the trail crossings would also be a method to help establish better visibility around each trail intersection.

Signage:

Where intersections occur, trails would be marked displaying the direction of travel and expectations. The City should expect to put up signage warning walkers and bikers of the crossings. There can also be signage placed at the entrance to further inform users of expectations as well as conditions of trails after rain events. Such as: "Riders must wait 2 hours after a rain event before trail use" and "Be good stewards remove all trash".

Request for Proposal Details:

The attached RFP is important in that it outlines the expectations that the City would have for the trail builder. Staff sent the Land Trust the RFP at the time that the first trail map was provided to them for review. The organization did not have any suggestions for edits to the RFP with the exception of adding language to improve the trails which are being removed. Staff does not believe this is largely impactful and something that can easily be accomplished. Some ideas to satisfy this requirement might be an Eagle Scout project or else the City could consider ordering a few more

trees for the Arbor Day give away that would be plated in the park. *Staff is aware that the maps have not been updated in the RFP but they will be changed out by the time the request is made public.*

FISCAL IMPACT (Estimated) :

There is $120,000 reserved for the development of bike trails throughout the park.

Signage $700 - $800 (intersection signage)

Trail Head Sign $1,000 - $2,000 staff would recommend revamping the entire kiosk at the park.

A report for trail maintenance was prepared by rails to trails conservancy, this is not solely specific to Minnesota but staff does not believe that trail maintenance and costs will dramatically vary. The full report can be found on the City website at http://www.lakeelmo.org/parks-commission-sunfish-lake-park-documents. The time and cost to maintain trails had a wide range which would depend on the amount of yearly maintenance such as mowing, vegetative clearing, and asphalt repair. The report was written to cover asphalt and crushed stone paths. Crushed stone is similar to mountain bike trials but different in design and natural material. However, the report indicated that entities that actively maintained their trails expected to spend $1,000 to $2,000 per mile depending on surface type.

After speaking to Minnesota Off-Road Cyclists (MORC) and the Recreation Manager at the City of Woodbury, those figures do appear to also apply to bike trails. Based on current information, there does not appear to be an increased cost to maintain mountain bike trails over other paved or natural surface trails.

OPTIONS:

Staff is requesting that the Parks Commission review and comment on the draft trail design.
The Parks Commission may:

1. Recommend approval of the bike trail and RFP as approved by the Land Trust.
2. Direct Staff to make amendments and then recommend approval.
3. Recommend denial of the bike trail and RFP as approved by the Land Trust

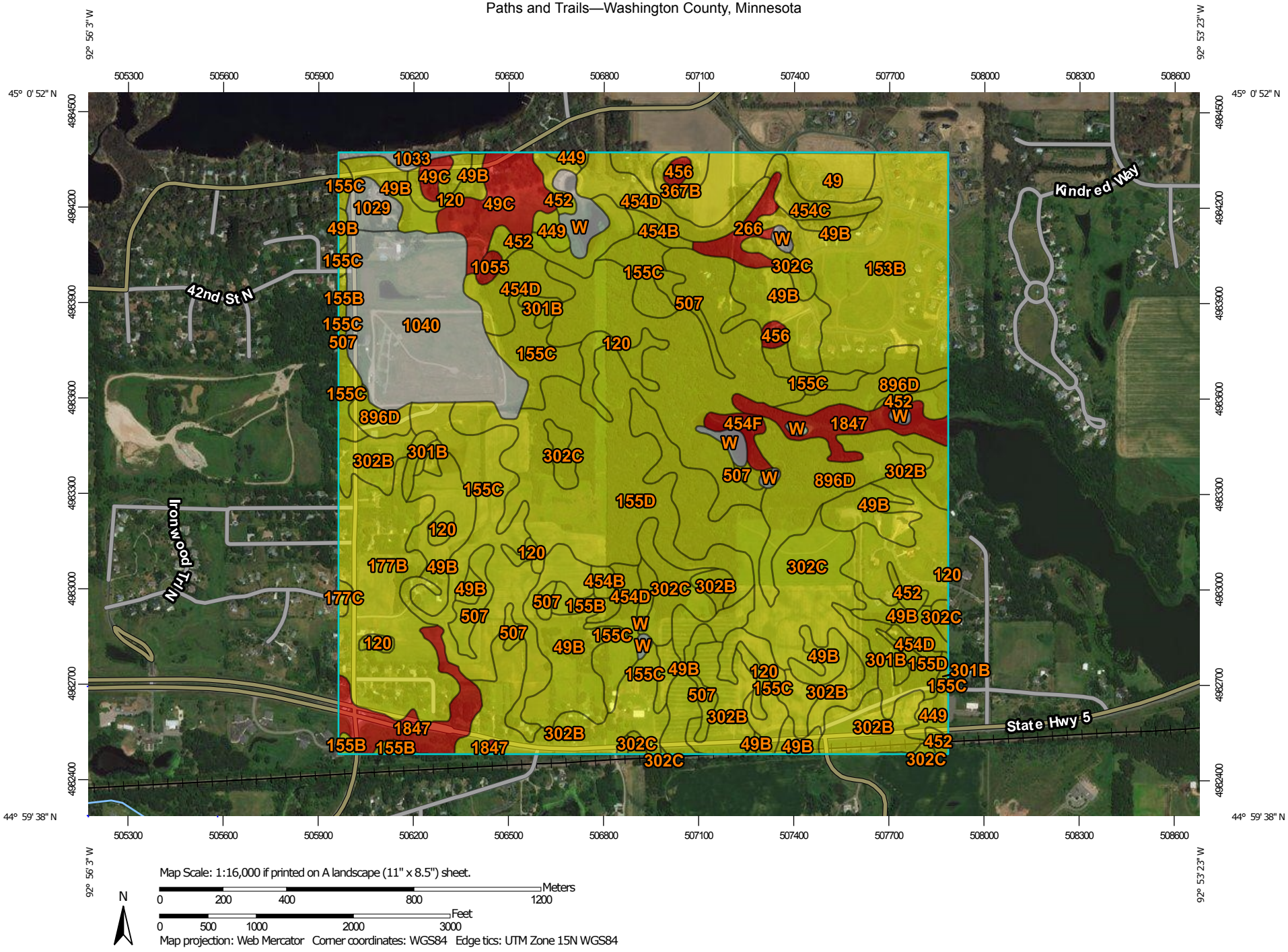
RECOMMENDATION:

At this time Staff believes that information known today is sufficient to know that bike trails, if designed, built, and maintained appropriately will not erode the park.

"Recommend approval of the Trail Plan and RFP to build the new trails which has been presented, within Sunfish Lake Park"

ATTACHMENTS:

- Draft Trail Map.
- April 18, 2019 Letter from MN Land Trust
- Due to the size of some of the attachments a City webpage has been established to hold the documents. Please visit http://www.lakeelmo.org/parks-commission-sunfish-lake-park-documents
    - Soil Survey
    - MN DNR Report
    - National Environmental Protection Agency Report (NEPA)
    - Ecological Review
    - Maintenance Report
    - Land Trust Easement
    - RFP



Map Scale: 1:16,000 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Lines

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Points

Very limited

Somewhat limited

Not limited

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County, Minnesota
Survey Area Data: Version 14, Oct 9, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 16, 2012—Sep 13, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Paths and Trails

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
12D	Emmert gravelly loamy coarse sand, 15 to 25 percent slopes	Somewhat limited	Emmert (90%)	Too sandy (0.50)	2.1	0.2%
				Slope (0.18)		
49	Antigo silt loam, 0 to 2 percent slopes	Somewhat limited	Antigo (80%)	Dusty (0.00)	23.3	2.6%
			Billyboy (8%)	Dusty (0.00)		
			Sconsin (5%)	Depth to saturated zone (0.50)		
				Dusty (0.00)		
			Rosholt (3%)	Dusty (0.00)		
			Brill (2%)	Depth to saturated zone (0.50)		
				Dusty (0.00)		
49B	Antigo silt loam, 2 to 6 percent slopes	Somewhat limited	Antigo (80%)	Dusty (0.00)	94.7	10.5%
			Billyboy (5%)	Dusty (0.00)		
			Sconsin (5%)	Depth to saturated zone (0.50)		
				Dusty (0.00)		
			Rosholt (5%)	Dusty (0.00)		
			Brill (3%)	Depth to saturated zone (0.50)		
				Dusty (0.00)		
49C	Antigo silt loam, 6 to 15 percent slopes	Very limited	Antigo (85%)	Water erosion (1.00)	19.3	2.1%
				Dusty (0.00)		
			Ossmer (2%)	Depth to saturated zone (1.00)		
				Dusty (0.00)		
120	Brill silt loam	Somewhat limited	Brill (90%)	Dusty (0.01)	16.5	1.8%
153B	Santiago silt loam, 2 to 6 percent slopes	Somewhat limited	Santiago (90%)	Dusty (0.01)	61.1	6.8%
155B	Chetek sandy loam, 0 to 6 percent slopes	Somewhat limited	Chetek (90%)	Dusty (0.00)	6.4	0.7%

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
155C	Chetek sandy loam, 6 to 12 percent slopes	Somewhat limited	Chetek (90%)	Dusty (0.00)	90.1	10.0%
155D	Chetek sandy loam, 12 to 25 percent slopes	Somewhat limited	Chetek (90%)	Slope (0.02)	135.5	15.0%
				Dusty (0.00)		
177B	Gotham loamy sand, 1 to 6 percent slopes	Somewhat limited	Gotham (90%)	Too sandy (0.57)	46.8	5.2%
177C	Gotham loamy sand, 6 to 12 percent slopes	Somewhat limited	Gotham (90%)	Too sandy (0.57)	0.9	0.1%
266	Freer silt loam	Very limited	Freer (90%)	Depth to saturated zone (1.00)	6.1	0.7%
				Dusty (0.01)		
301B	Lindstrom silt loam, 2 to 4 percent slopes	Somewhat limited	Lindstrom (90%)	Dusty (0.01)	5.1	0.6%
302B	Rosholt sandy loam, 2 to 6 percent slopes	Somewhat limited	Rosholt (80%)	Dusty (0.00)	88.3	9.8%
			Scott Lake (10%)	Dusty (0.00)		
			Antigo (5%)	Dusty (0.00)		
			Chetek (3%)	Dusty (0.00)		
302C	Rosholt sandy loam, 6 to 15 percent slopes	Somewhat limited	Rosholt (85%)	Dusty (0.00)	68.3	7.6%
			Chetek (7%)	Dusty (0.00)		
			Scott Lake (2%)	Dusty (0.00)		
367B	Campia silt loam, 0 to 8 percent slopes	Somewhat limited	Campia (90%)	Dusty (0.01)	3.6	0.4%
449	Crystal Lake silt loam, 1 to 3 percent slopes	Somewhat limited	Crystal Lake (90%)	Dusty (0.01)	6.5	0.7%
452	Comstock silt loam	Somewhat limited	Comstock (90%)	Depth to saturated zone (0.44)	16.9	1.9%
				Dusty (0.01)		
454B	Mahtomedi loamy sand, 0 to 6 percent slopes	Somewhat limited	Mahtomedi (90%)	Too sandy (0.72)	4.3	0.5%
454C	Mahtomedi loamy sand, 6 to 12 percent slopes	Somewhat limited	Mahtomedi (90%)	Too sandy (0.72)	5.9	0.7%
454D	Mahtomedi loamy sand,	Somewhat limited	Mahtomedi (90%)	Too sandy (0.72)	25.9	2.9%

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
	12 to 25 percent slopes			Slope (0.18)		
454F	Mahtomedi loamy sand, 25 to 40 percent slopes	Very limited	Mahtomedi (90%)	Slope (1.00)	3.8	0.4%
				Too sandy (0.72)		
456	Barronett silt loam	Very limited	Barronett (85%)	Depth to saturated zone (1.00)	2.8	0.3%
				Ponding (1.00)		
				Dusty (0.01)		
507	Poskin silt loam	Somewhat limited	Poskin (90%)	Depth to saturated zone (0.44)	16.0	1.8%
				Dusty (0.01)		
896D	Mahtomedi-Kingsley complex, 12 to 25 percent slopes	Somewhat limited	Mahtomedi (60%)	Too sandy (0.72)	44.4	4.9%
				Slope (0.18)		
			Kingsley (35%)	Slope (0.18)		
1029	Pits, gravel	Not rated	Pits, gravel (100%)		5.7	0.6%
1033	Udifluvents	Not rated	Udifluvents (90%)		2.5	0.3%
1040	Udorthents	Not rated	Udorthents (90%)		58.7	6.5%
1055	Aquolls and Histosols, ponded	Very limited	Histosols, ponded (50%)	Depth to saturated zone (1.00)	1.5	0.2%
				Organic matter content (1.00)		
				Ponding (1.00)		
				Dusty (0.01)		
			Aquolls, ponded (50%)	Depth to saturated zone (1.00)		
				Ponding (1.00)		
				Dusty (0.01)		
1847	Barronett silt loam, sandy substratum	Very limited	Barronett, sandy substratum (85%)	Depth to saturated zone (1.00)	28.2	3.1%
				Ponding (1.00)		
				Dusty (0.01)		
W	Water	Not rated	Water (100%)		11.5	1.3%
Totals for Area of Interest					**902.7**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Somewhat limited	762.5	84.5%
Very limited	61.8	6.8%
Null or Not Rated	78.4	8.7%
Totals for Area of Interest	**902.7**	**100.0%**

Description

Paths and trails for hiking and horseback riding should require little or no slope modification through cutting and filling.

The ratings are based on the soil properties that affect trafficability and erodibility. These properties are stoniness, depth to a water table, ponding, flooding, slope, and texture of the surface layer.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

DEPARTMENT OF NATURAL RESOURCES

MINNESOTA'S LIST OF ENDANGERED, THREATENED, AND SPECIAL CONCERN SPECIES

PURPOSE, SCOPE, AND RELATIONSHIP TO FEDERAL LAWS

Minnesota's Endangered Species Statute (Minnesota Statutes, Section 84.0895) requires the Minnesota Department of Natural Resources (DNR) to adopt rules designating species meeting the statutory definitions of endangered, threatened, or species of special concern. The resulting List of Endangered, Threatened, and Special Concern Species is codified as Minnesota Rules, Chapter 6134. The Endangered Species Statute also authorizes the DNR to adopt rules that regulate treatment of species designated as endangered and threatened. These regulations are codified as Minnesota Rules, Parts 6212.1800 to 6212.2300.

Minnesota's Endangered Species Statute and the associated Rules impose a variety of restrictions, a permit program, and several exemptions pertaining to species designated as endangered or threatened. A person may not take, import, transport, or sell any portion of an endangered or threatened species. However, these acts may be allowed by permit issued by the DNR; plants on certain agricultural lands and plants destroyed in consequence of certain agricultural practices are exempt; and the accidental, unknowing destruction of designated plants is exempt. Species of special concern are not protected by Minnesota's Endangered Species Statute or the associated Rules. Persons are advised to read the full text of the Statute and Rules in order to understand all regulations pertaining to species that are designated as endangered, threatened, or species of special concern.

Note that the federal Endangered Species Act of 1973, as amended (16 USC 1531 - 1544) requires the U.S. Department of the Interior to identify species as endangered or threatened according to a separate set of definitions, and imposes a separate set of restrictions pertaining to those species. In the following list, the federal status of seventeen federally-listed species that occur in Minnesota is noted to the right of those species' common names (E = endangered; T = threatened; P=proposed; C = candidate).

DEFINITIONS

A species is considered **endangered** if the species is threatened with extinction throughout all or a significant portion of its range within Minnesota.

A species is considered **threatened** if the species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range within Minnesota.

A species is considered a **species of special concern** if, although the species is not endangered or threatened, it is extremely uncommon in Minnesota, or has unique or highly specific habitat requirements and deserves careful monitoring of its status. Species on the periphery of their range that are not listed as threatened may be included in this category along with those species that were once threatened or endangered but now have increasing or protected, stable populations.

CONTENTS

FOR MORE INFORMATION, CONTACT:

Minnesota Endangered Species Coordinator
Division of Ecological and Water Resources
Minnesota Department of Natural Resources
500 Lafayette Rd., Box 25
St. Paul, MN 55155
1-888-646-6367 (or 612-296-6157 in the metro area)
http://www.dnr.state.mn.us/ets/index.html

Effective August 19, 2013

MAMMALS

Threatened

Spilogale putorius ..... eastern spotted skunk
Thomomys talpoides ..... northern pocket gopher

Special Concern

Alces americanus ..... moose
Cervus canadensis ..... elk
Cryptotis parva ..... North American least shrew
Eptesicus fuscus ..... big brown bat
Lynx canadensis ..... Canada lynx (Fed. Status: T)
Microtus ochrogaster ..... prairie vole
Microtus pinetorum ..... woodland vole
Mustela nivalis ..... least weasel
Myotis lucifugus ..... little brown myotis
Myotis septentrionalis ..... northern myotis (Fed. Status: P)
Onychomys leucogaster ..... northern grasshopper mouse
Perimyotis subflavus ..... tri-colored bat
Perognathus flavescens ..... plains pocket mouse
Phenacomys ungava ..... eastern heather vole
Puma concolor ..... mountain lion
Reithrodontomys megalotis ..... western harvest mouse
Sorex fumeus ..... smoky shrew
Synaptomys borealis ..... northern bog lemming
Urocitellus richardsonii ..... Richardson's ground squirrel

BIRDS

Endangered

Ammodramus bairdii ..... Baird's sparrow
Ammodramus henslowii ..... Henslow's sparrow
Anthus spragueii ..... Sprague's pipit (Fed. Status: C)
Athene cunicularia ..... burrowing owl
Calcarius ornatus ..... chestnut-collared longspur
Charadrius melodus ..... piping plover (Fed. Status: E/T)
Lanius ludovicianus ..... loggerhead shrike
Podiceps auritus ..... horned grebe
Rallus elegans ..... king rail

Threatened

Phalaropus tricolor ..... Wilson's phalarope
Sterna hirundo ..... common tern

Special Concern

Accipiter gentilis ..... northern goshawk
Aegolius funereus ..... boreal owl
Ammodramus nelsoni ..... Nelson's sparrow
Asio flammeus ..... short-eared owl
Buteo lineatus ..... red-shouldered hawk
Chondestes grammacus ..... lark sparrow
Coturnicops noveboracensis ..... yellow rail
Cygnus buccinator ..... trumpeter swan
Empidonax virescens ..... acadian flycatcher
Falco peregrinus ..... peregrine falcon
Gallinula galeata ..... common gallinule
Leucophaeus pipixcan ..... Franklin's gull
Limosa fedoa ..... marbled godwit
Parkesia motacilla ..... Louisiana waterthrush
Pelecanus erythrorhynchos ..... American white pelican
Progne subis ..... purple martin
Setophaga cerulea ..... cerulean warbler
Setophaga citrina ..... hooded warbler
Sterna forsteri ..... Forster's tern
Tympanuchus cupido ..... greater prairie-chicken
Vireo bellii ..... Bell's vireo

AMPHIBIANS AND REPTILES

Endangered

Acris blanchardi ..... northern cricket frog
Sistrurus catenatus ..... massasauga (Fed. Status: C)

Threatened

Crotalus horridus ..... timber rattlesnake
Emydoidea blandingii ..... Blanding's turtle
Glyptemys insculpta ..... wood turtle
Pantherophis obsoletus ..... western ratsnake

Special Concern

Ambystoma maculatum ..... spotted salamander
Anaxyrus cognatus ..... Great Plains toad
Apalone mutica ..... smooth softshell
Coluber constrictor ..... North American racer
Hemidactylium scutatum ..... four-toed salamander
Heterodon nasicus ..... plains hog-nosed snake
Necturus maculosus ..... mudpuppy
Pituophis catenifer ..... gopher snake
Plestiodon fasciatus ..... common five-lined skink
Tropidoclonion lineatum ..... lined snake

FISH

Endangered

Alosa chrysochloris ..... skipjack herring
Crystallaria asprella ..... crystal darter
Hybopsis amnis ..... pallid shiner
Noturus exilis ..... slender madtom

Threatened

Erimystax x-punctatus ..... gravel chub
Fundulus sciadicus ..... plains topminnow
Ictiobus niger ..... black buffalo
Notropis anogenus ..... pugnose shiner
Polyodon spathula ..... paddlefish

Special Concern

Acipenser fulvescens ..... lake sturgeon
Anguilla rostrata ..... American eel
Aphredoderus sayanus ..... pirate perch
Clinostomus elongates ..... redside dace
Coregonus kiyi ..... kiyi
Coregonus nipigon ..... Nipigon cisco
Coregonus zenithicus ..... shortjaw cisco
Couesius plumbeus ..... lake chub
Cycleptus elongatus ..... blue sucker
Etheostoma chlorosoma ..... bluntnose darter
Etheostoma microperca ..... least darter
Hybognathus nuchalis ..... Mississippi silvery minnow
Ichthyomyzon fossor ..... northern brook lamprey
Ichthyomyzon gagei ..... southern brook lamprey
Lepomis gulosus ..... warmouth
Lepomis peltastes ..... northern longear sunfish
Lythrurus umbratilis ..... redfin shiner
Morone mississippiensis ..... yellow bass
Moxostoma duquesnei ..... black redhorse
Notropis nubilus ..... Ozark minnow
Notropis topeka ..... Topeka shiner (Fed. Status: E)
Percina evides ..... gilt darter
Phenacobius mirabilis ..... suckermouth minnow
Platygobio gracilis ..... flathead chub
Prosopium coulterii ..... pygmy whitefish

MOLLUSKS

Endangered

Arcidens confragosus.....rock pocketbook
Cumberlandia monodonta .....spectaclecase (Fed. Status: E)
Cyclonaias tuberculata .....purple wartyback
Elliptio crassidens .....elephant-ear
Epioblasma triquetra .....snuffbox (Fed. Status: E)
Fusconaia ebena .....ebonyshell
Lampsilis higginsii.....Higgins eye (Fed. Status: E)
Lampsilis teres.....yellow sandshell
Megalonaias nervosa .....washboard
Plethobasus cyphyus.....sheepnose (Fed. Status: E)
Quadrula fragosa .....winged mapleleaf (Fed. Status: E)
Simpsonaias ambigua .....salamander mussel
Tritogonia verrucosa .....pistolgrip

Threatened

Actinonaias ligamentina .....mucket
Alasmidonta marginata.....elktoe
Ellipsaria lineolata .....butterfly
Elliptio dilatata .....spike
Lasmigona costata.....fluted-shell
Ligumia subrostrata.....pondmussel
Quadrula metanevra .....monkeyface
Quadrula nodulata .....wartyback
Truncilla donaciformis .....fawnsfoot
Venustaconcha ellipsiformis .....ellipse
Vertigo meramecensis.....bluff vertigo

Special Concern

Anodonta suborbiculata.....flat floater
Elliptio complanata .....eastern elliptio
Gastrocopta rogersensis.....Rogers' snaggletooth snail
Lasmigona compressa .....creek heelsplitter
Ligumia recta .....black sandshell
Planogyra asteriscus.....eastern flat-whorl snail
Pleurobema sintoxia.....round pigtoe
Striatura ferrea.....black striate snail
Zonitoides limatulus.....dull gloss

JUMPING SPIDERS

Threatened

Tutelina formicaria.....a species of jumping spider

Special Concern

Habronattus calcaratus maddisoni.....a species of jumping spider
Habronattus texanus .....a species of jumping spider
Habronattus viridipes.....a species of jumping spider
Marpissa formosa.....a species of jumping spider
Paradamoetas fontana .....a species of jumping spider
Pelegrina arizonensis .....a species of jumping spider
Phidippus apacheanus .....a species of jumping spider
Phidippus pius .....a species of jumping spider
Sassacus papenhoei .....a species of jumping spider

LEAFHOPPERS

Special Concern

Aflexia rubranura .....red-tailed leafhopper
Attenuipyga vanduzeei.....hill prairie shovelhead leafhopper
Macrosteles clavatus.....caped leafhopper

DRAGONFLIES

Threatened

Ophiogomphus susbehcha .....St. Croix snaketail

Special Concern

Aeschna sitchensis.....zigzag darner
Aeschna subarctica.....subarctic darner
Boyeria grafiana.....ocellated darner
Ophiogomphus anomalus .....extra-striped snaketail
Ophiogomphus howei .....pygmy snaketail
Somatochlora brevicincta..... .....Quebec emerald
Somatochlora forcipata ....forcipate emerald

BUTTERFLIES AND MOTHS

Endangered

Erynnis persius persius ..... persius dusky wing
Hesperia assiniboia ..... assiniboia skipper
Hesperia dacotae ..... Dakota skipper (Fed. Status: P)
Hesperia ottoe ..... ottoe skipper
Hesperia uncas ..... uncas skipper
Lycaeides melissa samuelis ..... Karner blue (Fed. Status: E)
Oarisma poweshiek ..... poweshiek skipper (Fed. Status: P)
Oeneis uhleri varuna ..... Uhler's arctic

Threatened

Oarisma garita ..... garita skipper

Special Concern

Atrytone arogos iowa ..... arogos skipper
Catocala abbreviatella ..... abbreviated underwing
Catocala whitneyi ..... Whitney's underwing
Erebia mancinus ..... disa alpine
Hesperia leonardus ..... leonardus skipper
Lycaeides idas nabokovi ..... Nabokov's blue
Pyrgus centaureae freija ..... grizzled skipper
Schinia indiana ..... phlox moth
Schinia lucens ..... leadplant flower moth
Speyeria idalia ..... regal fritillary

CADDISFLIES

Endangered

Hydroptila waskesia ..... a species of purse casemaker caddisfly
Limnephilus janus ..... a species of northern caddisfly
Limnephilus secludens ..... a species of northern caddisfly
Ochrotrichia spinosa ..... a species of purse casemaker caddisfly
Polycentropus milaca ..... a species of tube casemaker caddisfly

Threatened

Chilostigma itascae ..... headwaters chilostigman caddisfly
Goera stylata ..... a species of caddisfly
Hydroptila rono ..... a species of purse casemaker caddisfly
Ironoquia punctatissima ..... a species of northern caddisfly
Lepidostoma libum ..... a species of caddisfly
Limnephilus rossi ..... a species of northern caddisfly
Oecetis ditissa ..... a species of long-horned caddisfly
Oxyethira ecornuta ..... a species of purse casemaker caddisfly
Parapsyche apicalis ..... a species of netspinning caddisfly
Polycentropus glacialis ..... a species of tube casemaker caddisfly
Ylodes frontalis ..... a species of long-horned caddisfly

Special Concern

Agapetus tomus ..... a species of caddisfly
Anabolia ozburni ..... a species of northern caddisfly
Hydroptila metoeca ..... a species of purse casemaker caddisfly
Hydroptila quinola ..... a species of purse casemaker caddisfly
Hydroptila tortosa ..... a species of purse casemaker caddisfly
Oxyethira itascae ..... a species of purse casemaker caddisfly
Protoptila erotica ..... a species of saddle casemaker caddisfly
Triaenodes flavescens ..... a species of long-horned caddisfly

TIGER BEETLES

Endangered

Cicindela fulgida fulgida ..... crimson salflat tiger beetle, fulgida ssp.
Cicindela hirticollis rhodensis ..... hairy-necked tiger beetle
Cicindela limbata nympha ..... sandy tiger beetle

Threatened

Cicindela fulgida westbournei ..... crimson salflat tiger beetle, westb. ssp.
Cicindela lepida ..... ghost tiger beetle

Special concern

Cicindela denikei ..... Laurentian tiger beetle
Cicindela macra macra ..... sandy stream tiger beetle
Cicindela patruela patruela ..... northern barrens tiger beetle
Cicindela splendida cyanocephalata ..... splendid tiger beetle

VASCULAR PLANTS

Endangered

Achnatherum hymenoides.....Indian rice grass
Agalinis auriculata.....eared false foxglove
Agalinis gattingeri.....round-stemmed false foxglove
Agrostis hyemalis.....winter bentgrass
Allium schoenoprasum.....wild chives
Aristida longespica var. *geniculata*.....slimspike three-awn
Asclepias stenophylla.....narrow-leaved milkweed
Astragalus alpinus var. *alpinus*.....alpine milk-vetch
Bartonia virginica.....yellow bartonia
Botrychium ascendens.....upswept moonwort
Botrychium gallicomontanum.....Frenchman's Bluff moonwort
Botrychium lineare.....slender moonwort
Botrychium spathulatum.....spathulate moonwort
Calamagrostis purpurascens.....purple reedgrass
Caltha natans.....floating marsh marigold
Carex careyana.....Carey's sedge
Carex formosa.....handsome sedge
Carex pallescens.....pale sedge
Carex plantaginea.....plantain-leaved sedge
Carex supina ssp. *spaniocarpa*.....weak arctic sedge
Castilleja septentrionalis.....northern paintbrush
Chrysosplenium iowense.....Iowa golden saxifrage
Commelina erecta.....slender dayflower
Diarrhena obovata.....obovate beakgrain
Dodecatheon meadia var. *meadia*.....prairie shooting star
Draba cana.....hoary whitlow grass
Draba norvegica.....Norwegian whitlow grass
Dryopteris marginalis.....marginal shield fern
Eleocharis wolfii.....Wolf's spikerush
Elodea bifoliata.....two leaf waterweed
Empetrum atropurpureum.....purple crowberry
Empetrum nigrum.....black crowberry
Erigeron acris var. *kamtschaticus*.....bitter fleabane
Erythronium propullans.....dwarf trout lily (Fed. Status: E)
Escobaria vivipara.....ball cactus
Fimbristylis puberula var. *interior*.....hairy fimbry
Hasteola suaveolens.....sweet-smelling Indian-plantain
Hybanthus concolor.....eastern green-violet
Hydrastis canadensis.....goldenseal
Iodanthus pinnatifidus.....purple rocket
Isoetes melanopoda.....prairie quillwort
Juglans cinerea.....butternut
Juncus articulatus.....jointed rush
Juncus marginatus.....marginated rush
Juncus subtilis.....slender rush
Lechea tenuifolia var. *tenuifolia*.....narrow-leaved pinweed
Listera auriculata.....auricled twayblade
Lysimachia maritima.....sea milkwort
Malaxis paludosa.....bog adder's mouth
Marsilea vestita.....hairy waterclover
Montia chamissoi.....montia
Osmorhiza berteroi.....Chilean sweet cicely
Oxytropis viscida.....sticky locoweed
Packera cana.....gray ragwort
Packera indecora.....elegant grounsel
Paronychia canadensis.....Canada forked chickweed
Paronychia fastigiata var. *fastigiata*.....forked chickweed
Parthenium integrifolium.....wild quinine
Phegopteris hexagonoptera.....broad beech fern
Physaria ludoviciana.....bladderpod
Platanthera praeclara.....western prairie fringed orchid (Fed. Status: T)
Polanisia jamesii.....James' polanisia
Polemonium occidentale ssp. *lacustre*.....western Jacob's ladder
Polygala cruciata.....cross-leaved milkwort
Polystichum acrostichoides.....Christmas fern
Potamogeton bicupulatus.....snailseed pondweed
Potamogeton confervoides.....algae-like pondweed
Potamogeton diversifolius.....diverse-leaved pondweed
Potamogeton oakesianus.....Oake's pondweed
Potamogeton pulcher.....spotted pondweed
Prosartes trachycarpa.....rough-fruited fairybells
Psoralidium tenuiflorum.....slender-leaved scurf pea
Rhodiola integrifolia ssp. *leedyi*.....Leedy's roseroot (Fed. Status: T)
Rubus missouricus.....Missouri dewberry
Rubus stipulatus.....bristle-berry
Sagina nodosa ssp. *borealis*.....knotty pearlwort
Sagittaria brevirostra.....short-beaked arrowhead
Saxifraga cernua.....nodding saxifrage
Scleria triglomerata.....tall nutrush
Selaginella selaginoides.....northern spikemoss
Stuckenia vaginata.....sheathed pondweed
Tofieldia pusilla.....small false asphodel
Tsuga canadensis var. *canadensis*.....eastern hemlock
Utricularia purpurea.....purple-flowered bladderwort
Vaccinium uliginosum.....alpine bilberry
Xyris torta.....twisted yellow-eyed grass

VASCULAR PLANTS

Threatened

Achillea alpina ..... Siberian yarrow
Ammophila breviligulata ssp. *breviligulata* ..... beachgrass
Aristida tuberculosa ..... seaside three-awn
Arnica lonchophylla ..... long-leaved arnica
Arnoglossum plantagineum ..... tuberous Indian plantain
Arnoglossum reniforme ..... great Indian plantain
Asclepias amplexicaulis ..... clasping milkweed
Asclepias hirtella ..... prairie milkweed
Asclepias sullivantii ..... Sullivant's milkweed
Asplenium trichomanes ssp. *trichomanes* ..... maidenhair spleenwort
Aureolaria pedicularia ..... fernleaf false foxglove
Bacopa rotundifolia ..... water hyssop
Berula erecta ..... stream parsnip
Besseya bullii ..... kitten-tails
Bistorta vivipara ..... alpine bistort
Boechera retrofracta ..... Holboell's rock cress
Botrychium lanceolatum ssp. *angustisegmentum* ..... narrow triangle moonwort
Botrychium lunaria ..... common moonwort
Botrychium mormo ..... goblin fern
Botrychium oneidense ..... blunt-lobed grapefern
Callitriche heterophylla ..... larger water starwort
Cardamine pratensis ..... cuckoo flower
Carex conjuncta ..... jointed sedge
Carex davisii ..... Davis' sedge
Carex festucacea ..... fescue sedge
Carex garberi ..... Garber's sedge
Carex jamesii ..... James' sedge
Carex laevivaginata ..... smooth-sheathed sedge
Carex laxiculmis ..... loose-culmed sedge
Carex novae-angliae ..... New England sedge
Carex rossii ..... Ross' sedge
Carex sterilis ..... sterile sedge
Crassula aquatica ..... pigmyweed
Cyperus acuminatus ..... short-pointed umbrella-sedge
Cypripedium arietinum ..... ram's head orchid
Deschampsia flexuosa ..... slender hair grass
Desmodium cuspidatum var. *longifolium* ..... big tick trefoil
Desmodium nudiflorum ..... stemless tick trefoil
Diplazium pycnocarpon ..... narrow-leaved spleenwort
Eleocharis flavescens var. *olivacea* ..... olivaceous spikerush
Eleocharis robbinsii ..... Robbins' spikerush
Eleocharis rostellata ..... beaked spikerush
Erigeron lonchophyllus ..... short ray fleabane
Eupatorium sessilifolium ..... upland boneset
Floerkea proserpinacoides ..... false mermaid
Gaylussacia baccata ..... black huckleberry
Hamamelis virginiana ..... witch-hazel
Heteranthera limosa ..... mud plantain
Hudsonia tomentosa ..... beach heather
Huperzia porophila ..... rock fir moss
Leersia lenticularis ..... catchfly grass
Lespedeza leptostachya ..... prairie bush clover (Fed. Status: T)
Luzula parviflora ..... small-flowered woodrush
Melica nitens ..... three-flowered melic
Minuartia dawsonensis ..... rock sandwort
Moehringia macrophylla ..... large-leaved sandwort
Napaea dioica ..... glade mallow
Nymphaea leibergii ..... small white waterlily
Orobanche fasciculata ..... clustered broomrape
Orobanche ludoviciana var. *ludoviciana* ..... Louisiana broomrape
Orobanche uniflora ..... one-flowered broomrape
Phacelia franklinii ..... Franklin's phacelia
Phemeranthus rugospermus ..... rough-seeded fameflower
Piptatherum canadense ..... Canadian ricegrass
Platanthera flava var *herbiola* ..... tubercled rein orchid
Poa paludigena ..... bog bluegrass
Polystichum braunii ..... Braun's holly fern
Rhynchospora capillacea ..... hair-like beak rush
Rotala ramosior ..... toothcup
Rubus chamaemorus ..... cloudberry
Rubus fulleri ..... bristle-berry
Rubus semisetosus ..... swamp blackberry
Rudbeckia triloba var. *triloba* ..... three-leaved coneflower
Sagittaria calycina var. *calycina* ..... hooded arrowhead
Salicornia rubra ..... red saltwort
Salix pellita ..... satiny willow
Scleria verticillata ..... whorled nutrush
Scutellaria ovata var. *versicolor* ..... ovate-leaved skullcap
Shinnersoseris rostrata ..... annual skeletonweed
Silene nivea ..... snowy campion
Spiranthes casei var. *casei* ..... Case's ladies' tresses
Subularia aquatic ssp. *americana* ..... awlwort
Sullivantia sullivantii ..... reniform sullivantia
Trichophorum clintonii ..... Clinton's bulrush
Utricularia geminiscapa ..... hidden-fruit bladderwort
Utricularia resupinata ..... lavender bladderwort
Valeriana edulis var. *ciliata* ..... edible valerian
Viola lanceolata var. *lanceolata* ..... lance-leaved violet
Viola nuttallii ..... yellow prairie violet
Vitis aestivalis var. *bicolor* ..... silverleaf grape
Woodsia alpina ..... alpine woodsia
Woodsia glabella ..... smooth woodsia
Woodsia scopulina ssp. *laurentiana* ..... Rocky Mountain woodsia

VASCULAR PLANTS

Special Concern

Adlumia fungosa ..... Allegheny vine
Alisma gramineum ..... narrow-leaved water plantain
Allium cernuum ..... nodding wild onion
Androsace septentrionalis ..... northern androsace
Antennaria parvifolia ..... small-leaved pussytoes
Arabis laevigata var. *laevigata* ..... smooth rock cress
Arisaema dracontium ..... green dragon
Aristida purpurea var. *longiseta* ..... red three-awn
Asplenium platyneuron ..... ebony spleenwort
Astragalus flexuosus var. *flexuosus* ..... slender milk-vetch
Astragalus missouriensis var. *missouriensis* ..... Missouri milk-vetch
Avenula hookeri ..... oat-grass
Baptisia bracteata var. *glabrescens* ..... plains wild indigo
Baptisia lactea var. *lactea* ..... white wild indigo
Bidens discoidea ..... discoid beggarticks
Botrychium acuminatum ..... tailed grapefern
Botrychium campestre ..... prairie moonwort
Botrychium minganense ..... Mingan moonwort
Botrychium pallidum ..... pale moonwort
Botrychium rugulosum ..... St. Lawrence grapefern
Botrychium simplex ..... least moonwort
Buchloe dactyloides ..... buffalo grass
Calamagrostis lacustris ..... marsh reedgrass
Calamagrostis montanensis ..... Plains reedgrass
Carex annectens ..... yellow-fruited sedge
Carex exilis ..... coastal sedge
Carex flava ..... yellow sedge
Carex grayi ..... Gray's sedge
Carex hallii ..... Hall's sedge
Carex hookerana ..... Hooker's sedge
Carex media ..... intermediate sedge
Carex michauxiana ..... Michaux's sedge
Carex muskingumensis ..... Muskingum sedge
Carex obtusata ..... blunt sedge
Carex ormostachya ..... necklace sedge
Carex praticola ..... prairie-dweller sedge
Carex scirpoidea ..... northern singlespike sedge
Carex typhina ..... cattail sedge
Carex xerantica ..... dry sedge
Chamaesyce missurica ..... Missouri spurge
Cirsium pumilum var. *hillii* ..... Hill's thistle
Cladium mariscoides ..... twig rush
Crataegus calpodendron ..... late hawthorn
Crataegus douglasii ..... black hawthorn
Crotalaria sagittalis ..... rattlebox
Cymopterus glomeratus ..... Plains spring parsley
Cypripedium candidum ..... small white lady's slipper
Dalea candida var. *oligophylla* ..... western white prairie clover
Decodon verticillatus ..... water willow
Deparia acrostichoides ..... silvery spleenwort
Desmanthus illinoensis ..... prairie mimosa
Dicentra canadensis ..... squirrel corn
Draba arabisans ..... Arabian whitlow grass
Drosera anglica ..... English sundew
Drosera linearis ..... linear-leaved sundew
Dryopteris goldiana ..... Goldie's fern
Elatine triandra ..... three-stamened waterwort
Eleocharis coloradoensis ..... dwarf spikerush
Eleocharis nitida ..... neat spikerush
Eleocharis quinqueflora ..... few-flowered spikerush
Eryngium yuccifolium ..... rattlesnake master
Euphrasia hudsoniana var. *ramosior* ..... Hudson Bay eyebright
Fimbristylis autumnalis ..... autumn fimbry
Gaillardia aristata ..... blanket flower
Gentiana affinis ..... northern gentian
Gentianella amarella ..... felwort
Gymnocarpium robertianum ..... northern oak fern
Gymnocladus dioica ..... Kentucky coffee tree
Helianthemum canadense ..... Canada frostweed
Helianthus nuttallii ssp. *rydbergii* ..... Nuttall's sunflower
Huperzia appalachiana ..... Appalachian fir moss
Hydrocotyle americana ..... American water-pennywort
Jeffersonia diphylla ..... twinleaf
Juncus stygius var. *americanus* ..... bog rush
Juniperus horizontalis ..... creeping juniper
Limosella aquatica ..... mudwort
Listera convallarioides ..... broad-leaved twayblade
Littorella americana ..... American shore plantain
Lysimachia quadrifolia ..... whorled loosestrife
Malaxis monophyllos var. *brachypoda* ..... white adder's mouth
Muhlenbergia uniflora ..... one-flowered muhly

VASCULAR PLANTS

Special Concern (continued)

Myriophyllum heterophyllum ..... broadleaf water milfoil
Najas gracillima ..... slender naiad
Najas guadalupensis ssp. *olivacea* ..... southern naiad
Najas marina ..... sea naiad
Nuttallanthus canadensis ..... old field toadflax
Oenothera rhombipetala ..... rhombic evening primrose
Opuntia macrorhiza ..... devil's tongue
Osmorhiza depauperata ..... blunt-fruited sweet cicely
Panax quinquefolius ..... American ginseng
Pellaea atropurpurea ..... purple cliff brake
Persicaria careyi ..... Carey's smartweed
Phlox maculata ..... wild sweet William
Pinguicula vulgaris ..... butterwort
Plagiobothrys scouleri ..... Scouler's popcornflower
Plantago elongata ..... slender plantain
Platanthera clavellata ..... small green wood orchid
Poa wolfii ..... Wolf's bluegrass
Polytaenia nuttallii ..... prairie parsley
Pyrola minor ..... small shinleaf
Quercus bicolor ..... swamp white oak
Ranunculus lapponicus ..... Lapland buttercup
Rorippa sessiliflora ..... sessile-flowered yellow cress
Rubus multifer ..... Kinnickinnick dewberry
Rubus quaesitus ..... Prince Edward Island blackberry
Rubus vermontanus ..... Vermont blackberry
Ruellia humilis ..... wild petunia
Ruppia cirrhosa ..... spiral ditchgrass
Salix maccalliana ..... McCalla's willow
Salix pseudomonticola ..... false mountain willow
Sanicula trifoliata ..... beaked snakeroot
Saxifraga paniculata ..... encrusted saxifrage
Schedonnardus paniculatus ..... tumble grass
Shepherdia canadensis ..... soapberry
Silene drummondii ssp. *drummondii* ..... Drummond's campion
Solidago mollis ..... soft goldenrod
Stellaria longipes ssp. *longipes* ..... long-stalked chickweed
Symphyotrichum shortii ..... Short's aster
Taenidia integerrima ..... yellow pimpernel
Tephrosia virginiana ..... goat's rue
Thaspium barbinode ..... hairy-jointed meadow-parsnip
Torreyochloa pallida ..... Torrey's mannagrass
Trillium nivale ..... snow trillium
Triplasis purpurea var. *purpurea* ..... purple sandgrass
Trisetum spicatum ..... spike trisetum
Verbena simplex ..... narrow-leaved vervain
Waldsteinia fragarioides var. *fragarioides* ..... barren strawberry
Woodsia oregano ssp. *cathcartiana* ..... Oregon woodsia
Xanthisma spinulosum var. *spinulosum* ..... cutleaf ironplant
Xyris montana ..... montane yellow-eyed grass

FUNGI

Endangered

Psathyrella cystidiosa ..... a species of fungus
Psathyrella rhodospora ..... a species of fungus
Suillus weaverae ..... a species of fungus

Special concern

Boletus subcaerulescens ..... a species of fungus
Laccaria trullisata ..... a species of fungus
Lactarius fuliginellus ..... a species of fungus
Lysurus cruciatus ..... a species of fungus
Sarcosoma globosum ..... a species of fungus

LICHENS

Endangered

Caloplaca parvula ..... a species of lichen
Dermatocarpon moulinsii ..... a species of lichen
Leptogium apalachense ..... a species of lichen
Lobaria scrobiculata ..... a species of lichen
Parmelia stictica ..... a species of lichen
Pseudocyphellaria crocata ..... a species of lichen
Umbilicaria torrefacta ..... a species of lichen

Threatened

Allocetraria oakesiana ..... a species of lichen
Arthrorhaphis citrinella ..... golden dot-lichen
Coccocarpia palmicola ..... a species of lichen
Lecanora epanora ..... a species of rim lichen
Parmelia stuppea ..... a species of lichen
Peltula bolanderi ..... Bolander's peltula lichen
Protopannaria pezizoides ..... brown-gray moss-shingle lichen
Ramalina roesleri ..... frayed ramalina lichen
Usnea mutabilis ..... bloody beard lichen

Special concern

Ahtiana aurescens ..... a species of lichen
Amygdalaria panaeola ..... powdery almond lichen
Anaptychia crinalis ..... a species of lichen
Arctoparmelia centrifuga ..... concentric ring lichen
Arctoparmelia subcentrifuga ..... a species of ring lichen
Bryoria fuscescens ..... pale-footed horsehair lichen
Buellia nigra ..... a species of lichen
Caloplaca stellata ..... a species of firedot lichen
Cladonia pseudorangiformis ..... a species of lichen
Heteroderma obscurata ..... orange-tinted fringe lichen
Melanelia subolivacea ..... brown-eyed camouflage lichen
Menegazzia terebrata ..... port-hole lichen
Ochrolechia androgyna ..... powdery saucer lichen
Peltigera venosa ..... a species of lichen
Platismatia glauca ..... ragbag lichen
Ramalina thrausta ..... angel's hair lichen
Stereocaulon pileatum ..... pixie foam lichen
Sticta fuliginosa ..... a species of lichen
Thelocarpon epibolum ..... a species of thelocarpon lichen
Usnea longissima ..... Methuselah's beard lichen
Usnea rubicunda ..... red beard lichen

MOSSES AND LIVERWORTS

Endangered

Bryoxiphium norvegicum ..... sword moss
Schistostega pennata ..... luminous moss
Splachnum rubrum ..... red parasol moss

Threatened

Cirriphyllum piliferum ..... hair-pointed feather moss
Cryptocolea imbricata ..... hidden perianth liverwort
Cynodontium schisti ..... mowed mosquito moss
Lescuraea saxicola ..... lustrous bow moss
Sphagnum compactum ..... cushion peat moss
Sphagnum lescurii ..... red twisted peat moss
Trichocolea tomentella ..... down liverwort

Special Concern

Aphanorrhegma serratum ..... lidded earth moss
Atrichum crispum ..... wave-leaved crane's-bill moss
Atrichum tenellum ..... little saw moss
Aulacomnium androgynum ..... bud-headed thread moss
Aulacomnium heterostichum ..... differential branched crease capsule moss
Bryum cyclophyllum ..... egg-leaf true moss
Buxbaumia aphylla ..... bug-on-a-stick moss
Cyrto-hypnum pygmaeum ..... pygmy plume moss
Encalypta procera ..... tall extinguisher moss
Frullania selwyniana ..... Selwyn's ear-leaf liverwort
Heterocladium dimorphum ..... spaced-out tangle moss
Hyophila involuta ..... rolled-leaf wet-ground moss
Jaffueliobryum wrightii ..... Wright's blunt leaved true moss
Meesia uliginosa ..... swan moss
Pogonatum urnigerum ..... urn-bearing hair moss
Thelia hirtella ..... nipple moss
Tortella inclinata ..... shortleaf chalk moss

Alphabetical Index by Scientific Name

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SCIENTIFIC NAME	COMMON NAME	STATUS	TAXONOMIC GROUP
Accipiter gentilis	northern goshawk	SC	bird
Achillea alpina	Siberian yarrow	T	vascular plant
Achnatherum hymenoides	Indian rice grass	E	vascular plant
Acipenser fulvescens	lake sturgeon	SC	fish
Acris blanchardi	northern cricket frog	E	amphibian/reptile
Actinonaias ligamentina	mucket	T	mollusk
Adlumia fungosa	Allegheny vine	SC	vascular plant
Aegolius funereus	boreal owl	SC	bird
Aeschna sitchensis	zigzag darner	SC	dragonfly
Aeschna subarctica	subarctic darner	SC	dragonfly
Aflexia rubranura	red-tailed leafhopper	SC	leafhopper
Agalinis auriculata	eared false foxglove	E	vascular plant
Agalinis gattingeri	round-stemmed false foxglove	E	vascular plant
Agapetus tomus	a species of caddisfly	SC	caddisfly
Agrostis hyemalis	winter bentgrass	E	vascular plant
Ahtiana aurescens	a species of lichen	SC	lichen
Alasmidonta marginata	elktoe	T	mollusk
Alces americanus	moose	SC	mammal
Alisma gramineum	narrow-leaved water plantain	SC	vascular plant
Allium cernuum	nodding wild onion	SC	vascular plant
Allium schoenoprasum	wild chives	E	vascular plant
Allocetraria oakesiana	a species of lichen	T	lichen
Alosa chrysochloris	skipjack herring	E	fish
Ambystoma maculatum	spotted salamander	SC	amphibian/reptile
Ammodramus bairdii	Baird's sparrow	E	bird
Ammodramus henslowii	Henslow's sparrow	E	bird
Ammodramus nelsoni	Nelson's sparrow	SC	bird
Ammophila breviligulata ssp. *breviligulata*	beachgrass	T	vascular plant
Amygdalaria panaeola	powdery almond lichen	SC	lichen
Anabolia ozburni	a species of northern caddisfly	SC	caddisfly
Anaptychia crinalis	a species of lichen	SC	lichen
Anaxyrus cognatus	Great Plains toad	SC	amphibian/reptile
Androsace septentrionalis	northern androsace	SC	vascular plant
Anguilla rostrata	American eel	SC	fish
Anodonta suborbiculata	flat floater	SC	mollusk
Antennaria parvifolia	small-leaved pussytoes	SC	vascular plant
Anthus spragueii	Sprague's pipit (Fed. Status: C)	E	bird
Apalone mutica	smooth softshell	SC	amphibian/reptile
Aphanorrhegma serratum	lidded earth moss	SC	moss/liverwort
Aphredoderus sayanus	pirate perch	SC	fish
Arabis laevigata var. *laevigata*	smooth rock cress	SC	vascular plant
Arcidens confragosus	rock pocketbook	E	mollusk
Arctoparmelia centrifuga	concentric ring lichen	SC	lichen
Arctoparmelia subcentrifuga	a species of ring lichen	SC	lichen
Arisaema dracontium	green dragon	SC	vascular plant
Aristida longespica var. *geniculata*	slimspike three-awn	E	vascular plant
Aristida purpurea var. *longiseta*	red three-awn	SC	vascular plant
Aristida tuberculosa	seaside three-awn	T	vascular plant
Arnica lonchophylla	long-leaved arnica	T	vascular plant
Arnoglossum plantagineum	tuberous Indian plantain	T	vascular plant
Arnoglossum reniforme	great Indian plantain	T	vascular plant
Arthrorhaphis citrinella	golden dot-lichen	T	lichen
Asclepias amplexicaulis	clasping milkweed	T	vascular plant
Asclepias hirtella	prairie milkweed	T	vascular plant
Asclepias stenophylla	narrow-leaved milkweed	E	vascular plant
Asclepias sullivantii	Sullivant's milkweed	T	vascular plant
Asio flammeus	short-eared owl	SC	bird
Asplenium platyneuron	ebony spleenwort	SC	vascular plant
Asplenium trichomanes ssp. *trichomanes*	maidenhair spleenwort	T	vascular plant
Astragalus alpinus var. *alpinus*	alpine milk-vetch	E	vascular plant
Astragalus flexuosus var. *flexuosus*	slender milk-vetch	SC	vascular plant
Astragalus missouriensis var. *missouriensis*	Missouri milk-vetch	SC	vascular plant
Athene cunicularia	burrowing owl	E	bird
Atrichum crispum	wave-leaved crane's-bill moss	SC	moss/liverwort
Atrichum tenellum	little saw moss	SC	moss/liverwort
Atrytone arogos iowa	arogos skipper	SC	butterfly/moth
Attenuipyga vanduzeei	hill prairie shovelhead leafhopper	SC	leafhopper
Aulacomnium androgynum	bud-headed thread moss	SC	moss/liverwort
Aulacomnium heterostichum	differential branched crease capsule moss	SC	moss/liverwort
Aureolaria pedicularia	fernleaf false foxglove	T	vascular plant
Avenula hookeri	oat-grass	SC	vascular plant
Bacopa rotundifolia	water hyssop	T	vascular plant
Baptisia bracteata var. *glabrescens*	plains wild indigo	SC	vascular plant
Baptisia lactea var. *lactea*	white wild indigo	SC	vascular plant
Bartonia virginica	yellow bartonia	E	vascular plant
Berula erecta	stream parsnip	T	vascular plant
Besseya bullii	kitten-tails	T	vascular plant
Bidens discoidea	discoid beggarticks	SC	vascular plant
Bistorta vivipara	alpine bistort	T	vascular plant

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SCIENTIFIC NAME	COMMON NAME	STATUS	TAXONOMIC GROUP
Boechera holboellii	Holboell's rock cress	T	vascular plant
Boletus subcaerulescens	a species of fungus	SC	fungus
Botrychium acuminatum	tailed grapefern	SC	vascular plant
Botrychium ascendens	upswept moonwort	E	vascular plant
Botrychium campestre	prairie moonwort	SC	vascular plant
Botrychium gallicomontanum	Frenchman's Bluff moonwort	E	vascular plant
Botrychium lanceolatum ssp. *angustisegmentum*	narrow triangle moonwort	T	vascular plant
Botrychium lineare	slender moonwort	E	vascular plant
Botrychium lunaria	common moonwort	T	vascular plant
Botrychium minganense	Mingan moonwort	SC	vascular plant
Botrychium mormo	goblin fern	T	vascular plant
Botrychium oneidense	blunt-lobed grapefern	T	vascular plant
Botrychium pallidum	pale moonwort	SC	vascular plant
Botrychium rugulosum	St. Lawrence grapefern	SC	vascular plant
Botrychium simplex	least moonwort	SC	vascular plant
Botrychium spathulatum	spathulate moonwort	E	vascular plant
Boyeria grafiana	ocellated darner	SC	dragonfly
Bryoria fuscescens	pale-footed horsehair lichen	SC	lichen
Bryoxiphium norvegicum	sword moss	E	moss/liverwort
Bryum cyclophyllum	egg-leaf true moss	SC	moss/liverwort
Buchloe dactyloides	buffalo grass	SC	vascular plant
Buellia nigra	a species of lichen	SC	lichen
Buteo lineatus	red-shouldered hawk	SC	bird
Buxbaumia aphylla	bug-on-a-stick moss	SC	moss/liverwort
Calamagrostis lacustris	marsh reedgrass	SC	vascular plant
Calamagrostis montanensis	Plains reedgrass	SC	vascular plant
Calamagrostis purpurascens	purple reedgrass	E	vascular plant
Calcarius ornatus	chestnut-collared longspur	E	bird
Callitriche heterophylla	larger water starwort	T	vascular plant
Caloplaca parvula	a species of lichen	E	lichen
Caloplaca stellata	a species of firedot lichen	SC	lichen
Caltha natans	floating marsh marigold	E	vascular plant
Cardamine pratensis	cuckoo flower	T	vascular plant
Carex annectens	yellow-fruited sedge	SC	vascular plant
Carex careyana	Carey's sedge	E	vascular plant
Carex conjuncta	jointed sedge	T	vascular plant
Carex davisii	Davis' sedge	T	vascular plant
Carex exilis	coastal sedge	SC	vascular plant
Carex festucacea	fescue sedge	T	vascular plant
Carex flava	yellow sedge	SC	vascular plant
Carex formosa	handsome sedge	E	vascular plant
Carex garberi	Garber's sedge	T	vascular plant
Carex grayi	Gray's sedge	SC	vascular plant
Carex hallii	Hall's sedge	SC	vascular plant
Carex hookerana	Hooker's sedge	SC	vascular plant
Carex jamesii	James' sedge	T	vascular plant
Carex laevivaginata	smooth-sheathed sedge	T	vascular plant
Carex laxiculmis	loose-culmed sedge	T	vascular plant
Carex media	intermediate sedge	SC	vascular plant
Carex michauxiana	Michaux's sedge	SC	vascular plant
Carex muskingumensis	Muskingum sedge	SC	vascular plant
Carex novae-angliae	New England sedge	T	vascular plant
Carex obtusata	blunt sedge	SC	vascular plant
Carex ormostachya	necklace sedge	SC	vascular plant
Carex pallescens	pale sedge	E	vascular plant
Carex plantaginea	plantain-leaved sedge	E	vascular plant
Carex praticola	prairie-dweller sedge	SC	vascular plant
Carex rossii	Ross' sedge	T	vascular plant
Carex scirpoidea	northern singlespike sedge	SC	vascular plant
Carex sterilis	sterile sedge	T	vascular plant
Carex supina ssp. *spaniocarpa*	weak arctic sedge	E	vascular plant
Carex typhina	cattail sedge	SC	vascular plant
Carex xerantica	dry sedge	SC	vascular plant
Castilleja septentrionalis	northern paintbrush	E	vascular plant
Catocala abbreviatella	abbreviated underwing	SC	butterfly/moth
Catocala whitneyi	Whitney's underwing	SC	butterfly/moth
Cervus canadensis	elk	SC	mammal
Chamaesyce missurica	Missouri spurge	SC	vascular plant
Charadrius melodus	piping plover (Fed. Status: E/T)	E	bird
Chilostigma itascae	headwaters chilostigman caddisfly	T	caddisfly
Chondestes grammacus	lark sparrow	SC	bird
Chrysosplenium iowense	Iowa golden saxifrage	E	vascular plant
Cicindela denikei	Laurentian tiger beetle	SC	tiger beetle
Cicindela fulgida westbournei	crimson saltflat tiger beetle, tiger beetle, westb. ssp	T	tiger beetle
Cicindela fulgida fulgida	crimson saltflat tiger beetle, fulgida ssp	E	tiger beetle
Cicindela hirticollis rhodensis	hairy-necked tiger beetle	E	tiger beetle
Cicindela lepida	ghost tiger beetle	T	tiger beetle
Cicindela limbata nympha	sandy tiger beetle	E	tiger beetle
Cicindela macra macra	sandy stream tiger beetle	SC	tiger beetle

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Cicindela patruela patruela	northern barrens tiger beetle	SC	tiger beetle
Cicindela splendida cyanocephalata	splendid tiger beetle	SC	tiger beetle
Cirriphyllum piliferum	hair-pointed feather moss	T	moss/liverwort
Cirsium pumilum var. *hillii*	Hill's thistle	SC	vascular plant
Cladium mariscoides	twig rush	SC	vascular plant
Cladonia pseudorangiformis	a species of lichen	SC	lichen
Clinostomus elongates	redside dace	SC	fish
Coccocarpia palmicola	a species of lichen	T	lichen
Coluber constrictor	North American racer	SC	amphibian/reptile
Commelina erecta	slender dayflower	E	vascular plant
Coregonus kiyi	kiyi	SC	fish
Coregonus nipigon	Nipigon cisco	SC	fish
Coregonus zenithicus	shortjaw cisco	SC	fish
Coturnicops noveboracensis	yellow rail	SC	bird
Couesius plumbeus	lake chub	SC	fish
Crassula aquatica	pigmyweed	T	vascular plant
Crataegus calpodendron	late hawthorn	SC	vascular plant
Crataegus douglasii	black hawthorn	SC	vascular plant
Crotalaria sagittalis	rattlebox	SC	vascular plant
Crotalus horridus	timber rattlesnake	T	amphibian/reptile
Cryptocolea imbricata	hidden-perianth liverwort	T	moss/liverwort
Cryptotis parva	North American least shrew	SC	mammal
Crystallaria asprella	crystal darter	E	fish
Cumberlandia monodonta	spectaclecase (Fed. Status: E)	E	mollusk
Cycleptus elongatus	blue sucker	SC	fish
Cyclonaias tuberculata	purple wartyback	E	mollusk
Cygnus buccinator	trumpeter swan	SC	bird
Cymopterus glomeratus	Plains spring parsley	SC	vascular plant
Cynodontium schisti	mowed mosquito moss	T	moss/liverwort
Cyperus acuminatus	short-pointed umbrella-sedge	T	vascular plant
Cypripedium arietinum	ram's head orchid	T	vascular plant
Cypripedium candidum	small white lady's slipper	SC	vascular plant
Cyrto-hypnum pygmaeum	pygmy plume moss	SC	moss/liverwort
Dalea candida var. *oligophylla*	western white prairie clover	SC	vascular plant
Decodon verticillatus	water willow	SC	vascular plant
Deparia acrostichoides	silvery spleenwort	SC	vascular plant
Dermatocarpon moulinsii	a species of lichen	E	lichen
Deschampsia flexuosa	slender hair grass	T	vascular plant
Desmanthus illinoensis	prairie mimosa	SC	vascular plant
Desmodium cuspidatum var. *longifolium*	big tick trefoil	T	vascular plant
Desmodium nudiflorum	stemless tick trefoil	T	vascular plant
Diarrhena obovata	obovate beakgrain	E	vascular plant
Dicentra canadensis	squirrel corn	SC	vascular plant
Diplazium pycnocarpon	narrow-leaved spleenwort	T	vascular plant
Dodecatheon meadia var. *meadia*	prairie shooting star	E	vascular plant
Draba arabisans	Arabian whitlow grass	SC	vascular plant
Draba cana	hoary whitlow grass	E	vascular plant
Draba norvegica	Norwegian whitlow grass	E	vascular plant
Drosera anglica	English sundew	SC	vascular plant
Drosera linearis	linear-leaved sundew	SC	vascular plant
Dryopteris goldiana	Goldie's fern	SC	vascular plant
Dryopteris marginalis	marginal shield fern	E	vascular plant
Elatine triandra	three-stamened waterwort	SC	vascular plant
Eleocharis coloradoensis	dwarf spikerush	SC	vascular plant
Eleocharis flavescens var. *olivacea*	olivaceous spikerush	T	vascular plant
Eleocharis nitida	neat spikerush	SC	vascular plant
Eleocharis quinqueflora	few-flowered spikerush	SC	vascular plant
Eleocharis robbinsii	Robbins' spikerush	T	vascular plant
Eleocharis rostellata	beaked spikerush	T	vascular plant
Eleocharis wolfii	Wolf's spikerush	E	vascular plant
Ellipsaria lineolata	butterfly	T	mollusk
Elliptio complanata	eastern elliptio	SC	mollusk
Elliptio crassidens	elephant-ear	E	mollusk
Elliptio dilatata	spike	T	mollusk
Elodea bifoliata	two leaf waterweed	E	vascular plant
Empetrum atropurpureum	purple crowberry	E	vascular plant
Empetrum nigrum	black crowberry	E	vascular plant
Empidonax virescens	acadian flycatcher	SC	bird
Emydoidea blandingii	Blanding's turtle	T	amphibian/reptile
Encalypta procera	tall extinguisher moss	SC	moss/liverwort
Epioblasma triquetra	snuffbox (Fed. Status: E)	E	mollusk
Eptesicus fuscus	big brown bat	SC	mammal
Erebia mancinus	disa alpine	SC	butterfly/moth
Erigeron acris var. *kamtschaticus*	bitter fleabane	E	vascular plant
Erigeron lonchophyllus	short ray fleabane	T	vascular plant
Erimystax x-punctatus	gravel chub	T	fish
Eryngium yuccifolium	rattlesnake master	SC	vascular plant
Erynnis persius persius	persius dusky wing	E	butterfly/moth
Erythronium propullans	dwarf trout lily (Fed. Status: E)	E	vascular plant

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SCIENTIFIC NAME	COMMON NAME	STATUS	TAXONOMIC GROUP
Escobaria vivipara	ball cactus	E	vascular plant
Etheostoma chlorosoma	bluntnose darter	SC	fish
Etheostoma microperca	least darter	SC	fish
Eupatorium sessilifolium	upland boneset	T	vascular plant
Euphrasia hudsoniana var. *ramosior*	Hudson Bay eyebright	SC	vascular plant
Falco peregrinus	peregrine falcon	SC	bird
Fimbristylis autumnalis	autumn fimbry	SC	vascular plant
Fimbristylis puberula var. *interior*	hairy fimbry	E	vascular plant
Floerkea proserpinacoides	false mermaid	T	vascular plant
Frullania selwyniana	Selwyn's ear-leaf liverwort	SC	moss/liverwort
Fundulus sciadicus	plains topminnow	T	fish
Fusconaia ebena	ebonyshell	E	mollusk
Gaillardia aristata	blanket flower	SC	vascular plant
Gallinula galeata	common gallinule	SC	bird
Gastrocopta rogersensis	Rogers' snaggletooth snail	SC	mollusk
Gaylussacia baccata	black huckleberry	T	vascular plant
Gentiana affinis	northern gentian	SC	vascular plant
Gentianella amarella ssp. *acuta*	felwort	SC	vascular plant
Glyptemys insculpta	wood turtle	T	amphibian/reptile
Goera stylata	a species of caddisfly	T	caddisfly
Gymnocarpium robertianum	northern oak fern	SC	vascular plant
Gymnocladus dioica	Kentucky coffee tree	SC	vascular plant
Habronattus calcaratus maddisoni	a species of jumping spider	SC	jumping spider
Habronattus texanus	a species of jumping spider	SC	jumping spider
Habronattus viridipes	a species of jumping spider	SC	jumping spider
Hamamelis virginiana	witch-hazel	T	vascular plant
Hasteola suaveolens	sweet-smelling Indian-plantain	E	vascular plant
Helianthemum canadense	Canada frostweed	SC	vascular plant
Helianthus nuttallii ssp. *rydbergii*	Nuttall's sunflower	SC	vascular plant
Hemidactylium scutatum	four-toed salamander	SC	amphibian/reptile
Hesperia assiniboia	assiniboia skipper	E	butterfly/moth
Hesperia dacotae	Dakota skipper (Fed. Status: P)	E	butterfly/moth
Hesperia leonardus	leonardus skipper	SC	butterfly/moth
Hesperia ottoe	ottoe skipper	E	butterfly/moth
Hesperia uncas	uncas skipper	E	butterfly/moth
Heteranthera limosa	mud plantain	T	vascular plant
Heterocladium dimorphum	spaced-out tangle moss	SC	moss/liverwort
Heteroderma obscurata	orange-tinted fringe lichen	SC	lichen
Heterodon nasicus	plains hog-nosed snake	SC	amphibian/reptile
Hudsonia tomentosa	beach heather	T	vascular plant
Huperzia appalachiana	Appalachian fir moss	SC	vascular plant
Huperzia porophila	rock fir moss	T	vascular plant
Hybanthus concolor	eastern green-violet	E	vascular plant
Hybognathus nuchalis	Mississippi silvery minnow	SC	fish
Hydrastis canadensis	goldenseal	E	vascular plant
Hydrocotyle americana	American water-pennywort	SC	vascular plant
Hydroptila metoeca	a species of purse casemaker caddisfly	SC	caddisfly
Hydroptila quinola	a species of purse casemaker caddisfly	SC	caddisfly
Hydroptila rono	a species of purse casemaker caddisfly	T	caddisfly
Hydroptila tortosa	a species of purse casemaker caddisfly	SC	caddisfly
Hydroptila waskesia	a species of purse casemaker caddisfly	E	caddisfly
Hyophila involuta	rolled-leaf wet-ground moss	SC	moss/liverwort
Ichthyomyzon fossor	northern brook lamprey	SC	fish
Ichthyomyzon gagei	southern brook lamprey	SC	fish
Ictiobus niger	black buffalo	T	fish
Iodanthus pinnatifidus	purple rocket	E	vascular plant
Ironoquia punctatissima	a species of northern caddisfly	T	caddisfly
Isoetes melanopoda	prairie quillwort	E	vascular plant
Jaffueliobryum wrightii	Wright's blunt leaved true moss	SC	moss/liverwort
Jeffersonia diphylla	twinleaf	SC	vascular plant
Juglans cinerea	butternut	E	vascular plant
Juncus articulatus	jointed rush	E	vascular plant
Juncus marginatus	marginated rush	E	vascular plant
Juncus stygius var. *americanus*	bog rush	SC	vascular plant
Juncus subtilis	slender rush	E	vascular plant
Juniperus horizontalis	creeping juniper	SC	vascular plant
Laccaria trullisata	a species of fungus	SC	fungus
Lactarius fuliginellus	a species of fungus	SC	fungus
Lampsilis higginsii	Higgins eye (Fed. Status: E)	E	mollusk
Lampsilis teres	yellow sandshell	E	mollusk
Lanius ludovicianus	loggerhead shrike	E	bird
Lasmigona compressa	creek heelsplitter	SC	mollusk
Lasmigona costata	fluted-shell	T	mollusk
Lecanora epanora	a species of rim lichen	T	lichen
Lechea tenuifolia var. *tenuifolia*	narrow-leaved pinweed	E	vascular plant
Leersia lenticularis	catchfly grass	T	vascular plant
Lepidostoma libum	a species of caddisfly	T	caddisfly
Lepomis gulosus	warmouth	SC	fish
Lepomis peltastes	northern longear sunfish	SC	fish

Alphabetical Index by Scientific Name

STATUS CODES: E = Endangered; T = Threatened; SC = Special Concern

SCIENTIFIC NAME	COMMON NAME	STATUS	TAXONOMIC GROUP
Leptogium apalachense	a species of lichen	E	lichen
Lescuraea saxicola	lustrous bow moss	T	moss/liverwort
Lespedeza leptostachya	prairie bush clover (Fed. Status: T)	T	vascular plant
Leucophaeus pipixcan	Franklin's gull	SC	bird
Ligumia recta	black sandshell	SC	mollusk
Ligumia subrostrata	pondmussel	T	mollusk
Limnephilus janus	a species of northern caddisfly	E	caddisfly
Limnephilus rossi	a species of northern caddisfly	T	caddisfly
Limnephilus secludens	a species of northern caddisfly	E	caddisfly
Limosa fedoa	marbled godwit	SC	bird
Limosella aquatica	mudwort	SC	vascular plant
Listera auriculata	auricled twayblade	E	vascular plant
Listera convallarioides	broad-leaved twayblade	SC	vascular plant
Littorella americana	American shore plantain	SC	vascular plant
Lobaria scrobiculata	a species of lichen	E	lichen
Luzula parviflora	small-flowered woodrush	T	vascular plant
Lycaeides idas nabokovi	Nabokov's blue	SC	butterfly/moth
Lycaeides melissa samuelis	Karner blue (Fed. Status: E)	E	butterfly/moth
Lynx canadensis	Canada lynx (Fed. Status: T)	SC	mammal
Lysimachia maritima	sea milkwort	E	vascular plant
Lysimachia quadrifolia	whorled loosestrife	SC	vascular plant
Lysurus cruciatus	a species of fungus	SC	fungus
Lythrurus umbratilis	redfin shiner	SC	fish
Macrosteles clavatus	caped leafhopper	SC	leafhopper
Malaxis monophyllos var. *brachypoda*	white adder's mouth	SC	vascular plant
Malaxis paludosa	bog adder's mouth	E	vascular plant
Marpissa formosa	a species of jumping spider	SC	jumping spider
Marsilea vestita	hairy waterclover	E	vascular plant
Meesia uliginosa	swan moss	SC	moss/liverwort
Megalonaias nervosa	washboard	E	mollusk
Melanelia subolivacea	brown-eyed camouflage lichen	SC	lichen
Melica nitens	three-flowered melic	T	vascular plant
Menegazzia terebrata	port-hole lichen	SC	lichen
Microtus ochrogaster	prairie vole	SC	mammal
Microtus pinetorum	woodland vole	SC	mammal
Minuartia dawsonensis	rock sandwort	T	vascular plant
Moehringia macrophylla	large-leaved sandwort	T	vascular plant
Montia chamissoi	montia	E	vascular plant
Morone mississippiensis	yellow bass	SC	fish
Moxostoma duquesnei	black redhorse	SC	fish
Muhlenbergia uniflora	one-flowered muhly	SC	vascular plant
Mustela nivalis	least weasel	SC	mammal
Myotis lucifugus	little brown myotis	SC	mammal
Myotis septentrionalis	northern myotis (Fed. Status: P)	SC	mammal
Myriophyllum heterophyllum	broadleaf water milfoil	SC	vascular plant
Najas guadalupensis ssp. *olivacea*	southern naiad	SC	vascular plant
Najas gracillima	slender naiad	SC	vascular plant
Najas marina	sea naiad	SC	vascular plant
Napaea dioica	glade mallow	T	vascular plant
Necturus maculosus	mudpuppy	SC	amphibian/reptile
Hybopsis amnis	pallid shiner	E	fish
Notropis anogenus	pugnose shiner	T	fish
Notropis nubilus	Ozark minnow	SC	fish
Notropis topeka	Topeka shiner (Fed. Status: E)	SC	fish
Noturus exilis	slender madtom	E	fish
Nuttallanthus canadensis	old field toadflax	SC	vascular plant
Nymphaea leibergii	small white waterlily	T	vascular plant
Oarisma garita	garita skipper	T	butterfly/moth
Oarisma poweshiek	poweshiek skipper (Fed. Status: P)	E	butterfly/moth
Ochrolechia androgyna	powdery saucer lichen	SC	lichen
Ochrotrichia spinosa	a species of purse casemaker caddisfly	E	caddisfly
Oecetis ditissa	a species of long horned caddisfly	T	caddisfly
Oeneis uhleri varuna	Uhler's arctic	E	butterfly/moth
Oenothera rhombipetala	rhombic evening primrose	SC	vascular plant
Onychomys leucogaster	northern grasshopper mouse	SC	mammal
Ophiogomphus anomalus	extra-striped snaketail	SC	dragonfly
Ophiogomphus howei	pygmy snaketail	SC	dragonfly
Ophiogomphus susbehcha	St. Croix snaketail	SC	dragonfly
Opuntia macrorhiza	devil's tongue	SC	vascular plant
Orobanche fasciculata	clustered broomrape	T	vascular plant
Orobanche ludoviciana var. *ludoviciana*	Louisiana broomrape	T	vascular plant
Orobanche uniflora	one-flowered broomrape	T	vascular plant
Osmorhiza berteroi	Chilean sweet cicely	E	vascular plant
Osmorhiza depauperata	blunt-fruited sweet cicely	SC	vascular plant
Oxyethira ecornuta	a species of purse casemaker caddisfly	T	caddisfly
Oxyethira itascae	a species of purse casemaker caddisfly	SC	caddisfly
Oxytropis viscida	sticky locoweed	E	vascular plant
Packera cana	gray ragwort	E	vascular plant
Packera indecora	elegant grounsel	E	vascular plant

Alphabetical Index by Scientific Name

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SCIENTIFIC NAME	COMMON NAME	STATUS	TAXONOMIC GROUP
Panax quinquefolius	American ginseng	SC	vascular plant
Pantherophis obsoletus	western ratsnake	T	amphibian/reptile
Paradamoetas fontana	a species of jumping spider	SC	jumping spider
Parapsyche apicalis	a species of netspinning caddisfly	T	caddisfly
Parkesia motacilla	Louisiana waterthrush	SC	bird
Parmelia stictica	a species of lichen	E	lichen
Parmelia stuppea	a species of lichen	T	lichen
Paronychia canadensis	Canada forked chickweed	E	vascular plant
Paronychia fastigiata var. *fastigiata*	forked chickweed	E	vascular plant
Parthenium integrifolium	wild quinine	E	vascular plant
Pelecanus erythrorhynchos	American white pelican	SC	bird
Pelegrina arizonensis	a species of jumping spider	SC	jumping spider
Pellaea atropurpurea	purple cliff brake	SC	vascular plant
Peltigera venosa	a species of lichen	SC	lichen
Peltula bolanderi	Bolander's peltula lichen	T	lichen
Percina evides	gilt darter	SC	fish
Perimyotis subflavus	tri-colored bat	SC	mammal
Perognathus flavescens	plains pocket mouse	SC	mammal
Persicaria careyi	Carey's smartweed	SC	vascular plant
Phacelia franklinii	Franklin's phacelia	T	vascular plant
Phalaropus tricolor	Wilson's phalarope	T	bird
Phegopteris hexagonoptera	broad beech fern	E	vascular plant
Phemeranthus rugospermus	rough-seeded fameflower	T	vascular plant
Phenacobius mirabilis	suckermouth minnow	SC	fish
Phenacomys ungava	eastern heather vole	SC	mammal
Phidippus apacheanus	a species of jumping spider	SC	jumping spider
Phidippus pius	a species of jumping spider	SC	jumping spider
Phlox maculata	wild sweet William	SC	vascular plant
Physaria ludoviciana	bladderpod	E	vascular plant
Pinguicula vulgaris	butterwort	SC	vascular plant
Piptatherum canadense	Canadian ricegrass	T	vascular plant
Pituophis catenifer	gopher snake	SC	amphibian/reptile
Plagiobothrys scouleri	Scouler's popcornflower	SC	vascular plant
Planogyra asteriscus	eastern flat-whorl snail	SC	mollusk
Plantago elongata	slender plantain	SC	vascular plant
Platanthera clavellata	small green wood orchid	SC	vascular plant
Platanthera flava var. *herbiola*	tubercled rein orchid	T	vascular plant
Platanthera praeclara	western prairie fringed orchid (Fed. Status: T)	E	vascular plant
Platismatia glauca	ragbag lichen	SC	lichen
Platygobio gracilis	flathead chub	SC	fish
Plestiodon fasciatus	common five-lined skink	SC	amphibian/reptile
Plethobasus cyphyus	sheepnose (Fed. Status: E)	E	mollusk
Pleurobema sintoxia	round pigtoe	SC	mollusk
Poa paludigena	bog bluegrass	T	vascular plant
Poa wolfii	Wolf's bluegrass	SC	vascular plant
Podiceps auritus	horned grebe	E	bird
Pogonatum urnigerum	urn-bearing hair moss	SC	moss/liverwort
Polanisia jamesii	James' polanisia	E	vascular plant
Polemonium occidentale ssp. *lacustre*	western Jacob's ladder	E	vascular plant
Polycentropus glacialis	a species of tube casemaker caddisfly	T	caddisfly
Polycentropus milaca	a species of tube casemaker caddisfly	E	caddisfly
Polygala cruciata	cross-leaved milkwort	E	vascular plant
Polyodon spathula	paddlefish	T	fish
Polystichum acrostichoides	Christmas fern	E	vascular plant
Polystichum braunii	Braun's holly fern	T	vascular plant
Polytaenia nuttallii	prairie parsley	SC	vascular plant
Potamogeton bicupulatus	snailseed pondweed	E	vascular plant
Potamogeton confervoides	algae-like pondweed	E	vascular plant
Potamogeton diversifolius	diverse-leaved pondweed	E	vascular plant
Potamogeton oakesianus	Oake's pondweed	E	vascular plant
Potamogeton pulcher	spotted pondweed	E	vascular plant
Progne subis	purple martin	SC	bird
Prosartes trachycarpa	rough-fruited fairybells	E	vascular plant
Prosopium coulterii	pygmy whitefish	SC	fish
Protopannaria pezizoides	brown-gray moss-shingle lichen	T	lichen
Protoptila erotica	a species of saddle casemaker caddisfly	SC	caddisfly
Psathyrella cystidiosa	a species of fungus	E	fungus
Psathyrella rhodospora	a species of fungus	E	fungus
Pseudocyphellaria crocata	a species of lichen	E	lichen
Psoralidium tenuiflorum	slender-leaved scurf pea	E	vascular plant
Puma concolor	mountain lion	SC	mammal
Pyrgus centaureae freija	grizzled skipper	SC	butterfly/moth
Pyrola minor	small shinleaf	SC	vascular plant
Quadrula fragosa	winged mapleleaf (Fed. Status: E)	E	mollusk
Quadrula metanevra	monkeyface	T	mollusk
Quadrula nodulata	wartyback	T	mollusk
Quercus bicolor	swamp white oak	SC	vascular plant
Rallus elegans	king rail	E	bird
Ramalina roesleri	frayed ramalina lichen	T	lichen

Alphabetical Index by Scientific Name

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SCIENTIFIC NAME	COMMON NAME	STATUS	TAXONOMIC GROUP
Ramalina thrausta	angel's hair lichen	SC	lichen
Ranunculus lapponicus	Lapland buttercup	SC	vascular plant
Reithrodontomys megalotis	western harvest mouse	SC	mammal
Rhodiola integrifolia ssp. *leedyi*	Leedy's roseroot (Fed. Status: T)	E	vascular plant
Rhynchospora capillacea	hair-like beak rush	T	vascular plant
Rorippa sessiliflora	sessile-flowered yellow cress	SC	vascular plant
Rotala ramosior	toothcup	T	vascular plant
Rubus chamaemorus	cloudberry	T	vascular plant
Rubus fulleri	bristle-berry	T	vascular plant
Rubus missouricus	Missouri dewberry	E	vascular plant
Rubus multifer	Kinnickinnick dewberry	SC	vascular plant
Rubus quaesitus	Prince Edward Island blackberry	SC	vascular plant
Rubus semisetosus	swamp blackberry	T	vascular plant
Rubus stipulatus	bristle-berry	E	vascular plant
Rubus vermontanus	Vermont blackberry	SC	vascular plant
Rudbeckia triloba var. *triloba*	three-leaved coneflower	T	vascular plant
Ruellia humilis	wild petunia	SC	vascular plant
Ruppia cirrhosa	spiral ditchgrass	SC	vascular plant
Sagina nodosa ssp. *borealis*	knotty pearlwort	E	vascular plant
Sagittaria brevirostra	short-beaked arrowhead	E	vascular plant
Sagittaria calycina var. *calycina*	hooded arrowhead	T	vascular plant
Salicornia rubra	red saltwort	T	vascular plant
Salix maccalliana	McCalla's willow	SC	vascular plant
Salix pellita	satiny willow	T	vascular plant
Salix pseudomonticola	false mountain willow	SC	vascular plant
Sanicula trifoliata	beaked snakeroot	SC	vascular plant
Sarcosoma globosum	a species of fungus	SC	fungus
Sassacus papenhoei	a species of jumping spider	SC	jumping spider
Saxifraga cernua	nodding saxifrage	E	vascular plant
Saxifraga paniculata	encrusted saxifrage	SC	vascular plant
Schedonnardus paniculatus	tumble grass	SC	vascular plant
Schinia indiana	phlox moth	SC	butterfly/moth
Schinia lucens	leadplant flower moth	SC	butterfly/moth
Schistostega pennata	luminous moss	E	moss/liverwort
Scleria triglomerata	tall nutrush	E	vascular plant
Scleria verticillata	whorled nutrush	T	vascular plant
Scutellaria ovata var. *versicolor*	ovate-leaved skullcap	T	vascular plant
Selaginella selaginoides	northern spikemoss	E	vascular plant
Setophaga cerulea	cerulean warbler	SC	bird
Setophaga citrina	hooded warbler	SC	bird
Shepherdia canadensis	soapberry	SC	vascular plant
Shinnersoseris rostrata	annual skeletonweed	T	vascular plant
Silene drummondii ssp. *drummondii*	Drummond's campion	SC	vascular plant
Silene nivea	snowy campion	T	vascular plant
Simpsonaias ambigua	salamander mussel	E	mollusk
Sistrurus catenatus	massasauga (Fed. Status: C)	E	amphibian/reptile
Solidago mollis	soft goldenrod	SC	vascular plant
Somatochlora brevicincta	Quebec emerald	SC	dragonfly
Somatochlora forcipata	forcipate emerald	SC	dragonfly
Sorex fumeus	smoky shrew	SC	mammal
Speyeria idalia	regal fritillary	SC	butterfly/moth
Sphagnum compactum	cushion peat moss	T	moss/liverwort
Sphagnum lescurii	red twisted peat moss	T	moss/liverwort
Spilogale putorius	eastern spotted skunk	T	mammal
Spiranthes casei var. *casei*	Case's ladies' tresses	T	vascular plant
Splachnum rubrum	red parasol moss	E	moss/liverwort
Stellaria longipes ssp. *longipes*	long-stalked chickweed	SC	vascular plant
Stereocaulon pileatum	pixie foam lichen	SC	lichen
Sterna forsteri	Forster's tern	SC	bird
Sterna hirundo	common tern	T	bird
Sticta fuliginosa	a species of lichen	SC	lichen
Striatura ferrea	black striate snail	SC	mollusk
Stuckenia vaginata	sheathed pondweed	E	vascular plant
Subularia aquatica ssp. *americana*	awlwort	T	vascular plant
Suillus weaverae	a species of fungus	E	fungus
Sullivantia sullivantii	reniform sullivantia	T	vascular plant
Symphyotrichum shortii	Short's aster	SC	vascular plant
Synaptomys borealis	northern bog lemming	SC	mammal
Taenidia integerrima	yellow pimpernel	SC	vascular plant
Tephrosia virginiana	goat's rue	SC	vascular plant
Thaspium barbinode	hairy-jointed meadow-parsnip	SC	vascular plant
Thelia hirtella	nipple moss	SC	moss/liverwort
Thelocarpon epibolum	a species of thelocarpon lichen	SC	lichen
Thomomys talpoides	northern pocket gopher	T	mammal
Tofieldia pusilla	small false asphodel	E	vascular plant
Torreyochloa pallida	Torrey's mannagrass	SC	vascular plant
Tortella inclinata	shortleaf chalk moss	SC	moss/liverwort
Triaenodes flavescens	a species of long horned caddisfly	SC	caddisfly
Trichocolea tomentella	down moss	T	moss/liverwort

Alphabetical Index by Scientific Name

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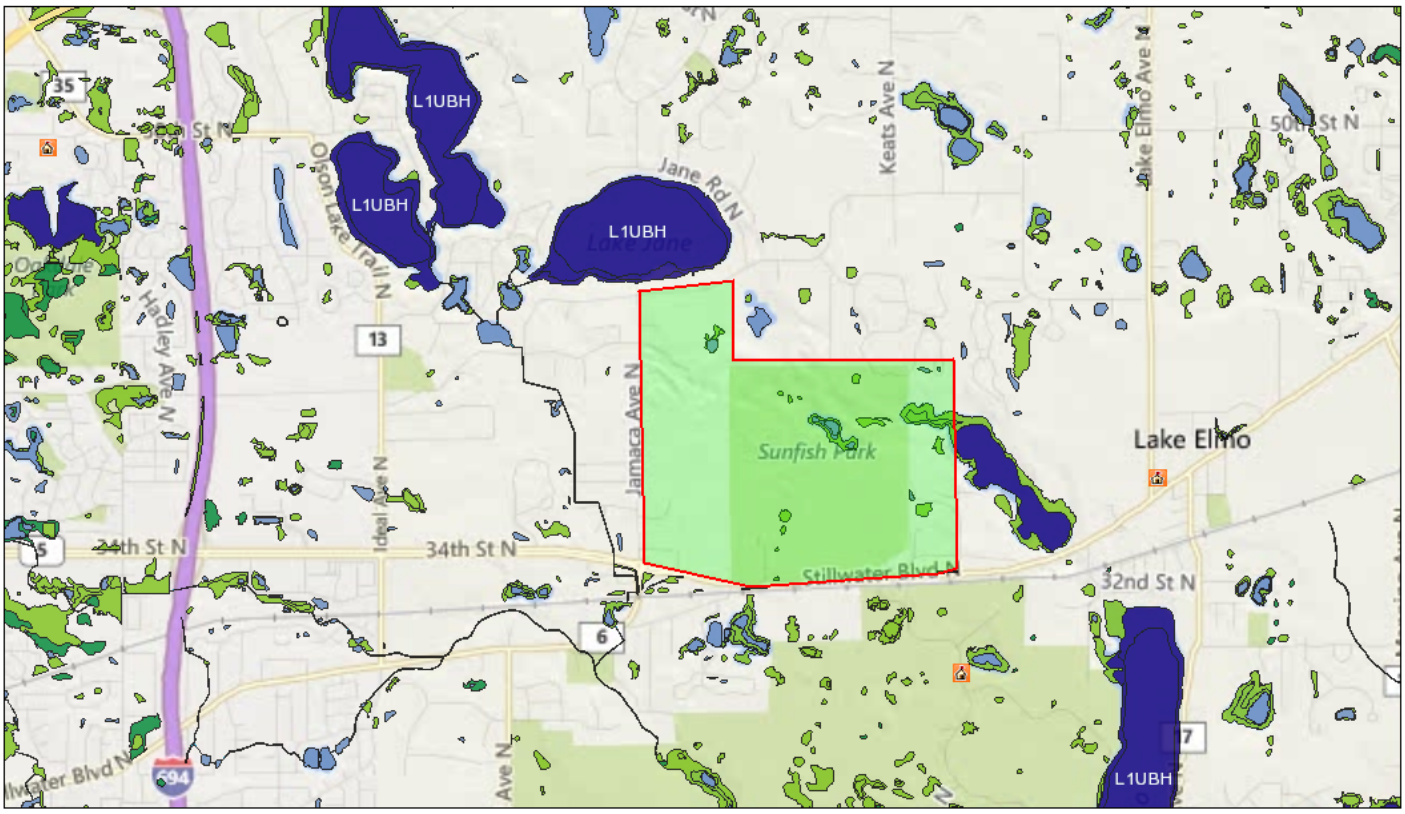
SCIENTIFIC NAME	COMMON NAME	STATUS	TAXONOMIC GROUP
Trichophorum clintonii	Clinton's bulrush	T	vascular plant
Trillium nivale	snow trillium	SC	vascular plant
Triplasis purpurea var. *purpurea*	purple sandgrass	SC	vascular plant
Trisetum spicatum	spike trisetum	SC	vascular plant
Tritogonia verrucosa	pistolgrip	E	mollusk
Tropidoclonion lineatum	lined snake	SC	amphibian/reptile
Truncilla donaciformis	fawnsfoot	T	mollusk
Tsuga canadensis var. *canadensis*	eastern hemlock	E	vascular plant
Tutelina formicaria	a species of jumping spider	T	jumping spider
Tympanuchus cupido	greater prairie-chicken	SC	bird
Umbilicaria torrefacta	a species of lichen	E	lichen
Urocitellus richardsonii	Richardson's ground squirrel	SC	mammal
Usnea longissima	Methuselah's beard lichen	SC	lichen
Usnea mutabilis	bloody beard lichen	T	lichen
Usnea rubicunda	red beard lichen	SC	lichen
Utricularia geminiscapa	hidden-fruit bladderwort	T	vascular plant
Utricularia purpurea	purple-flowered bladderwort	E	vascular plant
Utricularia resupinata	lavender bladderwort	T	vascular plant
Vaccinium uliginosum	alpine bilberry	E	vascular plant
Valeriana edulis var. *ciliata*	edible valerian	T	vascular plant
Venustaconcha ellipsiformis	ellipse	T	mollusk
Verbena simplex	narrow-leaved vervain	SC	vascular plant
Vertigo meramecensis	bluff vertigo	T	mollusk
Viola lanceolata var. *lanceolata*	lance-leaved violet	T	vascular plant
Viola nuttallii	yellow prairie violet	T	vascular plant
Vireo bellii	Bell's vireo	SC	bird
Vitis aestivalis var. *bicolor*	silverleaf grape	T	vascular plant
Waldsteinia fragarioides var. *fragarioides*	barren strawberry	SC	vascular plant
Woodsia alpina	alpine woodsia	T	vascular plant
Woodsia glabella	smooth woodsia	T	vascular plant
Woodsia oregano ssp. *cathcartiana*	Oregon woodsia	SC	vascular plant
Woodsia scopulina ssp. *laurentiana*	Rocky Mountain woodsia	T	vascular plant
Xanthisma spinulosum var. *spinulosum*	cutleaf ironplant	SC	vascular plant
Xyris montana	montane yellow-eyed grass	SC	vascular plant
Xyris torta	twisted yellow-eyed grass	E	vascular plant
Ylodes frontalis	a species of long horned caddisfly	T	caddisfly
Zonitoides limatulus	dull gloss	SC	mollusk

NEPAssist Report



February 12, 2019

Project 2

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland

1:44,303

0 0.375 0.75 1.5 mi

0 0.5 1 2 km

U.S. Fish and Wildlife Service, National Standards and Support Team, wetlands_team@fws.gov
U.S. Fish and Wildlife Service
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Input Coordinates: 44.996811,-92.898488,44.996568,-92.900033,44.995779,-92.914881,44.997175,-92.923293,45.012347,-92.923722,45.012954,-92.916255,45.008463,-92.916255,45.008524,-92.898831,44.996811,-92.898488

Project Area	1.13 sq mi
Within an Ozone 8-hr (1997 standard) Non-Attainment/Maintenance Area?	no
Within an Ozone 8-hr (2008 standard) Non-Attainment/Maintenance Area?	no
Within a Lead (2008 standard) Non-Attainment/Maintenance Area?	no
Within a SO2 1-hr (2010 standard) Non-Attainment/Maintenance Area?	no
Within a PM2.5 24hr (2006 standard) Non-Attainment/Maintenance Area?	no
Within a PM2.5 Annual (1997 standard) Non-Attainment/Maintenance Area?	no
Within a PM2.5 Annual (2012 standard) Non-Attainment/Maintenance Area?	no
Within a PM10 (1987 standard) Non-Attainment/Maintenance Area?	no
Within a Federal Land?	no
Within an impaired stream?	no
Within an impaired waterbody?	no
Within a waterbody?	yes
Within a stream?	no
Within an NWI wetland?	Available Online
Within a Brownfields site?	no
Within a Superfund site?	yes
Within a Toxic Release Inventory (TRI) site?	no
Within a water discharger (NPDES)?	no
Within a hazardous waste (RCRA) facility?	no

Within an air emission facility?	no
Within a school?	no
Within an airport?	no
Within a hospital?	no
Within a designated sole source aquifer?	no
Within a historic property on the National Register of Historic Places?	no
Within a Toxic Substances Control Act (TSCA) site?	no
Within a RADInfo site?	no

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Mountain Biking: A Review of the Ecological Effects

February 2010

Prepared by Michael Quinn and Greg Chernoff

MIISTAKIS INSTITUTE

Prepared for: Parks Canada – National Office (Visitor Experience Branch)

Mountain Biking: A Review of the Ecological Effects

A Literature Review for Parks Canada – National Office (Visitor Experience Branch)

FINAL REPORT

February 2010

Prepared by Michael Quinn and Greg Chernoff

Miistakis Institute
Faculty of Environmental Design – University of Calgary
2500 University Drive NW
Calgary, AB
T2N 1N4

Phone: (403) 220-8968
Email: institute@rockies.ca
Web: www.rockies.ca

EXECUTIVE SUMMARY

In order to inform an activity assessment of mountain biking within Canada's national protected heritage places, Parks Canada commissioned the following literature review on the ecological effects of mountain biking. The purpose of this review was to summarize the nature of the ecological perturbations or effects arising from the disturbance of recreational mountain biking. Extensive searches and cross-references were conducted using the most relevant on-line databases available through the University of Calgary library. Searches of the World Wide Web via leading search engines and focused reviews of known mountain biking and trail associations were also conducted. The intent of the initial search was to identify as many papers, reports and theses as possible that addressed topics related to mountain biking. Source materials were then filtered to identify those references that addressed ecological effects of the activity. The research described in this report is concurrent with a complementary effort to understand the demographics, culture, and social effects of mountain biking as a recreational activity.

Mountain biking is a popular and burgeoning recreational activity. Compared to other outdoor recreational activities, there is a relative dearth of understanding and peer-reviewed scientific papers on the ecological effects of mountain biking. The original objective of this literature review was to provide a comparison of published research on the relative effects of four distinct sub-disciplines of mountain biking: cross country, freeride, downhill and bike parks/dirt jumps. However, the lack of published literature focusing on the sub-disciplines, or the comparison between them, made this impossible. Therefore, the review provided herein primarily addresses cross-country riding. Specific effects associated with mountain biking activity and infrastructure characteristic of the other types of use have emerged as a considerable gap in the research literature.

The literature review was conducted within the framework of recreation ecology – the study of the biophysical effects of recreational activity. One of the most important theoretical generalizations arising from recreation ecology is referred to as the curvilinear use-impact relationship. In simple terms, the nonlinear nature of the use-effect relationship suggests that the greatest proportion of ecological effect is generated during the initiation and early use period of a new facility or infrastructural development. This phenomenon has been clearly established for a wide variety of soils and vegetation responses to activity, and suggests that the majority of the environmental effect occurs when a trail is first developed or constructed.

The review followed the approach used in the majority of the recreation ecology literature, exploring the ecological effects of the activity on soils, vegetation, water and wildlife individually. Although this framework provides a useful structure in which to discuss the effects of recreation, it is essential to recognized that there are connections, feedbacks and synergies between the categories. Ultimately, effects of disturbance must be addressed with an understanding of the cumulative and synergistic nature of their occurrence.

The available published literature indicates that mountain biking as an anthropogenic disturbance is similar in its environmental effects as other forms of summer season trail use. The effects of mountain biking on soils and vegetation have received the most attention and experimental

examination of the four categories. Research has mainly focused on quantifying erosion (created by shear forces) and compaction (created by normal forces) that result from mountain bike use and combine to create "tread incision". Other concerns include water runoff and resulting sediment transport (erosion), and trail widening to avoid muddy or puddled areas. As with other forms of trail-based recreation (hiking, horseback riding), research has shown that the soil type (erodability), terrain relief and amount of moisture have the greatest influence on the significance of mountain biking effects on soils. Researchers also reported that cycling technique and skill level influences the level of impact on soils, with braking/skidding and cutting switchbacks creating the most damage. Vegetation trampling and removal generally follows the curvilinear use-effect relationship described above with de-vegetated trails appearing even after relatively low levels of use. Mountain bike trails as vectors for the spread of non-native exotic plant species has been identified as a concern, but little empirical work is available to draw any conclusions beyond the knowledge that exists for other similar hiking and horse trails. The current review was unable to find any published research on the effects mountain biking on water quality.

The effects of mountain biking on wildlife are primarily related to habitat alteration as a result of impact to soils and vegetation, as well as disturbance of daily or seasonal habitat use. The significance of the disturbance is related to the type, timing, intensity, duration and spatial distribution of use. One of the most significant characteristics of mountain biking as a form of wildlife disturbance is a result of the potential relative speed and silence of the activity. A relatively fast moving, quiet mountain biker may approach an animal without being detected until well within the normal 'flight response zone'. The result may be a severe startle response by the wildlife species with significant consequences to the animal and/or the mountain biker. In the case of grizzly bears, such incidents may result in aggressive behaviour toward the mountain biker. In the case of bison, elk and pronghorn antelope, one study did not reveal a significant difference between hikers and mountain bikers with respect to the reaction of any of the three species to their presence.

This review clearly identifies significant gaps in the available literature to assess the ecological effects of mountain biking. Some of the most important knowledge gaps include: 1) To date, there have been few documented interdisciplinary studies of the environmental and social effects associated with mountain biking; 2) Very little has been studied of the recreational ecology of mountain bikes in the Canadian context. Since many of the environmental effects are known to vary according to regional geophysical traits, applying research carried out in other biomes and landscapes may be problematic. Similarly, there are few studies outside of mountainous and high relief terrain areas; 3) No specific research has been published on the water-related environmental effects of mountain biking; 4) Some more focused study of the effects of mountain biking on wildlife would be of benefit; 5) Existing research focuses mainly on the type of recreational activity with little or no emphasis on the timing, intensity, duration and spatial distribution of the activity. Furthermore, there is little in the literature to differentiate between different types of mountain biking; 6) There is a tremendous need for research that addresses the cumulative effects of human recreational activity in protected areas. This includes the need to identify thresholds associated with numbers, timing, type and distribution of use.

SOMMAIRE

Parcs Canada a fait établir la présente analyse documentaire dans le but de contribuer à l'évaluation nationale du vélo de montagne pour les aires patrimoniales protégées du Canada et de résumer la nature des effets ou des perturbations écologiques découlant de cette activité. Pour ce faire, on a rassemblé le plus de documents possible sur le vélo de montagne (articles, rapports, thèses, etc.) en réalisant des recoupements et des travaux de recherche poussés au moyen des bases de données pertinentes de la bibliothèque de l'Université de Calgary, en menant des recherches Internet grâce aux moteurs de recherches les plus couramment utilisés et en effectuant un examen ciblé de diverses associations bien connues dans le domaine du vélo de montagne et des sentiers. De ces documents, on n'a ensuite retenu que ceux portant sur les effets écologiques de l'activité. La recherche dont il est question dans le présent rapport s'inscrit dans un effort complémentaire de compréhension des effets démographiques, sociaux et culturels du vélo de montagne en tant qu'activité récréative.

Le vélo de montagne est une activité récréative populaire et florissante. Cependant, ses effets écologiques sont plutôt méconnus, et il n'existe que très peu d'articles scientifiques évalués par les pairs sur le sujet, comparativement aux autres activités de plein air. Le premier objectif de la présente analyse documentaire était de fournir un examen comparatif des effets relatifs de quatre sous-disciplines distinctes du vélo de montagne, soit le cross-country, le freeride, la descente et les parcs de vélo/sauts en terre battue. Toutefois, le manque de documentation publiée sur ces sous-disciplines ou le manque de comparaisons entre elles rend cette tâche impossible. Par conséquent, la présente analyse concerne principalement le cross-country. En ce qui concerne les effets spécifiques associés au vélo de montagne et aux caractéristiques de l'infrastructure des autres types d'utilisation, on a constaté qu'il y avait une lacune considérable sur le plan des comptes rendus de recherche.

On a mené la présente analyse documentaire dans le cadre de l'écologie de récréation – l'étude des effets biophysiques des activités récréatives. L'une des généralisations théoriques les plus importantes que l'on peut tirer de l'écologie de récréation a trait à la relation non linéaire entre l'utilisation et les effets qui en découlent. En termes simples, l'existence d'une relation utilisation-effets de nature non linéaire tend à montrer que la majeure partie des effets écologiques se manifestent lors de la période d'initiation et des premières utilisations d'une nouvelle installation ou infrastructure. Ce phénomène a été clairement établi dans le cas d'une grande variété de sols et de végétation, et laisse entendre que la majorité des effets sur l'environnement se produisent lors de l'aménagement d'un sentier ou de la construction d'une installation.

La présente analyse a été réalisée suivant l'approche utilisée dans la majorité des documents sur l'écologie récréative, qui consiste à explorer individuellement les effets écologiques de l'activité sur quatre grandes catégories, soit les sols, la végétation, l'eau et la faune. Bien que ce cadre fournisse une structure utile favorisant l'examen des effets de l'activité récréative, il est essentiel de reconnaître qu'entre ces différentes catégories, il existe des liens, des réactions et des synergies. En définitive, il faut connaître la nature cumulative et synergétique des effets de la perturbation pour arriver à les contrer.

Selon les documents consultés, les effets qu'entraîne sur l'environnement le vélo de montagne en tant que perturbation anthropique sont similaires à ceux découlant des autres formes activités de sentier pratiquées pendant la saison estivale. Les effets du vélo de montagne sur les sols et la végétation sont, des quatre catégories, ceux qui ont reçu le plus d'attention et fait l'objet du plus d'examens expérimentaux. Les recherches étaient principalement axées sur l'érosion quantifiable (créée par les forces de cisaillement) et sur la compaction (créée par les forces normales) qui résultent de l'utilisation du vélo de montagne et se combinent pour créer une « bande de roulement ». Parmi les autres préoccupations figurent aussi l'écoulement de l'eau et l'amenée de sédiment qui en résulte (l'érosion) ainsi que l'évitement des passages boueux et glaisés entraînant l'élargissement des sentiers. Comme pour les autres formes d'activités de sentier (par exemple, la randonnée et l'équitation), la recherche montre que le type de sol (caractère érodable), le relief du terrain et le taux d'humidité ont une grande incidence sur l'importance des effets du vélo de montagne sur les sols. Des chercheurs indiquent que les techniques de vélo et le degré d'habileté peuvent aussi avoir une incidence; en effet, le freinage, le dérapage et les virages dans les sentiers en lacet peuvent entraîner des dommages importants. Les dommages causés par le piétinement ainsi que l'élimination de la végétation suivent la relation utilisation-effets non linéaire décrite plus haut; des chemins dépourvus de végétation se forment malgré une utilisation relativement modérée des sentiers. Le fait que les sentiers de vélo de montagne constituent un vecteur de propagation d'espèces végétales exotiques soulève également des préoccupations, mais il n'existe pas suffisamment de travaux d'observation sur le sujet pour permettre de tirer des conclusions autres que celles qui existent déjà pour les sentiers de randonnée et d'équitation. Dans le cadre de la présente analyse, il a été impossible de trouver des documents publiés concernant les effets du vélo de montagne sur la qualité de l'eau.

Les effets du vélo de montagne sur la faune sont principalement liés à la modification de l'habitat, qui découle de l'incidence sur les sols et la végétation, et à la perturbation causée par l'utilisation quotidienne ou saisonnière de l'habitat. L'importance de la perturbation est liée au type et au temps d'utilisation, ainsi qu'à son intensité, à sa durée et à sa distribution spatiale. L'une des principales caractéristiques de la perturbation de la faune qu'entraîne le vélo de montagne résulte de la vitesse relative des vététistes et du caractère potentiellement silencieux de l'activité. Un vététiste silencieux roulant relativement rapidement peut s'approcher d'un animal sans se faire repérer et s'aventurer à l'intérieur de la « zone normale de fuite ». Dans une telle situation, les animaux sauvages peuvent avoir une vive réaction de sursaut entraînant des conséquences graves pour l'animal ou pour le vététiste. Le grizzly, par exemple, peut adopter un comportement agressif envers le vététiste. Selon une étude, la réaction que produit un vététiste sur le bison, le wapiti et l'antilocarpe ne serait pas tellement différente de celle que produit un randonneur.

La présente analyse montre clairement qu'il existe des lacunes importantes dans les documents publiés et que, pour cette raison, il est très difficile d'évaluer les effets écologiques du vélo de montagne. Parmi les lacunes les plus importantes, on trouve celles qui suit : 1) Jusqu'à aujourd'hui, on a mené peu d'études interdisciplinaires documentées sur les effets sociaux et environnementaux découlant du vélo de montagne. 2) On en connaît très peu sur l'écologie récréative liée au vélo de montagne au Canada; comme un grand nombre d'effets environnementaux varient en fonction des caractéristiques géophysiques régionales, l'application des résultats de recherche obtenus dans d'autres biomes et types de paysages peut d'avérer

problématique. De plus, très peu d'études ont été menées à l'extérieur des aires montagneuses et de haut-relief. 3) Aucun travail de recherche n'a été publié concernant les effets environnementaux du vélo de montagne sur l'eau. 4) Il serait utile de mener davantage de recherches axées sur les effets du vélo de montagne sur la faune. 5) Les recherches actuelles mettent principalement l'accent sur le type d'activité récréative, mais se concentrent peu, voire pas du tout, sur le temps, l'intensité, la durée et la distribution spatiale de l'activité. De plus, on trouve peu d'information permettant de faire la différence entre les différentes disciplines de vélo de montagne. 6) Il faudrait absolument effectuer des recherches sur les effets cumulatifs de l'activité récréative humaine dans les aires protégées. Il est notamment essentiel de déterminer les limites associées à la fréquence, au temps et au type d'utilisation, ainsi qu'à sa distribution.

INTRODUCTION

In order to inform an activity assessment of mountain biking within Canada's national protected heritage places, Parks Canada commissioned the following literature review. This report reviews both peer-reviewed scientific and grey literature sources, and represents not a comprehensive or exhaustive study of available literature, but rather a solid foundational overview upon which future efforts can hopefully build.

Throughout this review the authors assume that mountain biking constitutes an anthropogenic 'disturbance' to the physical environment in which it occurs. An ecological disturbance is "A cause; a physical force, agent, or process, either abiotic or biotic, causing a perturbation (which includes stress) in an ecological component or system; relative to a specified reference state and system; defined by specific characteristics" (Rykiel 1985, p. 364). Disturbances create changes to the background or 'average' environmental conditions that may be short-term, long-term or permanent. "Outdoor recreation, including nature-based tourism, has long been recognized as an agent of ecological change in natural systems, with the potential to affect soil, vegetation, wildlife, and water quality" (Monz et al. 2010). Whether such change is positive, negative or neutral is entirely a human construct based on societal values. The purpose of this review is to summarize the nature of the ecological perturbations or effects arising from the disturbance of recreational mountain biking. Although the term 'impact' is, by definition, value neutral (e.g., "the effective action of one thing or person upon another; the effect of such action; influence; impression", Oxford English Dictionary [online version] 2010) the term 'environmental impact' is generally received by the natural resource management community as referring to negative conditions or outcomes. Therefore, for the purpose of this review, we will primarily refer to the environmental 'effects' of the 'disturbance' (i.e., mountain biking).

The authors are confident that the references and annotated bibliography included in this document include the vast majority of papers, theses and reports dedicated solely to the assessment of the ecological effects of mountain biking. Extensive searches and cross-references were conducted using the most relevant on-line databases available through the University of Calgary library (e.g. Environmental Abstracts, ENVIROnetbase, Environment Complete, Wildlife & Ecology Studies Worldwide, Scopus, Web of Science, Index to Theses, Theses Canada Portal, ProQuest Dissertations and Theses). The majority of searches were conducted using the search terms 'mountain bike or biking'. This ensured that all literature pertaining to mountain biking was identified. Resultant titles and abstracts were then searched to identify those papers/reports/theses that addressed issues of ecological effects We included the search term 'impacts' as the term is commonly included in the literature. We also searched the World Wide Web using Google, Google Scholar and specific searches of known mountain biking and trail associations. Existing review papers were used as a means to validate our search results. We subsequently reviewed, summarized and synthesized all available, relevant material within the time constraints of the contract. An annotated bibliography of selected sources is included as Appendix A.

There are several existing literature reviews that address the ecological effects of mountain biking on wildlands. Cessford (1995) reviewed studies on environmental and social effects of mountain biking, focusing on examples from the US and Australia. Lathrop (2003) published a literature review for an American conservation advocacy group, counterbalanced by Marion & Wimpey's (2007) science review that was supported by the largest mountain bike advocacy group in the

world, the International Mountain Bike Association (IMBA). A more recent treatment was published by Pickering et al. (2010), who conducted a comprehensive review of studies related to the environmental effectss of hiking, horseback riding and mountain biking, focusing mainly on examples from the US and Australia. As with any topic, there are reports that present a particular normative position (e.g., Vandeman (2004) versus Sprung (2007)). In other words, some of the grey literature is clearly written to advocate for or against mountain biking in protected places. Therefore, we have relied primarily on literature that has been peer-reviewed wherever possible. In reviewing material that may have been biased, we attempted to focus on the primary evidence and not the opintions or conclusions of the authors.

The research described in this report is concurrent with a complementary effort to understand the demographics, culture, and social effects of mountain biking as a recreational activity. As such, we have reviewed little of the research that has been done on this subject with the understanding that it will be given fair treatment elsewhere. There exists, however, a grey area between human and ecological elements of this topic. Moreover, it is essential that these dimensions be integrated in an interdisciplinary approach that fully addresses the complexity of the management issues of importance to the managers of national protected heritage places and those participants in the activity assessment for mountain biking. The management of human recreational activity in national protected heritage places is ultimately about articulating and managing for an acceptable level of change. A sampling of studies on the social effects of mountain biking are included in later sections, where we discuss some research and management questions that arise from our findings.

Mountain Biking

Mountain biking is a popular and burgeoning recreational activity. From its humble beginnings in Marin County California in the early 1970's, it has grown to become an immensely popular recreational activity with at least one mountain bike in 52% of all Canadian households (Mosedale 2003, p.19). Compared to other outdoor recreational activities, there is a relative dearth of understanding and peer-reviewed scientific papers on the ecological effects of mountain biking (Newsome and Davies 2009). For example, the most recent peer-reviewed literature review that includes the environmental effects of mountain biking included only 11 published papers in the review (Pickering et al. 2010).

Within mountain biking there are a number of distinct disciplines (modified from the Statement of Work for this review):

1. Cross-Country (XC) is the most common form of mountain biking, practiced on trails that feature a wide variety of terrain and routes that consist of uphill, downhill and flat sections – often on trails that were originally developed for some other intended use (e.g., hiking). Trail types can vary from flat dirt roads to technical rocky/rooty singletrack, may include technical trail features, and can vary in length. Typical XC riders are self-sufficient and looking for solitude, nature, exercise, and challenge from their recreational experience. The type of bicycle used for this discipline will range from bikes that are more traditional looking with little or no suspension to more durable bikes with longer-travel suspension and aggressive tires. Slightly more technical and aggressive XC riding is sometimes referred to as trail or all-mountain riding.

2. Freeride is a discipline between cross-country mountain biking and downhill mountain biking. Aside from the usual climbing and descending found in cross-country, freeriding involves specific bike-handling skills and techniques and can practiced with natural and constructed obstacles that are either off-trail or can be included as part of a cross-country trail. The vehicle used for this discipline often has dual suspension and is lighter than downhill but heavier than XC bicycle.

3. Downhill - This gravity-assisted discipline involves manoeuvring a sustained descending trail that ends at a lower altitude than the start, requiring the rider to either push, shuttle (with a motorized vehicle or ski lift), or less commonly pedal his/her way to the top. The terrain for downhill trails can be steep and often includes jumps, drops, rocky sections, and roots. Participants are seeking challenge and speed, in some cases reaching speeds of 85 kilometres per hour. The downhill mountain biker requires a high level of technical skill, control, quick reflexes and intense concentration. The equipment used for this discipline is a downhill mountain bike specifically designed for descending challenging trails, which is heavier and more impact-resistant than freeride mountain bikes. It also has aggressive tires and participants commonly wear protective gear (e.g. downhill (full-face) helmet, goggles, body pads, etc.).

4. Bike Parks and Dirt Jumps - Bike parks usually consist of a variety of natural obstacles such as rocks and logs, constructed features such as ladder bridges, pumptracks and mounds of dirt for jumping over, all arranged in a controlled and confined area. This discipline requires a specific set of technical skills and bike-handling techniques. The types of bicycle used can include jumping-specific models of mountain bikes (called “dirt”, “park”, or “DJ” bikes), as well as all other types of mountain bikes. Dirt jumps are courses that include a series of mounds of dirt placed strategically to ride over, around or jump from. Constructed terrain may include dirt jumps, berms, etc. Similar to freeride, mountain biking, bike park obstacles are constructed using soil, raw timber, and man-made materials.

In general "[i]mpacts are likely to be greater when riding is faster, less controlled, occurs on steeper slopes and in wetter conditions" (Pickering et al. 2010). In terms of required degree of alteration to the natural landscape and amount of infrastructure development (construction of bike-specific features), there is a clear continuum evident in the four mountain biking disciplines described above. Newsome and Davies (2009) provide a slightly expanded list of mountain bike riding styles and their potential effects (Table 1).

The original objective of this literature review was to provide a comparison of published research on the relative effects of each of these four disciplines, but with the exception of an editorial article that makes specific reference to off-trail free-riding (Ferguson 2008) and an Australian study that enumerated and mapped unauthorized bike-specific obstacle construction (Davies & Newsome 2009), the current body of knowledge (published literature) appears unable to accommodate such differentiation. Therefore, the review provided herein primarily addresses cross-country riding. Specific effects associated with mountain biking activity and infrastructure characteristic of the other types of use have emerged as a considerable gap in the research literature.

Mountain biking differs from other non-motorized recreational activities (e.g., hiking, horseback riding) via the mediation of travel by wheels. In a malleable substrate, these wheels have the potential to create a groove / single-track that may subsequently conduct water and facilitate erosion. Skidding and braking may also result in the bicycle wheels physically moving soil and

vegetation. The activity may also occur at a greater speed than hiking or equestrian travel. The implications of this are twofold: 1) mountain bikes have the potential to rapidly approach animals without being detected, and 2) speed and mechanical advantage may allow mountain bikes to access relatively more terrain in a shorter period of time. In addition, access to existing trails may result in new trail proliferation as well as the alteration of terrain or construction of infrastructure for more technical mountain bike experiences. In most other respects, the following review indicates that mountain biking (at least trail-based) as an anthropogenic disturbance is similar in its environmental effects as other forms of summer season trail use.

Table 1. Analysis of rider styles.

Style	Requirements	Impact potential
Cross-country riding	The demands of this group embrace an interest in a wide range of trails and most mountain bike riding can fit into this category. Inexperienced riders tend to want to ride on wide, smooth dirt roads or dedicated bike paths for outdoor pleasure and exercise	Low speeds and no desire for technical difficulty Low risk on formed surfaces
Touring	Typically engage in longer trips including overnight stays. They are often carrying camping equipment in panniers and are looking for wide, gently sloping trails through natural areas	Low speeds and no desire for technical difficulty Low risk on formed surfaces
Downhill riding	Includes more experienced riders using highly sophisticated, full suspension bikes for descending technically challenging trails. Downhill bikes are usually heavy and this user group likes to have shuttle services or short cut tracks for pushing their bikes up to the trail	Heavy bikes and some degree of technical difficulty Moderate risk of natural surface trail degradation
Free riding	These riders are seeking technical trail features such as rocks, logs and elevated bridges, dirt jumps, drop offs and see-saws along with big jumps and tough descents to challenge rider skill (Webber, 2007). Such riders desire high-risk trails on unconventional (rough and unpredictable) terrain	High risk of off-trail riding High impact potential
Dirt jumping	These riders are looking for dedicated jumping areas and a mix of jumping styles. Jumps can be provided in a 'skills park' area or as part of a dedicated cross-country trail. Dirt jumpers also use a variety of bikes, including some specialised models	High environmental impact if not carried out in suitably planned and designed trail networks

(Newsome and Davies 2009, p. 239).

BACKGROUND – RECREATION ECOLOGY

Outdoor recreation soared in popularity following World War II when much of society saw an increase in disposable income, leisure time, improved access to information, advancements in technology, and the provision of recreational infrastructure (Gnieser 2000). Concomitantly, resource managers became acutely aware of, and concerned by, the environmental and social costs associated with recreational activity. The study of the biophysical effects of recreational activity is addressed by the field of recreation ecology (Liddle 1997). Recreation ecology is an applied science founded on the realization that recreation "impact is inevitable.... Avoiding impact is not an option unless all recreation is curtailed. Managers must make conscious decisions about tolerable levels of impact, and implement strategies that keep impacts within acceptable levels" (Cole 2004, 113). Although the studies of recreational effects have been conducted since as early as the 1920s (e.g., Meinecke 1928), it was not until the 1970s that long-term research programs were initiated to explore the effects of outdoor recreation on the receiving environment (e.g., Bayfield 1973, Liddle 1975, Cole 1978). The first textbooks dedicated primarily to issues of recreation ecology were published in the 1980s (e.g., Hammit and Cole 1987). Parks Canada has a long history in researching the effects of recreation on the biophysical environment. For example, extensive recreation effect studies and inventories were initiated in the Rocky Mountain National Parks in the 1970s (e.g., Geist 1971, 1975; Kuchar 1972, Landals and Knapik 1972; Landals and Scotter 1973; Leeson 1979; Lesko and Robson 1975; Nagy and Scotter 1974; Roemer 1975; Scotter 1976; Trottier and Scotter 1973) some of which were revisited in the 1990s (e.g., Achuff 1992, Scotter 1992). However, although Parks Canada has a reasonably long history in recreation ecology research, the work is limited in geographic scope and type of activity examined. In general, recreation ecology has tended to focus on single issues at relatively small scales. In order "for the field to advance, more attention needs to be given to other ecosystem attributes and to the larger aspects of environmental conservation occurring at landscape scales" (Monz et al. 2010).

We consider any disturbance to the ecological (biophysical) system resulting from recreational engagement by humans to be an ecological effect or perturbation. We focus herein on ecological effects that result in undesirable changes to the environment. The *significance* of such undesirable changes to the receiving environment is a function of the activity (type, timing, intensity, duration and spatial distribution) and the sensitivity of the environment (resistance and resilience) including the morphological characteristics of vegetation, the nature of the substrate and the behavioural ecology of the species of interest (Fig. 1). In this review, we do not attempt to make any judgements about the acceptability of undesirable change as this is ultimately a management decision.

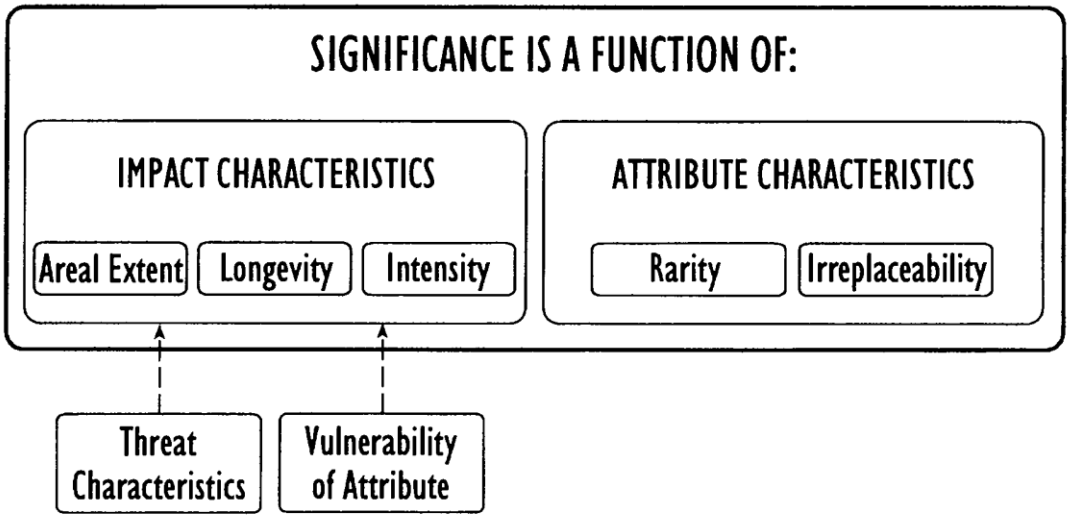


Figure 1. Criteria that help to define the significance of an ecological effect (Cole and Landres 1996).

This review is concerned principally with the environmental effects attributable to recreational activity, specifically mountain biking. A commonly used (Cessford 1995, Liddle 1997, Marion & Wimpey 2007, Mosedale 2003) and meaningful framework around which to organize these effects was first proposed by Wall and Wright (1977), and is illustrated in modified form in Figure 2. This approach divides major recreation effects into four main categories:

1. **Soil** – effects of activity on soil structure and composition, including increased erosion, compaction, and water runoff.

2. **Vegetation** – effects of activity on plant community composition, diversity, and structure.

3. **Wildlife** – the extent to which a recreational activity disturbs wildlife populations through mortality, removal/alteration of habitat, or behavioural stress or disturbance.

4. **Water** – effects of recreational activity on water resources, through introduction of nutrients or other pollutants, or as a transmitter of pathogens into a watershed.

This diagram depicts how recreational activities can affect the host systems: soil, water, vegetation, and (animal) wildlife. There are probably more linkages between the soil and the other systems that this type of diagram can portray.

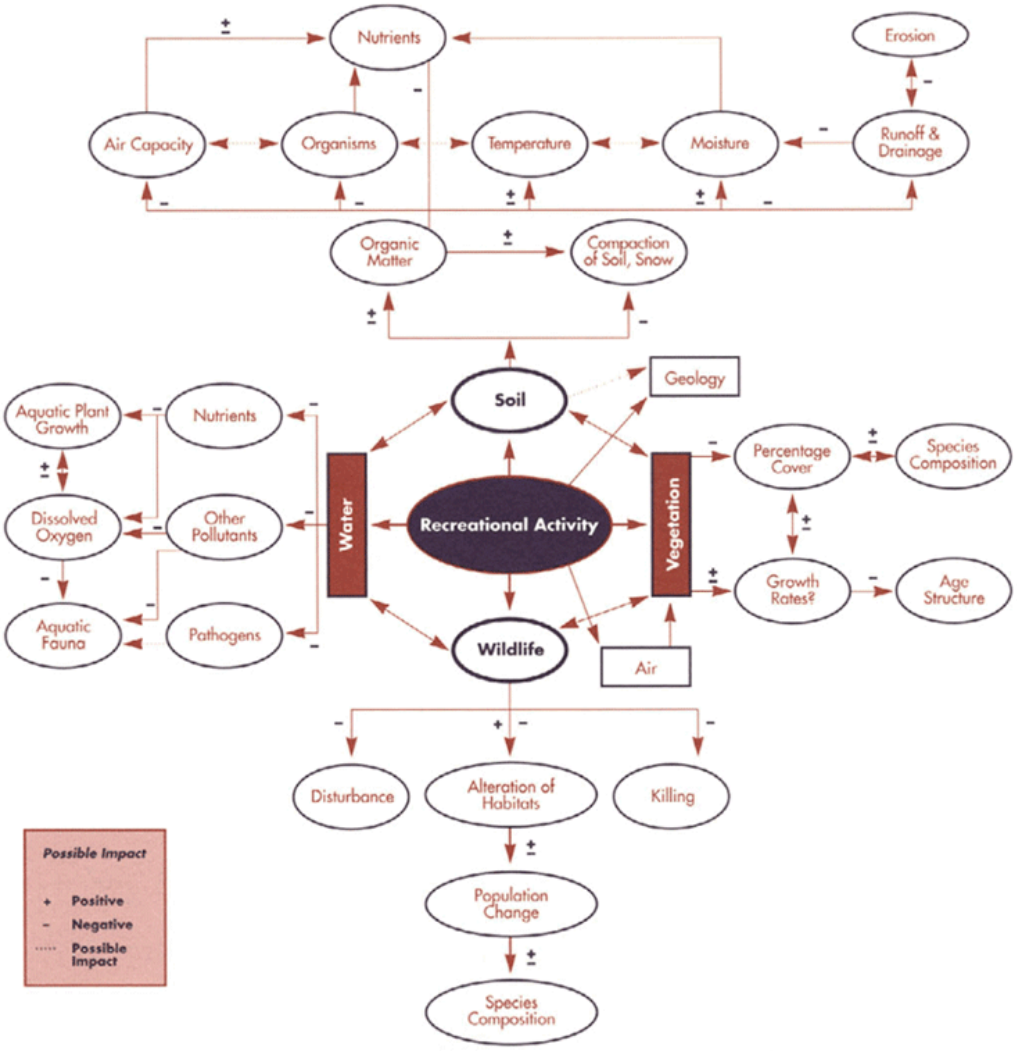


Figure 2. A framework for understanding the ecological effects of recreational activity (Adapted from Mathieson and Wall (1982), in ICLEI and IDRC 1996)

Although this framework provides a useful structure in which to discuss the effects of recreation, it is essential to note that there are connections, feedbacks and synergies between the categories. Ultimately, effects of disturbance must be addressed with an understanding of the cumulative and synergistic nature of their occurrence. A more recent conceptual model for understanding the ecological effects of outdoor recreation is presented in Figure 3. This model is congruent with the disturbance (agents of change) approach adopted for the current literature review.

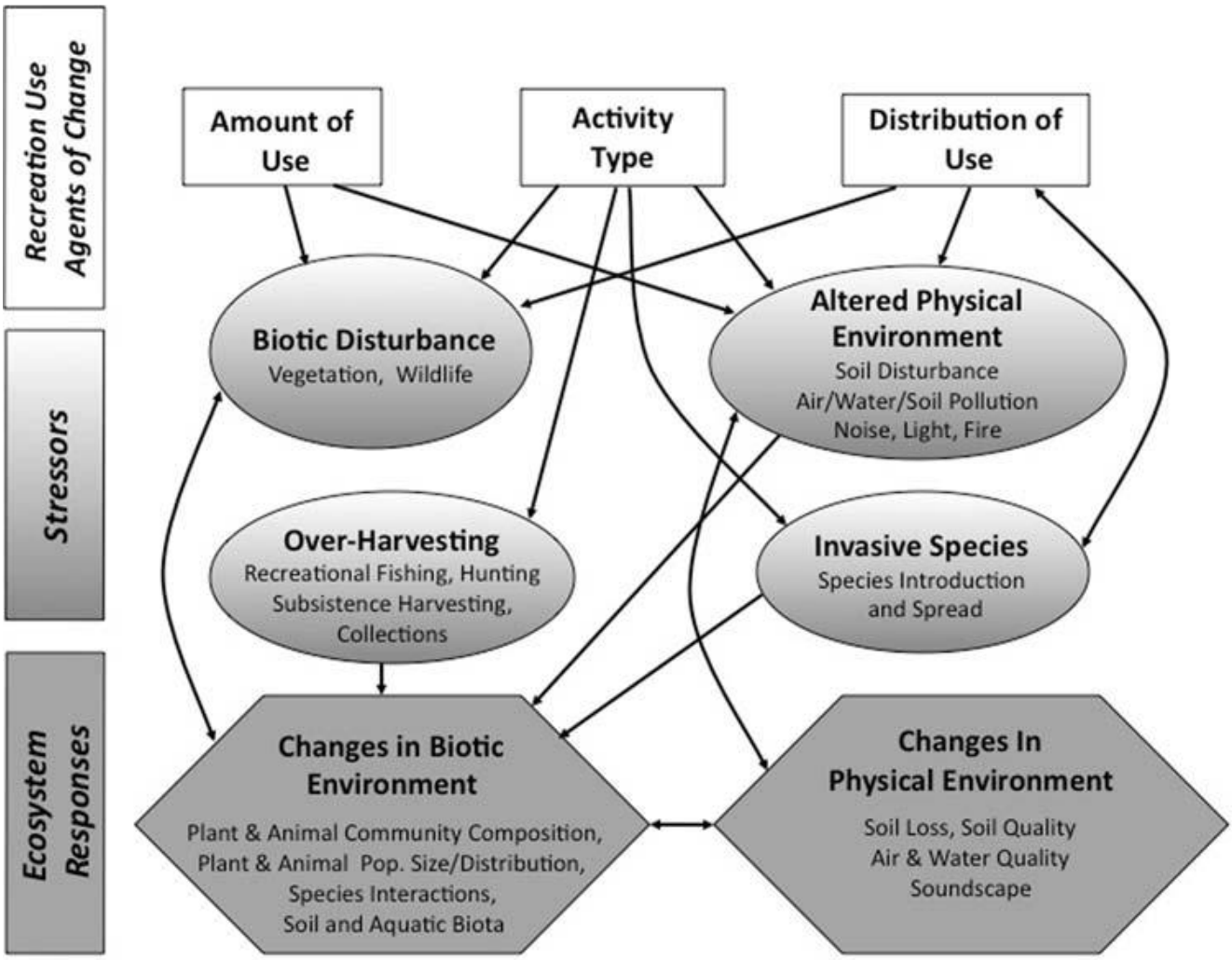
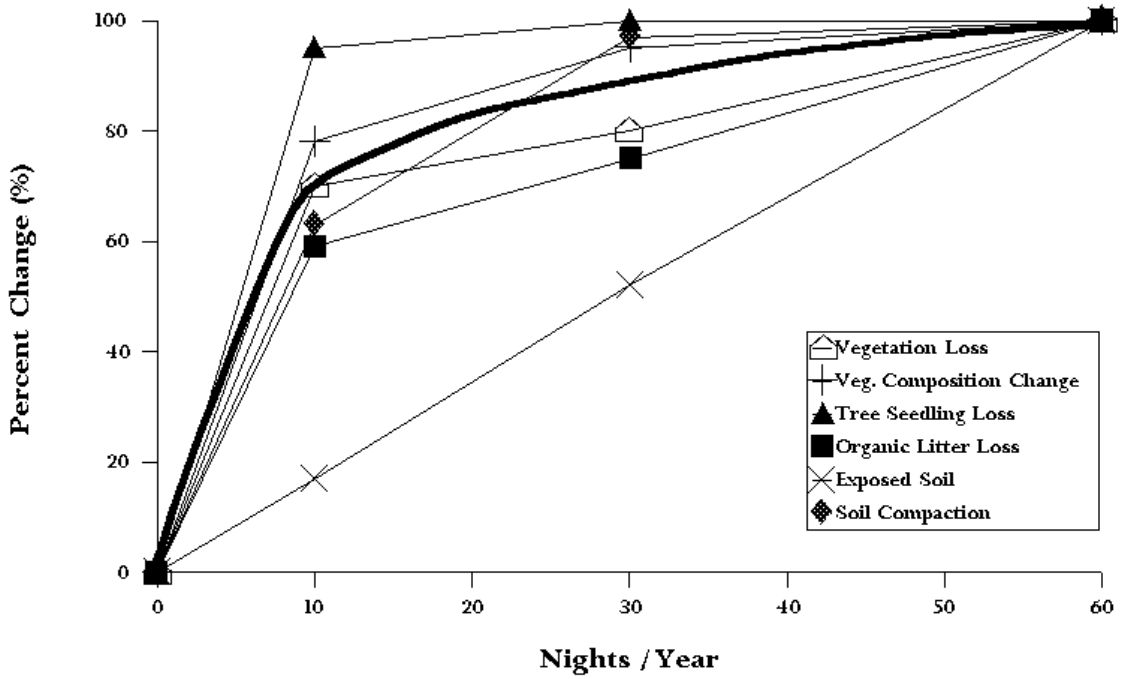


Figure 3. A conceptual model of ecological effects of outdoor recreation (Monz et al. 2010)

The study of recreation ecology involves considering activities that occur on land as well as in the air and water and below the ground. However, since we are concerned with effects of mountain biking, attention will be focused on terrestrial activities that happen in a similar setting (i.e., on trails).

A commonly noted characteristic of environmental effects related to nature-based recreation is referred to as the curvilinear use-impact relationship (Cessford 1995, Davies & Newsome 2009, Lathrop 2003, Liddle 1997, Marion & Wimpey 2007, Morlock et al. 2006, Pickering et al. 2010, Sprung 2004, Wilson & Seney 1994In fact, the "asymptotic nature of the use-impact relationship is among the most important generalization produced by recreation ecology" (Cole 2004, 111). In simple terms, the nonlinear nature of the use-effect relationship suggests that most of the ecological effect is generated in the first few uses. This phenomenon has been mostly observed in soils and vegetation responses to activity, and suggests that the majority of the environmental effect occurs when a trail is first developed or constructed – that very low levels of activity are responsible for creating a great deal of environmental degradation. Figure 4 provides an excellent example of this relationship showing that 60-70% of the vegetation loss, vegetation change, tree seedling loss,

organic litter loss, and soil compaction occurred on campsites after only 10 camping nights in the Boundary Waters Canoe Area (Marion 1998). A generalized model of the curvilinear use-effect relationship is presented in Figure 5.



Note: Change is expressed as a percentage of change on high use sites. Thus, approximately 70% of the vegetation loss that occurs on campsites receiving 60+ nights/year has already occurred on campsites receiving 10 nights/year. The generalized curvilinear use-impact relationship is depicted by the thicker black line.

Figure 4. An example of the curvilinear use-effect relationship (Marion 1998, p. 188).

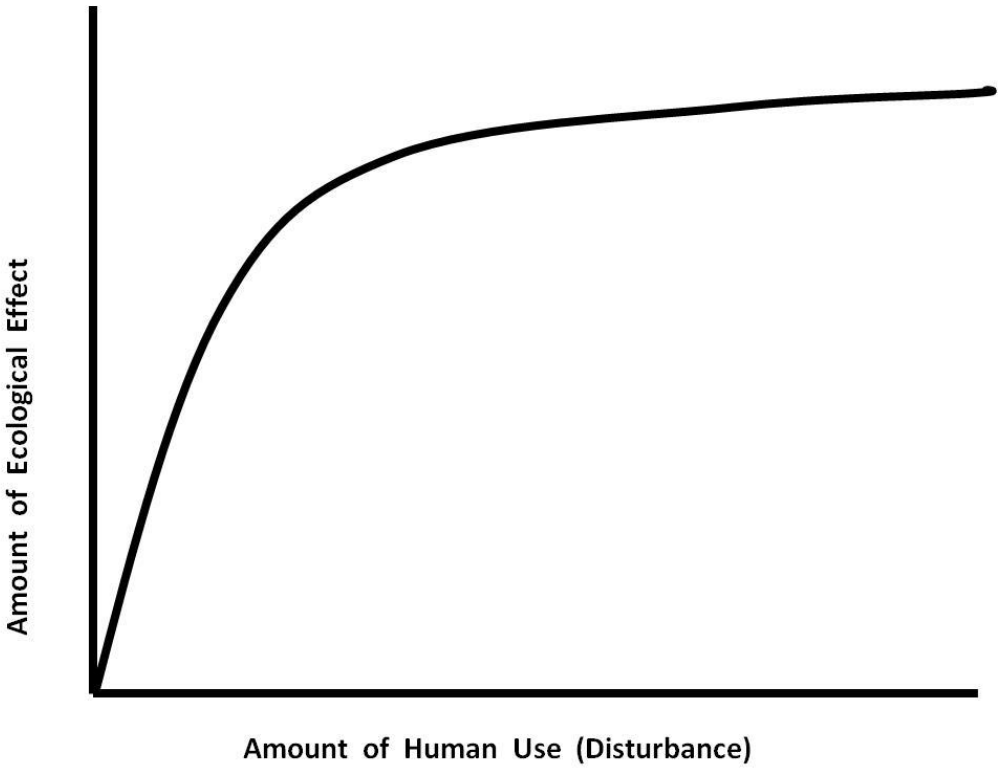


Figure 5. A generalized model of the curvilinear use-effect relationship.

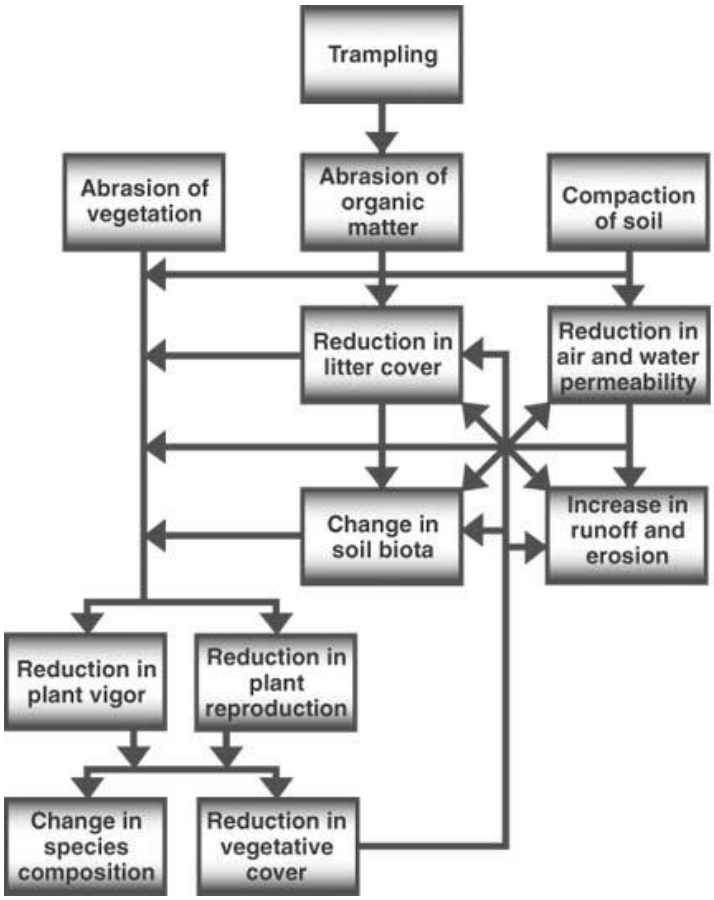


Figure 6. A conceptual model of trampling effects (Therrell et al. 2007)

Much of the research on this topic has come about as a result of the focus on 'trampling' as one of the primary effects of recreational activity in wildland settings. Figure 6 provides a conceptual model of trampling effects and the complexity of examining recreational effects. Incremental use, including use by new activities has been found to result in marginally less additional impact. This relationship makes comparative assessment of the impacts of one type of use over another problematic, as evidenced by many of the studies described in this report.

MOUNTAIN BIKING EFFECTS ON SOILS

There has been considerable research done on the effects of mountain biking on soils, in part because of the commonly held perception among other recreationists that mountain biking contributes disproportionately to soil degradation (Cessford 2003, Mann & Absher 2008, Mason & Leberman 2000). Research has mainly focused on quantifying erosion (created by shear forces) and compaction (created by normal forces) that result from mountain bike use and combine to create "tread incision" (Cessford 1995). Other concerns include water runoff and resulting sediment transport (erosion), and trail widening to avoid muddy or puddled areas (Pickering et al. 2010).

One of the most frequently cited studies of soil erosion was published by Wilson & Seney (1994), who applied a prescribed treatment (100 passes each with four different types of recreational activity, followed by simulated rainfall to assess soil erosion potential) to 108 sample plots along a trail network in Gallatin National Forest, Montana. The authors found that foot- and hoof-powered activities (hiking and horseback riding) had a greater erosive potential than did wheeled activities (off-road vehicles and mountain bikes). This effect was found to be especially pronounced when going downhill.

A similar experiment was conducted in a Provincial Park in southern Ontario, producing comparable results. Thurston & Reader (2001) applied mountain biking and hiking to adjacent, previously undisturbed plots at five different intensities, and recorded soil exposure. In her graduate work Thurston (1998) also measured soil compaction resulting from the two activities. The findings are consistent with the curvilinear use-impact relationship described above, and found no significant difference in the effects on soils of the two activities. A study that was conducted on a multi-use trail network in Kentucky and Tennessee found that of all types of trails, bike trails were found to be the narrowest, to have the least amount of soil loss, and to have the least incidence of running water on the trails (Marion & Olive 2006).

Many studies suggest that the site, situation, and landscape characteristics of a trail have more potential to effect soils than the actual nature of the activity. Trail steepness and orientation to terrain fall lines are both design factors that determine the extent of soil degradation; trails that are routed across slopes are less potentially erosive and have less water runoff potential than trails that run straight down slopes (Marion & Olive 2006, Cessford 1995, White et al. 2006). Landscape factors such as shade and moisture (Bjorkman 1998), and variability in composition of the soil (Marion & Olive 2006, Wilson & Seney 1994, Morlock et al. 2006) all have an effect on the

erosion and compaction potential from mountain biking. Soil moisture has the potential to be beneficial to trail sustainability if it leads to increased cohesion (and hence reduced erosion), but if too much moisture is present in the right soils it can lead to increased compaction and channelling of water by the action of wheeling (Cessford 1995, Pickering et al. 2010). Marion & Olive (2006) reported that trails with heterogeneous soil composition (including rocks and gravel) are less susceptible to erosion than trails over more homogeneous, finer-grained soils. Goeft & Alder (2001) noted a seasonal effect on soil erosion – the effect was more pronounced during rainy seasons.

Researchers commonly indicated that mountain biking effects on soils are often the result of poor trail design, or of trails being used for activities outside of their originally intended purpose (Callahan 2008, Davies & Newsome 2009, White et al. 2006). Therefore, careful planning, maintenance (e.g., construction of water bars, berming or banking corners, ensuring proper drainage, avoiding steep slopes or loose erodible soils) and designation of trails to specific uses (and seasonal trail closures) may help mitigate against some of the more serious effects of mountain bike recreation to soils (Marion & Wimpey 2007, Goeft & Alder 2001). In discussions of best practices, researchers mentioned that cycling technique also influences the level of impact on soils, with braking/skidding and cutting switchbacks creating the most damage (Callahan 2008, Morlock et al. 2006, Marion & Wimpey 2007).

MOUNTAIN BIKING EFFECTS ON VEGETATION

Of the impacts to vegetation attributable to mountain biking and other recreational activities, vegetation trampling/removal is most commonly studied, followed by changes to biodiversity and facilitation of encroachment by invasive species.

Vegetation removal occurs commensurate with soil exposure, and is most prevalent when a trail is first constructed. The linkage between vegetation removal and soil compaction/erosion is so strong that the two phenomena are often studied in tandem (Bjorkman 1998, Goeft & Alder 2001, Pickering et al. 2010, Sun & Walsh 1998, Thurston & Reader 2001). The curvilinear impact-use relationship described above is well-supported in scientific studies of vegetation removal – for example, Thurston & Reader (2001) reported vegetation loss of up to 100% within two weeks of introduction of cycling (and hiking) activities on previously undisturbed sample plots. The majority of the deleterious effects is shown to occur during the first stages of trail development, and effects appear to be the same or similar regardless of the type(s) of recreational activity that are present (Bjorkman 1998, Pickering et al. 2010).

Studies on loss of plant diversity as a result of recreational activity have recently been reviewed by Pickering & Hill (2007). The authors found that recreational activity in Australia contributes appreciably to a loss in vegetation and native biodiversity, but that further quantitative study is required in order to assess the magnitude of the problem and to differentiate between effects of various types of recreational use. Although it is assumed that mountain biking provides a vector for the spread of invasive non-native plant species, we found no specific published studies addressing this issue. Likewise, Pickering and Mount (in press) found no studies examining mountain bikes as seed vectors.

Crealock (2002) undertook a comparative study of c-stratum vegetation adjacent to hiking, multi-use, and biking trails in coastal California, and found that different exotic and/or invasive species respond differently to varied types and intensities of disturbance. The study found that native plant cover decreased in areas more proximal to trails of all types, and generally that invasive species were more likely to be found immediately adjacent to trails of all types. Experimental treatment of simulated recreational use on sample plots indicated that some types of recreation favoured the spread of certain invasive species, while other types of activity created niches for different invasive species.

Depending on climate, plant physiology, and other landscapes, the response of vegetation to disturbance can be highly variable. Regarding all recreational effects on vegetation, caution must be exercised in applying findings from one ecological region directly to another. In one study of recreational effects on soil and vegetation in the southwestern US, White et al. (2006) interpret their findings according to Common Ecological Regions (CERs), and advocate that future broad-ranging recreation ecology studies apply a similar prescription.

MOUNTAIN BIKING EFFECTS ON WILDLIFE

Recreational activity can affect wildlife in three main ways (Liddle 1997):

1. Stress/Disturbance: Wildlife becomes aware of human activity, and respond by becoming stressed, altering their behaviour, avoiding (fleeing) areas of activity, or confronting/attacking humans. Such responses may detrimentally affect the fitness of an individual or a population. Displacement of animals by recreational disturbance may be short term (i.e., minutes or hours) or permanent.
2. Alteration of Habitat: The presence of human activity and/or infrastructure serves to remove or fragment habitat for wildlife, or can create artificial habitat which elicits change in population dynamics or encroachment of new species/populations.
3. Collision/Mortality: Wildlife is struck by humans or their vehicles, resulting in injury or death.

Clearly the sensitivity of each of these effects will vary widely between and even within species, and depending on the type of human activity that is taking place (Hammitt & Cole 1998, Bath & Enck 2003, Tempel et al. 2008, Knight & Gutzwiller 1995). The response of different species to different disturbance activities is largely a function of:

- Detection distance – the distance between humans and wildlife at which human presence is first detected.
- The sensitivity of a given species to human presence (including previous experience with human activity).
- The zone of influence associated with a given activity (determined by noise generated, speed of travel, intensity of use).
- Timing of the effect (e.g., life stage of the animal, breeding season, dispersal season, etc.).

The following is a sample of the available literature on the responses of wildlife to recreation generally, and mountain biking in particular.

"The sudden encounter is the most common situation associated with grizzly bear inflicted injury" (Herrero 1989). Mountain bikers are at particular risk of this type of encounter because the potential speed and relative silence of a biker may facilitate closer proximity to bears before being detected. Schmor (1999) interviewed 41 mountain bikers in the Calgary region who cycled in the Rocky Mountains. The responses indicated that 84% of survey participants had come within 50 m of a bear while mountain biking and 66% of the encounters clearly startled the bear. Herrero & Herrero (2000) studied incidence of conflict/interaction between humans and grizzly bears (*Ursus arctos horribilis*) along the Moraine Lake Highline Trail in Banff National Park. They found that, though intensity of use was much lower for mountain bikers than for hikers along this trail, mountain bikers accounted for a disproportionately high incidence of conflict with bears. Herrero and Herrero (2000) suggest that grizzly bears are more likely to attack if a human is closer than 50 m before being detected. The speed and relative silence of mountain bikes, especially when combined with environmental factors (e.g., dense vegetation, hilly terrain, sound of running water), likely contributed to mountain bikers approaching bears closer than 50m before being detected by the bear. Parks Canada instituted a requirement to travel in tight groups of at least six, which has reduced human-bear conflict in the area (Simic 2007).

Attempts to mitigate the relative silence of mountain bikes include the use of sound devices such as 'bear bells'. Jope (1985) experimentally tested effect of bear bells on bear response to hikers in Glacier National Park. The results showed that a significantly greater number of bears responded by moving away from hikers with bear bells compared to hikers without bells. However, bear bells may not be as effective for mountain bikers as the sound may not be detected within the 50 m threshold distance. Schmor (1999) conducted field experiments to measure the sound of mountain bikers on uphill, downhill and flat sections of forested trail. The results indicated that increases in sound output over ambient sound levels ranged from 1 dB to 10.75 dB; very low levels that would only be detected in close proximity to the bicycle. Schmor (1999) repeated the trials using bear bells affixed to the handlebars of a mountain bike. Sound levels were measured at 2.5 dB to 12.75 dB over ambient sound levels with the greatest sound being produced over very rough terrain. Measurements indicated that the sound of a bear bell on a mountain bike was undetectable at a distance over 30 m. The author concludes that "bear bells are inadequate as a means of warning bears when used on mountain bikes" (p. 29). Schmor (1999) developed a conceptual design for a small, handle-bar mounted, ultrasonic sound device that was capable of providing a warning to bears at a distance of greater than 50 m while traveling at 20 km/hr. There is no indication that such a device has been tested or commercially produced as a means of warning wildlife of approaching mountain bikes.

Wildlife response to recreational activity is partly influenced by the nature and sequence of the sensory stimulus detection. The sensitivity to auditory, olfactory, visual and tactile stimuli is a function of the individual species characteristics. Recent advances in methods and monitoring technology have allowed researchers to collect data on sound (noise) and its potential disturbance to wildlife. The current literature review located only one study that focused on monitoring sounds of mountain biking and the potential effects on wildlife. However, a recent methods and review

paper provides valuable information on collecting sound data for trail monitoring (Pater 2009). Monitoring the sounds associated with mountain biking (and other types of trail use) would be highly valuable for two reasons: 1) to quantitatively test the above assertion that mountain biking constitutes a unique type of disturbance due to the speed and relative silence of the activity thereby resulting in pronounced startle responses by wildlife, and 2) an increase in sound levels of only a few decibels has been shown to cause substantial changes in wildlife response (Grubb et al. 1998).

In an attempt to understand the comparative effects of different types of use, Taylor & Knight (2003) examined the response of bison (*Bison bison*), mule deer (*Odocoileus hemionus*), and pronghorn antelope (*Antilocapra americana*) to hikers and mountain bikers at Antelope Island State Park, Utah, by comparing alert distance, flight distance, and distance moved. The study did not reveal a significant difference between hikers and mountain bikers with respect to the reaction of any of the three species to their presence. A recent study by Naylor & Wisdom (2009), however, produced contrary results, albeit for a different species. In a controlled experiment, the behavioural changes by 13 female elk (*Cervus elaphus*) were monitored in response to four types of recreational disturbance: all-terrain vehicle riding, mountain biking, hiking, and horseback riding. Compared to control periods when elk spent most of their time feeding and resting, travel time increased in response to all recreational disturbance, but decreasing in the order listed above (i.e. ATV use eliciting the greatest increase in travel time, horseback riding eliciting the least). Both mountain biking and hiking activities were found to significantly reduce resting time for elk.

Avian species have been studied extensively regarding their response to recreation and other human disturbance. Miller & Knight (1998) studied responses of multiple species of birds to recreational activities (including mountain biking) along a trail network in Boulder, Colorado. They found that the presence of trails and activity along them (types or intensities of use were not compared) led to an alteration of species composition in both ponderosa pine forest and open mixed grassland ecosystems. Specifically, generalist species such as American Robins (*Turdus migratorius*) were found to be more common along recreational trails. Nests for all species were less likely to occur and more susceptible to predation in areas proximal to trails. In a study conducted in the Black Forest in southwestern Germany (Thiel et al. 2008), Collared Capercaillie (*Tetrao urogallus*) were observed before and during ski season, and were found to experience elevated levels of stress during periods of increased human activity. Blumstein et al. (2005) gathered and analyzed all available data published between 1980 and 2003, and modeled behaviour of 150 avian species in response to disturbance by human recreation (specifically hiking). The model suggests that detection distance is a key factor explaining inter-specific variation in response to human disturbance and that, in general, larger birds detect human presence at greater distance than smaller birds. Whitfield et al. (2008) reviewed the literature for alert distance and flight initiation distance for 26 bird species of interest in Scotland. They found the literature wanting in empirical data to justify the establishment of buffer zones. Although expert opinion may provide the best available information, Whitfield et al. (2008) clearly demonstrate that such information be employed only as "a stopgap until empirical research has been conducted" (p. 2715).

The alteration and fragmentation of habitat that results from construction of linear features like trails and the resulting effect on wildlife that depend on that habitat is a topic of current concern in the literature. The majority of research has been conducted in a site-specific manner and over short periods of time. However, "[n]umerous studies assess the short-term responses of individual

animals to recreational disturbances.... But little is known about whether such disturbances have significant long-term impacts on... wildlife" (Cole 2004, 109). Thiel *et* al. (2008) as discussed above, discovered that Capercaillie abandoned otherwise ideal habitat that was located in areas adjacent to busy ski trails. Preisler *et* al. (2006) studied the response of elk (*Cervus elaphus* L.) to all-terrain vehicle use in a controlled-access area, and found that once displaced from an area by human activity, they habitually avoided those areas regardless of the attractiveness of the habitat within the zone of human influence.

Incidences of direct mountain-bike caused wildlife mortality are rare, the most frequent casualties being insects. Since mortality or injury from collision only becomes a concern with recreational activities that are largely prohibited in National Parks, further discussion of this effect is not warranted.

MOUNTAIN BIKING EFFECTS ON WATER

This review discovered no published research related to the effects of mountain biking on water resources.

Hammitt & Cole (1995) provide a good overview of water quality concerns that relate to outdoor recreation; these include:

- Introduction of pollutants or pathogens through careless disposal of human waste (see also Suk *et* al. 1987).
- Alteration to the nutrient content of water courses and water bodies, resulting in changes to aquatic biota.
- Increased sedimentation and turbidity resulting from activities that occur in or adjacent to water.

Cole and Landres (1996) indicate that "our understanding of recreational impacts on aquatic systems in wilderness is so rudimentary that a simple assessment of the prevalence and intensity of such impacts is a top research priority" (p. 171).

RESULTS AND KNOWLEDGE GAPS

This review of the literature has identified some important gaps in the current state of knowledge regarding the environmental effects associated with mountain biking.

The vast majority of research that has been conducted on this subject addresses the more "traditional" disciplines of mountain biking – that is, cross-country or trail riding. These are activities that occur largely on infrastructure (trails and associated features) that already exist, and that were likely originally developed for some other purpose. The fact that cross-country mountain biking often shares trails with other forms of recreation like hiking and horseback riding facilitates the comparison of these uses and their resulting environmental effects. Although the objective of

this study was to compare documented environmental effects among the different disciplines of mountain biking, such a comparison is currently impossible since there is no scientific literature to support it.

It is important to recognize that any form of recreational activity involves some degree of environmental effect on the soils, vegetation, wildlife and water of the landscape it which it takes place. Some clear conclusions can be drawn from the literature presented in this report:

- The science strongly indicates a curvilinear relationship between use and environmental effects; regardless of the type of activity that occurs, the most detrimental environmental effects (especially to soils and vegetation) occurs when a trail is first constructed.
- Though the effects on soil of wheeled travel are notably different than those of recreationists travelling on feet or hooves, it seems difficult to determine whether one mode of travel is universally more damaging than the other. The amount of erosion, compaction, and sediment damage that occurs is highly variable and depends on:
    - The ecosystem and resulting soil characteristics in which the activity is taking place.
    - The amount of moisture in or on the soil.
    - The steepness of the slope, its orientation in relation to the fall line, and the direction of travel (ascending or descending) of the user.
    - The behaviour of the user (whether or not best practices are known/applied).
    - The design of the trail (including mitigative infrastructure) and the recreational use for which it is intended.
- Effects on vegetation are highly commensurate with effects on soil, and are similarly difficult to assess universally in terms of types of recreation that are comparatively more or less detrimental. Vegetation is removed from a trail as part of its design, and activities that follow trails should not appreciably increase the amount of vegetation that has been removed. Certain invasive species seem to react favourably to the presence of mountain biking, but others prefer the vectors provided by other activities.
- There is support in the literature for the hypothesis that the effects on some species of wildlife are more pronounced with mountain bikes than they are with other forms of recreation (primarily related to the 'sudden encounter' effect), but again these effects are highly dependent on the species being considered and other factors.
- Recreation ecology, similar to other kinds of field ecology, is fraught with the challenges of conducting statistically valid research. "Most studies are deficient in any number of ways: they may be too short in duration, not have adequate controls or replications, be anecdotal in nature, or have too many potentially confounding variables" (Knight and Cole 1995).

Some gaps in the research are also evident from our review of the literature. Some of the most important knowledge gaps include:

- To date, there have been no documented interdisciplinary studies of the environmental effects associated with mountain biking.
- Very little has been studied of the recreational ecology of mountain bikes in the Canadian context. Since many of the environmental effects are known to vary according to regional geophysical traits, applying research carried out in other biomes and landscapes may be problematic.
- No specific research has been published on the water-related environmental effects of mountain biking.
- Some more focused study of the effects of mountain biking on wildlife would be of benefit.
- Existing research focuses mainly on the type of recreational activity with little or no emphasis on the timing, intensity, duration and spatial distribution of the activity.
- There is a tremendous need for research that addresses the cumulative effects of human recreational activity in protected areas. This includes the need to identify thresholds associated with numbers, timing and distribution of use.

DISCUSSION – RESEARCH QUESTIONS, MANAGEMENT IMPLICATIONS

In order to address the knowledge gaps identified in the previous section, we propose some potential questions to be answered by future research.

Since the different disciplines of mountain biking involve different equipment, infrastructure, and terrain, they can be expected to result in differing degrees of environmental effects. Some research questions that may be asked to aid in assessing these differences include:

- What are the effects to soils and vegetation of off-trail riding?
- Given that freeride and downhill bikes are generally heavier but also have larger, lower-volume tires, and also given that freeride and downhill disciplines involve more descending and less climbing, what are the comparative effects on soil erosion of these types of bicycles versus cross-country bicycles?
- Since speed and range of detectability are two main determinants of human-animal conflict, and since freeride and downhill mountain biking potentially involve travelling more quietly and quickly, are there increased risks of conflict associated with these forms of mountain biking over others?
- What are the effects related to construction of mountain biking infrastructure such as log bridges, ramps, and berms? How do the potentially negative effects (removal of vegetation including logs for construction purposes, shifting of soils and vegetation to alter landforms, etc.) weigh against the potential benefits (e.g. bridges elevate cyclists off the ground, reducing potential effects on soil and vegetation)?

With respect to the lack of a Canadian perspective in the current body of knowledge on this subject, obviously a nation-wide systematic study would be impractical. Instead we recommend that managers consider how the Canadian context differs from those of other studies, and consider some site-specific assessment of potential effects.

Similarly, concerns regarding the interaction between mountain bikers and wildlife are difficult to generalize on a national level – potential threats to critical species must be assessed at a local level and on a case-by-case basis. An easily accessible means of reporting human-wildlife interaction might assist in building a longitudinal data set which could be analyzed to identify problem areas and better focus research efforts.

Potential research questions related to effects of mountain biking on water resources might include:

- How do stream crossings by mountain bikes affect water quality, aquatic habitat, etc.?
- Are their additional effects (compared to other recreational activities) from mountain biking associated with stream-side or riparian areas?

The human dimensions research on the subject of the mountain biking community, public perceptions of this culture, and conflict between different user groups is extensive and growing. The results of many surveys (Cessford 2003, Chavez et al. 1993, Janowsky et al. 2003, Mann & Absher 2008, Mason & Leberman 2000) demonstrate a gap between the perception and reality of environmental effects associated with mountain biking, and suggest the need for management of not only the effects but the perception thereof as well.

To further complicate matters, there may be a perception-reality conflict among the mountain biking community as well. Two separate user preference studies (Bowker & English 2002 and Symmonds et al. 2000) reported conflicting results – surveyed mountain bikers reported a preference for technically challenging trails with loose rocks, exposed roots, and rutting, but also stated a preference for minimized environmental degradation. Results such as these suggest that some education on cycling best practices may be needed.

This leads to a grey area between natural and social science in the management of recreation in public spaces – it may be that in order to manage for minimization of negative environmental effects, some social intervention (e.g., education in best practices, user conflict resolution workshops, etc.) is necessary.

Another management concern may be related to designing trails for appropriate use. There are some design practices that make sense for all recreational uses, but others that are more use-specific. We speculate that very few trails in National Parks have been designed specifically with mountain biking and the minimization of associated environmental effects in mind – moreover, the majority of mountain biking currently occurs on old fire roads, hiking, or pack trails. Trail creation, maintenance, modification or access limitation that recognizes the different effects and designs to minimize these effects and promote best practices should be considered (Flickinger 1994). This gives rise to a suite of design-related research questions:

- If we recognize, for example, that erosional effects are most severe when cyclists climb steep hills and hikers descend steep hills, what reductions to erosion can we expect if we limit hiking to trails with minimal steep descents, and cycling to trails with minimal steep climbs?

- Can a reduction in environmental effects be achieved by offering (or mandating) best practice education programs for trail users?
- Do seasonal closures have the potential to reduce environmental effects?
- Can designing trails with mountain biking in mind (e.g., banking corners, surface treatment, minimizing fall line descents, ensuring proper trail drainage, etc.) tangibly reduce environmental damage?

There is potential to use spatially explicit modeling techniques to evaluate the potential benefits of these types of management practices (e.g. Itami et al. 2003).

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APPENDIX A - ANNOTATED BIBLIOGRAPHY

References are categorized by broad subject area. Grey text denotes grey literature sources. Annotations focus on any information that documents contain relating to ecological impacts.

Case Studies – Ecological

Bjorkman, Alan Wayne. 1998. Biophysical Impacts on and User Interactions with Mountain Bicycle Off-Road Corridors. PhD Thesis. University of Wisconsin – Madison.

A study of ecological impacts (focusing on soil and vegetation) of mountain bike trail use in the Kettle Moraine State Forest in southeastern Wisconsin. Bjorkman found that slope, shade and type surface treatment (and interestingly not intensity of use) were the strongest factors determining width of trampled vegetation. The dissertation also includes a sociography of MTB trail users, providing insight into the efficacy of different potential mitigative approaches.

Callahan, Joshua. 2008. Erosion and Trail Building: A Case Study of the East Tennessee State University Trail System. MSc Thesis. East Tennessee State University.

A study of the erosion associated with increased MTB use on a multi-use trail system at East Tennesse State University in Johnson City, Tennessee. More of a literature review with subsequent recommendations than a focused research project – no data collected on rates of erosion on ETSU trail network.

Cessford, Gordon R. 1995. Off-Road Impacts of Mountain Bikes – A Review and Discussion. New Zealand Department of Conservation. Science and Research Series, no.92. 41pp.

A comprehensive (current to 1995) review of existing literature on ecological and sociological impacts related to mountain bike trail use. Author asserts that there is a gap between perception and reality when it comes to impacts of mountain biking as compared to other activities.

Chiu, Luke, & Lorne Kriwoken. 2003. Managing Recreational Mountain Biking in Wellington Park, Tasmania, Australia. Annals of Leisure Research vol.6 no.4, pp.339-361.

This paper includes both a literature review of ecological and sociological impacts of MTB use, and also a focused study designed to determine the specific impacts of MTB use in Wellington Park. Specifically looks at comparing impacts related to MTB versus other uses. Ecological study addresses impact on soil impaction and erosion, with six main hypotheses (listed on p.349) related to trail site characteristics. Data collection was through a linear elevation measuring instrument. Sociological data gathered through a trail user survey.

Davies, Claire, & David Newsome. 2009. Mountain Bike Activity in Natural Areas: Impacts, Assessment and Implications for Management – A Case Study from John Forrest National Park, Western Australia. CRC for Sustainable Tourism Pty, Australia.

Literature Review on the impacts of MTB use, both ecological and sociological. Ecological impacts seem to focus on trail erosion. Aside from general impact assessment from literature review, includes a biophysical assessment of soil alteration/damage within John Forrest National Park near Perth Australia – use of GPS to map and enumerate informal trail network, constructed features, etc. Differentiates between different 5 types of MTB users. Also contains a section on proposed management strategies to mitigate against trail erosion/degradation.

Ferguson, Krystyn. June 2008. The Destructive Impact of Mountain Biking on Forested Landscapes. The Environmentalist vol.28 no.2, pp.67-68.

An editorial, written by a restoration ecology student, describing observed detrimental impacts of freeride MTB use on soils and native vegetation in the Natchez Hills forest tract near Kitchener, Ontario. Not a scientific study so much as an anecdotal editorial based on personal experience and observation.

Goeft, Ute, & Jackie Alder. 2001. Sustainable Mountain Biking: A Case Study from the Southwest of Western Australia. Journal of Sustainable Tourism vol.9 no.3, pp.193-211.

The authors report on a two-pronged study assessing mountain bike use in southwestern Australia. The first study focused on determining ecological impacts (soil and vegetation) through a systematic survey; the second assessed sociological impacts through a rider survey. The physical study assessed soil erosion and compaction as well as vegetation composition and removal (trail widening) on sample plots along both new and old trails with both open and limited access. Study results suggest suggest that trail erosion rates are determined by seasonality, slope, and age of trail.

Herrero, Jake, & Stephen Herrero. 2000. Management Options for the Moraine Lake Highline Trail: Grizzly Bears and Cyclists. Parks Canada.

A study of the reported incidences of bear-human conflicts along the Moraine Lake Highline Trail near Lake Louise in Banff National Park. The authors found that, though intensity of use is much lower for mountain bikers than for hikers along this trail, mountain bikers accounted for a disproportionately high incidence of conflict with grizzly bears. Furthermore, mountain bikers are more likely to be attacked, since they travel more swiftly and silently and are hence more likely to surprise a bear (bears demonstrate a greater propensity to attack when they first become aware of human presence at a distance of less than 50m).

Lathrop, Jason. 2003. Ecological Impacts of Mountain Biking: A Critical Literature Review. Wildlands CPR Report. 11pp.

An assessment of current (2003) literature on the ecological impacts of mountain biking, in terms of trampling (effects on vegetation), erosion (effects on soils), and wildlife disturbance. His is not a peer-reviewed article and the author appears to have an anti-MTB prejudice. Conclusions are that there is little documented difference in impact on vegetation between hiking and MTB use, that there is support for the generic "curvilinear response" of soils (most of the damage occurring during of immediately following construction) to trail construction and use, that soil damage may be less significant with wheeled use than with foot-based activities, and that though there is an intuitive

increase in human-wildlife conflict potential with mountain biking versus other activities, this has not been studied extensively.

Marion, Jeff, & Jeremy Wimpey. 2007. Environmental Impacts of Mountain Biking: Science Review and Best Practices. In Managing Mountain Biking: IMBA's Guide to Providing Great Riding.

A literature review of ecological effects associated with mountain biking, subdivided into impacts on vegetation, soil, water and wildlife. The review lists general recreation ecology studies as well as MTB-specific and comparative studies, and also suggests mitigative management practices that could serve to minimize disturbance by mountain bikers. The authors conclude that careful management of mountain biking and other recreation (designation of specific trails for specific uses, use-specific and ecologically conscientious trail design, user education, seasonal closures, etc.) can effectively minimize the environmental impacts associated with mountain bike use. IMBA endorsement suggests potential for some prejudice.

Marion, Jeffrey L., & Nate Olive. 2006. Assessing and Understanding Trail Degradation: Results from Big South Fork National River and Recreation Area. USGS Patuxent Wildlife Research Center/National Park Service Research Report. 84pp.

This paper documents a ecological impact study that was conducted on a multi-use trail network in Big South Fork National River and Recreation Area, located on the Cumberalnd Plateau in Kentucky and Tennessee. The author includes a literature review and description of the research project, it's findings, and some management recommendations. 24% of the trail network was sampled, stratified by use (hiking, mountain biking, OHV, horseback riding, and mixed use trails. Data was collected related to soil erosion, exposure of roots, widening/re-routing of trails (secondary tracks), wet (muddy) soil, and running water on trails. Site characteristics such as vegetation type, topography, soils, and infrastructure were also recorded. Of all use types, bike trails were found to be the narrowest, to have the least amount of soil loss, and to have the least (0) incidence of running water on the trails.

Miller, Scott G., & Richard L. Knight. 1998. Influence of Recreational Trails on Breeding Bird Communities. Department of Fishery and Wildlife Biology, Colorado State University. 31pp.

The influence of proximity recreational trails on behavioural ecology of breeding birds was examined in two ecosystems (ponderosa pine forest containing 29 bird species, and mixed-grass prairie containing 13 bird species)in Boulder, Colorado. The authors found that the presence of trails led to an alteration of species composition in both ecosystems, favouring an increase in generalist avian species. In grassland areas, birds were less likely to nest near trails; in both ecosystems the presence of trails was found to result in an increased rate of nest predation. Though mountain bike use is not assessed independent of other uses, it is one of the documented uses on the trail network.

Morlock, Phil, Dave D. White, Don Applegate, & Pam Foti. 2006. Planning & Managing Environmentally Friendly Mountain Bike Trails – Ecological Impacts – Managing for Future Generations – Resources. 59pp.

A guide to trail construction and maintenance that considers environmental impacts. Ecological/ biophysical impacts are assessed both generally through a literature review, and specifically through three separate studies conducted in the southwestern US (collectively referred to as the Southwest Mountain Bike Study). In the first study, biophysical characteristics of 31 MTB trails were assessed. The trails were located in 5 distinct ecological regions, and the authors emphasize the need to compare ecological impact studies within Common Ecological Regions (CERs). The second study assesses the effectiveness of a management policy implemented in the Lake Tahoe Basin. The third study examined the pre- and post-race ecological conditions of the site of an annual MTB race in Arizona. Main conclusions of the report are that mountain biking has an ecological impact, but that this impact is mitigable with proper trail design, trail use, and management; that impacts of mountain bike use must be assessed within CERs; and that more empirical studies are required in order to determine the impacts and suggested management strategies within different ecoregions.

Naylor, Leslie M., Michael J. Wisdom, & Robert G. Anthony. 2009. Behavioural Responses of North American Elk to Recreational Activity. Journal of Wildlife Management, vol.73 no.3, pp.328-338.

The authors assess the behavioral changes demonstrated by 13 female elk (*Cervus elaphus*) in response to four types of recreational disturbance: all-terrain vehicle riding, mountain biking, hiking, and horseback riding. Compared to control periods when elk spent most of their time feeding and resting, travel time increased in response to all recreational disturbance, but decreasing in the order listed above. Observed increases were highest during mornings. Both mountain biking and hiking are demonstrated to reduce resting time for elk. Study area is Starkey Experimental Forest and Range in northeast Oregon.

Newsome, David and Claire Davies. 2009. A case study in estimating the area of informal trail development and associated impacts caused by mountain bike activity in John Forrest National Park, Western Australia. Journal of Ecotourism 8(3):237-253.

The authors develop and test a rapid assessment tool for evaluating the effects of mountain biking in natural areas. The emphasis is on the spatial identification of new trails and modifications to existing trails.

Pickering, Catherine Marina, Wendy Hill, David Newsome, & Yu-Fai Leung. 2010. Comparing Hiking, Mountain Biking, and Horse Riding Impacts on Vegetation and Soils in Australia and the United States of America. Journal of Environmental Management 91(3):551-562.

A systematic, comprehensive review of all known empirical studies from the US and Australia that have sought to identify and/or compare the effects of hiking, mountain biking, and horseback riding on soils and vegetation. A very good and current synopsis of known literature related to soils and vegetation recreation ecology. Impacts associated with each type of use are described individually, and there is also a section describing the findings of comparative, cross-use studies.

Pickering, Catherine Marina, & Wendy Hill. 2007. Impacts of Recreation and Tourism on Plant Biodiversity and Vegetation in Protected Areas in Australia. Journal of Environmental Management, vol.85, pp.791-800.

A systematic literature review of the ecological impacts of outdoor recreation in Autralia, specifically related to vegetation. Along with denudation of landscapes, the research also points to indirect impacts such as addition of nutrients (human waste), creation of vectors for invasive plants, and the introduction of pathogens (e.g. root rot). The authors point to one study that showed a higher degree of erosion attributed to mountain bikes than to high-use hiking trails. Mostly a general treatment of recreation ecology, but some comparative or single-use research is cited.

Preisler, Haiganoush K., Alan A. Ager, & Michael J. Wisdom. 2006. Statistical Methods for Analysing Responses of Wildlife to Human Disturbance. Journal of Applied Ecology, vol. 43, pp.164-172.

A controlled study of the response of Rocky Mountain elk (*Cervus elaphus* L.) to all-terrain vehicle use along a 32km trail inside a 1453ha elk enclosure. Human movement was recorded using GPS, and elk movement was recorded by telemetry. The methods used suggest that elk respond (with flight/avoidance) to human presence upwards of 1km distant. Furthermore, elk displayed avoidance of the trail even when no ATVs were present.

Schmor, Mathew Robert. 1999. An exploration into bear deterrents, as related to mountain biking, and the design of an ultrasonic bear warning device. Masters Degree Project, Faculty of Environmental Design, University of Calgary.

A masters degree projected conducted to evaluate the noise produced by mountain biking. This is one of the only studies to quantitatively assess the sounds produced by mountain biking. The author tests the effectiveness of bear bells and concludes that they are ineffective in providing adequate warning to bears on trails. A design for an ultrasonic warning device is developed, but not tested.

Simic, Jovan. 2007. Moraine Lake – 2007 Group Access Study: Visitor Experience, Compliance and Awareness. Parks Canada. 15pp.

Partly as a result of Herrero and Herrero's research (see above), Banff National Park implemented a minimum group size of six (subsequently reduced to four) in the Moraine Lake area of Banff National Park. The author finds that a reduction in minimum group size from six to four increased both compliance and visitor satisfaction, while keeping incidence of human-bear conflicts well below historical levels.

Sprung, Gary. 2004. Natural Resource Impacts of Mountain Biking – A Summary of Scientific Studies that Compare Mountain Biking to Other Forms of Trail Travel. In Trail Solutions: IMBA's Guide to Building Sweet Singletrack.

An annotated bibliography or research on the ecological impacts of mountain biking. The author clearly displays some pro-bike prejudice in the discussion sections, but regardless there are some good resources cited, especially regarding impacts on wildlife.

Taylor, Audrey R., & Richard L. Knight. 2003.Wildlife Responses to Recreation and Associated Visitor Perceptions. Ecological Applications, vol.13 no.4, pp951-963.

An attempt to address the gap in knowledge regarding the response of wildlife to mountain bike use as compared to other types of recreation. The study examined the response of bison (*Bison bison*), mule deer (*Odocoileus hemionus*), and pronghorn antelope (*Antilocapra americana*) to hikers and mountain bikers at Antelope Island State Park, Utah, by comparing alert distance, flight distance, and distance moved. The study did not reveal a significant difference between hikers and mountain bikers with respect to the reaction of any of the three species to their presence. The zone of human influence within the study area constituted 7% of the total area of the island. The study also surveyed recreational users to determine their perceived impact on wildlife, and found a strong propensity for users to blame other user groups for having a greater impact on wildlife.

Thiel, Dominik, Susanne Jenni-Eiermann, Veronika Braunisch, Rupert Palme, & Lukas Jenni. 2008. Ski Tourism Effects Habitat Use and Evokes a Physiological Stress Response in Capercaille *Tetrao urogallus*: A New Methodological Approach. Journal of Applied Ecology, vol.45, pp.845-853.

The authors radio-tracked and collected fecal samples of capercaille in the Black Forest of Germany, and compared levels of corticosterone metabolites (indicators of stress) detected in feces before and during ski season. The results indicate that increased intensity of use is a stressor to capercaille; other research indicated that the birds avoided high-intensity human use areas that were otherwise ideal habitat.

Thurston, Eden, & Richard J Reader. 2001. Impacts of Experimentally Applied Mountain Biking and Hiking on Vegetation and Soil of a Deciduous Forest. Environmental Management, vol.27 no.3, pp.397-409.

The authors constructed an experiment wherein mountain biking and hiking were applied to adjacent, previously undisturbed sample plots in Boyne Valley Provincial Park in southern Ontario. Uses were systematically applied at five different intensities, and changes in plant stem density, species richness, and soil exposure were recorded before, shortly after, and a year after treatment. The findings support the well-documented curvilinear response of soil and vegetation to disturbance, and found little appreciable difference in the measured characteristics to the two different types of recreational use. In general, recreational use of deciduous understory resulted in 100% removal of vegetation, and up to 54% increase in exposed soil.

Thurston, Eden. 1998. An Experimental Examination of the Impacts of Hiking and Mountain Biking on Deciduous Forest Vegetation and Soil. PhD Thesis, University of Guelph. 150pp.

The PhD dissertation from which the previous citation originated. Aside from the research described above, the author also measured changes in soil impaction (trail depth), and found no appreciable difference between mountain bike and hiking applications, and indeed very little change in trail depth for the different intensities of use applied in the study.

White, Dave D., M. Troy Waskey, Grant P. Brodehl, & Pamela E. Foti. 2006. A Comparitive Study of Impacts to Mountain Bike Trails in Five Common Ecological Regions of the Southwestern U.S. Journal of Park and Recreation Administration, vol.24 no.2, pp.21-41.

A peer-reviewed article on the Southwest Mountain Bike Study described in the IMBA trail guide – see Morlock et al citation above. Analysis was done on soil erosion characteristics (trail incision (depth) and width) at sample plots on 163 miles of MTB trails over 5 distinct ecological regions in the southwestern US. The authors found that degree of erosion varied between ecological region and attributed this variability to characteristics of soil and vegetation typical to the local landscape. Soil erosion increased with steeper slopes for all ecoregions studied. Intensity/level of use was neither accounted nor controlled for in the study.

Wilson, John P., & Joseph P. Seney. 1994. Erosional Impact of Hikers, Horses, Motorcycles, and Off-Road Bicycles on Mountain Trails in Montana. Mountain Research and Development, vol.14 no.1, pp.77-88.

A systematic study that compared the erosive (water runoff and sediment yield) impacts associated with hiking, horseback riding, motorcycles, and mountain bikes at 108 sample plots along a trail network in Gallatin National Forest, Montana. The main findings of this study suggest that foot-powered use (horses and hikers) create more erosive potential than wheeled forms of recreation.

Case Studies – Sociological

Bowker, JM and Donald BK English. 2002. Mountain Biking at Tsali: An Assessment of Users, Preferences, Conflicts, and Management Alternatives. USDA Forest Service, Athens, GA.

The authors, Social Scientist for the USDA Forest Service, report on the results of a 13-month survey of MTB trail users in the Tsali Recreation Area in western North Carolina's Nantahala National Forest. Findings focus on the demographics, behavior, trip profile, and attitude towards user fees. Some brief mention (pp.10-11) of ecology-related trail management (horse/bike rotation, trail surfacing, etc.). Survey questionnaires included as Appendix.

Cessford, Gordon. 2003. Perception and Reality of Conflict: Walkers and Mountain Bikes on the Queen Charlotte Track in New Zealand. Journal for Nature Conservation, vol.11, pp.310-316.

Also in Cessford, Gordon R. 2002. Perception and Reality of Conflict: Walkers and Mountain Bikes on the Queen Charlotte Track in New Zealand. In Arnberger, A.,C. Brandenburg, & A. Muhar (eds.). Monitoring and Management of Visitor Flows in Recreational and Protected Areas; Proceedings of the Conference held at Bodenkultur University, Vienna. pp.102-108.

Following a brief review of the study of ecological and sociological impacts related to mountain biking, the author reports results of a survey of 370 hikers on a trail in New Zealand that had recently been opened to cyclists. A distinct difference was noted between the opinions of hikers who had actually encountered a mountain biker (generally positive towards bikes and cyclists) and those who had not (generally more negative).

Chavez, Deborah J., Patricia L. Winter, & John M. Baas. 1993. Recreational Mountain Biking: A Management Perspective. Journal of Park and Recreation Administration vol.11 no.3, pp.29-36.

Results of a survey of 40 recreational managers from the USDA Forest Service and the USDI Bureau of Land Management. The survey focused on intensity of use and inter-use conflict, but also recorded qualitative information on trail degradation related to mountain bike use.

Janowsky, Dagmar V., & Gero Becker. 2003. Characteristics and Needs of Different User Groups in the Urban Forest of Stuttgart. Journal for Nature Conservation, vol.11, pp.251-259.

A combination of video capturing, expert interviews, and GIS modeling was used to profile different user groups of an urban forest in Stuttgart, Germany, and to identify times and places with the highest potential for user conflict. Optimal solutions also sought to minimize environmental damage from human activity.

Mann, Carsten, & James D. Absher. 2008. Recreation Conflict Potential and Management Implications in the Northern/Central Black Forest nature Park. Journal of Environmental Planning and Management vol.51 no.3, pp.363-380.

A quantitative study that assesses conflict in recreational use by six different user groups in the Black Forest Nature Park in southwest Germany. Results from hikers and mountain bikers are analyzed and compared in depth. The results elucidate some of the general cultural differences between "nature-oriented" recreationists (hikers), and "activity-oriented" recreationists (mountain bikers), and how each perceives infrastructural and social conflicts.

Mason, Peter, & Sarah Leberman. 2000. Local Planning for Recreation and Tourism: A Case Study of Mountain Biking from New Zealand's Manawatu Region. Journal of Sustainable Tourism, vol.6 no.2, pp.97-115.

User surveys and use monitoring are employed to assist in the identification of MTB rider preference (terrain, duration of trip, etc.) and potential user conflict. An iterative approach to planning mountain bike use in the Manawatu region of New Zealand is favourably compared to the reactive, *ad hoc* approach that has been used more commonly in the past.

Mosedale, Jan. 2003. Planning for Appropriate Recreation Activities in Mountain Environments: Mountain Biking in the Canadian Rocky Mountains. York University, Faculty of Environmental Studies Outstanding Graduate Student Paper Series, vol.7 no.5. 114pp.

A review of the literature on ecological and social impacts associated with mountain biking. The author assesses the current state of MTB activity in multiple areas (under different jurisdiction/management) along the Rocky Mountains from Edson Alberta south to Fernie BC. Best management practices are proposed and discussed.

Naber, Michael David. 2008. Integrating Trail Condition Assessment with Recreational Demand Modeling of Mountain Bikers in the Research Triangle, North Carolina. PhD Thesis. North Carolina State University. 119pp.

Solidly in the gray area between sociological and ecological aspects of recreation study, the author models demand for mountain biking (recreation demand) on six trails in North Carolina, using variables related to trail challenge (level of difficulty), degree of environmental degradation (erosion, exposed roots, trail surface material, landform, etc. - variables mostly related to soils and

vegetation), and extent of development of associated facilities/infrastructure. Condition of trails was measured systematically. The findings of this study suggest that mountain bikers exhibit a strong preference for trails that are technically challenging, that have well-developed facilities, and that have a minimal amount of environmental damage.

Symmonds, Mathew C., William E. Hammitt, & Virgil L, Quisinberry. Managing Recreational Trail Environments for Mountain Bike User Preferences. Environmental Management, vol.25 no.5, pp.549-564.

An online survey was conducted in order to determine preferences of mountain bikers related to environmental and landscape characteristics of trails (e.g. soil erosion and management thereof). The survey was administered globally, with most responses coming from the US, UK, Australia and New Zealand. Water bars were found to be a preferred erosion control technique, though many respondents demonstrated a preference for heavily eroded (rooty, rocky, gullied) terrain.

Modeling Tools for Recreation Ecology

Bennett, Victoria J., Matthew Beard, Patrick A. Zollner, Esteban Fernandez-Juricic, Lynne Westphal, & Cherie LeBlanc. 2008. Understanding wildlife responses to human disturbance through simulation modeling: A management tool. Ecological Complexity (2008), doi:10.1016/j.ecocom.2008.08.002.

An illustration of the use of a spatially explicit modeling tool called SODA (Simulation of Disturbance Activities), using two case studies. SODA focuses on modeling the ecological impacts of disturbance (recreational use) related to wildlife ecology and habitat. Parameterization of the model allows for consideration of different types of recreation. Some cited references may be valuable for better understanding of recreation ecology.

Cole, David N., & Terry C. Daniel. 2003. The Science of Visitor Management in Parks and Protected Areas: From Verbal Reports to Simulation Models. Journal for Nature Conservation, vol.11, pp.269-277.

A study on the evolving science of monitoring type and intensity of human recreational use in wilderness areas. The authors argue that traditional surveying methods do not provide an accurate assessment of human recreation patterns, and that a more robust and defensible approach is required. To this end they propose the use of travel simulation modeling approaches (e.g. Extend).

Itami, Robert, Rob Raulings, Glen MacLaren, Kathleen Hirst, Randy Gimblett, Dino Zanon, & Peter Chladek. 2003. RBSim 2: Simulating Complex Interactions Between Human Movement and the Outdoor Recreation Environment. Journal for Nature Conservation, vol.11, pp.278-286.

Introduction to a human recreational behaviour simulation modeling application, RBSim 2. The application allows for the spatially explicit assessment of changes to use, behaviour, and environmental impacts that could be expected to result from hypothetical changes to trails (or other linear features) and associated infrastructure.

General Recreation Ecology – Not Mountain-Bike-Specific

Bath, Alistair J., & Jody W. Enck. 2003. Wildlife-Human Interactions in National Parks in Canada and the USA. Social Science Research Review, vol.4 no.1, 32pp.

A literature review that identifies the principle concerns and issues related to human-wildlife interaction within national parks. Though a good general overview of the issues, there is no specific mention of mountain biking, or comparison of the nature of human-wildlife conflict for cyclists as compared to other uses.

Blumstein, Daniel T., Esteban Fernandez-Juricic, Patrick A. Zollner, & Susan C. Garity. 2005. Inter-specific Variation in Avian Response to Human Disturbance. Journal of Applied Ecology, vol.42, pp.943-953.

Using recorded data published between 1980 and 2003, the authors modeled behaviour of 150 avian species in response to human disturbance. The model suggests that detection distance is a key factor explaining inter-specific variation in response to human disturbance, and that in general, larger birds detect human presence at greater distance than smaller birds. Certain fitness-related factors (e.g. quantity of food consumed) were found to be sensitive to detection distance, suggesting the need for consideration of impacts on avian species when managing human activity within their habitat.

Crealock, Anne G. 2002. The Role of Trails and Trail-Users in the Spread of Non-Native Plants. MSc Thesis, San Jose State University.

Thesis that examines the role of human use trails as both habitat and vectors for spread of invasive plant species. Studies are conducted in field and simulated situations that compare different types of trail use, and conclude that non-native invasion is facilitated by all types of recreation, and that different invasive species respond differently to different types/levels of use.

Hadwen, Wade L., Wendy Hill, & Catherine M. Pickering. 2007. Icons Under Threat: Why Monitoring Visitors and Their Ecological Impacts in Protected Areas Matters. Ecological Management & Restoration, vol.8 no.3, pp.177-181.

The authors point to the threats of overuse at "icon sites" due to increased levels of human recreational activity. They suggest current methods of collection and reporting of visitor data are inadequate to answer important questions related to ecological impact and carrying capacity, and make the case for more proactive, targeted visitor impact monitoring.

Hebblewhite, Mark, & Evelyn Merrill. 2008. Modelling Wildlife-Human Relationships for Social Species with Mixed-Effects Resource Selection Models. Journal of Applied Ecology, vol.45, pp.834-844

A resource selection function (RSF) model is applied to demonstrate that behaviour of wolves (*Canis lupus*) changes with proximity to human activity, and that different packs of wolves exhibit different behaviour. Specifically, the authors report that in areas of elevated human activity, wolves selected areas closer to humans (though they avoided humans during daylight).

Knight, Richard L., & Kevin G. Gutzwiller, Eds. 1995. Wildlife and Recreationists: Coexistence Through Management and Research. Island Press. 372pp.

A book dedicated to describing the current (1995) state of knowledge in the field of wildlife recreation ecology. Sections on general theory, specific case studies and examples, and management implications are included. Very little specific reference to mountain biking and its impacts on wildlife.

Liddle, Michael. 1997. Recreation Ecology: The Ecological Impact of Outdoor Recreation and Ecotourism. Chapman & Hall. 639pp.

The standard recreation ecology textbook, and a good overview of the theory and underlying principles of recreation ecology.

Marion, Jeffrey L. 1998. Recreation Ecology Research Findings: Implications for Wilderness and Park Managers. USGS Patuxent Wildlife Research Center. 6pp.

A brief summary of recreation ecology, including recommended further reading. Focus of section on environmental impacts is on soils and vegetation.

Sun, D., & D. Walsh. 1998. Review of Studies on Environmental Impacts of Recreation and Tourism in Australia. Journal of Environmental Management, vol.53, pp.323-338.

A review of literature related to the ecological impacts of Australian recreation and tourism, with a focus on vegetation and soils. Some inter-use comparison is attempted, but more informative cross-use assessments can be found in other literature reviews cited herein.

Tempel, Douglas, Vita Wright, Janet Neilson, & Tammy Mildenstein. 2008. Linking Wilderness Research and Management – vol.5. Understanding and Managing Backcountry Recreation Impacts on Terrestrial Wildlife – An Annotated Reading List. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO. 70pp.

An extensive annotated reading list of impacts of backcountry recreation on wildlife behavior and habitat. Subsections include general concepts, specific examples, management policies and practices, and other resources. No specific mention or citation of research related to mountain biking.

Wagar, Alan. 1964. The Carrying Capacity of Wild Lands for Recreation. Forest Science, Monograph 7. Society of American Foresters. 31pp.

Mostly of archival interest, Wagar attempts to lay some foundation for the future consideration of ecological carrying capacity when managing for recreational use of public wilderness. Even in 1964 it was clear that both ecological and social costs and benefits need to be considered by land managers.

Maintenance Practices and Costs of Rail-Trails

rails-to-trails conservancy

CONTENTS

Wallkill Valley Rail Trail, NY.

Rails-to-Trails Conservancy serves as the national voice for more than 160,000 members and supporters, 30,000 miles of rail-trails and multiuse trails, and more than 8,000 miles of potential trails waiting to be built, with a goal of creating more walkable, bikeable communities in America. Since 1986, we have worked from coast to coast, supporting the development of thousands of miles of rail-trails for millions to explore and enjoy.

Rails-to-Trails Conservancy

Northeast Regional Office
2133 Market Street, Suite 222
Camp Hill, PA 17011
Tel 717.238.1717 / Fax 717.238.7566

National Headquarters
2121 Ward Court, NW, 5th Floor
Washington, D.C. 20037
Tel 202.331.9696 / Fax 202.223.9257

railstotrails.org
TrailLink.com

ACKNOWLEDGMENTS

Produced by Rails-to-Trails Conservancy

Carl Knoch
Tom Sexton

June 2015

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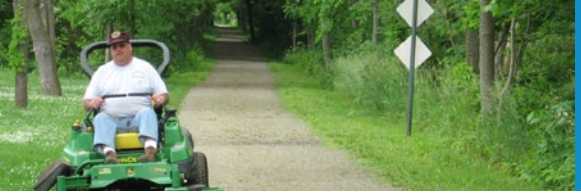
This study was made possible by the generous support of the Pennsylvania Department of Conservation and Natural Resources, Bureau of Recreation, Community and Conservation Partnership Program.

Allegheny River Trail, PA.



EXECUTIVE SUMMARY

For the past three decades of rail-trail development, maintenance costs have generally been seen as being expensive. These expenses, however, have remained largely untracked on a state or national basis. Further, a comprehensive breakdown and ranking of maintenance priorities did not exist.

To better understand this issue, RTC conducted a comprehensive survey of trail maintenance costs. Results of this study show that, contrary to popular belief, maintenance costs are not as high as many perceive them to be. In fact, when taking into account for volunteers, this study found that maintenance costs on average range from $500 to $1,000 per trail mile per year depending on surface.

St. John Valley Heritage Trail, ME.

In the 10 years that RTC's Northeast Regional Office has tracked technical inquiries, there has been a steady decline in the number of maintenance-related request. There are likely several reasons for this decline. Rail-trail managers and others share maintenance methods through a variety of networks, in addition to providing direct assistance to one another. Earlier documents on maintenance best management practices have also likely been helpful. In addition, many individual trails have been combined into larger systems, thus creating economies of scale. Volunteer programs also have grown in size and dependability and have taken on more responsibility.

Finally, it is evident that maintenance also has been deferred.

Therefore, it is possible that although maintenance costs have declined over time, perception of those costs has remained the same.

Trail managers and local stakeholders often cite the need for dedicated state or federal funding to help pay for trail maintenance. Up to this point, RTC has lacked sufficient data to make that case effectively to decision-makers at the state or federal level. This study was initiated to bring some clarity to this issue. Whether in a town hall meeting or a discussion with a member of Congress about the reauthorization of federal funding, more accuracy regarding rail-trail maintenance costs is required.

Because funding for rail-trails is difficult to secure, over-estimating maintenance costs can inadvertently give opponents easy leverage to speak against rail-trail development. In addition, funders often question if all aspects of any community development project should be funded by state and federal grants, particularly maintenance-related costs, which are often perceived as a "local issue."

This study presents a more comprehensive understanding of rail-trail maintenance, as has been done for other rail-trail issues such as construction costs, economic impact and rails-with-trails. Such an approach enables the rail-trail community to focus its limited resources more effectively on addressing the most critical issues.

This publication is the third in a series of similar works prepared by the RTC Northeast Regional Office. The first was released in 1996 in collaboration with a U.S. Department of Agriculture AmeriCorps staff member based in Fayette County, Pennsylvania. The second was released in 2005 and, as with this document, was made possible through a Growing Greener grant from the Commonwealth of Pennsylvania, Department of Conservation and Natural Resources, Bureau of Recreation and Conservation.

Each successive study has grown in size and scope and, ideally, usefulness. The 1996 study contained 40 questions and received responses from 60 rail-trail managers. The 2005 study expanded to 70 questions and 100 respondents. This latest version asked 117 questions and drew answers from 200 respondents.

Of all the 2014 participants, 37 percent represented rural rail-trails, 14 percent urban, 13 percent suburban and 36 percent mixed. The mixed category contained primarily a rural/suburban combination.

In addition to identifying the types and frequency of maintenance tasks, this study sought for the first time to secure data on the cost of rail-trail maintenance. Almost 50 percent of the 200 trail managers provided a total maintenance cost, though far fewer had an actual budget. With the help of several veteran trail managers, RTC went a step further and prepared an additional 44-question survey that broke down the cost of each task. Only 25 managers completed this survey, and many of these required repeated follow-up by e-mail and phone.

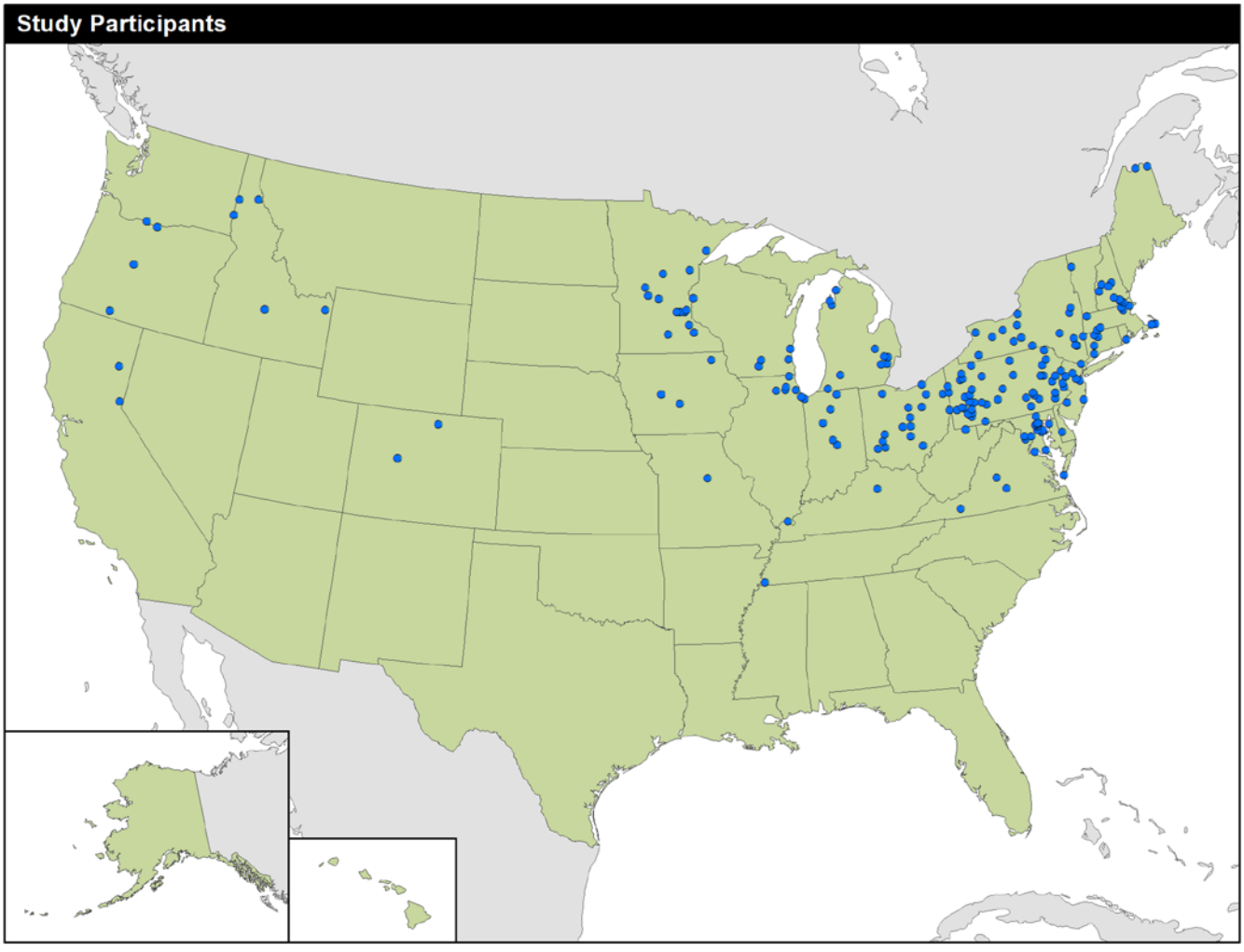


Figure 1. Map of Trail Groups Participating in Study

State and county managers said that it was too difficult to separate these costs from larger existing budgets. Small entities and private nonprofits said they simply did not have the capacity to track these figures.

If the need for maintenance funding is so critical, however, it would stand to reason that this data would be more available or that completion of the questionnaire would have greater value. This research indicates that the more likely explanation for why these costs are not tracked more rigorously is that rail-trails do not require as much maintenance as some fear or promote. This finding is critical in the ongoing case for funding support for rail-trails.

Snow covered bridge on the Piscataquog Trail in NH.

METHODOLOGY

The comparisons illustrated in this study are mostly between the 2005 and 2014 findings. The 1996 study contained too many "check all that apply" questions, which resulted in multiple answers and thus participation greater than 100 percent; comparison of the latter two studies was more reliable, as the answers in each added up to 100 percent. Further, not all the same trails were surveyed in the three studies. Unfortunately, only including those trails that participated in all three studies would have yielded too low a number to be significant.

The 2014 study began with a review of the earlier studies to determine which topics required updating. Our technical assistance team provided additional insights of the questions they typically are asked. We then did a review to determine what, if any, recent literature addressed the topics of trail maintenance activities and associated cost.

We then developed a survey instrument that would collect as much information as possible regarding the most important topics. During this process, we realized that there were different sets of questions for different trail surface types. This increased the number of questions in the survey to an overwhelming 195, which could prove prohibitive to trail managers.

This potential problem was solved by the decision to create the cost survey in Survey Monkey. Using this vehicle, we could provide trail managers with a link to the online survey, and they could take the survey at their convenience. This also enabled us reduce the number of questions by utilizing the skip logic in Survey Monkey, the manager of an asphalt-surfaced trail, for example, could "skip" all of the questions not applicable to their surface type.

To make comparisons across the trails, we limited our query to states with four seasons. We did not send invitations to trail managers in the southern tier of states.

Links to the online survey were sent to approximately 300 trail management organizations contained in RTC's national trails database as of January 6, 2014. Reminders to participate were sent to those organizations that did not immediately respond.

Of the responding trail management organizations, 95 indicated that they had a trail maintenance budget. A follow-up survey to gather more detailed maintenance cost information was sent to these 95 organizations. This was not an online survey but a Microsoft Excel spreadsheet, with 48 maintenance tasks as rows. Columns captured labor hours, hourly labor cost, volunteer hours, equipment costs, material costs, contracted services and total cost.

Many follow-up emails, phone calls and personal pleas were made over several months to encourage participation in this phase of the study.

Trail side mowing along the Perkiomen Tail in PA.

MAJOR MAINTENANCE TASKS

The 2005 study indicated that trail group volunteers performed maintenance tasks on 46 percent of the survey trails. In the 2014 study, this percentage increased to 58 percent. Municipal government was the second most cited entity for performing maintenance tasks after trail-group volunteers, at 32 percent in 2005 and jumping to 43 percent in 2014. The percent of municipal governments owning trails remained nearly the same in the two studies, at 30 percent and 34 percent in 2005 and 2014, respectively.

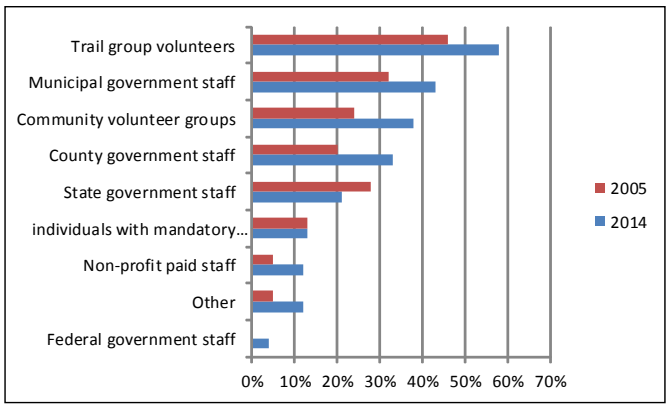


Figure 2. Who Performs Maintenance (2014 Survey)

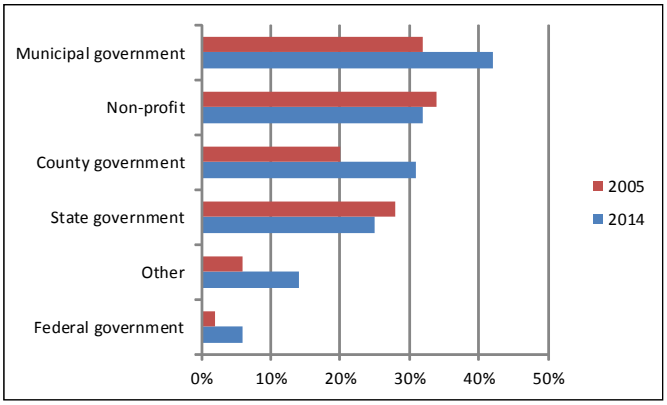


Figure 3. Trail Maintenance Funders (2014 Survey)

Administration

Written trail maintenance plan

We were surprised that 60 percent of the responding trail managers indicated they do not have a written trail maintenance plan. A written maintenance plan will save time and money and contribute to a better experience for trail users.

Funding trail maintenance

In the 2014 survey, municipal government was the leading funder of trail maintenance, mentioned by 42 percent of respondents. This is a significant increase from the 2005 maintenance study, when 26 percent mentioned municipal government funding. Funding by a nonprofit fell slightly from 34 percent in 2005 to 32 percent in 2014.

Of the trail managers who indicated that they had a budget specifically for trail maintenance, the figures for that budget ranged from less than $500 to more than $700,000. This range is nearly identical to that reported in the 2005 study.

Tracking annual users

Although not strictly a maintenance issue, the number of annual users of a trail does affect maintenance needs. Fifty four percent of our respondents indicated that they do not currently track the number of trail users; another 23 percent indicated that they guess or estimate. Of those trail managers who do conduct user counts, 16 percent do a manual count, and 23 percent conduct the count using an automated counter of some type. The reported annul usage ranged from 2,000 to more than 2 million.

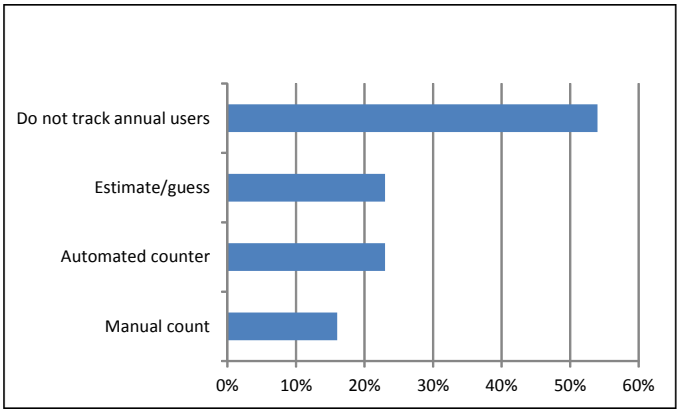


Figure 4. Tracking by Trail Managers (2014 Survey)

Hours of operation

Consistent with the 2005 trail maintenance and operations study, two-thirds of the trails surveyed in 2014 are open on a dawn-to-dusk schedule.

Perkiomen Rail Trail, PA.

Vegetation – Grass, Trees, Herbicides and Invasives!

Mowing

Sixty percent of detailed cost survey respondents reported that mowing was a labor-intensive maintenance activity and a significant component of the annual maintenance budget. We conducted a correlation analysis to determine if there was a relationship between labor hours and the length of trails. The graph below reveals that such a relationship does not exist.

Based on the data provided in the detailed cost analysis, it is apparent that the amount of time and expense associated with mowing is really a function of how the trail was designed. Some trails have a lot of grassy areas on the shoulders of the trail tread, while others have crushed stone or other shoulder materials that don't require periodic mowing.

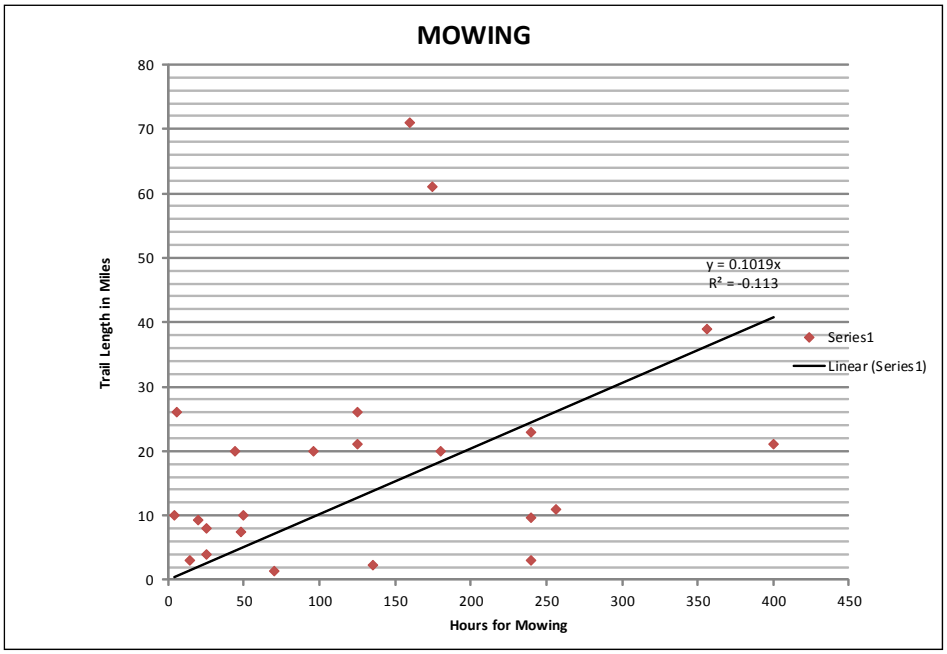
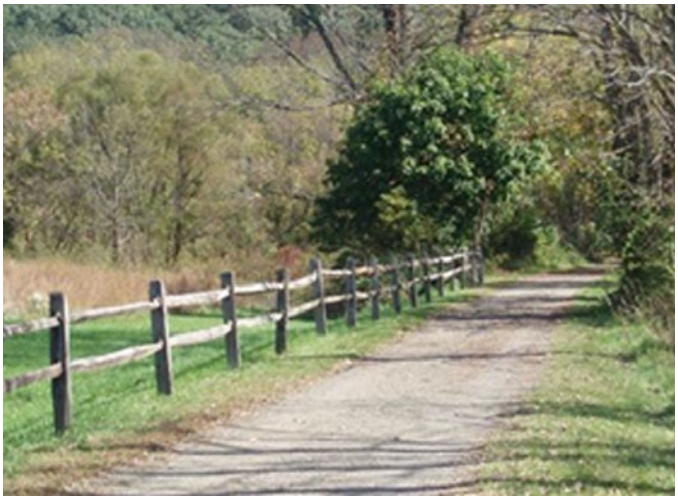


Figure 5. Correlation analysis shows no relationship between labor hours and length of trails.

MAJOR MAINTENANCE TASKS

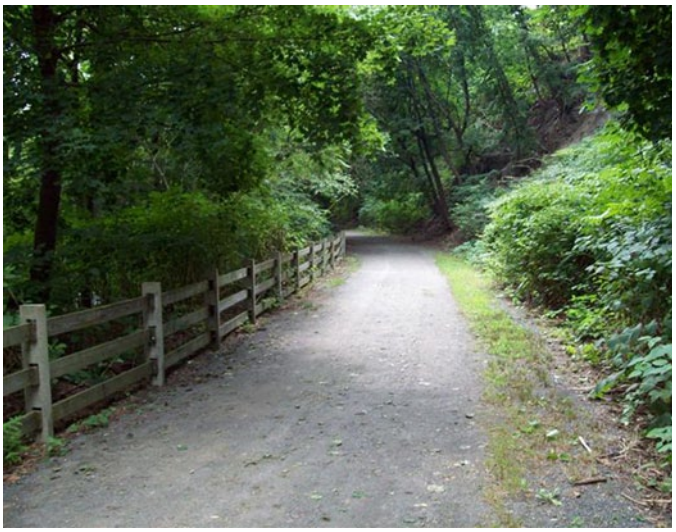


Perkiomen Rail Trail, PA
20 miles
Annual mowing costs $12,542

Rio Grande Rail Trail, CO
20 miles
Annual mowing costs $2,112

The Perkiomen Trail has a significant amount of grass along the shoulders of the trail and fencing that needs to be cut around manually. On the other hand, the Rio Grande Trail has more native vegetation or stone shoulders that do not require frequent mowing.

Heritage Rail Trail County Park, PA
21.1 miles
Annual mowing costs $6,000



Lackawanna River Heritage Trail, PA
19.9 miles
Annual mowing costs $7,367

The mowing cost for these two trails is fairly close on a per mile basis. The Heritage Rail Trail has a parallel rail bed along most of its length that requires herbicide treatment but no mowing. The Lackawanna Trail allows natural vegetation to grow along the shoulders or has placed stone shoulders.

MAJOR MAINTENANCE TASKS

Lititz-Warwick Trailway, PA
3 miles
Annual Hours mowing 240
Annual mowing costs $3,553

Oil Creek State Park Trail, PA
9.7 miles
Annual hours mowing 240
Annual mowing costs $3,739

The Lititz-Warwick Trailway has significant amounts of grassy areas that require mowing along trail edges in a primarily suburban setting. Oil Creek State Park Trail is more rural and relies on natural vegetation along the trail edges that does not require much maintenance. Surprisingly, however, both reported 240 hours was required for mowing each year. This example appears to indicate that there is no correlation between labor hours and costs.

Vegetation Management

We asked trail managers how much time they dedicate to vegetation management along the trail because this work is the second most labor-intensive, costly maintenance item reported by respondents to the detailed cost analysis survey. Of these respondents, 62 percent reported on this maintenance activity. The amount of time reported on a per-mile basis varied from as little as 0.25 hours per mile to 106 hours per mile (most of this work is carried out by volunteers).

We provided a list of 12 tasks to 2014 maintenance survey respondents when asking about their management of trail-side vegetation. More than 90 percent of our respondents reported that they do litter cleanup, tree pruning, fallen tree removal, tree removal as a safety issue, and mowing.

Removal of invasive tree species is becoming an increasingly necessary maintenance task. In the 2005 report, 36 percent of respondents reported invasive species removal as an important task; in 2014, almost 93 percent reported it as a major activity.

In the 2005 survey, about a third of the respondents indicated that they used a chemical herbicide to control vegetation. That percentage increased to 55 percent in the 2014 survey. Seventy-five percent of 2014 respondents reported that trail maintenance staff has responsibility for application of the herbicide. This activity was contracted out by only 14 percent of the respondents.

Tree down on Heritage Rail Trail County Park, PA.

Volunteers trimming brush, Three Rivers Heritage Trail, PA.

On average, respondents said they spent 13.5 hours per mile on vegetation management. The cost of vegetation management varied widely, from less than $100 for a four-mile trail to more than $55,000 for a 24-mile trail. Much of this work is carried out by trail management staff or volunteers, although some trail organizations do contract out this type of work. Volunteers should have some degree of training and supervision, especially when working with an herbicide.

Tree Removal

Tree removal was a significant maintenance task reported in our detailed maintenance cost analysis survey. Most of the reported costs were in excess of $1,000. Forty percent of the reporting trails indicated that they contracted out this activity. There are a number of reasons stated for removing trees. In some cases storms cause tress to block the trail. In others, a dead tree presents a potential hazard to trail users and is removed before limbs come crashing down on the trail.

Surface – Repair, Clearing, Snow

In the 2014 study we asked respondents to identify the predominant trail surface material based on six choices: asphalt, concrete, crushed stone, original railroad cinders, dirt/soil and boardwalk. The number of responses for concrete, railroad cinders, dirt and boardwalk were so small (seven or fewer) that analysis was not possible. Therefore, we concentrated our analysis on asphalt and crushed stone.

In the 2005 study, 45 percent of respondents indicated that their trails were composed of asphalt, and 41 percent said crushed stone. In 2014, asphalt increased to 52 percent, and crushed stone decreased to 34 percent. This increase in asphalt could either be because of increased use of asphalt surfaced trails or the samples included in the survey. In some cases, state policy dictates that trails must have an asphalt surface.

Beaver caused erosion damage, Ashuelot Rail-Trail, NH.

Maintenance of Non-asphalt Trails

The labor hours and resulting cost of repairs to non-asphalt trails varied widely among survey respondents. Labor hours reported for repairs ranged from 0.2 hours per mile for an 11-mile trail in Pennsylvania to 9.3 hours per mile for a three-mile trail in Massachusetts. The total cost of making repairs varied from a low of $31 to a high of nearly $13,000.

Not only did these costs vary widely across our sample, but they also varied widely from year to year. The major cause of damage to non-asphalt trails was because of water erosion, as reported by 55 percent of survey respondents.

The second biggest cause for repairs is because of vegetation, as reported by 25 percent of survey respondents. This can be caused by grass growing through non-asphalt trail surface, vegetation encroaching on trail edges or proliferation of invasive species. Controlling damage caused by vegetation encroachment is manageable with a program of regular, scheduled inspection and preventative maintenance.

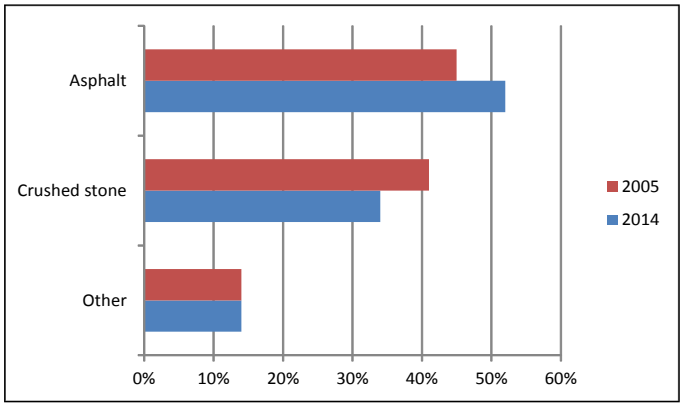


Figure 6. Predominant Trail Surfaces (2014 Survey)

Uncontrolled weed growth through trail surface.

Regrading of some or the entire surface is another requirement in non-asphalt trail maintenance. The amount of labor hours involved to perform this task varied widely, from 14 hours to regrade a three-mile trail to two hours to regrade a 10-mile trail. The nature of the re-grading process and the type of equipment used contribute to this variability. A good estimate of the average, based on those reporting this activity, is two hours per mile for re-grading a non-asphalt surface trail.

Maintenance of Asphalt Surfaced Trails

New to the 2014 were questions regarding causes of damage to asphalt trails. Survey respondents could list multiple causes of damage. As shown in Figure 7, tree roots are by far the leading cause of damage to an asphalt trail surface at 63 percent. The frost/freeze cycle and water erosion rank second and third, at 44 and 43 percent, respectively.

Respondents to the detailed maintenance cost survey submitted significant costs for repair of asphalt-surfaced trails. Examples include $9,600 for a 71-mile trail; $7,350 for a three-mile trail; and $7,200 for 39-mile trail. Only 30 percent of trail managers reported any asphalt repair. Only eight percent of managers of asphalt-surface trails reported that they seal-coated their trail. On a three-mile trail, the cost of the sealant material was $4,000 and the labor to apply it took 24 hours, or three work days.

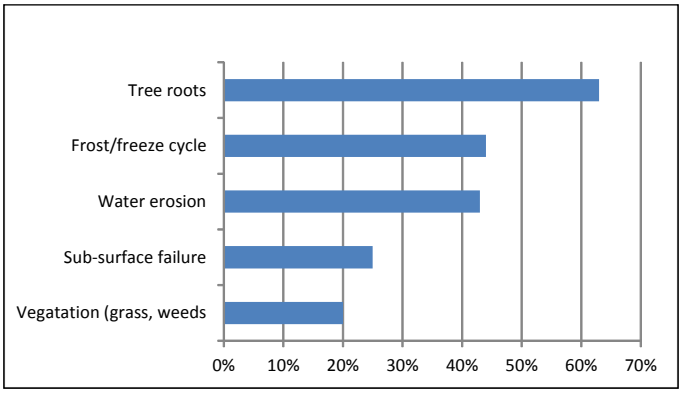


Figure 7. Sources of Surface Damage (2014 Survey)

Tree root damage Manhan Rail Trail, MA.

Another task required for maintenance of asphalt trails is crack sealing. The Willard Munger State Trail in Minnesota reported spending 240 hours sealing cracks on the 71-mile trail. That's $5,760 in labor costs and $2,500 in material costs. Similarly, the Oil Creek State Park Trail in Pennsylvania had labor costs of $935 and material costs of $1,500 to seal cracks along the 9.7-mile asphalt trail. Lack of a crack-sealing program can lead to vegetation growing up through the cracks, and this will contribute to deterioration of the asphalt surface.

MAJOR MAINTENANCE TASKS

Maintenance of crushed stone

More than one-half, or 56 percent, of 2014 respondents with a predominantly crushed stone surfaced trail reported that their trail had been resurfaced since original construction. This is a decrease from two-thirds in the 2005 study. In 2014, the most mentioned interval for resurfacing was 10 years or longer, compared with nine years in the 2005 study.

Consistent with the 2005 study, 71 percent of respondents indicated that crushed surface trails are primarily repaired manually, with a rakes, shovels and other hand tools. Light duty power equipment such as a Bobcat was used to repair damage by 42 percent of the respondents, and 32 percent responded that they utilized heavy equipment such as a grader. The type of equipment used is dictated by the severity of the damage to the crushed stone surfaced trail.

Forty-four percent of our survey respondents indicated that their crushed stone trail had been regraded since its original construction. This maintenance activity is carried out on an as-needed basis by 70 percent of the trail managers.

Water erosion is the most frequently mentioned cause of damage to a crushed stone surfaced trail, with 77 percent of respondents reporting it the 2014 study.

Water erosion is the most frequently mentioned cause of damage to a crushed stone surfaced trail.

Vegetation encroaching through the trail surface was the second most common cause of damage to a crushed stone trail, with one-third of respondents citing this cause. Less than 2 percent of respondents indicated tree roots as a cause of damage to a crushed stone surface trail.

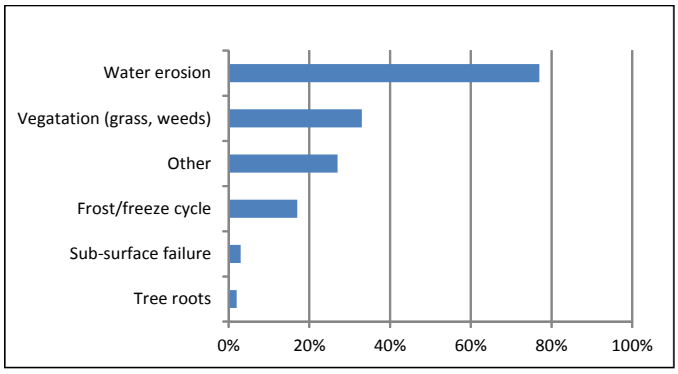


Figure 8. Sources of Damage to Crushed Stone Surface (2014 Survey)

Surface Clearing of Trail

For the purpose of the survey, trail clearing was defined as the removal of material such as leaves, sticks and stones from the trail surface. A third of the respondents to our detailed cost survey indicated that time was spent clearing the surface of the trail. This activity was mostly confined to asphalt surfaced trails. On average, surface clearing took 3.5 hours per mile, at an average cost of $22.25 per hour.

Erosion damage to stone dust trail.

Maintenance of Pavement Markings

Pavement markings are generally associated with asphalt-surfaced trails. This study found that a painted center line was the most common type of pavement marking. Other pavement markings are safety or instructional in nature. Some markings are painted on the trail surface, while others are applied thermally. The detailed cost analysis revealed that this activity, while not reported by many respondents, varied in cost from $19 per mile to $140 per mile.

Pavement markings, Hanover Trolley Trail, PA.

Snow Removal

Winter use of the Torrey C. Brown Trail, MD.

In the general maintenance study, 33 percent of respondents reported that they removed snow from portions of the trail, and 9 percent reported that they remove snow from the entire length of the trail. Generally, full or partial snow removal was more common on trails in urban or suburban areas.

According to respondents to the detailed cost study who reported snow removal (25 percent), the time and cost of snow removal varied widely. Time spent ranged from 500 hours on the 71-mile Traverse Area Recreation Trail in Michigan to 15 hours on the 24-mile Three Rivers Heritage Trail in Pittsburgh, Pennsylvania. This activity varied widely from year to year based on the frequency and amount of snowfall.

Some trail managers who did not report clearing snow from the trail surface did report that they cleared snow from trailhead parking lots. Trails can get a great deal of winter use if potential trail users have a place to park. Cross country skiing is a popular activity on many rail-trails in snow country. The Heritage Rail Trail County Park in Pennsylvania spent $600 clearing trailhead parking lots for skiers but does not clear the trail surface. In 2014, 63 percent of respondents reported doing trailhead snow removal, compared with half that number in 2005.

Drainage

Maintenance of drainage areas is critical to helping minimize the damage to both asphalt and crushed stone surfaced trails caused by water erosion. As we found in the 2005 survey, this activity is primarily carried out manually with the use of rakes and shovels. In both surveys, this manual activity was reported by 70 percent or more of the respondents.

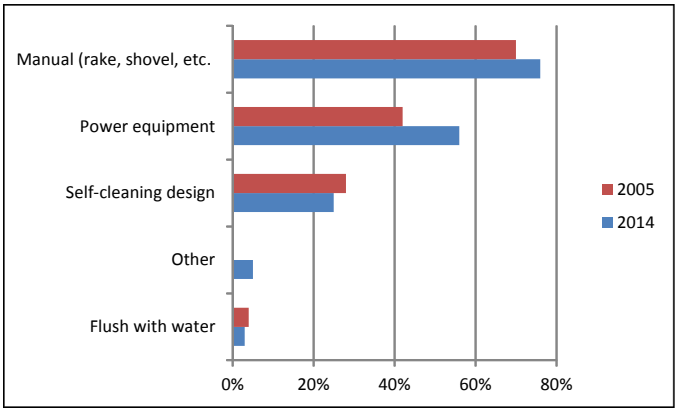


Figure 9. Drainage Activities (2014 Survey)

Culvert failure, Allegheny River Trail, PA.

Clearing of drainage swales and culverts

Periodically investing several hundred or even several thousand dollars in maintaining trail drainage systems and culverts can prevent catastrophic damage to a trail when a major water event occurs.

Culvert failure, Manhan Rail Trails, MA.

Forty-one percent of respondents to the detailed cost analysis survey reported spending staff and volunteer hours on this task. A quarter of those reporting indicated that this activity was carried out entirely by volunteers.

Volunteers on the four-mile Greater Hazelton Rails to Trails in Pennsylvania spent 60 hours on this task.

Of those trail management organizations that reported carrying out this this activity, the cost varied from $85 per mile to $350 per mile. Cost depended

on the type of drainage system used along the trail, the number of culverts that required cleaning and the method used to clean drainage swales and culverts.

The Montgomery County Pennsylvania Regional Trail maintenance schedule requires that drains, pipes, culverts and inlets are cleared out three times per year and must be checked after all heavy rainfalls. All leaf litter, branches and other debris are required to be removed at inlets and along drainage swales.

The West Penn trail maintenance plan calls for clearing drainage swales twice a year or as needed. Most of this work is done with rakes and shovels. Some larger ditches may require the use of a backhoe.

Drainage swale in need of cleaning.

Trailhead Amenities

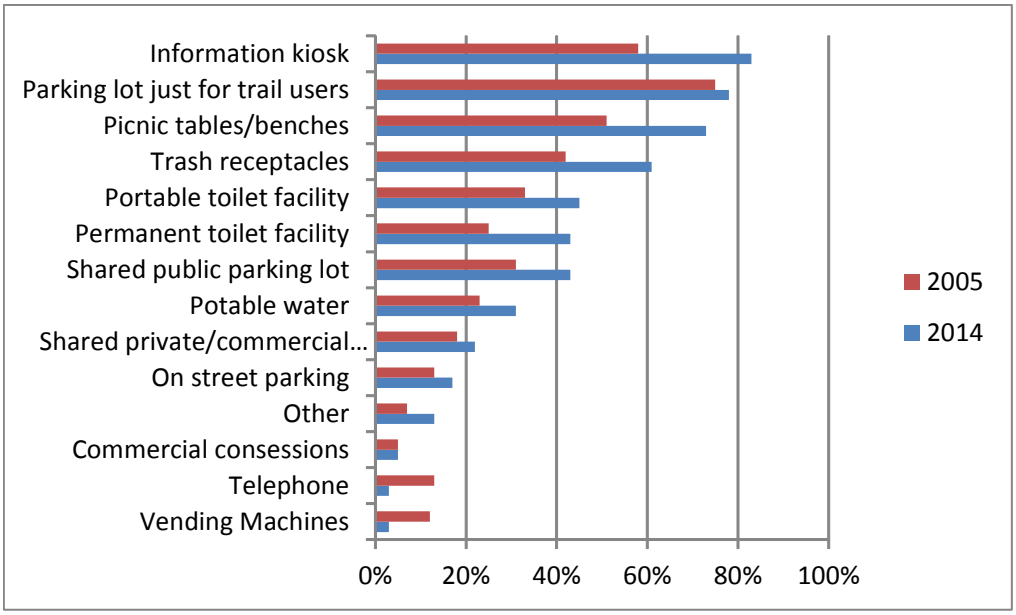
Between 2005 and 2014, dramatic changes were made in the types of facilities that trail managers provide at trailheads.

In 2005, only 58 percent of the survey respondents indicated that they provided an information kiosk at the trailheads. In the 2014 survey, however, 83 percent of respondents indicated that an information kiosk was part of the trailhead facility.

Availability of a permanent restroom facility increased from 25 percent in 2005 to 43 percent in 2014. Availability of portable toilet facilities at trailheads increased from 33 percent in 2005 to 45 percent in 2014, and the availability of trash receptacles increased from 42 percent to 61 percent over the decade between surveys.

Down East Sunrise Trail, ME.

MAJOR MAINTENANCE TASKS



Between 2005 and 2014, dramatic changes were made in the types of facilities that trail managers provide at trailheads.

Figure 10. Trailhead Features (2014 Survey)

In 2005, 51 percent of the respondents reported trailheads featuring picnic tables and benches; that number increased to 73 percent in 2014. Telephones at trailheads fell from 13 percent in 2005 to 3 percent in 2014, consistent with an overall decline in public phones in the United States.

In 2005 only 43 percent of survey respondents reported the availability of picnic tables and benches along the trail. Today, 76 percent of trail managers' report that picnic tables or benches are provided along their trails.

Trailheads

Respondents were asked to provide a detailed cost for several aspects of trailhead maintenance, including landscaping, toilet facilities and kiosks. For the majority of those reporting, landscaping at trailheads was carried out by volunteers. Volunteer hours annually ranged from as few as eight to as many as 500. The largest cost item at trailheads was maintenance of restroom facilities. The lowest cost item was maintenance of informational kiosks at the trailhead.

Amenities

The cost of maintaining amenities such as picnic tables and benches varied among trail managers reporting detailed cost information. It was most strongly correlated to the length of the trails, as longer trails required more benches and picnic tables to maintain. For example, the 71-mile Willard Munger State Trail in Minnesota spent $1,260 on maintenance of amenities, while the eight-mile section of the Ghost Town Trail in Pennsylvania spent only $25. This type of maintenance spending likely also varies on a year to year basis.

Trailhead signage, Youghiogheny Rive Trail, Great Allegheny Passage, PA.

Sanitation

Litter Clean-Up

More than half of the trail managers who responded to the detailed trail maintenance cost survey reported on the number of hours spent cleaning up litter. Although the amount of time spent on litter removal is greater along urban trails, rural trails also require this task. Friends of the Riverfront, which manages the 24-mile Three Rivers Heritage Trail system in Pittsburgh, spends 2,000 hours annually on litter control. The 56-mile Trail of the Coeur d' Alenes in Idaho spends 300 hours on litter cleanup.

Cub Scouts help with litter clean-up on the Heritage Rail Trail County Park, PA.

Restroom Maintenance

Maintenance of restroom facilities, whether at trailheads or along the trail, can be an ongoing annual expense. Respondents to the detailed cost analysis survey provided information about maintenance of both permanent facilities and portable toilets. Costs varied widely. The Heritage Rail Trail County Park in Pennsylvania has both permanent and portable toilets at trailheads along the 21- mile trail. Maintenance costs for these facilities were reported at more than $14,000 a year.

Permanent toilet facility along the Pine Creek Rail Trail, PA.

Earth Day trash pick up along the Capital Greenbelt, Harrisburg, PA.

Signage

The 2014 survey revealed that trail managers are increasing the number and types of signs along trails, which adds to the need for maintenance. Posted trail identification signs increased from 75 percent in 2005 to 91 percent in 2014. More trails have mileage markers as well, an increase from 55 percent in 2005 to 74 percent in 2014. The placement of interpretive signs has also grown substantially, from 31 percent in 2005 to 57 percent in 2014. All of this additional signage helps to provide a better trail experience. However, 76 percent of trail managers reported that their signs were subject to vandalism.

Welcome sign, Ashuelot Rail Trail, NH.

Repair and Maintenance of Signage

Another major maintenance task is the repair and maintenance of trail signage. More than 40 percent of respondents reported this as a significant maintenance activity. In this case, trail length is correlated with cost: typically, the longer the trail the more signs that need to be maintained and the more time and cost is involved.

The four-mile Path of the Flood Trail in Pennsylvania reported spending two hours on signage repair and maintenance, and the 26-mile Catskill Scenic Trail in New York reported spending 135 hours on this work.

More than 75 percent of the respondents to the general maintenance survey reported that vandalism was the major cause of damage requiring signage repair and maintenance.

Greenline Trail sign used for target practice.

Access Control

Maintenance of Gates and Bollards

Gates and bollards are used to keep automobiles and other motorized vehicles off of trails that are intended only for non-motorized use. While maintenance costs associated with gates and bollards were reported by only 15 percent of detailed cost analysis respondents, most indicated costs of between $2,300 and $5,000.

Bollard at intersection, Bruce Freeman Rail Trail, MA.

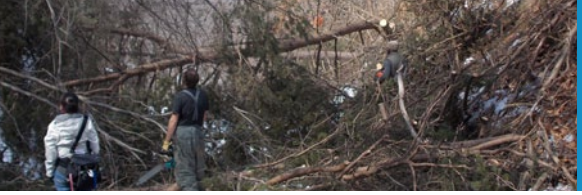
Fencing

A majority of the respondents to our survey, 51 percent, indicated that they had some type of fencing along their trail. Most common was split rail wooden fencing, which was mentioned by 45 percent of the respondents. Over time this becomes a maintenance issue, as posts and rails rot or become damaged in some way.

Fencing generally is deployed along trails to protect trail users from a potential danger, such as a steep slope, or to prevent them from entering adjacent properties. In the detailed cost analysis, we looked at three types of typical trail side fencing: wooden, chain link and vinyl.

Of these three types, wooden fencing was reported to require the most maintenance. Thirty percent of the detailed cost survey respondents reported time repairing wooden fencing. This maintenance can take the form of replacing fencing that had rotted or fencing that had been damaged by accident or acts of vandalism. Only 8 percent of respondents reported repairs to chain link fence. No respondents reported repairs to vinyl fencing.

Damaged split rail fence along the Pine Creek Rail Trail, PA.



Split rail fencing, Pine Creek Rail Trail, PA.

Trail Features

Bridges

A full 88 percent of the trail managers indicated that they have at least one bridge along their trail. The most common — 61 percent — are original railroad bridges. The second most common type of bridge is new bike/pedestrian bridges with vehicle capacity. Surprisingly, 43 percent of respondents indicated that their bridges are not inspected on a regular basis by a certified inspectors or professional engineers. Fortunately, the number of trail managers reporting that their bridges are inspected increased from 33 percent in 2005 to 57 percent in 2014. The most frequent interval for bridge inspections reported in 2014 was two to three years, which is a shorter interval than that reported in 2005.

Scott Glen Bridge, Ghost Town Trail, PA.

Tunnels or Culverts

Tunnels are one of the most distinctive features of many rail-trails. In our 2014 survey, 41 percent of the surveyed trails reported that they had a tunnel on the trail, an increase of 14 percent from those reporting in 2005. Forty percent of the tunnels are illuminated, mostly on a dusk-to-dawn basis, with lighting triggered by a light sensor and powered by a municipal utility.

Other

Vandalism and Illegal Dumping

A third of the respondents to our detailed cost analysis survey reported that they spent time repairing trails due to acts of vandalism or dumping along the corridor. Managers of four trails between 21 and 26 miles long in predominantly suburban/rural environments spent between 40 and 150 hours repairing trails after acts of vandalism or illegal dumping.

Cleaning-up illegal dumping along the Hanover Trolley Trail, PA.

Average Labor Rate

Fifty nine percent of the respondents to the detailed maintenance cost survey reported labor rates for various trail maintenance activities. The rates ranged from a low of $10 per hour to a high of $75 per hour. Most labor rates were clustered around $25 per hour plus or minus $5. The average labor rate for all activities was $22.25.

Contracted Services

Many trail maintenance activities were carried out by trail management organizations and volunteers. Some, however, are better performed by outside contractors. In the survey, activities most commonly reported as being completed by contractors included tree removal, restroom maintenance, herbicide application, bridge inspections and clearing of drainage culverts and mowing.

Volunteers painting over graffiti.

Howard Tunnel, Heritage Rail Trail County Park, PA.

CONCLUSIONS

To better understand this issue, RTC conducted a comprehensive survey of trail maintenance costs. Results of this study show that, contrary to popular belief, maintenance costs are not as high as expected. Per mile yearly average costs for rail-trail maintenance assessed in this study ranged from $1,000 to $2,000, depending on whether the trail was asphalt or stone dust. This assessment supports the findings of the more detailed budgets that a few dozen trail managers provided, which averaged $2,026 per mile per year. This figure includes the value of volunteer service, which was assigned an equivalent hourly rate. When compared against the finding that 58 percent of trails reported using volunteers, both of the annual cost figures may decrease significantly.

Several additional significant findings from this study are summarized below.

Tree pruning even occurs in the dead of winter, Three Rivers Heritage Trail, PA.

Damage to asphalt trails from tree roots is significant and growing.

More than 60 percent of asphalt trail managers reported tree roots as the major source of trail damage. Clearly, as more asphalt trails are being built rather than stone dust trails (as required by some departments of transportation and metropolitan planning organizations); the true costs of these facilities needs to be better understood and shared. Replacing asphalt after several years is costly and frequently becomes a rebuild that is often funded by Transportation Enhancement (TE) programs or Transportation Alternatives Programs (TAP). This costly maintenance requirement might be prevented with better construction standards and possible use of root barriers in certain segments of a trail or periodic trenching to cut root growth. The removal of healthy trees several years after the trail is built is not the only option.

As an additional way to save money, several trail groups could work together to purchase materials or share equipment. State Departments of Natural Resources might use Recreation Trails Program funding to purchase equipment that can be used by any trail.

Invasive species concerns nearly tripled in importance from 2005 to 2014.

Some invasive species can be disproportionally destructive compared with native vegetation because natural control mechanisms do not exist in their new environment. This study found an increase in herbicide use, which is needed to control some invasive species. As a secondary issue, because trail groups rely heavily on volunteers and only contract out a small percent of herbicide application to professionals, it is logical to question if volunteers are adequately trained. Municipal workers, who would have adequate training, may be doing most of the herbicide application; however, this potential safety issue may warrant further examination.

CONCLUSIONS

Surprisingly, the survey found that 60 percent of rail-trails do not have maintenance plans.

This is surprising not only from a management perspective, but from a liability standpoint. All trail managers should have proof that they exercise a reasonable amount of due diligence to ensure that the trails are safe. Many government-owned and maintained rail-trails are included under larger park or civil works maintenance schedules. As a result, managers may believe that specific safety assurance for trails is not required. However, any trail that is owned, maintained or operated by a private, nonprofit organization should have a detailed safety management and maintenance plan with a schedule of tasks and inspections of related structures and facilities.

Estimating per-mile costs.

A total of 95 survey respondents provided an annual budget amount required to maintain their trail representing 40 percent of the trails included in the survey. Using the interquartile range (IQR) of those 95 trails gave us a total annual budget amount for maintenance. We determined that, of the sample group, annual maintenance cost per mile in 2013–2014 averaged $1,006 for a crushed stone trail and $1,971 for a paved asphalt trail. These figures do not include any extensive or exceptional repairs and are assumed to include only the most basic maintenance tasks needed to keep the trail usable.

Table 1. Estimated Costs Per Mile

Source	Asphalt Surface	Non-Asphalt Surface
RTC Maintenance & Operations Report - 2014	$1,971/mile	$1,006/mile
RTC Maintenance & Operations 2004 Report	$1,458/mile	$1,478/mile

Cost per activity.

Based upon the detailed cost analysis survey, we were able to determine the percentage that each activity represents in a typical trail maintenance budget. Data on asphalt and non-asphalt surfaces have been combined.

Table 2 Typical Maintenance Budget

Maintenance Activity	Percent of Budget
Surface clearing of trail	10.8%
Mowing	12.0%
Vegetation management (leaf clearing, pruning, etc.)	11.2%
Keep trail-side land clear of trash and debris	11.5%
Whole tree removal	5.4%
Application of herbicides or pesticides	2.3%
Clearing of drainage channels and culverts	5.4%
Surface maintenance of parking areas	2.7%
Litter clean up, trash cans	2.7%
Maintenance of toilets at trailheads	13.0%
Maintenance of toilets along the trail	1.2%
Trailhead parking snow removal	1.1%
Repair/maintenance of signs	6.3%
Recovery from illegal acts of vandalism/dumping	5.3%
Other trail maintenance activities	9.1%

Summary

Trail managers and local stakeholders often cite the need for dedicated state or federal funding to help pay for trail maintenance. Up to this point, RTC has lacked sufficient data to make that case effectively to decision-makers at the state or federal level. This study was initiated to bring some clarity to this issue. Because funding for rail-trails is difficult to secure, over-estimating maintenance costs can inadvertently give opponents easy leverage to speak against rail-trail development. In addition, funders often question if all aspects of any community development project should be funded by state and federal grants, particularly maintenance-related costs, which are often perceived as a "local issue."

This study presents a more comprehensive understanding of rail-trail maintenance, as has been done for other rail-trail issues such as construction costs, economic impact and rails-with-trails. Such an approach enables the rail-trail community to focus its limited resources more effectively on addressing the most critical issues.

Volunteers clear storm damage along trail in Heritage Rail Trail County Park, PA.

APPENDIX A 2014 SURVEY RESULTS

Please answer the following questions as completely and accurately as possible. If it is necessary to have more than one person in your organization answer different questions based on their personal areas of experience and expertise, please do so.

Please provide accurate information about the person to be contacted if any follow-up information is needed.

1. Please provide you name and contact information

Name
Title/Agency
Email
Phone

2. What is your Trail Name and state:

Trail name
State
Mileage

ADMINISTRATIVE

3. What is the trail surrounding Environment (check all that apply):

37%	Rural
12%	Urban
13%	Suburban
38%	Mixed

4. What are the permitted uses on your trail? (check all that apply)

3%	ATV
99%	Bike
79%	Cross Country Skiing
	Fishing
40%	Horseback Riding
56%	Inline skating
66%	Mountain Biking
16%	Snowmobile
100%	Walking
86%	Wheelchair Access

5. Who owns the land under the trail? If more than one, please indicate an approximate percentage.

23%	Federal government
43%	State government
34%	Municipal government
42%	County government
31%	Railroad
9.9%	Single private owner
46%	Non-profit entity
21%	Utility
12%	Multiple private owners

6. On a general basis, who PERFORMS maintenance of the trail? If more than one, please indicate an approximate percentage.

58%	Trail Group Volunteers
39%	Other volunteer community groups (please specify)
13%	Individuals with mandatory community service
4%	Federal government
21%	State government
33%	County government
43%	Municipal government
12%	Non-profit entity (paid staff)
12%	Other (specify)

7. Do you have a written Trail Maintenance Plan?

40%	Yes
60%	No

8. Who FUNDS maintenance of the trail? If more than one, please indicate an approximate percentage.

6%	Federal government
31%	County government
32%	Non-profit entity
25%	State government
42%	Municipal government
14%	Other (specify)

Rail-Trail Maintenance and Operations

9. What is the annual maintenance budget for this trail? (Average for all respondents that provided a budget.)

$66,430

9.a. If known, please provide the dollar amounts for the following within your maintenance program. (Insufficient data)

Labor
Equipment
Supplies

10. How is the maintenance funded?

7%	Federally legislated (REC Trails funding)
24%	State Budget
49%	Municipal Budget
9%	Unique funding streams or fees collected through the community (e.g. hotel tax)?
39%	Local Fundraising activities (please describe)
29%	In-kind Donations

11. Is the trail covered by liability insurance?

77% Yes (If yes go to 12)
23% No (If no go to 15)

12. What is your coverage amount ?

Most indicated $1 - 2 Million

13. Who is your carrier?

Various

14. What is your annual cost?

Various

15. In what year was the trail first opened for public use?

Various

16. How do you track annual users:

54%	Do not currently track the number of annual users (Skip to 18)
23%	Estimate / guess
16%	Manual count
23%	Automated counter

17. How many users does your trail have on an annual basis?

Varied

18. What are the hours of operation of your trail?

63%	Dawn until dusk
30%	Open 24/7
7%	Other

SURFACE - GENERAL

19. What is the average width of your trail?

6%	6ft.
16%	8ft.
60%	10ft.
15%	12ft.
3%	Other (specify)

20. What surface material exists on any sections of your trail? (check all that apply)

76%	Asphalt
7%	Concrete
55%	Crushed Stone
9%	Cinders
21%	Dirt/ Soil
8%	Other (specify)

21. Please indicate any reused or recycled materials used in the surface of your trail?

69%	None
1%	Tires or other rubber
0%	Glassphalt
19%	Asphalt / pavement milling
2%	Coal ash (cinders)
8%	Quarry waste from stone/rock processing (tailings, etc.)
5%	Other (specify)

22. What is the predominant surface material on your trail?

52%	Asphalt	(Go to 23)
2%	Concrete	(Go to 35)
40%	Crushed Stone	(Go to 43)
4%	Original railroad cinders	(Go to 53)
4%	Dirt / Soil	(Go to 59)
0%	Boardwalk	(Go to 65)
5%	Other (specify)	(Go to 72)

SURFACE - ASPHALT

23. Has your trail been repaved or resurfaced since the original paving construction?

35%	Yes	(If yes go to 24)
65%	No	(If no go to 29)

24. At what frequency (in years)?

45%	Recurring
3%	3 to 5
7%	6 to 10
45%	10 plus

25. Has your trail been seal-coated since the original paving?

25% Yes	(If yes go to 26)
75% No	(If no go to 27)

26. At what frequency (in years)?

41%	Recurring
27%	3 to 5
23%	6 to 10
9%	10 plus

27. Do you have a crack sealing programing?

35% Yes	(If yes go to 28)
65% No	(If no go to 29)

28. At what frequency (in years)?

78%	Recurring
13%	3 to 5
9%	6 to 10
0%	10 plus

29. What are the major causes of damage to your asphalt surfaced trail?

43%	Water/erosion
63%	Tree roots
20%	Vegetation (grass, weeds)
25%	Sub surface failure
44%	Frost/freeze cycle

30. Is snow removed from your trail?

9%	Yes, fully
33%	Yes, partially
58%	No

31. How is the surface of your trail kept clear of trash and debris? (Check all that apply)

9%	Street sweeper
18%	Rotary brush
65%	Blower
58%	Manual (broom, rake, etc.)
7%	Other (specify)

32. Does your trail employ pavement markings? (Check all that apply.)

51% No (if no skip to 72)
49% Yes

33. Do you indicate a Center Line of the trail?

44% Yes
24% Painted
4% Thermal transfer
51% No

34. Do you employ other safety markings?

61% Yes:
35% Painted
14% Thermal transfer
35% No

SURFACE – CONCRETE

35. Have sections of your trail been re-poured or resurfaced since the original paving construction?

25% Yes (If yes go to 36)
75% No (If no go to 37)

36. At what frequency (in years)?

Recurring
3 to 5
6 to 10
10 plus

37. What are the major causes of damage to your concrete surfaced trail?

67% Water/erosion
33% Tree roots
0% Vegetation (grass, weeds)
0% Sub surface failure
33% Frost/freeze cycle
33% Other

38. Is snow removed from your trail?

33% Yes fully
0% Yes partially
67% No

39. How is the surface of your trail kept clear of trash and debris? (Check all that apply)

33% Street sweeper
33% Rotary brush
100% Blower
0% Manual (broom, rake, chainsaw, etc)
Other (specify)

40. Does your trail employ pavement markings? (Check all that apply.)

67% Yes (if yes go to 41)
33% No (If no go to 72)

41. Do you indicate a center line of the trail?

100% Yes
0% Painted
0% Thermal transfer
0% No

42. Do you employ other safety markings?

100% Yes:
0% Painted
0% Thermal transfer
0% No

SURFACE – CRUSHED/GRANULAR STONE

43. How was trail surface applied?

60% Paving machine
21% Box spreader
23% Tailgate from dump truck
11% Bucket spread from loader
0% Wheelbarrow or other manual
8% Other (specify)

44. Has your trail been re-surfaced since the original construction?

56%	Yes	(If yes go to 45)
48%	No	(If no go to 46)

45. At what frequency (in years)?

32%	Recurring
3%	3 to 5 years
21%	6 to 10 years
44%	10 years or longer

46. How is the surface material compacted?

14%	Not
38%	Steel drum roller (static)
47%	Steel drum roller (vibratory)
5%	Rubber tired roller
0%	Rammer
7%	Vibratory plates
10%	Other (specify)

47. If applicable, please indicate the size of aggregate used for your trail surface.

40%	Unknown
10%	1A
0%	1B 3% 2A
0%	2B 2% 2RC
30%	AASHTO #10
2%	DSA
18%	Other (specify)

48. Do you use any type of soil or aggregate binder?

97%	No
3%	Yes

49. What are the major causes of damage to your crushed stone surfaced trail:

77%	Water/erosion
2%	Tree roots
2%	Vegetation (grass, weeds)
3%	Sub surface failure
17%	Frost/freeze cycle
27%	Other (specify)

50. How are damages to your trail surface repaired:

32%	Grader or other heavy equipment
42%	Light duty power equipment
40%	Dragging
71%	Manual (rake, shovel, etc.)
13%	Other (specify)

51. Has your trail been re-graded since the original construction?

44%	Yes	(If yes go to 34a)
54%	No	(If no go to 36)

52. At what frequency (in years)?

74%	Recurring
4%	2 to 3 years
4%	4 to 5 years
19%	6 to 10 years

SURFACE – ORIGINAL RAILROAD CINDERS

53. How was the surface prepared after removal of the rails and ties

56%	Grader or other heavy equipment
11%	Light duty power equipment
33%	Dragging
11%	Manual (rake, shovel, etc.)
22%	Other (specify)

54. How was the surface material compacted ?

20%	Steel drum roller (static)
80%	Steel drum roller (vibratory)
0%	Rubber tired roller
0%	Rammer
0%	Vibratory plates
0%	Other (specify)

55. What are the major causes of damage to your cinder surfaced trail?

87%	Water/erosion
0%	Tree roots
25%	Vegetation (grass, weeds)
13%	Sub surface failure
50%	Frost/freeze cycle

56. How are damages to your trail surface repaired?

63%	Grader or other heavy equipment
63%	Light duty power equipment
25%	Dragging
50%	Manual (rake, shovel, etc)

Other (specify)

57. Has your trail been re-graded since the original construction?

71%	Yes	(If yes go to 58)
29%	No	(If no go to 65)

58. At what frequency (in years)?

100%	Recurring
0%	2 to 3 years
0%	4 to 5 years
0%	6 to 10 years

SURFACE – DIRT/SOIL

59. How was the surface prepared?

43%	Grader or other heavy equipment
43%	Light duty power equipment
15%	Dragging
29%	Manual (rake, shovel, etc)

Other (specify)

60. How was the surface material compacted?

20%	Steel drum roller (static)
20%	Steel drum roller (vibratory)
20%	Rubber tired roller
20%	Rammer
20%	Vibratory plates
40%	Other (specify)

61. What are the major causes of damage to your dirt/soil surfaced trail?

71%	Water/erosion
14%	Tree roots
14%	Vegetation (grass, weeds)
14%	Sub surface failure
29%	Frost/freeze cycle
43%	Other (specify)

62. How are damages to your trail surface repaired?

29%	Grader or other heavy equipment
71%	Light duty power equipment
0%	Dragging
71%	Manual (rake, shovel, etc)
0%	Other (specify)

63. Has your trail been re-graded since the original construction?

50%	Yes	(If yes go to 64)
50%	No	(If no go to 65)

64. At what age / frequency (in years)?

33%	Recurring
0%	2 to 3 years
33%	4 to 5 years
33%	6 to 10 years

SURFACE – BOARDWALK

65. Does you trail contain any segments of boardwalk?

18%	Yes	(If yes go to 66)
82%	No	(If no go to 53)

66. How long is the boardwalk segment of your trail?

0 %	10 feet or less
23%	10 to 50 feet
19%	51 to 100 feet
29%	101 to 500 feet
8%	501 to 1,000 feet
19%	1,001 feet or more

67. How wide is the boardwalk segment of your trail?

28%	5 to 7 feet
37%	8 to 10 feet
28%	11 to 12 feet
6%	Greater than 12 feet

68. What is the decking material of the boardwalk?

6%	Wood (pine, oak, et.) not pressure treated
0%	Wood (teak, red wood, etc.)
84%	Wood – pressure treated
3%	Synthetic wood (Trex, NewTechWood, ArmorGuard etc.)
0%	Concrete
7%	Other

69. How old is the boardwalk segment of your trail?

23%	1 to 3 years
42%	4 to 9 years
26%	10 to 20 years
10%	More than 20 years

70. Has your boardwalk been re-decked since its original construction?

33%	Yes	(If yes go to 71)
67%	No	(If no go to 72)

71. At what frequency has re-decking occurred?

11%	2 to 3 years
0%	4 to 5 years
22%	6 to 10 years
67%	More than 10 years

ADJACENT LAND AND VEGETATION

72. Does annual or perennial vegetation grow along your trail?

97%	Yes	(if yes go to 73)
3%	No	(if no go to 75)

73. Do you use any herbicides or pesticides in your trail maintenance?

45%	Yes	(If yes go to 73a)
54%	No	(If no go to 75)

If yes, please list:

74. Who is responsible for herbicide/pesticide application (check all that apply)

77%	Trail maintenance staff
20%	Volunteers
14%	Contractor

Rail-Trail Maintenance and Operations

75. Do trees grow along your trail?

100%	Yes
0%	No

76. If planting new trees, what is the distance between the trees and the edge of the trail?

15%	8
7%	10
6%	12
5%	20
7%	other?

77. Please indicate any activities that are performed relative to trail side vegetation. (Check all that apply.)

93%	Litter clean-up
91%	Tree pruning
30%	Tree and shrub planting
90%	Tree removal - Safety
44%	Tree removal - Health
93%	Tree removal - Fallen
26%	Tree removal - Aesthetics (improve view shed)
92%	Mowing
40%	Leaf removal
62%	Invasive species removal
27%	Flower and ground cover planting
3%	Other (specify)

78. How is drainage accommodated? (Check all that apply.)

80%	Trail surface is crowned or sloped
76%	Trail-side drainage channels (ditches, gullies)
72%	Culverts
5%	Other (specify)

79. How are drainage areas kept clear? (Check all that apply.)

56%	Power equipment (backhoe, etc.)
76%	Manual (rake, shovel, etc.)
3%	Flush with water
25%	Self-cleaning design
5%	Other (specify)

PARKING, TRAILHEADS, and SANITATION

80. How many trailheads are there along your trail?

5%	None
26%	1-3
28%	3-5
26%	5-10
12%	10-15
4%	Other (please specify)

81. Please indicate the features of your trailheads. (Check all that apply.)

78%	Parking lot just for trail users
22%	Shared private/commercial parking lot
43%	Permanent toilet facility
83%	Information kiosk
31%	Potable water
5%	Any other commercial concession
3%	Telephone
43%	Shared public parking lot
45%	Portable toilet facility
17%	On-street parking
61%	Trash receptacles
3%	Vending machines
73%	Picnic tables/benches
13%	Other (specify)

82. What is the primary surface material for your trailhead parking area(s)?

53%	Asphalt
38%	Crushed Stone
0%	Cinders
6%	Dirt / Soil
3%	Other (specify)

83. Is snow removed from your trailhead parking lots?

63%	Yes
37%	No

84. Aside from trailheads, are any of these amenities provided along your trail. (Check all that apply.)

22%	Permanent toilet facility
52%	Informational kiosk
24%	Potable water
7%	Any other commercial concession
62%	Interpretive signage
22%	Portable toilet facility
43%	Trash receptacles
1%	Vending machines
76%	Picnic tables/benches
8%	Other (specify)

SIGNS, ACCESS CONTROL AND PUBLIC SAFETY

85. What types of signs do you use? (Check all that apply.)

91%	Trail identification sign ("welcome to ABC Trail")
74%	Mile marker
6%	Quarter miles
7%	1/10 mile
77%	Traffic control for trail users (stop, yield)
60%	Traffic control for cars at crossings
75%	Trail rules and regulations
25%	Property boundary sign (no trespassing)
57%	Interpretive signs
28%	Wayfinding on trail
20%	Wayfinding (off trail)
2%	No trail specific signage
12%	Other (specify)

86. Do you experience vandalism of your signs?

76%	Yes
24%	No

87. Please indicate any techniques you use to separate users by direction of travel or use? (e.g. pedestrian vs. bicycle) Check all that apply.

68%	None
13%	Pavement markings
23%	Signs
3%	Physical separation
3%	Different surface type
4%	Separate tread (Bridle or carriage path)
3%	Other (specify)

88. Is your trail patrolled by any professional policing authority?

65%	Yes	(If yes go to 89)
35%	No	(If no go to 90)

89. Police agency type:

5%	State police or state sheriff
42%	Municipal police
33%	Park or trail rangers
20%	Other (specify)

Rail-Trail Maintenance and Operations

90. Is your trail patrolled by a volunteer or a non-police group (e.g. crime watch)?

30%	Yes
70%	No

91. Do you have an on-going problem with any of the following activities on the trail? (Check all that apply.)

49%	Dumping
12%	Crimes against persons
28%	After hours use
17%	Trespass
71%	Vandalism
21%	Crimes against property
22%	Other (specify)

92. Are your trailheads lighted?

16%	Yes	(If yes go to 93)
84%	No	(If no go to 96)

93. During what times?

75%	Dusk until dawn
25%	Other

94. How are the lights controlled? (Check all that apply.)

13%	Always on
4%	Manual switch
25%	Clock / timer
75%	Light / dark sensor
4%	Motion sensor
18%	Other (specify)

95. How are the lights powered?

96%	Municipal power supply
4%	Solar panel
0%	Battery

96. Do you have emergency call boxes on along your trail or trailhead?

3%	Yes
97%	No

97. How is vehicular access to your trail controlled? (Check all that apply.)

22%	Vehicular access is not controlled
45%	Gates
26%	Fixed bollards
54%	Removable bollards
11%	Other (specify)

98. Do you use fencing along your trail?

64%	Yes	(if yes go to 99)
36%	No	(if no go to 101)

99. What types of fencing do you use?

18%	Chain link
45%	Split rail
7%	Woven Wire
3%	Stockade
27%	Other (specify)

100. What is the average height of the fence (in INCHES)?

48 “	most common

APPENDIX A 2014 SURVEY RESULTS

101. In what areas have you made accommodation for ADA standards or handicapped accessibility?

78%	Parking
50%	Restrooms
35%	Picnic tables
12%	Visitor's Center
15%	Interpretive areas
75%	Grade of trail
61%	Grade of access to trail
67%	Trail Surface
3%	Our trail has specific features for individuals with sight, hearing, or other impairments.
5%	Other (specify)

BRIDGES, TUNNELS and ROAD CROSSINGS

102. Do you have any bridges on your trail?

88%	Yes	(If yes go to 103)
12%	No	(If no go to 109)

103. What types of bridges do you have?

61%	Existing railroad bridge
33%	Pre-Fabricated
9%	New Bike/Ped (no vehicular capacity)
40%	New bike/ped (with vehicle capacity)
16%	Small foot bridge(less than 5' wide)
8%	Other (specify)

104. What is the deck material on your bridges? (Check all that apply.)

74%	Wood
9%	Synthetic lumber
1%	Rubber
11%	Metal
16%	Asphalt
36%	Concrete
11%	Stone/dirt/cinders
Other (specify)	

105. Do you have railings on your bridges?

97%	Yes	(If yes go to 106)
3%	No	(If no go to 109)

106. What is the height of the fence/railing (in INCHES)?

48"	most common

107. Are your bridges inspected on a regular basis by a certified inspector or professional engineer?

57%	Yes
43%	No

108. At what frequency (in years)?

0%	Recurring
66%	2 to 3 years
23%	4 to 5 years
11%	6 to 10 years

109. Do you have any tunnels or culverts for user passage under roads etc.

41%	Yes	(If yes go to 110)
59%	No	(If no go to 114)

Rail-Trail Maintenance and Operations

110. Are your tunnels lighted?

40%	Yes
60%	No

111. During what times?

31%	24/7
61%	Dusk to dawn
8%	Other (please specify time of day/ night)

112. How are lights controlled?

23%	Always on
0%	Manual switch
31%	Clock / timer
46%	Light / dark sensor
0%	Motion sensor

Other (specify)

113. How are the lights powered?

92%	Municipal power supply
8%	Solar
0%	Battery
0%	Generator

114 Do you paint/stain/treat bridge structures or decks, tunnel/underpass walls, etc?

45%	Yes	(If yes go to 115)
54%	No	(If no go to 116)

115. At what frequency (in years)?

68%	Recurring
0 %	2 to 3 years
10%	4 to 5 years
23%	6 to 10 years

116. How are at-grade crossings of roads controlled? (Check all that apply.)

89%	Stop sign for trail users
17%	Yield sign for trail users
17%	Traffic signal (red, yellow, green)
69%	Ped /bike crossing sign
17%	Stop sign for road users
20%	Yield sign for road users
30%	Pedestrian crossing signal (walk)
51%	Road striping

Other (specify)

APPENDIX B LIST OF PARTICIPANTS

Trail Name	State	Opened	Mileage	Surface
Tahoe City Public Utility District Multi-use trails	CA	1991	20	Asphalt
Bizz Johnson National Recreation Trail	CA	1983	25.4	Ballast, Gravel
Fort Collins City Trails	CO	1998	36	Concrete
Rio Grande Trail	CO	1987	42	Asphalt
Middlebury Greenway	CT	2008	5	Asphalt
Sue Grossman Still River Greenway	CT	1995	3	Asphalt
Trumbull Rails to Trails	CT	2006	7	Crushed Stone
Farmington Canal Heritage Trail	CT	2010	56	Asphalt
Metropolitan Branch Trail	DC	2000	3.5	Asphalt
Prairie Farmer Recreational Trail	IA	1999	22	Asphalt
Raccoon River Valley Trail	IA	1990	89	Asphalt, Concrete
Gay Lea Wilson Trail	IA	2000	17	Asphalt, Concrete
Ashton-Tetonia Rail Trail	ID	1913	30	Crushed Stone
Latah Trail	ID	1984	16	Asphalt
Trail of the Coeur d'Alenes Recreational Trailway	ID	2006	73	Asphalt
Wood River Trail	ID	1990	22	Asphalt
Route of the Hiawatha	ID &MT	1986	15	Ballast, Dirt, Gravel
George Rogers Clark Discovery Trail	IL	2010	9.2	Concrete
Forest Preserves of Cook County	IL	2009	100	Crushed Stone
Burnham Greenway	IL	2004	2.5	Asphalt
Millennium Trail and Greenway	IL	2003	8	Crushed Stone
Great Western Trail	IL	1990	12	Crushed Stone
Illinois Prairie Path	IL	1966	62	Crushed Stone
DeKalb Nature Trail	IL	1985	1.2	Asphalt
Oak Savannah Trail	IN	2010	8	Asphalt
Nickel Plate Trail	IN	2012	35	Crushed Stone
Pumpkinvine Nature Trails	IN	1996	20	Asphalt
Delphi Historic Trails	IN	2008	10	Crushed Stone
Zionsville Rail Trail	IN	1997	3.75	Asphalt
Monon Trail	IN	1997	9	Asphalt, Crushed Stone
Brighton East Rail Trail	KY	1998	2	Asphalt, Crushed Stone
Narrow Gauge Rail Trail	MA	2010	3	Crushed Stone
Bruce Freeman Rail Trail	MA	1992	6.8	Asphalt
Cape Cod Rail Trail	MA	2011	22	Asphalt
Methuen Rail Trail	MA	1995	2.4	Crushed Stone
Danvers Rail Trail	MA	1994	4.3	Crushed Stone
Old Colony Rail Trail	MA	1992	3	Asphalt
Southwick Rail Trail	MA	1994	6	Asphalt
Springfield Riverfront Bikeway/Walkway	MA	1994	3.7	Asphalt
Ashuwillticook Rail Trail	MA	2003	11	Asphalt
Gwynns Falls Trail	MD	2005	15	Asphalt

Trail Name	State	Opened	Mileage	Surface
Jones Falls Trail	MD	2006	9.1	Asphalt
Herring Run Trail	MD	1978	2.5	Asphalt
Stony Run Trail	MD	2013	2.9	Asphalt
Three Notch Trail	MD	2013	7	Asphalt
Gilchrest Trail	MD	2011	1.2	Asphalt
Broadneck Trail	MD	2000	6.6	Asphalt
Washington, Baltimore & Annapolis Trail	MD	1983	10.25	Asphalt
Baltimore Washington International Airport Trail	MD	2013	12.5	Asphalt
Torrey C. Brown/Northern Central Railroad Trail	MD	1984	20	Crushed Stone
Baltimore & Annapolis Trail	MD	1991	14	Asphalt
Catonsville Short Line Trail	MD	2013	3.5	Dirt, Gravel
St. John Valley Heritage Trail	ME	1998	29	Crushed Stone
Bangor Aroostook Trail & Aroostook Valley Trail	ME	1999	61	Gravel, Dirt, Soil
Aroostook Valley Trail	ME	1991	28	Crushed Stone, Dirt
Polly Ann Trail	MI	1998	30	Asphalt, Crushed Stone
Riverfront Trail	MI	2005	2.25	Asphalt
Kalamazoo River Valley Trail	MI	1999	17	Asphalt
Clinton River Trail	MI	2004	1	Crushed Stone
Flint River Trail	MI	2009	20	Asphalt
Leelanau Trail	MI	1987	20	Asphalt
I-275 Metro Trail	MI	mid-1970's	30	Asphalt
Conner Creek Greenway	MI	2009	9.5	Asphalt
Traverse Area Recreation Trail	MI	1831	10.5	Asphalt
Little Traverse Wheelway	MI	1996	26	Asphalt
Dakota Rail Regional Trail	MN	2002	12.4	Asphalt
Rocori Trail	MN	2005	12.9	Asphalt
Paul Bunyan and Cuyuna State Trails	MN	2004	128	Asphalt
Kenilworth Regional Trail	MN	2005	0.15	Asphalt
Central Lakes State Trail	MN	1986	55	Asphalt
Willard Munger State Trail (Gateway Segment)	MN	1993	18	Asphalt, Crushed Stone
Bruce Vento Trail	MN	2010	23	Asphalt
Willard Munger State Trail (Matthew Lourey State Trail)	MN	1980	80	Asphalt, Crushed Stone
Cannon Valley Trail	MN	1986	20	Asphalt
Dairyland Trail	MN	1995	6.2	Crushed Stone
Lake Wobegon Trail	MN	1999	54	Asphalt
Sakatah Singing Hills State Trail	MN	1980	38	Asphalt
Duluth Winnipeg and Pacific Trail	MN	1985	8	Gravel
Douglas State Trail	MN	1974	26	Asphalt
MKT Nature and Fitness Trail	MO	1982	8.9	Concrete, Crushed Stone
Northern Rail Trail	NH	1995	23	Crushed Stone
Sugar River Trail	NH	1997	9	Dirt, Soil

APPENDIX B LIST OF PARTICIPANTS

Trail Name	State	Opened	Mileage	Surface
Goffstown Rail Trail	NH	2005	5.5	Crushed Stone
Windham Rail Trail	NH	2000	4	Asphalt
Winnipesaukee River Trail	NH	2005	7.9	Crushed Stone
WOW Trail	NH	1990	1.3	Asphalt
Derry Rail Trail	NH	2004	4.5	Asphalt
Gloucester Township Health & Fitness Trail	NJ	2001	2	Asphalt
Henry Hudson Trail	NJ	1995	24.5	Asphalt
Delaware and Raritan Canal State Park	NJ	1980	80	Crushed Stone
Barnegat Branch Trail	NJ	1971	15.6	rushed Stone
Middlesex Greenway	NJ	2006	3.1	Asphalt
Columbia Trail	NJ	1990	7.5	Crushed Stone
Paulinskill Valley Rail Trail	NJ	1992	27	Cinders, Dirt, Grass, Ballast
Traction Line Recreation Trail	NJ	1986	3	Asphalt
Dutchess Rail Trail	NY	1991	13.5	Asphalt
Oswego County Recreation Trail	NY	1979	24.35	Original railroad cinders
Joseph B. Clarke Rail Trail	NY	1998	2.5	Asphalt
Ontario Pathway	NY	1992	23.5	Cinders, Grass, Gravel
Town of Ballston Veterans Bike Path.	NY	1960	3.6	Asphalt
Auburn Trail	NY	1993	10	Crushed Stone
Clarence Bike Paths	NY	2004	10.2	Asphalt
Hudson Valley Rail Trail	NY	1824	3.6	Asphalt
Pat McGee Trail	NY	1987	13	Crushed Stone
South Hill Recreation Way	NY	1988	3.4	Crushed Stone
Wallkill Valley Rail Trail	NY	2000	24	Asphalt, Cinders, Gravel
Harlem Valley Rail Trail	NY	1978	17	Asphalt
Genesee Valley Greenway	NY	1992	90	Original railroad cinders
Catskill Scenic Trail	NY	1990	26	Original railroad cinders
Catharine Valley Trail State Park	NY	2002	10	Crushed Stone
Ballston Veterans Bike Path	NY	1994	20	Asphalt
Vestal Rail Trail	NY	2002	5	Asphalt
Heritage Trail	NY	1996	11	Asphalt, Crushed Stone
Hockhocking Adena Bikeway	OH	1990	21	Asphalt
Kokosing Gap Trail	OH	1982	13.5	Asphalt
4-C Bicentennial Trail and Peace Path	OH	1972	2.5	Asphalt
Fairfield Heritage Trail	OH	1999	9.3	Asphalt
Infirmary Mound Park trails	OH	1991	7	Asphalt, Dirt
Taft Reserve Trails	OH	1992	8	Asphalt, Dirt
Lobdell Reserve Trails	OH	1992	8	Asphalt, Dirt
Holmes County Trail	OH	1995	15	Asphalt
Richland B&O Trail	OH	1999	18.4	Asphalt
Lebanon - Countryside YMCA Trail	OH	2011	8	Asphalt

Trail Name	State	Opened	Mileage	Surface
Cleveland Metro Parks	OH	1990	250	Asphalt, Crushed Stone, Dirt
Heart of Ohio Trail	OH	1989	16	Asphalt
MetroParks Bikeway	OH	1990	11	Asphalt
Bike & Hike / Towpath / Freedom	OH	1966	60.4	Asphalt
Simon Kenton Trail	OH	2003	18	Asphalt
Alum Creek Trail	OH	2010	20	Asphalt
Hock-Hocking Adena Bikeway	OH	1992	22	Asphalt
Slippery Elm Trail	OH	1995	13.5	Asphalt
Creekside trail and others	OH	2005	62	Asphalt. Concrete
Deschutes River Railbed Trail	OR	2008	16	Dirt, Soil
Deschutes River Trail (some surfacing cut off)	OR	1989	24	Crushed Stone. Asphalt, Ballast, Cinders
OC&E and Woodsline State Trail	OR	1994	108	Woodchips
Panhandle Trail in Allegheny County	PA	1999	7.5	Crushed Stone
Chester Valley Trail	PA	2007	11.5	Asphalt
Capital Area Greenbelt	PA	1978	22	Asphalt
Five Star Trail	PA	1990	7.75	Crushed Stone
McClintock Trail	PA	1996	3.5	Asphalt
Trout Island Trail	PA	1980	2.5	Asphalt
Greater Hazleton Rails to Trails	PA	2011	6	Crushed Stone
Steel Valley Trail	PA	1988	19	Asphalt
Warren/North Warren Bike/Hike Trail	PA	2011	3	Asphalt
Allegheny River Trail	PA	1983	34.2	Asphalt
Sandy Creek Trail	PA	1998	12	Asphalt
Great Allegheny Passage (Yough River Trail)	PA	2000	185	Crushed Stone
Path of the Flood Trail	PA	2012	9	Asphalt, Ballast
Luzerne County National Recreation Trail	PA	1989	1.8	Crushed Stone
Ghost Town Trail	PA	1992	18	Crushed Stone
Stavich Bike Trail	PA	1983	7	Asphalt
Swatara Rail Trail	PA	1994	10	Crushed Stone
Roaring Run Trail	PA	2005	5	Crushed Stone
Clarion-Little Toby Trail	PA	1994	18	Crushed Stone
Lebanon Valley Rail-Trail	PA	1987	15.5	Crushed Stone
Lehigh Gorge Trail	PA	1994	26	Original railroad cinders
Queen City Trail	PA	2008	1	Asphalt
Montour Trail	PA	1985	47	Crushed Stone
Pine Creek Rail Trail - Tioga County	PA	2001	27	Crushed Stone
Great Allegheny Passage - Somerset County Segment	PA	2001	42	Crushed Stone
Butler Freeport Community Trail Council	PA	1997	20.4	Crushed Stone
Warwick Trial system	PA	1992	6	Asphalt
Perkiomen Trail	PA	2010	20	Crushed Stone

APPENDIX B LIST OF PARTICIPANTS

Trail Name	State	Opened	Mileage	Surface
Lackawanna River Heritage Trail	PA	1986	35	Crushed Stone
Oil Creek State Park Bike Trail	PA	1998	9.7	Asphalt
Great Allegheny Passage	PA	1996	150	Crushed Stone
Delaware Canal State Park	PA	2003	60	Crushed Stone
West Penn Trail	PA	1991	15	Crushed Stone
Three Rivers Heritage Trail	PA	1986	24	Asphalt
D&H Rail-Trail	PA	1997	38	Original railroad cinders
York County Heritage Rail Trail	PA	1999	23.5	Crushed Stone
The Lower Trail	PA	1998	17	Crushed Stone
Redbank Valley Trail	PA	1999	51	Crushed Stone
Armstrong Trail	PA	1992	36	Crushed Stone
Plainfield Township Trail	PA	1991	6.7	Crushed Stone
Pine Creek Rail Trail - Lycoming County	PA	1992	38	Crushed Stone
Blue and White Trails	PA	2002	2	Asphalt
Delaware Canal State Park Towpath	PA	1940	60	Crushed Stone, Dirt
Coal and Coke Trail	PA	2007	5	Asphalt, Crushed Stone
Five Star Trail	PA	1997	7.5	Crushed Stone
Ironton Rail Trail	PA	1995	9.2	Asphalt
West Penn Trail	PA	2002	15	Crushed Stone
Panhandle Trail - Washington County	PA & WV	1999	17	Crushed Stone
William O'Neill/South County Bike Path	RI	2013	8	Asphalt
Shelby Farms Greenline Trail	TN	1966	6	Asphalt
High Bridge Trail State Park	VA	2007	30.9	Crushed Stone
Virginia Capital Trail	VA	2005	16	Asphalt, Boardwalk
Southern Tip Bike & Hike Trail	VA	2008	2.6	Asphalt
New River Trail State Park	VA	2007	57	Asphalt
Virginia Blue Ridge Railway Trail	VA	1987	7	Crushed Stone
Dahlgren Railroad Heritage Trail	VA	1998	15.7	Dirt, Soil
Washington & Old Dominion Trail	VA	2001	45	Asphalt
Burlington Bike Path	VT	1987	25	Asphalt
Klickitat Trail	WA	2002	31	Gravel, Dirt
Ozaukee Interurban Trail	WI	1963	29.5	Asphalt
Hank Aaron State Trail	WI	2006	14	Asphalt
Gandy Dancer Trail	WI	2001	20.3	Crushed Stone
Badger and Glacial Drumlin State Trails	WI	1984	60	Crushed Stone
Southwest Path	WI	2010	4.5	Asphalt
Mon River	WV	2008	6	Crushed Stone
Caperton Trail	WV	1999	6	Asphalt
Deckers Creek Trail	WV	1999	19	Asphalt, Crushed Stone

Pine Creek Trail, PA.

National Headquarters
2121 Ward Court, NW, 5th Floor
Washington, DC 20037
tel 202.331.9696

railtrail@railstotrails.org

railstotrails.org
www.TrailLink.com

1194266

Receipt#: 112894

CVE $46.00

CRV Not Required
Transfer Entered
Exempt from Tax

Certified Filed and/or recorded on:
9/22/2009 11:47 AM
1194266
Certificate #: 22102

Office of the Registrar of Titles
Property Records & Taxpayer Services
Washington County, MN
Kevin J Corbid, County Recorder

Return to:
OLD REPUBLIC - MPLS
400 SECOND AVENUE SOUTH
MINNEAPOLIS MN 55401

CONSERVATION EASEMENT

3749285

Receipt#: 106429

EAS $46.00

CRV Not Required
Transfer Entered
Exempt from Tax

Certified Filed and/or recorded on:
7/10/2009 8:19 AM

3749285

Office of the County Recorder
Property Records & Taxpayer Services
Washington County, MN
Kevin J Corbid, County Recorder

Return to:
OLD REPUBLIC - MPLS
400 SECOND AVENUE SOUTH
MINNEAPOLIS MN 55401

CONSERVATION EASEMENT

This is a CONSERVATION EASEMENT granted by the City of Lake Elmo, a political subdivision under the laws of the State of Minnesota, (the "Owner") to the Minnesota Land Trust, a non-profit corporation organized and existing under the laws of the State of Minnesota (the "Land Trust".)

RECITALS:

A. OWNER. The Owner is the current owner of approximately 256 acres of real property located in Washington County, Minnesota. That real property is more fully described below as the "Protected Property."

B. PROTECTED PROPERTY. The Protected Property is that real property legally described in Exhibit A and generally depicted on the "Property Map" in Exhibit B. Both exhibits are attached to this conservation easement and incorporated by this reference.

The Protected Property, known to area residents as "Sunfish Lake Park," consists of approximately 173 acres of rolling forest land that includes a number of hardwood tree species such as oak, maple, birch, and cherry. The Protected Property also consists of approximately 2 acres of woodland, 25 acres of grassland, 20 acres of wetland, and 4 acres of open water ponds. Sunfish Lake, which is classified by the Minnesota Department of Natural Resources as a natural environment lake, covers approximately 17 acres of the eastern

portion of the Protected Property. Approximately 15 acres of the site consists of cultivated fields currently planted in corn.

Two clustered residential developments with open space protected by conservation easements are located adjacent to the Protected Property, contributing to a larger expanse of open space.

Sunfish Lake Park is part of the Lake Elmo park system, and it has been used primarily as a passive park for activities such as walking, hiking, cross country skiing, horseback riding, solitude, and nature observation. The Protected Property has an unimproved divided access road and parking area, barbeque grills, a portable toilet, and fencing. A power line traverses the western portion of the Protected Property. No other structures or improvements currently exist on the Protected Property.

C. MINNESOTA LAND TRUST. The Minnesota Land Trust is a non-profit corporation organized and operated exclusively for charitable and educational purposes, including the preservation and protection of land in its natural, scenic or other open space condition. The Land Trust is a public charity as defined in Sections 501(c)(3) and 509(a) of the Internal Revenue Code and an organization qualified to hold conservation easements under Minnesota law and Section 170(h) of the Internal Revenue Code and related regulations.

D. CONSERVATION VALUES. The Protected Property has the following natural, scenic and open space qualities of significant importance:

- The Protected Property includes native upland aspen-oak and upland hardwood forests, which provide habitat for a variety of species in greatest conservation need as established by the Minnesota Department of Natural Resources in *Tomorrow's Habitat for the Wild and the Rare: An Action Plan for Minnesota's Wildlife,* Comprehensive Wildlife Conservation Strategy, 2006.

- The Protected Property also is a component of a regionally significant wildlife corridor and project focus area identified by the Minnesota Department of Natural Resources and the Metropolitan Conservation Corridors Partnership, a collaboration of public and private conservation entities funded in part by Minnesota Laws 2007, Chapter 30, Section 2, Subd.4(c).

- The undeveloped shoreline along Sunfish Lake helps maintain the water quality and near-shore aquatic habitat of the lake.

- The Protected Property provides outstanding opportunities for the public to experience, appreciate and learn about the natural and scenic environment through low-impact outdoor recreation and educational activities.

Collectively, these outdoor recreational and educational, natural, scenic and open space qualities of the Protected Property comprise its "Conservation Values."

These Conservation Values have not been and are not likely to be adversely affected to any substantial extent by the continued use of the Protected Property as described above or as authorized below or by the use, maintenance, or construction of those structures and improvements that presently exist on the Protected Property or that are authorized below.

E. CONSERVATION POLICY. Preservation of the Protected Property will further those governmental policies established by the following:

- Minnesota Statutes Chapter 116P, which establishes the Environmental and Natural Resources Trust Fund, and Minnesota Laws 2008, Chapter 367, Section 2, Subdivision 3(a), which provides funding from that Fund to accelerate programs for the purposes of planning, restoring, and protecting important natural areas in the metropolitan region and portions of the surrounding counties.

- Minnesota Statutes Chapter 103A, which promotes protection of Minnesota's waters and their adjacent lands and Minnesota Statutes Section 103A.206 in particular, which recognizes the economic and environmental importance of maintaining and enhancing the soil and water resources of this state and role of private lands in these conservation efforts.

- Minnesota Statutes Section 103A.201, which specifically promotes the protection of wetlands and Minnesota Statutes Section 103A.202, which specifically declares that it is in the public interest to preserve the wetlands of this state to conserve surface waters, maintain and improve water quality, preserve wildlife habitat, reduce runoff, provide for floodwater retention, reduce stream sedimentation, contribute to improved subsurface moisture, and enhance the natural beauty of the landscape.

- Minnesota Statutes Chapter 84C, which recognizes the importance of private conservation efforts by authorizing conservation easements for the protection of natural, scenic, or open space values of real property, assuring its availability for agriculture, forest, recreational, or open space use, protecting natural resources, and maintaining or enhancing air or water quality.

- City of Lake Elmo 2030 Comprehensive Plan, which outlines a city-wide planning policy to "evaluate available options to increase the long-term viability of its park system in an environmentally sensitive manner" (Chapter II, Page II-5), and more specifically, sets out goals to "have recreational and natural parks available to all residents" and to "prevent use of parkland for non recreational or non-conserving purposes." (Chapter IX, Page IX-2)

F. CONSERVATION INTENT. The Owner and the Land Trust are committed to protecting and preserving the Conservation Values of the Protected Property in perpetuity. Accordingly, it is their intent to create and implement a conservation easement that is binding upon the current Owner and all future owners of the Protected Property and that conveys to

the Land Trust the right to protect and preserve the Conservation Values of the Protected Property for the benefit of this generation and generations to come.

CONVEYANCE OF CONSERVATION EASEMENT:

Pursuant to the laws of the State of Minnesota, and in particular Minnesota Statutes Chapter 84C, and in consideration of the facts recited above and the mutual covenants contained herein and as an absolute and unconditional gift, the Owner hereby conveys and warrants to the Land Trust and its successors and assigns a perpetual conservation easement over the Protected Property. This conservation easement consists of the following rights, terms, and restrictions (the "Easement"):

1. CONSERVATION PURPOSE. The purpose of this Easement is to preserve and protect in perpetuity the Conservation Values of the Protected Property identified above by confining the development, management and use of the Protected Property to activities that are consistent with the preservation of these Conservation Values, by prohibiting activities that significantly impair or interfere with these Conservation Values, and by providing for remedies in the event of any violation of this Easement.

   The terms of this Easement are specifically intended to provide a significant public benefit by:

   - Providing an opportunity for the public to learn about, experience, and enjoy the out-of-doors in a significant and relatively undisturbed natural setting.
   - Protecting natural habitat that contributes to a larger complex of protected forest and wetlands that support a variety of wildlife and plants, both terrestrial and aquatic.
   - Protecting the water quality and near-shore aquatic habitat of Sunfish Lake by restricting development of the lakeshore of the Protected Property.

2. LAND USE RESTRICTIONS. Any activity on or use of the Protected Property that is inconsistent with the purposes of this Easement is prohibited.

   This prohibition specifically includes any intrusion or future development that would interfere with the essential scenic quality of the Protected Property or the visual enjoyment of the open and natural character of the Protected Property by the general public.

   Except as specifically permitted in section 3 below and without limiting the general prohibition above, restrictions imposed upon the Protected Property expressly include the following:

2.1. Industrial and Commercial Activity. No industrial or commercial use of the Protected Property is allowed except for that agricultural use, forest or habitat management, or minimal commercial recreational use specifically permitted in section 3 below.

2.2. Agricultural Use. No agricultural use of the Protected Property is allowed except as specifically permitted in section 3 below.

2.3. Residential Development. No residential use or development of the Protected Property is allowed.

2.4. Rights of Way. No new right of way shall be granted across the Protected Property by the Owner in conjunction with any industrial, commercial, or residential use or development of other land not protected by this Easement without the prior approval of the Land Trust under the provisions of section 7.7 of this Easement. This provision does not affect any rights of way existing at the time of conveyance.

The Owner may, however, grant an easement to the Commissioner of the Minnesota Pollution Control Agency as needed to permit the location, operation and maintenance of a monitoring well or wells on the Protected Property.

2.5. Division of the Protected Property. The Protected Property may not be divided, subdivided, or partitioned. The Protected Property may be conveyed only in its entirety as a single parcel under single ownership (joint or undivided) regardless of whether it now consists of separate parcels, was acquired as separate parcels, or is treated as separate parcels for property tax or other purposes.

This provision does not, however, prohibit:

- The division of the Protected Property when a portion of the Protected Property is being conveyed to a conservation organization defined in section 7.1 below.

- The correction or adjustment of boundary lines to resolve an ownership dispute.

2.6. Development Rights. No portion of the Protected Property may be used to satisfy land area requirements for other property not subject to this Easement for purposes of calculating building density, lot coverage, open space, or natural resource use or extraction under otherwise applicable laws, regulations, or ordinances controlling land use. The development rights that have been encumbered or extinguished by this Easement may not be transferred to any other property or used to obtain any regulatory mitigation credits.

2.7. Structures and Improvements. No temporary or permanent buildings, structures, utilities, roads or other improvements of any kind may be placed or constructed on the Protected Property except as specifically authorized in section 3 or as set forth below:

a. Utilities. Utility systems and facilities may be installed, maintained, repaired, extended, and replaced to serve only uses and activities specifically permitted by this Easement.

Permitted utility systems and facilities include, without limitation, all systems and facilities necessary to provide on-site power, fuel, water, waste disposal, and communication but do not include communication towers, wind turbines, or similar structures without the prior approval of the Land Trust.

Permitted utility systems and facilities shall be installed or constructed with minimal grading and disturbance to vegetation. Following installation or construction, the surface shall be restored in a timely manner to a condition consistent with the purposes of this Easement.

b. Signs. No billboards or other signs may be placed or erected on the Protected Property except for small signs for informational or interpretive purposes. These permitted small signs include signs necessary for monitoring, safety, and security purposes in conjunction with those recorded easements and agreements between the Owner and the Minnesota Pollution Control Agency.

Additionally, the Owner may also construct and maintain a park entry monument and signs as permitted in section 3.5 below. With the Owner's permission, the Land Trust may place signs on the Protected Property identifying the land as protected.

c. Roads and Parking Areas. The existing park access road and parking area may be maintained and improved but may not be widened, enlarged, or relocated without the prior written approval of the Land Trust.

No other roads or paved areas may be established or constructed on the Protected Property without the prior written approval of the Land Trust.

d. Trails. Unpaved paths or foot trails, including necessary footbridges and boardwalks, may be established and maintained for non-motorized recreational uses. Paved trails may be established and maintained only within Area 2 of the Protected Property, which is generally depicted on the Property Map attached as Exhibit B. Paved trails may be allowed in Area 1 of the Protected Property, as generally depicted on the Property Map, only as necessary to meet requirements of the American with Disabilities Act and only with advance written approval from the Land Trust. Trails shall be established, maintained and used in a manner that does not result in significant erosion or have an adverse impact on the natural and scenic quality of the Protected Property.

e. Fences. Fences may be constructed, maintained, improved, replaced or removed to mark boundaries, to secure the Protected Property, or as needed in carrying out activities permitted by this Easement and by recorded documents between the Owner and the Minnesota Pollution Control Agency, including those documents specifically referenced in section 7.5.

f. Outdoor Lighting. In order to minimize sky glow or light pollution originating from the Protected Property, no permanent outdoor lighting is permitted within Area 1 of the Protected Property. Any outdoor light fixtures within Area 2 must minimize light emitted above the plane of the horizon of the fixture through the use of earthward directed or full cut-off fixtures or lamps with single or minimal-color light sources, or other equally effective fixtures designed to minimize light pollution.

2.8. Dumping. No trash, non-compostable garbage, debris, unserviceable vehicles or equipment, junk, other unsightly material or hazardous or toxic substances may be dumped or accumulated on the Protected Property. This does not prohibit burning or composting of excess brush or other plant material resulting from activities permitted by this easement.

2.9. Mining. No mining, drilling, exploring for, or removing any minerals, sand, gravel, rock, or fossil fuels from the Protected Property is allowed.

2.10. Topography and Surface Alteration. No alteration or change in the topography or the surface of the Protected Property is allowed. This includes no ditching, draining or filling and no excavation or removal of soil or other material, except as incidental to activities or uses specifically permitted by this Easement.

Any permitted alteration shall be undertaken with minimal grading and disturbance to vegetation and with the surface restored in a timely manner to a condition consistent with the purposes of this Easement.

2.11. Water. No alteration or manipulation of natural watercourses, lakes, shorelines, wetlands or other surface or subsurface bodies of water or creation of new wetlands or water bodies is allowed except to restore or enhance wildlife habitat or native biological communities or to improve or enhance the function and quality of existing wetlands or water bodies. Any alteration or creation of wetlands or water bodies must be undertaken in accordance with a habitat management plan approved by the Land Trust under section 3 below.

No activities on or uses of the Protected Property that cause significant erosion or are seriously detrimental to water quality or purity are allowed.

2.12. Vegetation Management. No removal, cutting, pruning, trimming or mowing of any trees or other vegetation, living or dead, and no introduction of non-native species is allowed except as follows:

a. In conjunction with agricultural use and forest or habitat management as specifically permitted in section 3 below.

b. As reasonably required to construct and maintain permitted buildings, structures, roads, trails and other permitted improvements and provided that vegetation shall be restored by the Owner following any construction to a condition consistent with the purpose of this Easement.

c. As reasonably required to prevent or control insects, noxious weeds, invasive vegetation, disease, fire, personal injury, or property damage.

d. Landscaping in areas immediately adjacent to permitted buildings, within the divided entry road corridor, or as specifically authorized in section 3 below.

2.13. Vehicles. Motorized vehicles may not be used on the Protected Property except on roads or parking areas permitted under this Easement or in conjunction with construction and maintenance of permitted buildings, structures, roads, trails, or other improvements, forest or habitat management, agricultural use, or in conjunction with Minnesota Pollution Control Agency permitted activities including those permitted under the recorded documents specifically referenced in section 7.5 below. Use of motorized vehicles shall not result in significant erosion or have an adverse impact on the natural and scenic quality of the Protected Property.

3. RESERVED RIGHTS. The Owner retains all rights associated with ownership and use of the Protected Property that are not expressly restricted or prohibited by this Easement. The Owner may not, however, exercise these rights in a manner that would adversely impact the Conservation Values of the Protected Property. Additionally, the Owner must give notice to the Land Trust before exercising any reserved right that might have an adverse impact on the Conservation Values of the Protected Property.

Without limiting the generality of the above, the following rights are expressly reserved and the Owner may use and allow others to use the Protected Property as follows:

3.1. Right to Convey. The Owner may sell, give, lease, bequeath, devise, mortgage or otherwise encumber or convey the Protected Property. This right to convey the Protected Property is subject to the following:

a. Any conveyance or encumbrance of the Protected Property is subject to this Easement.

b. The Owner will reference or insert the terms of this Easement in any deed or other document by which the Owner conveys title to the Protected Property. The Owner will also specify to what extent reserved rights have been exercised, if at all, and are no longer available for use by the new owner and which reserved rights are specifically allocated to the property being conveyed in accordance with other provisions of this Easement.

c. The Owner will notify the Land Trust of any conveyance within fifteen (15) days after closing and will provide the Land Trust with the name and address of the new owner and a copy of the deed transferring title.

d. If the Protected Property is owned by a trust, business entity or any common or jointly held ownership, the Owner shall designate a representative authorized to receive notice on behalf of the owner and provide the Land Trust with the name and address of the designated representative. The Owner shall notify the Land

Trust of any change in the designated representative and provide the Land Trust with the new name, address and other contact information.

The enforceability or validity of this Easement will not be impaired or limited by any failure of the Owner to comply with this section 3.1.

3.2. Agricultural Use. Agricultural use of the Protected Property is limited to only that area designated as Cultivated Land on the Property Map attached as Exhibit B. If this area is restored to forest or grassland, then no further agricultural use is permitted.

3.3. Forest and Habitat Management. The Protected Property may be used to create, maintain, restore, or enhance habitat for wildlife and native biological communities in accordance with a restoration or habitat management plan approved in writing by the Land Trust. The Owner may remove timber and other wood products and otherwise manage the vegetation on the Protected Property in accordance with this approved plan.

3.4. Recreational and Educational Uses. The Protected Property may be used for hiking, cross-country skiing, horseback riding, nature observation or study, and other non-intensive recreational and educational programs or activities that have no more than minimal impact on the Conservation Values of the Protected Property.

The Protected Property may not be used for more than minimal commercial recreational purposes.

3.5. Recreational and Educational Structures. Minor rustic structures such as tents, trail barriers, boardwalks, overlook decks, footbridges, benches, birdhouses, and informational kiosks may be placed on the Protected Property in conjunction with permitted recreational and educational activities.

Additionally, the Owner may choose to use and develop Area 2 of the Protected Property, or a portion of it, as an educational, outdoor recreational, nature observation or interpretive center. Such use must be consistent with and must not interfere with the Conservation Values and purposes of this Easement. The size, location, and characteristics of the buildings and structures, as well as all necessary utilities, driveways, parking areas, and all other improvements associated with the facility or the uses described in this section, including a park entry monument and signs, must be in accordance with a park concept plan developed by the Owner and approved in writing by the Land Trust. All buildings, structures and improvements must be designed and constructed so as not to detract from the natural and scenic character of the Protected Property. Review and written approval of architectural plans by the Land Trust is required prior to commencing construction.

The Owner will request and obtain approvals and give the Land Trust notices as set out in section 7.7 of this Easement before beginning any construction permitted under this section.

4. LAND TRUST'S RIGHTS AND REMEDIES. In order to accomplish the purposes of this Easement to preserve and protect the Conservation Values of the Protected Property, the Land Trust has the following rights and remedies:

4.1. Right to Enter. The Land Trust has the right to enter the Protected Property at reasonable times and in a reasonable manner for the following purposes:

a. To inspect the Protected Property and to monitor compliance with the terms of this Easement.

b. To obtain evidence for use in seeking judicial or other enforcement of this Easement.

c. To survey or otherwise mark the boundaries of all or part of the Protected Property if necessary to determine whether there has been or may be a violation of this Easement. Any survey completed under this provision will be at the Owner's expense.

d. To otherwise exercise its rights under this Easement.

4.2. Right of Enforcement. The Land Trust has the right to prevent or remedy violations of this Easement, including prohibiting the construction of buildings or improvements, through appropriate judicial action brought in any court of competent jurisdiction against the Owner or other responsible party.

a. Notice. The Land Trust may not initiate judicial action until the Owner has been given notice of the violation, or threatened violation, of this Easement and a reasonable opportunity to correct the situation. This provision shall not apply if, in the sole discretion of the Land Trust, immediate judicial action is necessary to prevent or mitigate significant damage to the Conservation Values of the Protected Property or if reasonable, good faith efforts to notify the Owner are unsuccessful.

b. Remedies. In enforcing this Easement, the Land Trust has the right to:

- Temporary or permanent injunctive relief for any violation or threatened violation of this Easement.

- Require restoration of the Protected Property to its condition at the time of this conveyance or as otherwise necessitated by a violation of this Easement.

- Specific performance or declaratory relief.

- Recover damages resulting from a violation of this Easement or injury to any Conservation Values associated with the Protected Property.

These remedies are cumulative and are available without requiring the Land Trust to prove actual damage to the Conservation Values of the Protected Property.

The Land Trust and the Owner agree that the damages created by a violation of this Easement may be determined by calculating the cost of acquiring a conservation easement over similar property. The Land Trust and the Owner also recognize that restoration, regardless of cost, may be the only adequate remedy for certain violations of this Easement.

The Land Trust is entitled to seek expedited relief, ex parte if necessary, and shall not be required to post any bond applicable to a petition for such relief.

c. Costs of Enforcement. The Owner shall be responsible for all reasonable costs incurred by the Land Trust in enforcing this Easement, including without limitation costs of suit, attorneys' fees, and expenses related to restoration of the Protected Property. If, however, the Owner ultimately prevails in a judicial enforcement action, each party shall be responsible for its own costs and attorneys' fees.

d. Discretionary Enforcement. Enforcement of the terms of this Easement is solely at the discretion of the Land Trust. The Land Trust does not waive or forfeit the right to take any action necessary to assure compliance with the terms of this Easement by any delay or prior failure of the Land Trust in discovering a violation or initiating enforcement proceedings. The Land Trust shall not be barred by any applicable statute of limitations in bringing any action to enforce the term of this Easement.

e. Acts Beyond Owner's Control. The Land Trust may not bring an action against the Owner for any change to the Protected Property resulting from:

- causes beyond the Owner's control such as changes caused by fire, flood, storm, natural deterioration or the unauthorized acts of third parties, or

- reasonable actions taken in good faith under emergency conditions to prevent or mitigate damage resulting from such causes.

Actions by the Owner's lessees, agents, employees or contractors are not considered unauthorized acts of third parties.

This section does not preclude the Owner or the Land Trust from recovering damages or bringing an action against any third party for trespass or other violation of their respective rights in this Easement or in the Protected Property.

f. Right to Report. In addition to other remedies, the Land Trust has the right to report any environmental concerns or conditions or any actual or potential violations of any environmental laws to appropriate regulatory agencies.

g. Enforcement Rights of Others. Nothing in this Easement is intended to create any right to enforce this Easement in any third party where no such right otherwise exists under this Easement or under law.

4.3. Limitation on Rights. Nothing in this Easement gives the Land Trust the right or responsibility to exercise physical control over day-to-day operations on the Protected Property or to become involved in management decisions involving the use or disposal of hazardous substances or to otherwise become an operator of the Protected Property within the meaning of the Comprehensive Environmental Response, Compensation and Liability Act, the Minnesota Environmental Response and Liability Act, or other similar successor federal, state or local statutes or laws regarding responsibility for environmental conditions associated with contamination.

5. PUBLIC ACCESS AND USE. The public shall have the right to use the Protected Property and any trail established on the Protected Property for low-impact recreational and educational purposes, subject to the restrictions set out in this easement and subject to any reasonable use restrictions established by the Owner.

6. DOCUMENTATION. The current uses of the Protected Property, the state of any existing improvements, and the specific Conservation Values of the Protected Property that are briefly described in this Easement will be more fully described in a property report on file at the office of the Land Trust. The Owner and the Land Trust acknowledge that this property report will accurately represent the condition of the Protected Property at the time of this conveyance and may be used by the Land Trust in monitoring future uses of the Protected Property, in documenting compliance with the terms of this Easement and in any enforcement proceeding. This property report, however, is not intended to preclude the use of other information and evidence to document the present condition of the Protected Property in the event of a future controversy.

7. GENERAL PROVISIONS.

7.1. Assignment. This Easement may be assigned or transferred by the Land Trust only to a conservation organization defined as a qualified organization under Section 170(h) of the Internal Revenue Code and related regulations and as an authorized conservation easement holder under Minnesota law. Any future holder of this Easement shall have all of the rights conveyed to the Land Trust by this Easement.

As a condition of any assignment or transfer, the Land Trust will require any future holder of this Easement to continue to carry out the purpose of this Easement in perpetuity.

The Land Trust will notify the Owner of any assignment within thirty (30) days of the assignment and will provide the Owner with the name and address of the new holder.

7.2. Amendment. Under appropriate circumstances, this Easement may be modified or amended. However, no amendment or modification will be allowed if, in the sole and exclusive judgment of the Land Trust any of the following apply:

- The amendment does not further the purposes of this Easement.

- The amendment will adversely impact the Conservation Values of the Protected Property.

- The amendment affects the perpetual duration of this Easement.

- The amendment affects the validity of this Easement under Minnesota law or the status of the Land Trust under Sections 501(c)(3) and 170(h) of the Internal Revenue Code.

Any amendment or modification must be in writing and recorded in the same manner as this Easement.

7.3. Termination. This Easement may be terminated or extinguished only as follows:

- The Owner and the Land Trust recognize that circumstances may arise that make continued use of the Protected Property in a manner consistent with the purpose of this Easement impossible or impractical. In this event, this Easement may be extinguished through judicial proceedings.

- This Easement may be extinguished pursuant to the proper exercise of the power of eminent domain.

7.4. Proceeds. Following any extinguishment or termination of this Easement in whole or in part, the Land Trust shall be entitled to a portion of the proceeds from any sale, exchange or involuntary conversion of the Protected Property.

The Land Trust's share of the proceeds shall be an amount equal to the fair market value of this Easement at the time of the extinguishment but not less than an amount equal to the proportionate value that this Easement bears to the value of the Protected Property as a whole at the time of this conveyance (excluding the value of any permitted improvements made after the conveyance of this Easement.)

The value of this Easement shall be calculated by the method required by the Internal Revenue Service for calculating an income tax deduction for the charitable donation of a conservation easement.

The Land Trust will use its share of any proceeds in a manner consistent with the purpose of this Easement.

7.5. Warranties. The current Owner represents and warrants as follows:

a. The Owner is the sole owner of the Protected Property in fee simple and has the right and ability to convey this Easement to the Land Trust.

b. The Protected Property is free and clear of all rights, restrictions and encumbrances other than those subordinated to this Easement or otherwise specifically agreed to by the Land Trust.

c. A portion of the Protected Property is subject to the terms and restrictions of the following documents:

- Landfill Cleanup Agreement by and between Washington County, Ramsey County, the City of Lake Elmo and the Commissioner of the Minnesota Pollution Control Agency dated November 21, 1995, recorded December 14, 1995, as Document Number 866611;

- Easement in favor of the State of Minnesota dated November 13, 1995, recorded December 14, 1995, as Document Number 866615; and

- Declaration of Restrictions and Covenants dated November 13, 1995, recorded December 14, 1995, as Document Number 866619.

d. The Owner has no actual knowledge of any use or release of hazardous waste or toxic substances on the Protected Property that is in violation of a federal, state, or local environmental law and will defend, indemnify and hold the Land Trust harmless against any claims of contamination from such substances.

7.6. Ownership Responsibilities, Costs and Liabilities. The Owner retains all responsibilities and shall bear all costs and liabilities of any kind related to the use, ownership, and maintenance of the Protected Property.

a. Taxes. The Owner shall pay all real estate taxes and assessments levied against the Protected Property, including any levied against the interest of the Land Trust created by this Easement. The Land Trust may, at its discretion, pay any outstanding taxes or assessments and shall then be entitled to reimbursement from the Owner.

b. Regulatory Compliance. All activities or construction permitted by this Easement shall be undertaken in accordance with applicable federal, state and local laws, regulations and ordinances and nothing in this Easement shall be construed to exempt the Protected Property or the Owner from otherwise applicable laws or regulations.

The Owner is solely responsible for obtaining any required governmental permits.

c. Indemnity. The Owner shall defend, indemnify, and hold the Land Trust harmless from any and all costs or liability for any loss, damage, or personal injury occurring on or related to the Protected Property or the existence of this Easement, except to the extent attributable to the negligence of the Land Trust.

d. Insurance. The Owner will name the Land Trust as an additional insured on any general liability insurance policy carried by the Owner with respect to the Protected Property.

e. Future Environmental Condition. The Owner is solely responsible for Owner's use or release on the Protected Property of any hazardous or toxic substances as

defined by the Comprehensive Environmental Response, Compensation and Liability Act, the Minnesota Environmental Response and Liability Act, or other similar successor federal, state or local law or regulation regarding responsibility for environmental conditions associated with contamination. The Owner shall take all steps necessary to assure any needed containment or remediation resulting from any release of such substance.

7.7. Notice and Approval. Any notice or request for approval required by this Easement must be in writing and is subject to the following:

a. Delivery. Any required notice or request for approval must be delivered personally or sent by first class mail or other nationally recognized delivery service to the appropriate party at the following addresses (or other address specified in writing):

To the Owner:
City of Lake Elmo
3800 Laverne Avenue N.
Lake Elmo, MN 55042

To the Land Trust:
Minnesota Land Trust
2356 University Avenue West
St. Paul, MN 55114

b. Timing. Unless otherwise specified in this Easement, any required notice or request for approval must be delivered at least 30 days prior to the date proposed for initiating the activity in question.

c. Content. The notice or request for approval must include sufficient information to allow the Trust to make an informed decision on whether any proposed activity is consistent with the terms and purposes of this Easement. At a minimum, this should include:

- The location, nature, and scope of the proposed activity.
- The proposed use, design, and location of any building, structure or improvement.
- The potential impact on the Conservation Values of the Protected Property.

d. Approval. The Land Trust may withhold its approval if it determines that the proposal is inconsistent with the terms or purposes of this Easement or lacks sufficient information to allow the Land Trust to reach an informed decision. The Land Trust may condition its approval on the Owner's acceptance of modifications, which would, in the Land Trust's judgment, make the proposed activity consistent with the Easement or otherwise meet any concerns.

Approval of the Land Trust must be in writing to be effective.

7.8. Binding Effect. This Easement creates a property right immediately vested in the Land Trust and its successors and assigns that cannot be terminated or extinguished except as set out herein.

This Easement shall run with and burden the Protected Property in perpetuity. The terms of this Easement are binding and enforceable against the current Owner of the Protected Property, all successors in title to the Protected Property and all other parties entitled to possess or use the Protected Property.

If at any time the Land Trust or other holder of this Easement becomes the owner of all or a portion of the fee interest in the Protected Property, this Easement shall not be deemed to merge with the underlying fee interest but shall remain in force and effect unless otherwise terminated or extinguished as set out herein.

7.9. Definitions. Unless the context requires otherwise, the term "Owner" includes, jointly and severally, the current owner or owners of the Protected Property identified above and their personal representatives, heirs, successors and assigns in title to the Protected Property. The term "Land Trust" includes the Minnesota Land Trust and its successors or assigns to its interest in this Easement.

7.10. Termination of Rights and Obligations. A party's rights and obligations under this Easement terminate upon the transfer or termination of that party's interest in this Easement or the Protected Property, provided, however, that any liability for acts or omissions occurring prior to the transfer or termination will survive that transfer or termination.

7.11. Recording. The Land Trust will record this Easement in a timely manner in the official records for the county in which the Protected Property is located. The Land Trust may re-record this Easement or any other documents necessary to protect its rights under this Easement or to assure the perpetual enforceability of this Easement.

7.12. Interpretation. This Easement shall be interpreted as follows.

a. Controlling Law and Construction. This Easement shall be governed by the laws of the State of Minnesota and construed to resolve any ambiguities or questions of validity of specific provisions in favor of giving maximum effect to its conservation purposes and to the policies and purposes of Minnesota Statutes Chapter 84C.

b. Severability. A determination that any provision or specific application of this Easement is invalid shall not affect the validity of the remaining provisions or any future application.

c. Captions. Captions have been inserted in this document solely for convenience of reference and shall have no effect upon interpretation or construction.

d. Future Economic Condition. In conveying this Easement, the Owner has considered the possibility that uses of the Protected Property prohibited by this Easement may in the future become more economically valuable than uses permitted by this Easement and that neighboring properties may be put entirely to such prohibited uses. Such changes alone are not deemed to be circumstances justifying the extinguishment of this Easement as otherwise set forth above.

7.13. Additional Documents. The Owner agrees to execute or provide any additional documents reasonably needed by the Land Trust to carry out in perpetuity the provisions and the intent of this Easement, including, but not limited to any documents needed to correct any legal description or title matter or to comply with any federal, state, or local law, rule or regulation.

7.14. Entire Agreement. This document sets forth the entire agreement of the parties with respect to this Easement and supersedes all prior discussions or understandings.

7.15. Signatures. This Easement may be completed with the signatures of the parties to this Easement executed and notarized on separate pages which when attached to this document shall constitute one complete document.

The remainder of this page has been intentionally left blank.

IN WITNESS WHEREOF, the Owner has voluntarily executed this Conservation Easement on the 30th day of June, 2009.

OWNER:

CITY OF LAKE ELMO

By: _____
Mayor

By: _____
City Administrator

State of MINNESOTA)
) ss
County of Washington)

The foregoing instrument was acknowledged before me this 30th day of June, 2009, by Dean Johnston and Craig Dawson, the Mayor and the City Administrator, respectively, of the City of Lake Elmo, a municipal corporation in the State of Minnesota, on behalf of the City.

_____
Notary Public
My Commission Expires:

SARAH STROMMEN
Notary Public
Minnesota
My Commission Expires January 31, 2010

ACCEPTANCE

The MINNESOTA LAND TRUST hereby accepts the foregoing Conservation Easement effective as of the 30th day of June, 2009.

MINNESOTA LAND TRUST

By: _____

Title: President

State of MINNESOTA)
) ss
County of Ramsey)

The foregoing instrument was acknowledged before me this 30th day of June, 2009, by Jane Prohaska, the President of the Minnesota Land Trust, a non-profit corporation under the laws of the State of Minnesota, on behalf of said corporation.

_____
Notary Public
My Commission Expires:

SARAH STROMMEN
Notary Public
Minnesota
My Commission Expires January 31, 2010

This document drafted by:

Minnesota Land Trust
2356 University Avenue West
St. Paul, MN 55114

Exhibit A

Legal Description of the Protected Property

The Northwest Quarter of the Northwest Quarter (NW 1/4 of NW 1/4) of Section Fourteen (14), Township Twenty-nine (29), Range Twenty-one (21), and the West Thirty-three (33) feet of the Southwest Quarter of the Northwest Quarter (SW ¼ of NW ¼) of Section Fourteen (14), Township Twenty-nine (29), Range Twenty-one (21), Washington County, Minnesota.

AND

That part of the Northeast quarter of the Northwest quarter of Section 15, Township 29, Range 21, Washington County, Minnesota, described as commencing at the Northeast corner of said Northeast quarter of Northwest quarter; thence South 0° 51' 45" East, assumed bearing, along the East line thereof, 501.27 feet to the South line of the North 30 acres of said Northwest quarter and to the actual point of beginning of the land to be hereinafter described; thence South 89° 01' 54" West along said South line of North 30 acres 800 feet; thence South 0° 51' 45" East 734.30 feet; thence North 89° 01' 54" East 800 feet to the East line of said Northeast quarter of the Northwest quarter; thence North 0° 51' 45" West along said East line 734.30 feet to the actual point of beginning.

AND

The Northwest quarter of the Northeast quarter, the Northeast quarter of the Northeast quarter, the Southwest quarter of the Northeast quarter, the North three-quarters of the Southeast quarter of the Northeast quarter and that part of the East 87 feet lying South of the North three-quarters of the Southeast quarter of the Northeast quarter all in Section 15, Township 29, Range 21.

AND

The east 87 feet of that part of the Southeast quarter of Section 15, Township 29, Range 21, lying Northerly of the Northerly right of way line of State Highway #212, subject to the right of way Stillwater Lane (formerly State Highway #212).

AND

The Southwest Quarter of the Northeast Quarter of the Northwest Quarter (SW1/4 of NE ¼ of NW ¼) of Section Fourteen (14), Township Twenty-nine (29) North, Range Twenty-one (21) West, Washington County, Minnesota.

AND

The North Three (3) rods of the Northwest Quarter of the Southeast Quarter of the Northwest Quarter (NW 14/ of SE ¼ of NW1/4) of Section Fourteen (14), Township Twenty-nine (29), Range Twenty-one (21), Washington County, Minnesota.

AND

The South Forty (40) acres of Government Lot Five (5), Section Ten (10) and the Southeast Quarter of the Southwest Quarter (SE ¼ of SW ¼) of Section Ten (10). AND the North Thirty (30) acres of the North one-half of the Northwest Quarter (N ½ of NW ¼) of Section Fifteen (15), all in Township Twenty-nine (29) North of Range Twenty-one (21) West, containing 110 acres more or less.

EXCEPT:

All that part of the South 40 acres of Government Lot 5, Section 10, and the Southeast Quarter of the Southwest Quarter of Section 10, and the North 30 acres of the North One-Half of the Northwest Quarter of Section 15, all in Township 29 North, Range 21 West, Washington County, Minnesota, described as follows:

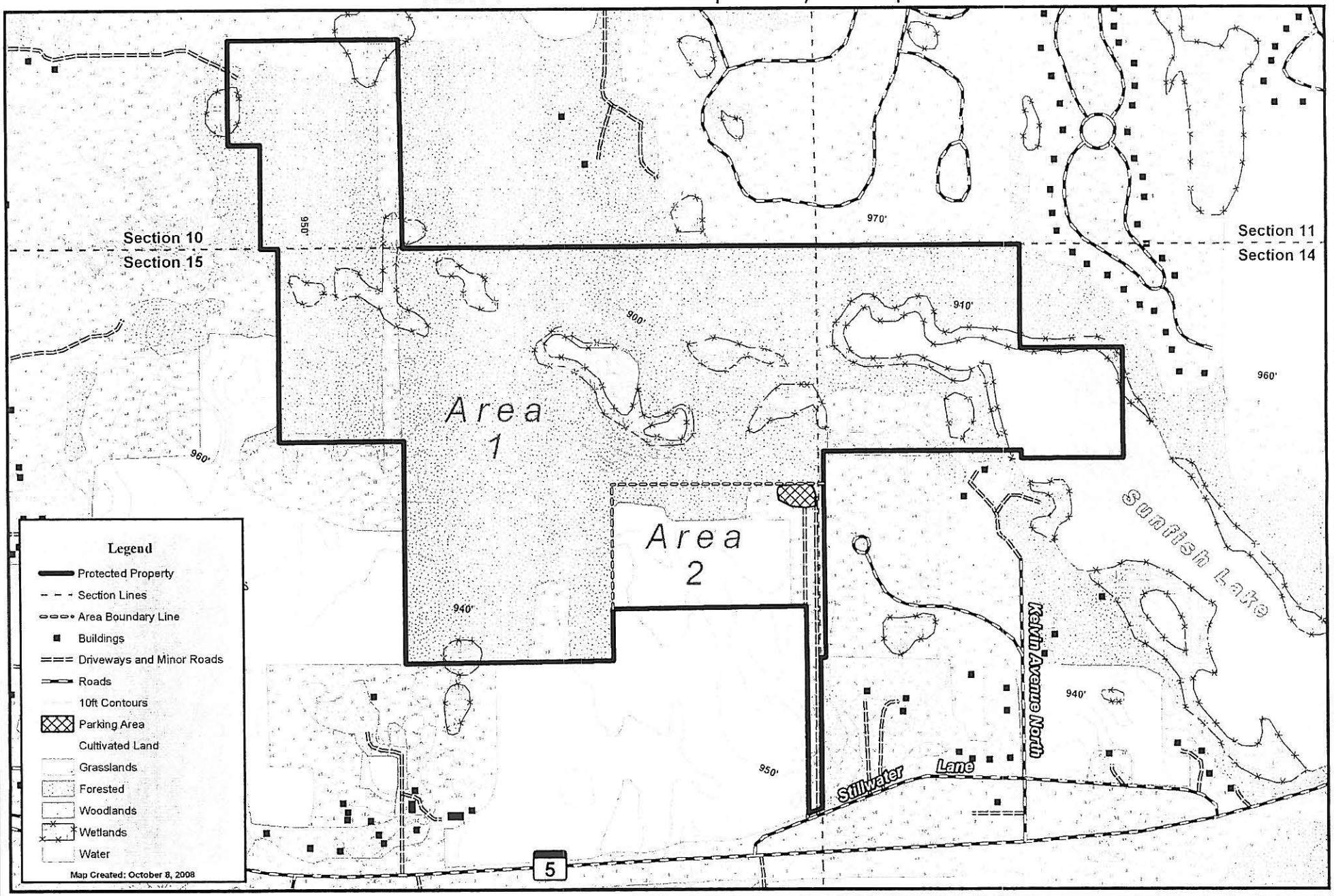
Beginning at the northwest corner of said Section 15, thence South 00 degrees, 18 minutes, 30 seconds West, bearings are based on the Washington County Coordinate System NAD83, along the west line of said Section 15, a distance of 501.27 feet to the south line of said North 30 acres of the North One-Half of the Northwest Quarter of Section 15, thence North 89 degrees, 51 minutes, 00 seconds East, along said south line, a distance of 1808.59 feet, thence North 00 degrees, 02 minutes, 32 seconds West and parallel with the east line of said Northwest Quarter of Section 15, a distance of 501.26 feet to the north line of said Section 15, thence South 89 degrees, 51 minutes, 00 seconds West, along said north line a distance of 105.52 feet, thence North 00 degrees, 53 minutes, 21 seconds West and parallel with the west line of said Section 10, a distance of 650.00 feet, thence South 89 degrees, 51 minutes, 00 seconds West and parallel with the south line of said Section 10, a distance of 200.00 feet, thence North 00 degrees, 53 minutes, 21 seconds West and parallel with the west line of said Section 10, a distance of 656.24 feet, to a point on the north line of said Southeast Quarter of the Southwest Quarter of Section 10, thence South 89 degrees, 45 minutes, 24 seconds West, along said north line, a distance of 193.17 feet to the northwest corner of said Southeast Quarter of the Southwest Quarter, thence North 00 degrees, 42 minutes, 39 seconds West, along the east line of said Government Lot 5, a distance of 29.52 feet to the northeast corner of said South 40 acres of Government Lot 5, thence South 89 degrees, 51 minutes, 00 seconds West, along the north line of said South 40 of Government Lot 5, a distance of 706.92 feet, thence South 00 degrees, 53 minutes, 21 seconds East and parallel with the west line of said Section 10, a distance of 200.00 feet, thence South 50 degrees, 54 minutes, 08 seconds West, a distance of 127.25 feet, thence South 89 degrees, 51 minutes, 00 seconds West and parallel with the north line of said South 40 acres of Government Lot 5, a distance of 500.00 feet to the west line of said Section 10, thence South 00 degrees, 53 minutes, 21 seconds East along the west line of said Section 10, a distance of 1055.45 feet to the point of beginning, containing 65.9 acres, more or less.

AND ALSO EXCEPT:

All that part of the South 40 acres of Government Lot 5, Section 10, Township 29 North, Range 21 West, Washington County, Minnesota, described as follows:

Commencing at the southwest corner of said Section 10, thence North 00 degrees, 53 minutes, 21 seconds West along the west line of said Section 10, a distance of 1055.45 feet to the point of beginning, thence continuing North 00 degrees, 53 minutes, 21 seconds West along the west line of said Section 10, a distance of 280.00 feet to the northwest corner of said South 40 acres of Government Lot 5, thence North 89 degrees, 51 minutes, 00 seconds East along the north line of said South 40 acres of Government Lot 5, a distance of 600.00 feet, thence South 00 degrees, 53 minutes, 21 seconds East and parallel with the west line of said Section 10, a distance of 200.00 feet, thence South 50 degrees, 54 minutes, 08 seconds West, a distance of 127.25 feet, thence South 89 degrees, 51 minutes, 00 seconds West and parallel with the north line of said South 40 acres of Government Lot 5, a distance of 500.00 feet to the point of beginning, containing 3.8 acres, more or less.

Exhibit B: Property Map



Map Resource Information

Protected Property, Section Lines, Area Boundary Line, Buildings, Roads, Driveways & Minor Roads, 10-Foot Contours, Parking Area, Cultivated Land, Grasslands, Forests, Woodlands, Wetlands, and Water created by Community GIS Services Inc

Users of this map agree and acknowledge that Community GIS Services Inc, and the Minnesota Land Trust cannot be held liable for accuracy of GIS material provided. GIS materials should not be relied upon to establish legal title, boundary lines, or locations of improvements.

communitygis geographic information systems

Site: Sunfish Park - Tract: City of Lake Elmo

Washington County - Twp. 29 N Rng. 21 W Sec. 10, 14 & 15

MINNESOTA LAND TRUST

Scale: 1" = 800'

800 400 0 800 Feet

Request for Proposals on Mountain Bike Trail Construction

City of Lake Elmo

Sunfish Lake Park

Proposals Due: 3-30-20XX

Address Proposals to:

Attention: Ben Prchal - City Planner
3880 Laverne Ave. N.,
Lake Elmo, MN 55042
Phone: 651-747-3911
Email: bprchal@lakeelmo.org

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PART A: GENERAL INFORMATION

SECTION 1: PROJECT DESCRIPTION AND SCOPE

1.0 General Project Description

The City of Lake Elmo is seeking a contractor to provide labor, supervision, materials (as necessary) and equipment to perform specified trail construction for a cross country/flow single track mountain bike trail system within Sunfish Lake Park.

Sunfish Lake Park is located in Lake Elmo Minnesota, which is 25 minutes from downtown St. Paul. The park consists of 268 acres of mature woodland and rolling hills. The City would like the accepted contractor to review the trail design and make adjustments to the design where appropriate, to help mitigate erosion, environmental impacts, and increase the user experience. Though the City is developing mountain bike trails within the park, preservation of the existing features is a priority and an environmentally conscious design and build is expected. There is a conservation easement over the property that is monitored by the Minnesota Land Trust. Because of this, most areas of the trail will need to be built by hand. Throughout the whole build, the City expects the selected contractor to use best practices and follow the International Mountain Bicycling Association guidelines (IMBA).

The City would like to see a flowing trail through the park that will appeal to the majority of riders. The intent is to create a trail system that is dynamic and can create an intimate experience that allows the rider to enjoy the aesthetics of the park. At this time the City does not want to see features that are technically challenging on the main trail. However, those features are not intended during this stage of the trail development. The trail should only be as wide as necessary to safely use the trail. The intent is to keep a low profile and to minimize disturbance to the park and its natural features.

1.1 Site Conditions

The terrain is hilly and forested, with elevation ranging from 920 ft. to 978ft. The City Recommends that the prospective builders visit the site as well as review the soils on the USDA Web Soil Survey. A soils map has been attached but please perform more research as necessary. The characteristics of the soil are listed as being somewhat limited. The USDA further indicates that the limitations can be overcome with appropriate trail design and installation.

1.2 Project Scope

The City has reserved funding to help support the project and the project's scope of work includes at least **22,158** feet of new construction. There is an existing trail system within the park and appropriate slowing methods will need to be used to aide in safety at those crossings. Completed work must meet the specifications outlined in "Part B Project Details." Our preference is to have work start as soon as possible to have the build done in 2019 to summer of 2020.

SECTION 2: CONTRACTOR QUALIFICATIONS, REQUIREMENTS AND RESPONSIBILITIES

2.1 Experience and Portfolio

The Contractor shall have demonstrable experience in building sustainable cross country/flow single-track trail on terrain and/or soil characteristics similar to that of Sunfish Lake Park. The Contractor shall provide a portfolio showing work accomplished and references from 3 past comparable or relevant projects. The City also wants the contractor to be able to provide a GIS file of the final trail.

2.2 Insurance

The Contractor will provide the City of Lake Elmo with a copy of current insurance policy and will show the City as additional insured and showing the type, amount, class of operations covered, effective dates, and dates of expiration of policies.

2.3 Workman's compensation

The Client reserves the right to request proof of compliance with workmen's compensation laws.

2.4 Tools

The Contractor shall perform the required work using hand tools and/or small mechanized equipment that is a maximum of 50" in width. Equipment with adjustable width tracks should be able to reduce track width to less than 50" for building the new trail. Some sites may not be suitable for equipment this large and other sites may not be suitable for any mechanized equipment regardless of size due to terrain and environmental constraints. Permanent modification of trail outside the scope of work to accommodate equipment access is not desirable and must be approved by the City before building the modification.

2.5 Mechanized equipment

All mechanized equipment shall be in good mechanical condition, free of any fluid leaks. All equipment will be clean and free of debris before introduced to work site. Equipment is subject to inspection at the start and during the project. Any equipment that appears to not meet these criteria shall be removed from the project site at the request of the Client's representative and at no additional cost to the Client.

2.6 Meetings and progress reviews

The Contractor shall meet with City Staff as necessary or as otherwise agreed upon by both parties to review progress and project expectations throughout the build.

2.7 What contractor provides

The Contractor shall provide the necessary supervision, labor, equipment and tools to perform specified trail construction on identified trails and sites, including fuel for any mechanized equipment or tools and any and all personal protection and safety equipment that may be required.

2.8 Timetable

The Contractor shall provide an approximate timetable and schedule detailing how all project work will be met.

2.9 Guarantee and Warranty

A one (1) year guarantee and warranty will be provided by the Contractor on all work of this project. Any portions needing replacement or repair within one (1) year from the date of written acceptance by the City shall be completed by the Contractor at their expense, within a time frame agreed upon by the City.

SECTION 3: FINAL INSPECTION

3.1 Final inspection

At the conclusion of the work, the contractor shall demonstrate to the City that the work is fully complete and in compliance with contract specifications. Any deficiencies shall be promptly and permanently corrected by the contractor at the contractor's expense prior to final acceptance of the work. The City also expects the contractor to provide a GIS file to be provided of the final trail route.

SECTION 4: TIMELINE AND SCHEDULE

4.1 Optional Pre-bid Site Visit

A site visit may be arranged with the project manager prior to bid submission. Please contact Ben Prchal at bprchal@lakeelmo.org to arrange a visit.

4.2 Proposal submission deadline (March 30, 2018)

Proposals must be submitted to City Hall - bprchal@lakeelmo.org no later than April XXX, 20XX to be considered.

4.3 Work Complete (October 12, 20XX)

The City of Lake Elmo would like to begin the project as soon as conditions will allow and achieve a completion date of **Fall 2020.**

SECTION 5: PROPOSAL SUBMISSION PACKAGE

Each bid proposal must be delivered via email to bprchal@lakeelmo.org by March 30, 20XX. The proposal package must contain each of the following in the order which they are listed.

- Complete the bid worksheet. If more space is needed, please provide a separate sheet and indicate that a separate sheet is being used on the form.
- A recommended project schedule and timetable.
- Three references from previous trail construction projects.
- Portfolio containing descriptions and pictures of at least three past projects similar to this project. Project descriptions shall include short explanation of work performed, client, project location, dates, and duration.
- As estimation of future annual trail maintenance costs including materials.
- The Contractor shall include in the proposal price the cost to provide the following:
    - Letter of Surety, stating ability to obtain a Performance Bond, and Labor and Material Bond for 100% of the project amount.

Any and all questions or clarifications shall be submitted via email to the project contact no later than March 22, 20XX. All questions, comments and answers provided shall be distributed via email to all respondents who requested a copy of the RFP package.

SECTION 6: BASIS FOR AWARD AND RIGHT OF REJECTION

6.1 Basis for award

The City reserves the rights to eliminate from consideration for award any or all offers at any time prior to the award of the contract; to negotiate with bidders in the competitive range; and to award the contract to the bidders submitting the bid determined to represent the best values.

6.2 Right of rejection

The City reserves the right to waive any informality in any bid, to reject any or all bids in whole or part, with or without cause, and/or to accept the proposal that in their judgment will be in the best interest of the City of Lake Elmo and its Citizens.

6.3 Qualifications and experience

The qualifications and experience of the Contractor in completing similar work will be given equal weight to price of the bids in determining value of qualified bids. It is considered in the best interest of the City to allow consideration of award to the lowest bidder or most qualified bidder regardless of cost.

6.4 Additional information

The City reserves the right to request that the bidder supply additional information prior to the award of the contract should such action be deemed in the Client's best interest.

SECTION 7: BID WORKSHEETS

7.1 Bid Worksheet A (Please know an overflow sheet may be used. Is used indicate so on the form)

Company name:_____

Contact person:_____

Contact person's phone number:_____

Contact person's email:_____

Company address:_____

_____

Statement and Detailed Approach to the Project:

_____

_____

_____

_____

References- Please insert names, address, phone numbers and description of similar projects completed.

1._____

_____

_____

2._____

_____

_____

3._____

_____

_____

Provide a detailed list of likely project team members, including skill sets and relevant experience.

Provide a list of the equipment and tools intended to be used in completing the scope of work.

Provide a recommended schedule/timetable that allows for work completion per the specified schedule.

Provide a list of other certifications or memberships, such as the Professional Trail Builders Association (PTBA).

7.2 Bid Worksheet B

- Quantities for each Trail are estimated. Final quantities may change, but the unit price will be fixed.
- Feature types (as defined in section 9.2) should be separated into individual line items.
- Feature quantities shall be determined by Contractor.
- Provide cost for one round trip mobilization and associated contractor travel fees.

Sunfish Lake Mountain Bike Trail

Type of Work:	**Unit of Measure:**	**Est. Quantity:**	**Price/Unit:**	**Est. Cost:**
Field Layout/	linear feet	22,158	_____	_____
Flagging Tread	linear feet	22,158	_____	_____
Construction			_____	_____
Mapping File		1	_____	_____
Mobilization		1	_____	_____
			_____	_____
			_____	_____
	Subtotal:		_____	_____

PART B: PROJECT DETAIL

SECTION 8: FINISHED TRAIL CONSTRUCTION AND MAINTENANCE GUIDELINES

8.1 Trail Design

The construction of this trail must be guided by the sustainable trail principles promulgated by accepted resources such as the current editions of the Trail Solutions; IMBA's Guide to Building Sweet Single-track, Managing Mountain Biking; IMBA's Guide to Providing Great Riding, Bike Parks; IMBA's Guide to New School Trails, and the USDA's Trail Construction and Maintenance Notebook.

8.2 Bike Specific Trail Flow

The bike trails proposed for Sunfish Lake would be narrow trails called single-track. Once established, single-track trails average 18-24" in width, are not paved, reach a broad range of riders and are designed to flow through natural areas with gradual inclines and declines in topography. The City is hopeful of modern trail design and construction uses sustainable trail building techniques. The City would like the Contractor to build single-track trails that can have minimal impact on the environment, resist erosion through proper design, construction and maintenance, co-exist with the natural environment and blend with the surrounding area:

· Synergy with the landscape: Making the most of what the natural terrain contours present.

· Opposition to user forces: Flow trails maximize the efficiencies afforded by using a bicycle, and are designed to counteract forces that direct a user off the trail. Bermed turns and cambered tread surfaces, for example, promote traction, safety, sustainability and enjoyment.

· Conservation of momentum: the ideal trail avoids "flow killers" such as sharp turns, incongruent features and disjointed climbs and descents. Instead, it utilizes undulations and cambered turns to reward smooth, deliberate riding and maximize forward motions. A flow trail encourages a better understanding of the bicyclist/bicycle interface, allowing riders to reach that unique sensation of floating through the landscape

· Leading the user forward: A sense of discovery, combined with a design that maximizes a rider's forward momentum, helps to draw the user forward. The trail is never repetitive or predictable, nor is it "awkward", with a variety and innovation combining to create an intuitive feel.

8.3 Trail Construction Best Practices - Staff would like the contractor to pay attention to the graphics page following the descriptions.

To satisfy erosion and sediment control requirements, the trail must be finished as the project advances. Ideally, all roughed-in corridor will be finished the same day. Any segments requiring delayed finishing should be planned out in advance to finish as quickly as possible.

8.4 Corridor Clearing

Corridor clearing shall be confined to within five (5') feet of the trail and back-slope edges. The City may expect wider clearing where the mountain bike trail crosses over an existing walking trail.

8.5 Trail Flagging

A flag line or marked line will be pre-installed by the Contractor (at a minimum of every 50 feet) marking the desired corridor, but only suggests the tread location based on the Master Trail Plan. The actual tread location depends on finer analysis and will need to be laid out using pin flags at a minimum of 20 ft. intervals.

8.6 Debris

Cut and scatter all branches and brush cut as part of the trail development. No debris shall be left within ten (10) feet of the trail. Butt-ends of any sawed limbs must face away from the trail.

8.7 Rocks

All rock embedded in the trail surface should be stable. When used in structures, care will be taken to match construction rock to rocks native to the area. Non-native rock may not be imported into the park or work area without approval of the City.

8.8 Woody Material

Woody material such as stumps, logs and brush shall be removed from the trail tread. No stumps less than twelve (12") inches in diameter shall be left within five (5') feet of the trail tread.

8.9 Fall Zone Clearing

Areas adjacent to dynamic trail segments where visitors have a greater potential to exit the immediate trail corridor will be cleared of impact focusers; butt-end branches, stumps and rocks under six (6) inches in diameter.

8.10 Back-Slope/ Out-Slope

Back-slope of trail should be graded to three-to-one (3:1) slope or until it matches the existing slope. In areas where the back-slope has the potential to become part of the active tread it must be finished to trail tread specifications.

Out-slope should range between 3-5% towards the downhill side of the trail.

8.11 Trail, Finished Condition

Hand finishing and grading of the trail tread, back-slope, down-slope spoils, and drainage features shall result in a surface that matches the texture of the surrounding forest floor while enabling water to drain off the trail.

8.12 Spoils Stabilization

All excavated material not used in the trail tread or other trail structures must be stabilized. Spoils shall be distributed in a thin layer adjacent to the trail tread. When possible, spoils should be mulched with native materials to discourage erosion while native seed stocks reestablished.

8.13 Turns

All turns are in-sloped or "bermed" where appropriate. Use generally acceptable values for turn radii and grades across the turns. All turns must include an entrance and exit rolling grade dip.

8.14 Grade Reversals

A designed grade reversal or constructed rolling grade dip should occur as often as necessary. Any grade reversal must be strongly anchored to discourage short cutting. The uphill and downhill cuts of the trail also should not exceed more than 10% of the slope of the hill/ elevation.

Grade reversals also double as flow elements: rollers and pump/rhythm sections. In this context, grade reversal shape, size and placement should reflect its placement within the system. Specific details will be determined by the contractor in partnership with the City.

8.15 Above Grade Earthen Structures

Any portion of trail above the grade of its surroundings must be approved by the City in terms of design and material before construction.

Fill structures must have a fill slope of at least two-to-one (2:1) or the angle of repose of the local soil, whichever is greater. A retaining wall may be substituted for a fill slope with prior permission of the City. Fill structures must be completely stabilized and compacted. Acceptable techniques include track-packing or compaction via a dedicated tamping unit. Raw soil faces that do not become tread must be mulched and seeded in the same fashion as spoils and satisfy the terms of the project erosion control methodologies.

Examples of above-grade earthen structures include grade-reversals (“rollers”) and turn pads on in-sloped switchbacks.

8.16 Water Diversions

The majority of the tread should be out-sloped. When not possible or desirable due to purpose-built in-sloping, resource concerns or obstruction, water can be directed down the trail for up to six (6) feet before a water diversion location (grader reversal).

8.17 Invasive Species

To reduce the spread of invasive plant species, the following protocols are required:

1 All hand tools and mechanized equipment must be free of invasive seeds and clean of any dirt and mud when entering the project site.

2 Consideration should be made while trail clearing and construction through areas occupied by invasive species (such areas to be identified by the client) as to not propagate as construction progresses.

3 Imported surface/organic material is prohibited.

8.18 Filter Strips

Filter strips are vegetated areas down-slope of the trail corridor intended to treat sheet flows coming off the tread. Filter strips function by slowing down flow velocities, filtering out sediments and providing an opportunity for infiltration into the underlying soils. Properly mulched spoils may be designated as part of the filter strip. Filter strips shall not be used as regular travel-ways for equipment and materials. Areas with inadequate filter strip capacity above water-ways may require installation of formal erosion control measures to satisfy erosion and sediment control methodologies.

8.19 Mechanized Equipment Best Practices

All track marks will be raked smooth. Affected area will be finished to have a natural shape, spoils piles rounded, smoothed and cleared of significant brush, blade edges blended, etc. A spill kit suitable for five gallons of fluid will be onsite and within 200 yards of mechanized equipment whenever equipment is being operated.

8.20 Preservation of Vegetation

The Contractor shall exercise care to preserve the natural landscape, including trees and shrubs, and shall conduct construction operations to prevent any unnecessary

destruction, scarring, or defacing of the natural surroundings in the vicinity of the work. Except where clearing is required for permanent works or excavation operations, all trees, native shrubbery, and vegetation, shall be preserved and protected from damage by the Contractor's construction operations and equipment. The City would not like to see trees larger than 8 inches in diameter removed.

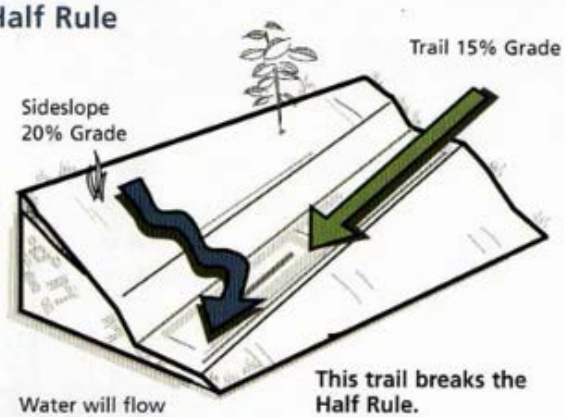
All unnecessary destruction, scarring, damage or defacing of the landscape resulting from the Contractor's operations, shall be repaired, replanted, reseeded or otherwise corrected as directed by the City and at the Contractor's expense.

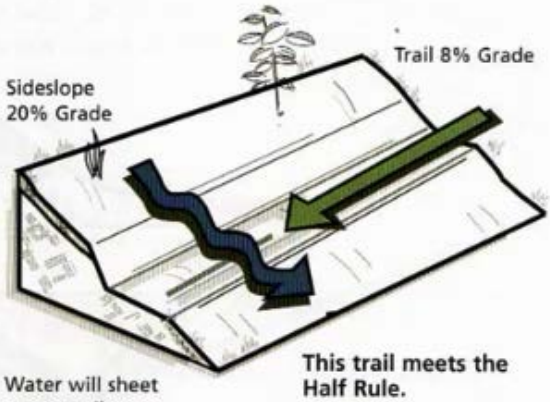
After completion of the work, all areas disturbed by construction that do not require landscaping or planting, shall be scarified and left in a condition which will facilitate natural vegetation, provide for proper drainage and prevent erosion.

8.21 Ground Disturbance

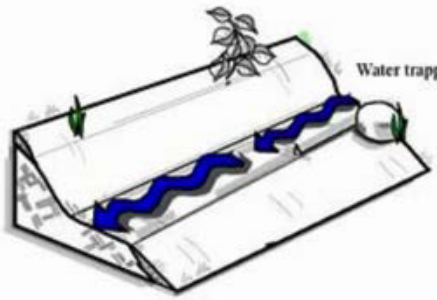
The grading limits along the trail corridor are defined by the approved tread width plus additional width defined by the required back-sloping, unless further excavation is required for prescribed features, as approved, and performed according to 8.20. Rutting should be avoided outside grading limits along the corridor, by limiting traffic intensity and avoiding wet soil conditions, and corrected as per 8.20.

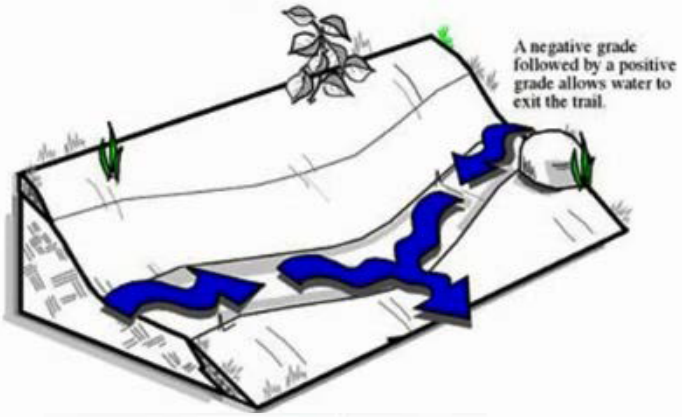
Half Rule

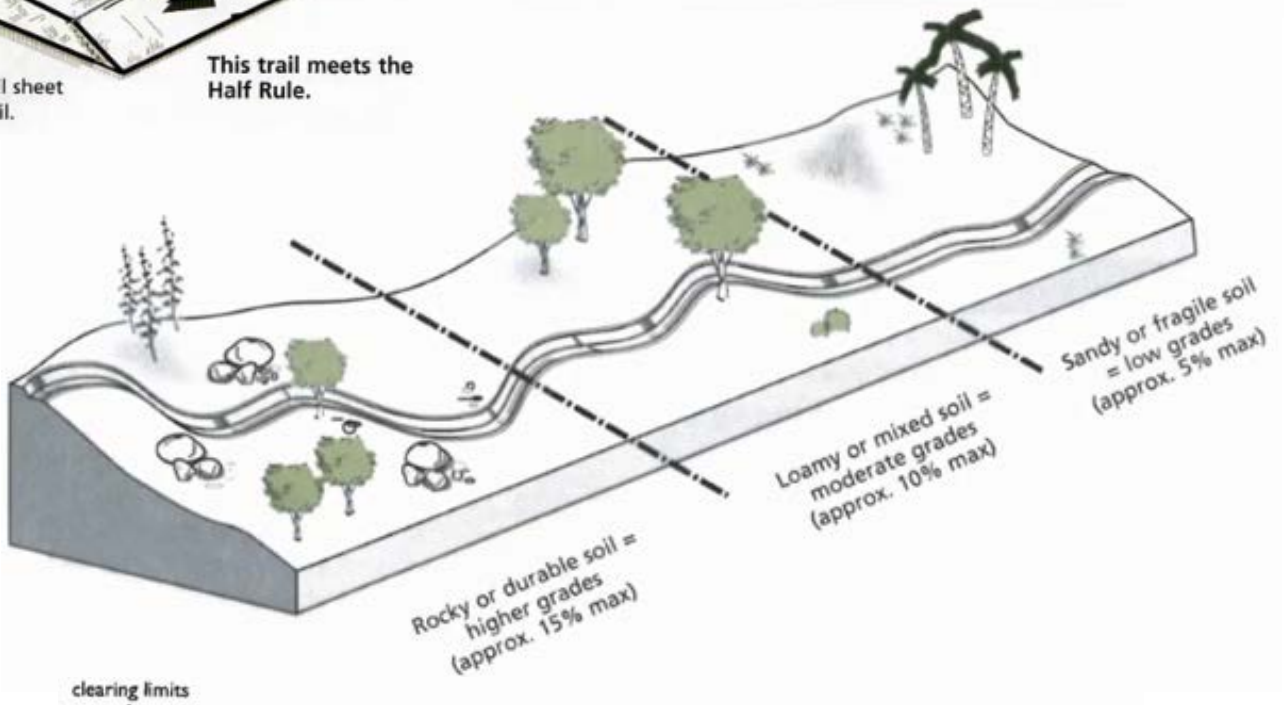


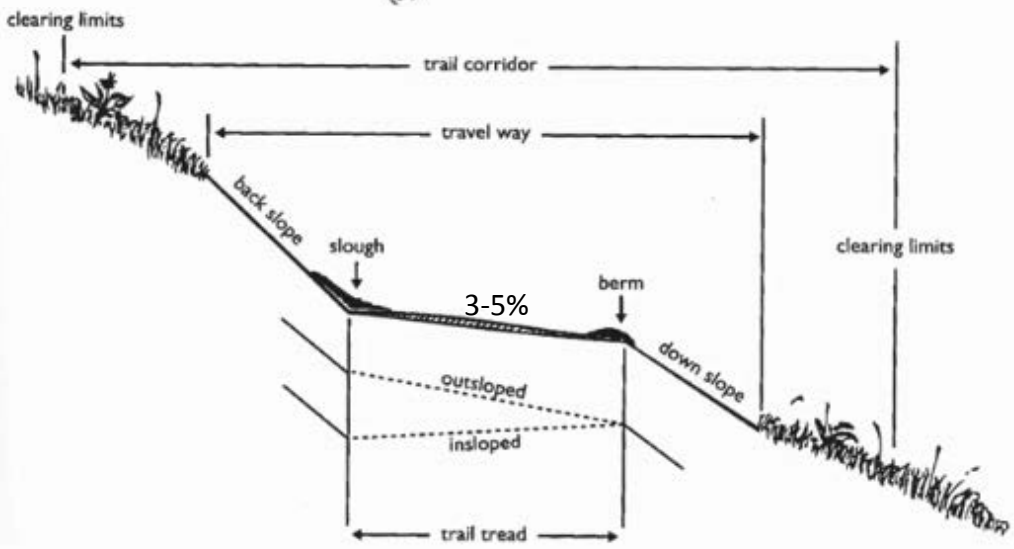


Grade Reversal









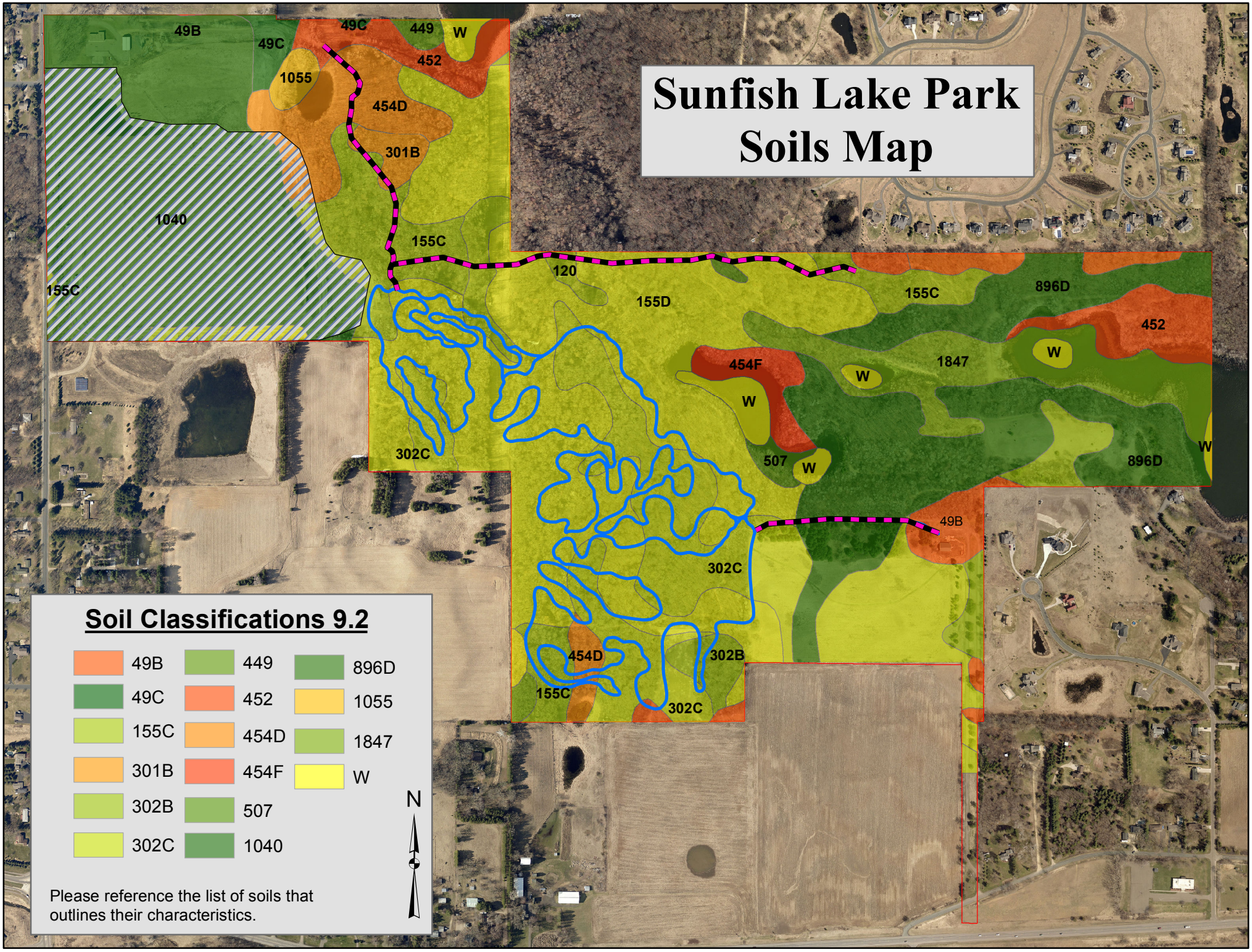
SECTION 9: MAPS

9.1 Field Design - Site Topography

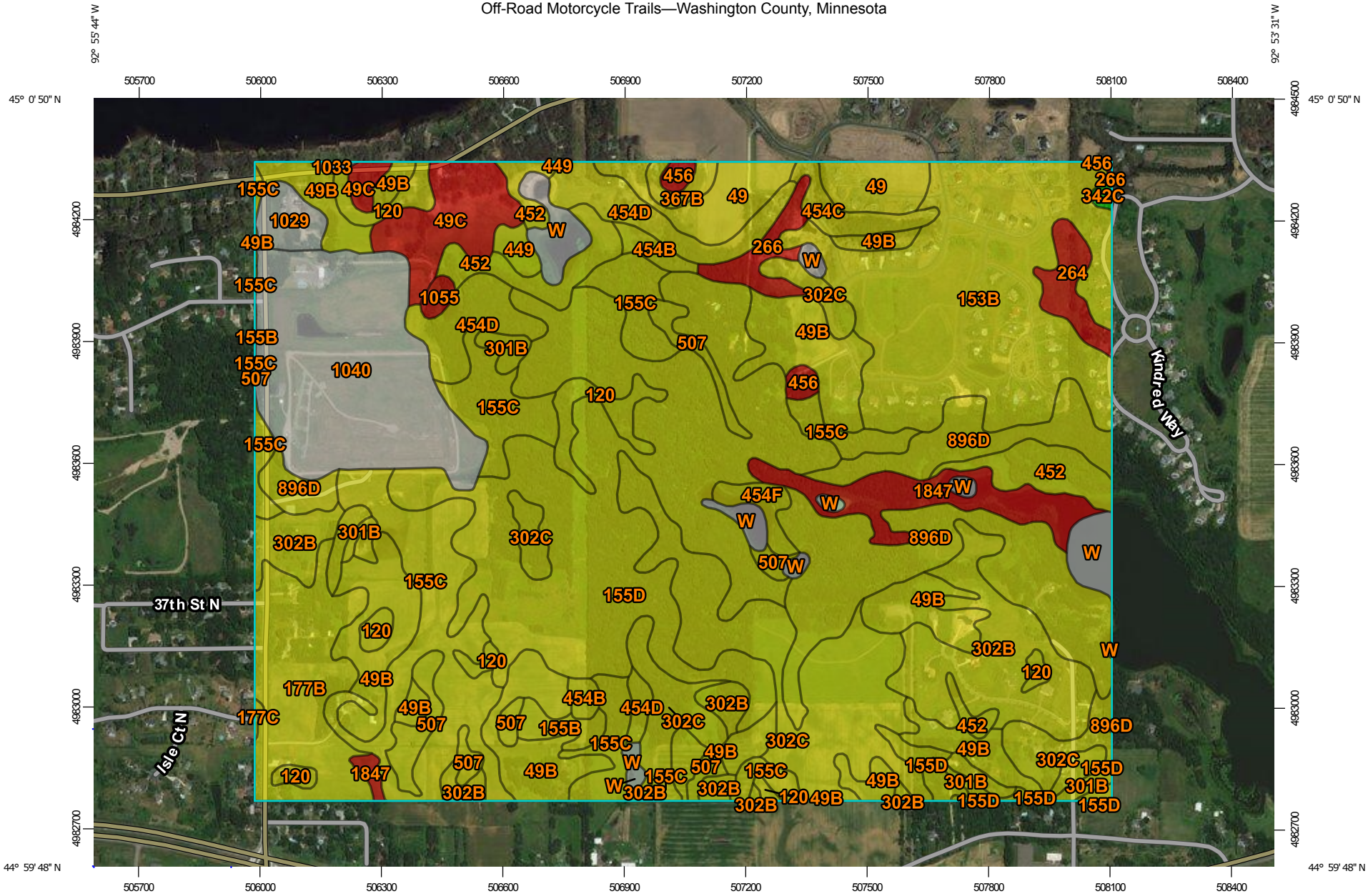
9.2 Soil Analysis

- **Map with Soil Types**

9.3 Access, Supply and Staging



DATA: USDA , Washington County



Map Scale: 1:13,300 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 150 300 600 900

Feet
0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Lines

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Points

Very limited

Somewhat limited

Not limited

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County, Minnesota
Survey Area Data: Version 14, Oct 9, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 1, 2013—Sep 13, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Off-Road Motorcycle Trails

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
12D	Emmert gravelly loamy coarse sand, 15 to 25 percent slopes	Somewhat limited	Emmert (90%)	Too sandy (0.50)	2.1	0.3%
49	Antigo silt loam, 0 to 2 percent slopes	Somewhat limited	Antigo (80%)	Dusty (0.00)	18.5	2.2%
			Billyboy (8%)	Dusty (0.00)		
			Sconsin (5%)	Depth to saturated zone (0.50)		
				Dusty (0.00)		
			Rosholt (3%)	Dusty (0.00)		
			Brill (2%)	Depth to saturated zone (0.50)		
				Dusty (0.00)		
49B	Antigo silt loam, 2 to 6 percent slopes	Somewhat limited	Antigo (80%)	Dusty (0.00)	74.1	9.0%
			Billyboy (5%)	Dusty (0.00)		
			Sconsin (5%)	Depth to saturated zone (0.50)		
				Dusty (0.00)		
			Rosholt (5%)	Dusty (0.00)		
			Brill (3%)	Depth to saturated zone (0.50)		
				Dusty (0.00)		
49C	Antigo silt loam, 6 to 15 percent slopes	Very limited	Antigo (85%)	Water erosion (1.00)	18.0	2.2%
				Dusty (0.00)		
			Ossmer (2%)	Depth to saturated zone (1.00)		
				Dusty (0.00)		
120	Brill silt loam	Somewhat limited	Brill (90%)	Dusty (0.01)	15.5	1.9%
153B	Santiago silt loam, 2 to 6 percent slopes	Somewhat limited	Santiago (90%)	Dusty (0.01)	84.8	10.3%
155B	Chetek sandy loam, 0 to 6 percent slopes	Somewhat limited	Chetek (90%)	Dusty (0.00)	3.8	0.5%

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
155C	Chetek sandy loam, 6 to 12 percent slopes	Somewhat limited	Chetek (90%)	Dusty (0.00)	71.5	8.6%
155D	Chetek sandy loam, 12 to 25 percent slopes	Somewhat limited	Chetek (90%)	Dusty (0.00)	133.4	16.1%
177B	Gotham loamy sand, 1 to 6 percent slopes	Somewhat limited	Gotham (90%)	Too sandy (0.57)	30.7	3.7%
177C	Gotham loamy sand, 6 to 12 percent slopes	Somewhat limited	Gotham (90%)	Too sandy (0.57)	0.3	0.0%
264	Freeon silt loam, 2 to 6 percent slopes	Very limited	Freeon (80%)	Depth to saturated zone (1.00)	6.6	0.8%
				Dusty (0.01)		
			Magnor (10%)	Depth to saturated zone (1.00)		
				Dusty (0.01)		
			Capitola (3%)	Depth to saturated zone (1.00)		
				Ponding (1.00)		
				Dusty (0.01)		
			Freeon, very stony (2%)	Depth to saturated zone (1.00)		
				Large stones content (0.50)		
				Dusty (0.01)		
266	Freer silt loam	Very limited	Freer (90%)	Depth to saturated zone (1.00)	6.2	0.8%
				Dusty (0.01)		
301B	Lindstrom silt loam, 2 to 4 percent slopes	Somewhat limited	Lindstrom (90%)	Dusty (0.01)	5.3	0.6%
302B	Rosholt sandy loam, 2 to 6 percent slopes	Somewhat limited	Rosholt (80%)	Dusty (0.00)	43.4	5.2%
			Scott Lake (10%)	Dusty (0.00)		
			Antigo (5%)	Dusty (0.00)		
			Chetek (3%)	Dusty (0.00)		
302C	Rosholt sandy loam, 6 to 15 percent slopes	Somewhat limited	Rosholt (85%)	Dusty (0.00)	67.9	8.2%
			Chetek (7%)	Dusty (0.00)		
			Scott Lake (2%)	Dusty (0.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
342C	Kingsley sandy loam, 6 to 12 percent slopes	Not limited	Kingsley (90%)		0.7	0.1%
367B	Campia silt loam, 0 to 8 percent slopes	Somewhat limited	Campia (90%)	Dusty (0.01)	2.7	0.3%
449	Crystal Lake silt loam, 1 to 3 percent slopes	Somewhat limited	Crystal Lake (90%)	Dusty (0.01)	2.6	0.3%
452	Comstock silt loam	Somewhat limited	Comstock (90%)	Depth to saturated zone (0.44) Dusty (0.01)	21.2	2.6%
454B	Mahtomedi loamy sand, 0 to 6 percent slopes	Somewhat limited	Mahtomedi (90%)	Too sandy (0.72)	4.3	0.5%
454C	Mahtomedi loamy sand, 6 to 12 percent slopes	Somewhat limited	Mahtomedi (90%)	Too sandy (0.72)	5.6	0.7%
454D	Mahtomedi loamy sand, 12 to 25 percent slopes	Somewhat limited	Mahtomedi (90%)	Too sandy (0.72)	25.4	3.1%
454F	Mahtomedi loamy sand, 25 to 40 percent slopes	Somewhat limited	Mahtomedi (90%)	Too sandy (0.72) Slope (0.22)	3.8	0.5%
456	Barronett silt loam	Very limited	Barronett (85%)	Depth to saturated zone (1.00) Ponding (1.00) Dusty (0.01)	2.7	0.3%
507	Poskin silt loam	Somewhat limited	Poskin (90%)	Depth to saturated zone (0.44) Dusty (0.01)	13.2	1.6%
896D	Mahtomedi-Kingsley complex, 12 to 25 percent slopes	Somewhat limited	Mahtomedi (60%)	Too sandy (0.72)	62.7	7.6%
1029	Pits, gravel	Not rated	Pits, gravel (100%)		5.7	0.7%
1033	Udifluvents	Not rated	Udifluvents (90%)		0.5	0.1%
1040	Udorthents	Not rated	Udorthents (90%)		58.7	7.1%

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
1055	Aquolls and Histosols, ponded	Very limited	Histosols, ponded (50%)	Depth to saturated zone (1.00)	1.5	0.2%
				Organic matter content (1.00)		
				Ponding (1.00)		
				Dusty (0.01)		
			Aquolls, ponded (50%)	Depth to saturated zone (1.00)		
				Ponding (1.00)		
				Dusty (0.01)		
1847	Barronett silt loam, sandy substratum	Very limited	Barronett, sandy substratum (85%)	Depth to saturated zone (1.00)	17.6	2.1%
				Ponding (1.00)		
				Dusty (0.01)		
W	Water	Not rated	Water (100%)		16.2	2.0%
Totals for Area of Interest					**827.0**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Somewhat limited	692.6	83.7%
Very limited	52.6	6.4%
Not limited	0.7	0.1%
Null or Not Rated	81.2	9.8%
Totals for Area of Interest	**827.0**	**100.0%**

Description

Off-road motorcycle trails are intended primarily for recreational use. They require little or no site preparation. They are not covered with surfacing material or vegetation. Considerable compaction of the soil material is likely.

The ratings are based on the soil properties that influence erodibility, trafficability, dustiness, and the ease of revegetation. These properties are stoniness, slope, depth to a water table, ponding, flooding, and texture of the surface layer.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

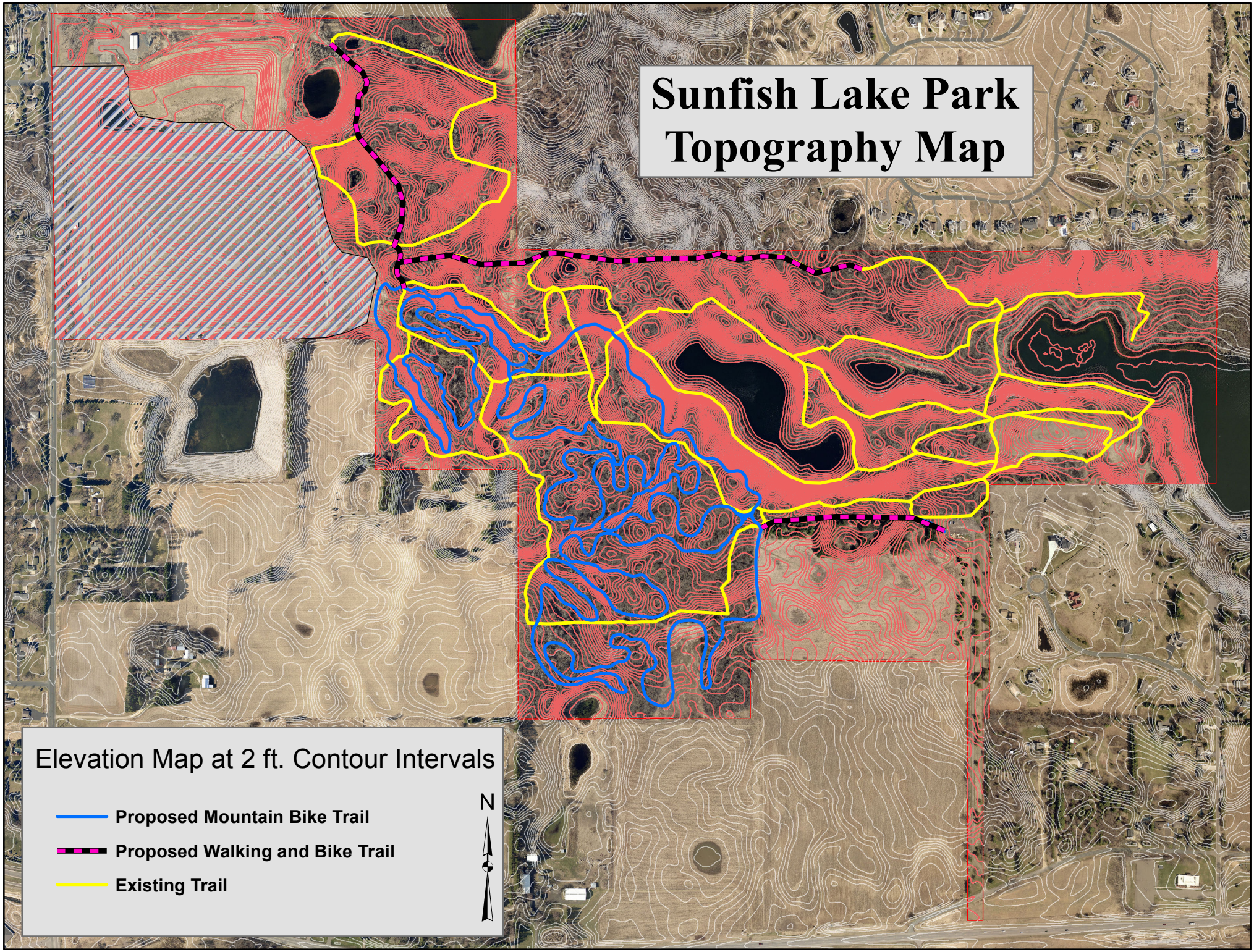
Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Rating Options

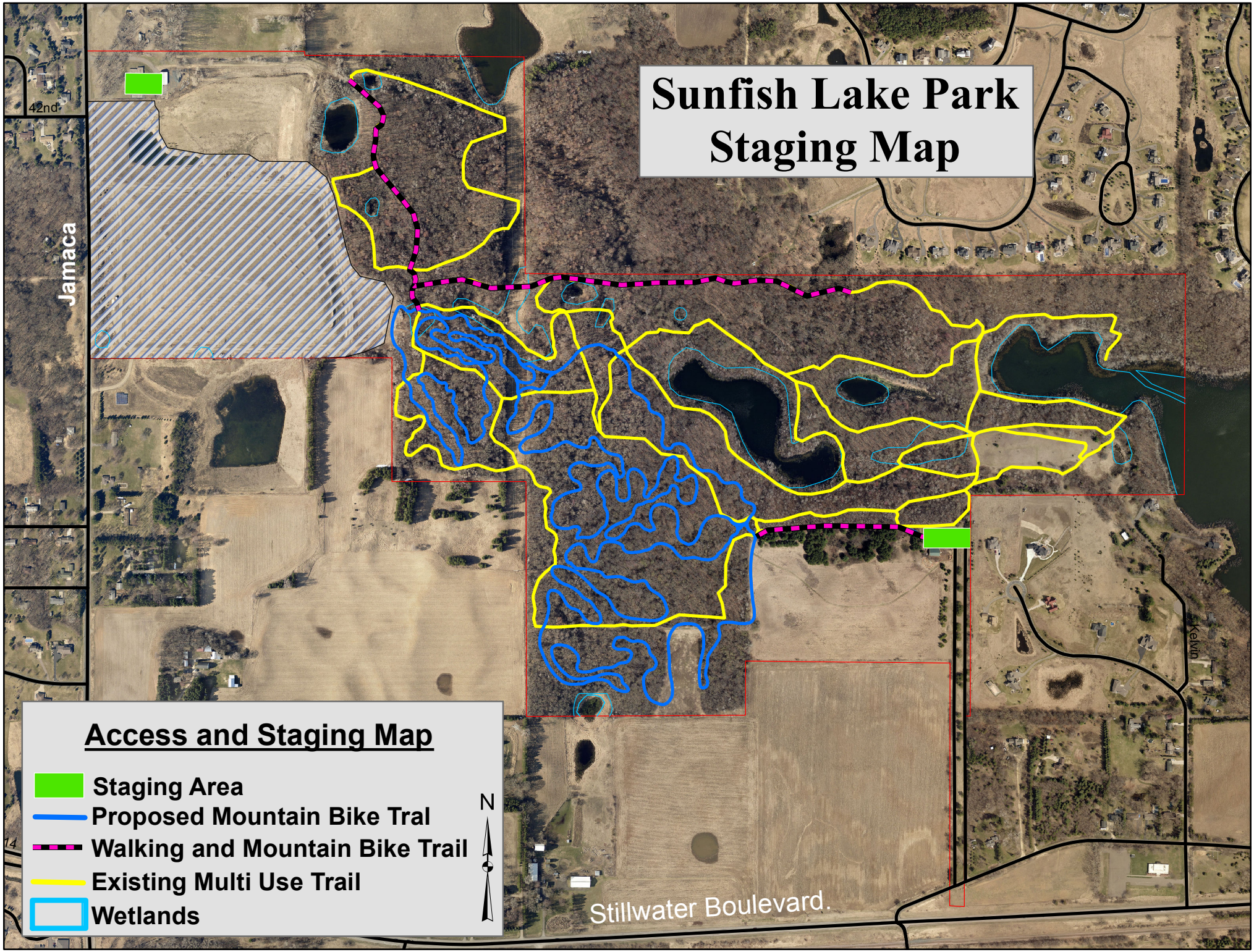
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



DATA: USDA , Washington County


Sunfish Lake Park
Staging Map
42nd
Jamaca
Kelvin
Stillwater Boulevard.
Access and Staging Map
Staging Area
Proposed Mountain Bike Tral
Walking and Mountain Bike Trail
Existing Multi Use Trail
Wetlands
N

THE CITY OF LAKE ELMO

STAFF REPORT

DATE: May 20, 2019
ITEM #:

TO: Parks Commission
FROM: Kristina Handt, City Administrator
AGENDA ITEM: 2020-2024 Parks CIP
REVIEWED BY: Ben Prchal, Planner
Marty Powers, Public Works Director

BACKGROUND:

A Capital Improvement Program, or CIP, is a multi-year (typically 5 years) capital expenditure plan for a City's infrastructure (such as streets, parks and utility systems), and equipment and public buildings. It identifies the major projects needed and desired by the community, their potential costs and how they would be financed. A project identified and budgeted through the CIP does not commit the city to that project. The City Council must specifically authorize each one, and the associated funding before any project may proceed. When the CIP is reviewed (ideally annually, in conjunction with the budgeting process) projects may go forward as planned, advance ahead of schedule, be removed entirely, or new projects may be added, these adjustments are dependent upon changes in circumstances and priorities.

The Minnesota Land Planning Act requires that the implementation plan portion of the Comprehensive Plan include a CIP for major infrastructure needs (transportation, wastewater, water supply, parks and open space) for a five-year time period. Cities often expand the scope of their CIPs to include other capital needs (major equipment replacements, for example) and sometimes look beyond the five-year time period, up to 20 years in the future for some projects. Such projects represent more of a "wish-list" that can be evaluated each time the plan is updated.

As a part of the Comprehensive Plan, the CIP has some legal standing. Minnesota Statutes Chapter 473.865 provides that "a local governmental unit shall not adopt any official control or fiscal device which is in conflict with its comprehensive plan." A fiscal device includes a budget or bond issue; so it is important that the plan and CIP be kept up to date and in synch with city budgets.
The primary benefit of a CIP is as a financial planning tool, to help the city plan for the impact of capital needs on future budgets and property taxes, and to help forecast the need for borrowing to undertake major projects. The information developed as part of the capital planning process can help document the need for various projects and help the City Council sort out competing priorities.

Lake Elmo's CIP includes all capital projects that cost at least $25,000 and have a useful life span of five years or longer.

ISSUE BEFORE COMMISSION:

What parks improvements should be included in the 2020-2024 CIP? When should they be completed?

PROPOSAL DETAILS/ANALYSIS:

Included in your packet is a document listing all of the City parks and trail projects staff is aware of at this time. Note that we have reduced the amount shown for the Central greenway Corridor only because of the five year limitation. It has been aligned to coincide with projects that Washington County has in their 2019-2023 CIP. More costs will be added as more segments of the trails are planned. City costs for the full build out may be around $3 million depending on grants, development and county cost share.

The commission may also want to consider putting a place holder in the CIP for improvements needed to other city trails throughout the community. Public works staff will be working over the summer to review all city trails and develop a maintenance plan and long range improvement plan that could be included next year in the 2021-2025 CIP.

Other Items? Any other items the Parks Commission would like to see in the 2020-2024 CIP need to be identified. Each member should come prepared to identify their top 5 priorities for the next 5 years. The commission can then also assign a priority to each project based upon the following framework:

1. Critical or urgent, high-priority projects that should be done if at all possible; a special effort should be made to find sufficient funding for all of the projects in this group.
2. Very important, high-priority projects that should be done as funding becomes available.
3. Important and worthwhile projects to be considered if funding is available; may be deferred to a subsequent year.
4. Less important, low-priority projects; desirable but not essential.
5. Future Consideration

Items Scheduled for 2019. There are projects scheduled for 2019 that have been planned for but the funds have not been spent yet. Those projects are listed below.

- Lions Park – about $93,000 more related to the improvements in the Old Village Phase 4 project
- Village Preserve/Wildflower Park-about $105,000 for new park
- Pebble Park- no bids but budgeted amount is $65,000 for paving the parking area, development of two volleyball courts and lighting and security features. Resurfacing of tennis courts and basketball court. It is unlikely that all of these improvements can be completed with the stated budget. As we have seen, volleyball courts alone cost about $10,000 apiece. The parking lot was not able to be paved with the road project in the area. The parking lot at the library for example cost about $75,000. Adjustments will need to be made to the budget or the project scope.

FISCAL IMPACT:

The fiscal impact is dependent upon project selection and available funds. The City's parkland dedication fund as of **5.3.2019 is $667,191**

2019 Expenses still to come:

Village Preserve/Wildflower	$105,000
Lions	$93,000
Pebble Park	$65,000
TOTAL 2019 Expenses	**$263,000**

Incoming Funds in 2019:

Phase 3 of Royal Golf	$140,767 For Park Dedication and tree mitigation. Funds may not be received until 2020 due to final plat extension. There will likely be one more phase of the Royal Golf development that will bring in a similar amount of funding post 2020. The $1 million dedicated to ballfields is required with Phase 3 which could come in either 2019 or 2020.
Bentley Village	Will be required to pay 10% of land value with each phase expected to begin in 2019 (estimate $280,000).

Continental Apts	Will be required to pay 10% of land value. One phase expected in 2019 (estimate $140,000)
Legacy at Northstar	City will receive payment for the equivalent of about 3 acres in future phases. Estimate is $60,000 post 2020.
Wyndham	$75,000 in 2019. Expected to complete all in one phase.

Expected Fund Balance as of 12/31/2019 - $822,958

2020 Projected Project Cost(s)	
Inwood Park	$150,000
Sunfish	$120,000
Proposed Budget for 2020	**$270,000**

OPTIONS:

1) Commission identifies additional projects to add to the 2020-2024 CIP
2) No further projects are added so just the previously-identified projects would be forwarded on in the review process by Finance and Council.

ATTACHMENTS:

- 2020-2024 Draft Capital Improvement Plan for Parks

City of Lake Elmo, Minnesota

Capital Improvement Plan - 2020 - 2024

2020 thru **2024**

PROJECTS BY FUNDING SOURCE

Source	Project #	Priority	2020	2021	2022	2023	2024	Total
Grants/Donation								
New or Refurbished Ballfields	*PR-017*	1			1,000,000			*1,000,000*
Grants/Donation Total					**1,000,000**			***1,000,000***
Park Dedication Fund								
Sunfish Lake Park Improvements	*PR-007*	3	120,000	90,000				*210,000*
Central Greenway Regional Trail	*PR-009*	3				50,000		*50,000*
New Park Development	*PR-018*	4	150,000					*150,000*
Dog Park	*PR-019*	4				25,000		*25,000*
Park Dedication Fund Total			**270,000**	**90,000**		**75,000**		***435,000***
Vehicle Replacement Fund								
Dump Truck	*PR-015*	3			90,000			*90,000*
Utility Vehicile/Trail Groomer	*PR-020*	3					37,000	*37,000*
Vehicle Replacement Fund Total					**90,000**		**37,000**	***127,000***
GRAND TOTAL			**270,000**	**90,000**	**1,090,000**	**75,000**	**37,000**	***1,562,000***

Capital Improvement Plan - 2020 - 2024

2020 *thru* 2024

City of Lake Elmo, Minnesota

Project #	PR-007
Project Name	Sunfish Lake Park Improvements

Department	Parks and Recreation
Contact	City Administrator
Type	Improvement
Useful Life	
Category	Park Improvements
Priority	3 Important
Status	Active

Description

(2020)
Development of 4 miles of mountain biking trails at $30,000 per mile per Trail Source

(2021)
Paving of trails
Cost estimate:
Improve trails to ADA standards in Area 2 (prairie area): $90,000 for 6 foot wide asphalt 1 mile trail

Justification

Explore Mt biking at direction of Council (10/17)
ADA trails consistent with Development Guide for Sunfish Lake Park as approved by MN Land Trust

Expenditures	2020	2021	2022	2023	2024	Total
Construction/Maintenance	120,000	90,000				210,000
Total	**120,000**	**90,000**				**210,000**

Funding Sources	2020	2021	2022	2023	2024	Total
Park Dedication Fund	120,000	90,000				210,000
Total	**120,000**	**90,000**				**210,000**

Budget Impact/Other

Capital Improvement Plan - 2020 - 2024

2020 *thru* 2024

City of Lake Elmo, Minnesota

Project #	PR-009
Project Name	Central Greenway Regional Trail

Department	Parks and Recreation
Contact	City Administrator
Type	Improvement
Useful Life	
Category	Park Improvements
Priority	3 Important
Status	Active

Description

Central Greenway Regional Trail beginning at CSAH 19 and I-94, traveling through Lake Elmo Park Reserve, east along Stillwater Bvld to Manning Ave and then north to TH36.

Justification

Trail would address the following community needs:
-Deliver students safely to school
-Bring people to our downtown
-Bring people to our parks
-Provide safe recreation
-Trail Diversity-Provide feel of Lake Elmo
-Omit need to bike down Hwy 5/CSAH 14
-Compatibility with public grant opportunities
-Compatibility with private funding opportunities

Feasibility of land acquisition will be a consideration

Trail likely to be built in segments in conjuction with county road projects and as funding allows through Met Council or other state grants

Expenditures	2020	2021	2022	2023	2024	Total
Construction/Maintenance				50,000		50,000
Total				**50,000**		**50,000**

Funding Sources	2020	2021	2022	2023	2024	Total
Park Dedication Fund				50,000		50,000
Total				**50,000**		**50,000**

Budget Impact/Other

Additional trails to maintain-labor and materials for snow removal if desired by city

Trail construction cost may be as high as $12 million. City would expect cost share with county as well as grants to offset costs.

2023 costs are for trail through new roundabout at CSAH 19 and CSAH 10

Future costs will be added as they are known

Capital Improvement Plan - 2020 - 2024

2020 *thru* 2024

City of Lake Elmo, Minnesota

Project #	PR-015
Project Name	Dump Truck

Department	Parks and Recreation
Contact	Public Works Director
Type	Equipment
Useful Life	
Category	Vehicles
Priority	3 Important
Status	Active

Description

550 dump pickup with hook replaces 2009 vehicle. Truck will have interchangeable boxes and flat beds for multiple uses.

Justification

End of Useful life

Expenditures	2020	2021	2022	2023	2024	Total
Equip/Vehicles/Furnishings			90,000			90,000
Total			**90,000**			**90,000**

Funding Sources	2020	2021	2022	2023	2024	Total
Vehicle Replacement Fund			90,000			90,000
Total			**90,000**			**90,000**

Budget Impact/Other

Capital Improvement Plan - 2020 - 2024

2020 *thru* 2024

City of Lake Elmo, Minnesota

Project #	PR-017
Project Name	New or Refurbished Ballfields

Department	Parks and Recreation
Contact	City Administrator
Type	Improvement
Useful Life	40 years
Category	Park Improvements
Priority	1 Critical
Status	Active

Description

New ballfields to be constructed or refurbished after Tartan ball fields are no longer used by the public

Justification

Replacement of some of the fields at Tartan Park lost to development of Royal Oaks Golf Course Community

Expenditures	2020	2021	2022	2023	2024	Total
Construction/Maintenance			1,000,000			1,000,000
Total			**1,000,000**			**1,000,000**

Funding Sources	2020	2021	2022	2023	2024	Total
Grants/Donation			1,000,000			1,000,000
Total			**1,000,000**			**1,000,000**

Budget Impact/Other

Funding to be provided from developer in development agreement with Royal Golf. Funds to be used for acquisition of land, if necessary, and builidngor refurbishing of (a) new ballfield(s).

Capital Improvement Plan - 2020 - 2024

2020 *thru* 2024

City of Lake Elmo, Minnesota

Project #	PR-018
Project Name	New Park Development

Department	Parks and Recreation
Contact	City Administrator
Type	Improvement
Useful Life	40 years
Category	Park Improvements
Priority	4 Less Important
Status	Active

Description

New park to be developed in the Wildflower/Village Preserve area in 2019 and in Inwood in 2020

Justification

Areas identified during development as a park search area to provide recreational opportunities to new residents.

Expenditures	2020	2021	2022	2023	2024	Total
Construction/Maintenance	150,000					150,000
Total	**150,000**					**150,000**

Funding Sources	2020	2021	2022	2023	2024	Total
Park Dedication Fund	150,000					150,000
Total	**150,000**					**150,000**

Budget Impact/Other

Capital Improvement Plan - 2020 - 2024

2020 *thru* 2024

City of Lake Elmo, Minnesota

Project #	PR-019
Project Name	Dog Park

Department	Parks and Recreation
Contact	Public Works Director
Type	Improvement
Useful Life	25 years
Category	Park Improvements
Priority	4 Less Important
Status	Active

Description

Parks commission recommended the search and planning for a dog park somewhere near the denser developments

Improvements would be minimal such as fencing

Justification

Residents on small lots in denser developments need a place to take their dogs for exercise.

By providing a dog park those who let their dogs run off leash in other parks can be redirected

Expenditures	2020	2021	2022	2023	2024	Total
Construction/Maintenance				25,000		25,000
Total				**25,000**		**25,000**

Funding Sources	2020	2021	2022	2023	2024	Total
Park Dedication Fund				25,000		25,000
Total				**25,000**		**25,000**

Budget Impact/Other

Capital Improvement Plan - 2020 - 2024

2020 *thru* 2024

City of Lake Elmo, Minnesota

Project #	PR-020
Project Name	Utility Vehicile/Trail Groomer

Department	Parks and Recreation
Contact	Public Works Director
Type	Equipment
Useful Life	10 years
Category	Vehicles
Priority	3 Important
Status	Active

Description

Replaces 2014 Kubota

Justification

End of Useful Life

Expenditures	2020	2021	2022	2023	2024	Total
Equip/Vehicles/Furnishings					37,000	37,000
Total					**37,000**	**37,000**

Funding Sources	2020	2021	2022	2023	2024	Total
Vehicle Replacement Fund					37,000	37,000
Total					**37,000**	**37,000**

Budget Impact/Other

Capital Improvement Plan - 2020 - 2024

2020 *thru* 2024

City of Lake Elmo, Minnesota

Project #	PR-007
Project Name	Sunfish Lake Park Improvements

Department	Parks and Recreation
Contact	City Administrator
Type	Improvement
Useful Life	
Category	Park Improvements
Priority	3 Important
Status	Active

Description

(2020)
Development of 4 miles of mountain biking trails at $30,000 per mile per Trail Source

(2021)
Paving of trails
Cost estimate:
Improve trails to ADA standards in Area 2 (prairie area): $90,000 for 6 foot wide asphalt 1 mile trail

Justification

Explore Mt biking at direction of Council (10/17)
ADA trails consistent with Development Guide for Sunfish Lake Park as approved by MN Land Trust

Expenditures	2020	2021	2022	2023	2024	Total
Construction/Maintenance	120,000	90,000				210,000
Total	**120,000**	**90,000**				**210,000**

Funding Sources	2020	2021	2022	2023	2024	Total
Park Dedication Fund	120,000	90,000				210,000
Total	**120,000**	**90,000**				**210,000**

Budget Impact/Other

Capital Improvement Plan - 2020 - 2024

2020 *thru* 2024

City of Lake Elmo, Minnesota

Project #	PR-009
Project Name	Central Greenway Regional Trail

Department	Parks and Recreation
Contact	City Administrator
Type	Improvement
Useful Life	
Category	Park Improvements
Priority	3 Important
Status	Active

Description

Central Greenway Regional Trail beginning at CSAH 19 and I-94, traveling through Lake Elmo Park Reserve, east along Stillwater Bvld to Manning Ave and then north to TH36.

Justification

Trail would address the following community needs:
-Deliver students safely to school
-Bring people to our downtown
-Bring people to our parks
-Provide safe recreation
-Trail Diversity-Provide feel of Lake Elmo
-Omit need to bike down Hwy 5/CSAH 14
-Compatibility with public grant opportunities
-Compatibility with private funding opportunities

Feasibility of land acquisition will be a consideration

Trail likely to be built in segments in conjuction with county road projects and as funding allows through Met Council or other state grants

Expenditures	2020	2021	2022	2023	2024	Total
Construction/Maintenance				50,000		50,000
Total				**50,000**		**50,000**

Funding Sources	2020	2021	2022	2023	2024	Total
Park Dedication Fund				50,000		50,000
Total				**50,000**		**50,000**

Budget Impact/Other

Additional trails to maintain-labor and materials for snow removal if desired by city

Trail construction cost may be as high as $12 million. City would expect cost share with county as well as grants to offset costs.

2023 costs are for trail through new roundabout at CSAH 19 and CSAH 10

Future costs will be added as they are known

Capital Improvement Plan - 2020 - 2024

2020 *thru* 2024

City of Lake Elmo, Minnesota

Project #	PR-015
Project Name	Dump Truck

Department	Parks and Recreation
Contact	Public Works Director
Type	Equipment
Useful Life	
Category	Vehicles
Priority	3 Important
Status	Active

Description

550 dump pickup replaces 2009 vehicle. Truck will have interchangeable boxes and flat beds for multiple uses.

Justification

End of Useful life

Expenditures	2020	2021	2022	2023	2024	Total
Equip/Vehicles/Furnishings			90,000			90,000
Total			**90,000**			**90,000**

Funding Sources	2020	2021	2022	2023	2024	Total
Vehicle Replacement Fund			90,000			90,000
Total			**90,000**			**90,000**

Budget Impact/Other

Capital Improvement Plan - 2020 - 2024

2020 *thru* 2024

City of Lake Elmo, Minnesota

Project #	PR-017
Project Name	New or Refurbished Ballfields

Department	Parks and Recreation
Contact	City Administrator
Type	Improvement
Useful Life	40 years
Category	Park Improvements
Priority	1 Critical
Status	Active

Description

New ballfields to be constructed or refurbished after Tartan ball fields are no longer used by the public

Justification

Replacement of some of the fields at Tartan Park lost to development of Royal Oaks Golf Course Community

Expenditures	2020	2021	2022	2023	2024	Total
Construction/Maintenance			1,000,000			1,000,000
Total			**1,000,000**			**1,000,000**

Funding Sources	2020	2021	2022	2023	2024	Total
Grants/Donation			1,000,000			1,000,000
Total			**1,000,000**			**1,000,000**

Budget Impact/Other

Funding to be provided from developer in development agreement with Royal Golf. Funds to be used for acquisition of land, if necessary, and builidngor refurbishing of (a) new ballfield(s).

Capital Improvement Plan - 2020 - 2024

2020 *thru* 2024

City of Lake Elmo, Minnesota

Project #	PR-018
Project Name	New Park Development

Department	Parks and Recreation
Contact	City Administrator
Type	Improvement
Useful Life	40 years
Category	Park Improvements
Priority	4 Less Important
Status	Active

Description

New park to be developed in the Wildflower/Village Preserve area in 2019 and in Inwood in 2020

Justification

Areas identified during development as a park search area to provide recreational opportunities to new residents.

Expenditures	2020	2021	2022	2023	2024	Total
Construction/Maintenance	150,000					150,000
Total	**150,000**					**150,000**

Funding Sources	2020	2021	2022	2023	2024	Total
Park Dedication Fund	150,000					150,000
Total	**150,000**					**150,000**

Budget Impact/Other

Capital Improvement Plan - 2020 - 2024

2020 *thru* 2024

City of Lake Elmo, Minnesota

Project #	PR-019
Project Name	Dog Park

Department	Parks and Recreation
Contact	Public Works Director
Type	Improvement
Useful Life	25 years
Category	Park Improvements
Priority	4 Less Important
Status	Active

Description

Parks commission recommended the search and planning for a dog park somewhere near the denser developments

Improvements would be minimal such as fencing

Justification

Residents on small lots in denser developments need a place to take their dogs for exercise.

By providing a dog park those who let their dogs run off leash in other parks can be redirected

Expenditures	2020	2021	2022	2023	2024	Total
Construction/Maintenance				25,000		25,000
Total				**25,000**		**25,000**

Funding Sources	2020	2021	2022	2023	2024	Total
Park Dedication Fund				25,000		25,000
Total				**25,000**		**25,000**

Budget Impact/Other

Capital Improvement Plan - 2020 - 2024

2020 *thru* 2024

City of Lake Elmo, Minnesota

Project #	PR-020
Project Name	Utility Vehicile/Trail Groomer

Department	Parks and Recreation
Contact	Public Works Director
Type	Equipment
Useful Life	10 years
Category	Vehicles
Priority	3 Important
Status	Active

Description

Replaces 2014 Kubota

Justification

End of Useful Life

Expenditures	2020	2021	2022	2023	2024	Total
Equip/Vehicles/Furnishings					37,000	37,000
Total					**37,000**	**37,000**

Funding Sources	2020	2021	2022	2023	2024	Total
Vehicle Replacement Fund					37,000	37,000
Total					**37,000**	**37,000**

Budget Impact/Other

THE CITY OF LAKE ELMO

STAFF REPORT

DATE: May 20, 2019
ITEM #:

TO: Parks Commission
FROM: Kristina Handt, City Administrator
AGENDA ITEM: Stantec Grant Proposal for Sunfish Lake Natural Resource Management
REVIEWED BY: Ben Prchal, Planner
Marty Powers, Public Works Director

BACKGROUND:

George Johnson mentioned at the March meeting that he had been in contact with city staff about a proposal from Paul Bockenstedt with Stantec to apply for a grant for buckthorn removal and forest management in Sunfish Lake Park. Mr. Bockenstedt did provide a letter proposal to public works last fall. A copy of that letter is included in your packet. Given that bike trails in Sunfish Lake Park had been given a higher priority for staff time and the possibility of coordination between these two efforts, staff did not support bringing this proposal forward until this time. Also the grant referenced is mostly funded in September of each year so there wasn't an urgency to bring this issue forward any sooner.

The 2018 budget had included $7,000 for forest management activities in Sunfish Lake Park. The previous public works director had applied for a grant with Great River Greening in spring 2018. That proposal did not receive state funding but would have included the following:
Focus on the northeastern side including area right off the main entrance.

$62,000 - Woody invasive removal (Buckthorn and exotic honeysuckle). Could be accomplished through cut/treat and burn piles or forestry mowing w a follow up foliar treatment of resprouts and seedlings)
$20,000 - Removal of dead down material. Some of this could be mowed up with a forestry mower, pile burned or hauled off.
$13,000 – Project management (RFP writing and release through public bid process, hiring contractor and overseeing all aspects of on the ground work making sure work being done is compliant to specifications in RFP, Grant administration and reporting)

$95,000 total budget

$88,000 (grant ask from the state)
$7,000 (City cash match)

Since that grant application was not successful, staff instead directed those 2018 funds to weed treatment and a prescribed prairie burn completed by MN Native Landscapes in the fall.

ISSUE BEFORE COMMISSION:

Would the Commission like for Mr. Bockenstedt to prepare a detailed work plan for consideration in grant applications related natural resource management at Sunfish Lake Park?

PROPOSAL DETAILS/ANALYSIS:

Stantec has offered to write the grant for no charge and suggests the MN DNR Conservation Partners Legacy Grant (CPL). FAQs about the grant requirements is attached.

The next steps would be to develop a detailed work plan to include with a grant submission later this summer. Paul's suggestions include:

- 10 acres of disturbed pioneer forest restoration (including invasive buckthorn removal, native woodland seeding, and follow-up treatments)
- 30 to 40 acres of management of oak forest areas (including invasive buckthorn/brush management and follow-up treatments)
- 5 acres of prairie/pollinator habitat restoration (including site preparation, prescribed burn, pollinator seeding and grow-in maintenance).

Staff would need to receive more details on the specific tasks and location of tasks proposed above to render a recommendation. Staff would recommend that any treatments be coordinated with the new bike trail proposal.

FISCAL IMPACT:

The CPL grant requires a 10% local match. The 2019 parks budget included $10,000 for forest management at Sunfish Lake Park.

OPTIONS:

1) Motion to seek a detailed proposal from Stantec
2) Motion to recommend to the City Council not to move forward with pursuing a grant
3) Motion to recommend to the City Council that goats be rented for buckthorn removal in Sunfish Lake Park.

ATTACHMENTS:

- October 28, 2018 Stantec Letter
- CPL FAQs

Stantec Consulting Services Inc.
2335 Highway 36 West, St. Paul MN 55113-3819

October 28, 2018

Attention: Mr. Rob Weldon, Public Works Director
City of Lake Elmo
3445 Ideal Avenue North
Lake Elmo, MN 55042

Dear Rob,

Reference: Sunfish Lake Regional Park Natural Resources Management

Thank you for the opportunity to meet with you and George Johnson recently to learn more about Sunfish Lake Regional Park and the Sally Manzara Interpretive Nature Center. After learning more about your goals for the site and the resources you currently have committed to natural resources management at this site, I am providing a recommendation for the City of Lake Elmo to consider.

After walking Sunfish Lake Park and reviewing existing natural resources information, it's clear to me that the site has a great deal of potential for achieving and sustaining gains from active ecological restoration, including activities such as invasive brush (buckthorn) management, pollinator habitat restoration in grassland/reconstructed prairie areas, restoration of pioneer/disturbed forest areas, and others.

It is my understanding that the City of Lake Elmo currently has $10,000 dedicated toward natural resources management at Sunfish Lake Park. Based on the observations I've made in the field and the things I've learned from discussing goals for the site with you, I recommend that the City consider utilizing the $10,000 as matching funds for a grant application to accomplish on-the-ground ecological restoration at the site.

While there are number of suitable grants available to accomplish restoration at the site, I would suggest considering a Minnesota Department of Natural Resources Conservation Partners Legacy (MN DNR CPL) Grant application. The MN DNR CPL Grant requires a 10% cash and/or in-kind match. This means that the $10,000 in funds currently set aside by the City could secure an additional $90,000 of CPL funds. As well, the nature center has a strong volunteer program to conduct activities such as buckthorn management - that would allow their dedication to be utilized as in-kind matching effort to secure additional CPL funds.

It is my opinion that Lake Elmo is very well situated to secure grant funding to conduct ecological restoration at Sunfish Lake Park.

I am willing to assist the City on my own time and at no charge with developing a work plan and submitting a grant application that would be anticipated to total approximately $100,000 to $125,000. I would work closely with you to develop a detailed work plan and budget that is a good fit for the City and grant program. I would recommend seeking approval from the Park Commission to utilize the $10,000 in funding currently allocated for matching grant funds and to proceed with development of a draft grant work plan that could later be presented to the commission prior to being submitted to a grant program.

Reference: **Sunfish Lake Regional Park Natural Resources Management**

While the details of a work plan would still need to be defined, I would anticipate that a grant application work plan would enable initial intense restoration activities and three years of follow-up management for approximately:

- 10 acres of disturbed pioneer forest restoration (including invasive buckthorn removal, native woodland seeding, and follow-up treatments)
- 30 to 40 acres of management of oak forest areas (including invasive buckthorn/brush management and follow-up treatments)
- 5 acres of prairie/pollinator habitat restoration (including site preparation, prescribed burn, pollinator seeding and grow-in maintenance).

Specifically related to the MN DNR CPL Grant program, the historic application period is September of each year with a potential second round of applications in January if funds remain from the initial round. If the City chooses to move forward with making an application to CPL, a potential application could be made in January 2019 or September 2019.

Again, thank you for the chance to learn more about Sunfish Lake Park and the City's goals for the site. I am excited about the potential to help Lake Elmo secure grant funding and look forward to the potential to help you reach your goals. Please let me know if you have any questions or need additional information.

Regards,

Stantec Consulting Services Inc.

Paul Bockenstedt
Ecologist/Project Manager

Phone: (651) 604-4812
Fax: (651) 636-1311
Paul.Bockenstedt@stantec.com

Attachment:
c.
bp document2

Frequently Asked Questions

Applicants

I am a new applicant and don't have a lot of grant writing experience. Is there anyone that can help me with the application process?

- The How to Apply webpage is a great place to start. This page will walk you through the process.
- Use the grant cycle comparison chart to see what type of project you should aim for. Then see details for Traditional, Metro, and Expedited projects. For Traditional and Metro grant requests under $25,000 the application is streamlined.
- If you have questions, CPL staff are available to help. Applicants are strongly advised to contact staff before beginning an application to determine whether your project will be eligible and competitive in the CPL program.
- For small organizations it is often useful to have partners to help with both applying for a grant and managing a project.

Who can apply for a CPL grant?

- Applicants can include government agencies (cities, counties, conservation districts) that are a subdivision of the state of Minnesota, federal agencies, federally recognized tribal governments, and registered 501 (c) 3 nonprofits.
- Private individuals and corporations are not eligible.

Who should fill the different roles in the application?

- Project Manager: This person applies for the grant, is responsible for the project, must be affiliated with the grantee organization, and will be the main contact.
- Land Manager: This person manages or owns the land where the project is located. The Land Manager and Project Manager cannot be the same person.
- Fiscal Contact: This person generally manages the grant funds, pays bills, makes payment requests, etc. The Project Manager and Fiscal Contact can be the same person.

Can work on private lands be funded?

- Work on private lands is only eligible if there is a permanent conservation easement on the project lands.

Can I use quotes from contractors to estimate my project budget?

- Yes. This is a good way to show that budget details are realistic. We suggest getting multiple quotes from contractors that specialize in the work you will require. Please note that pre-award planning cannot be reimbursed. If needed, quotes from contractors outside your local area can be used to ensure reasonable prices for work are being given.

What insurance documents are required?

- Grantees are required to carry insurance that meets or exceeds the requirements of the landowner whose land they will be working on. Insurance requirements are available on the CPL website. Applicants should investigate the cost of insurance before submitting an application.

I don't have access to the Natural Heritage Database system. Can someone review this for me?

- Typically CPL staff will be able to do a Heritage review for applicants who don't have access to the database. However, to ensure the review can be completed in time, it must be requested at least 10 days prior to the application deadline. Accurate maps and a description of project methods and goals will be required. There is no charge to the applicant if the applicant works directly with CPL staff for the review.

Can someone review my application before I submit it?

- Yes, CPL staff can do a brief administrative review to ensure your application is complete and eligible for funding. Please request this at least one week before the application deadline or staff may not have time to complete your request.

For acquisition projects, is a prior agreement with the current land owner required?

- An agreement is not needed, but a letter of support from the land owner could be an important supporting statement during the review process.

For acquisition projects, can I get an appraisal before applying for funds? Will the appraisal be reimbursed?

- An appraisal is helpful to show the actual value of the property, and to provide an accurate grant proposal budget. However, if an appraisal is done before applying for funds, the cost cannot be reimbursed. The cost of an appraisal can be used as match if the project is funded, as long as the appraisal is less than 12 months old.

I'm having trouble obtaining the 10% matching funds, is there any way to avoid this requirement?

- No, 10% matching funds from a non-state source are always required. This helps to encourage community participation and partnerships among organizations. In addition, there is high demand for CPL funds, and having a strong match can make a proposal more competitive.

What types of activities are not eligible for CPL funding or match?

The most common ineligible costs include:

- Indirect or overhead costs for basic operational functions (utilities, rent, office supplies)
- Work on sites not approved in the work plan, unless approved in writing from CPL staff prior to the work being done
- Research
- Education, interpretive signs, outreach, fundraising
- Planning and survey work
- Parking

- Capital equipment (e.g., vehicles, trailers, chainsaws, sprayers, etc.)
- Acquisition of land already owned by the state or a subdivision of the state
- Activities on conservation easements that are the responsibility of landowners under terms of the easement

Are engineering and design costs eligible?

- These costs are not eligible for reimbursement, but may be used for pre-award match if incurred within 18 months prior to the application deadline. Please see the RFP for details.

Can we get more time to complete our project?

- Most projects will have 3-3 ½ years for completion, depending on when the contract is executed. Although restoration and enhancement projects often take more than 3-4 years to complete, CPL contracts cannot be extended. If you anticipate a longer time scale for your project, we suggest breaking the project into clearly defined phases and using CPL funds for one phase.

Grantees

When can I start work on my project?

- No work can begin until the contract has received final DNR signatures and you have been contacted by CPL staff stating that the contract has been executed. This typically happens within a month after the grant is awarded, but depends largely on how quickly the grantee submits required documentation. Costs occurring before the grant execution date are not reimbursable.

When are annual reports due?

- Annual Accomplishment Reports are due at the end of the calendar year, but if annual work is complete, reports may be submitted early.
- Reports should be cumulative, so new information can simply be added to the prior report in consecutive years. This will make final reporting easier as well.

How do I report acres completed?

- Generally acres completed should be counted only once during the grant period, even if multiple treatments or activities occur on the same land. Your work plan should reflect this so final acres are comparable to proposed acres.

Do I need to put up CPL signs at my project sites? How many signs will I need to put up?

- Yes, signage is required by law. Signs display an 18” tall x 9” wide Legacy Logo and are shipped for free to grantees. CPL staff will contact the project manager to determine how many signs are needed. CPL staff typically coordinate one sign order for the entire program in the fall of each year.

- We generally suggest having a sign at the major access point(s) to a project area, though the number is up to the discretion of the land manager. This may be one sign for a small site with one access point, such as a trailhead or parking lot, or may include many signs for large project areas with many access points. If you're unsure how many signs are needed, please contact CPL staff.

Can I hire new staff to work on my project?

- No, the grantee organization cannot hire new staff (either permanent or temporary) using CPL funds. Existing paid staff can be reimbursed for up to 7.5% of the grant amount for project management. Of this amount, 2.5% may be used for grant administration. Personnel costs beyond 7.5% can be used for in-kind match.

Reimbursements and Payment Requests

Please see the Payment Manual for details regarding reimbursements.

Who submits payments?

- The project manager or financial contact should submit all payments, not the land manager or contractors. CPL staff can only reimburse the grantee, and grantees are responsible for paying the contractors.

Where do I submit payments?

- Please submit all payments directly to CPL staff or the general CPL email, not to DNR accounting. The preferred method of submitting payments is via email.

Can I request reimbursement at any time, or do I need to wait until the end of the grant period?

- Reimbursements can occur at any time and can include some or all of the grant costs. For the final payment request, the Final Accomplishment Report is required and 5% of the grant amount will be held back until all match is submitted.

How do I report personnel costs?

- Required documentation includes name of employee(s), dates of work, hours worked, a brief description of work, and the hourly rate. Supporting documentation for each employee should include either paystubs, payroll records, or a signed supervisor letter stating that the hours and rates are correct. The documentation is required for both grant and match funds.
- Personnel rates can include only hourly wage and fringe (FICA/Medicare, retirement, health insurance).
- Personnel rates cannot include overhead, bonuses or other indirect costs.
- Personnel costs may not exceed 7.5% of the grant amount. Of this amount, up to 2.5% may be used for grant administration costs. Personnel costs beyond 7.5% of the grant amount may be used for match.

How much can I claim for volunteers?

- As of August 1, 2015, the standard hourly volunteer rate is $20.
- Volunteers providing skilled labor or services may use current market wages if proof of wage can be provided.

Who do I contact if I have payment questions?

- CPL contact information can be found here.

General Questions

I use a Mac and have trouble using the Adobe pdf fillable forms, what should I do?

- Mac defaults to its own "Preview" program for pdfs, which sometimes doesn't work for filling in text boxes. Save the form to your computer and open it in the Adobe platform.

I forgot my password for the grant website. Can I have this reset?

- Try resetting this by clicking on "Forgot My Password" on the application page. Contact CPL staff if this does not work.

PARKS COMMISSION COMMUNICATION

DATE: May 20, 2019
REGULAR
MOTION

AGENDA ITEM: Sally Manzara Interpretive Nature Center Patio Addition
SUBMITTED BY: Ben Prchal, City Planner
REVIEWED BY: Kristina Handt, City Administrator

BACKGROUND:
At its December 2016 meeting, the Parks Commission reviewed the Draft Sally Manzara Interpretive Nature Center Development, Lease, License and Operating Agreement (Agreement) between the City and the Friends of the Lake Elmo Sunfish Lake Park (Friends) for the City to lease an acre of Sunfish Lake Park (Park) to the Friends for the purpose of constructing the Sally Manzara Interpretive Nature Center. Since then the Nature Center has held several classes and invited many groups out to the Park. Tony Manzara recently approached the City with hopes to build a patio south of the Nature Center building.

ISSUE BEFORE COMMISSION:
Would the Commission like to recommend approval of the Construction of the proposed Patio?

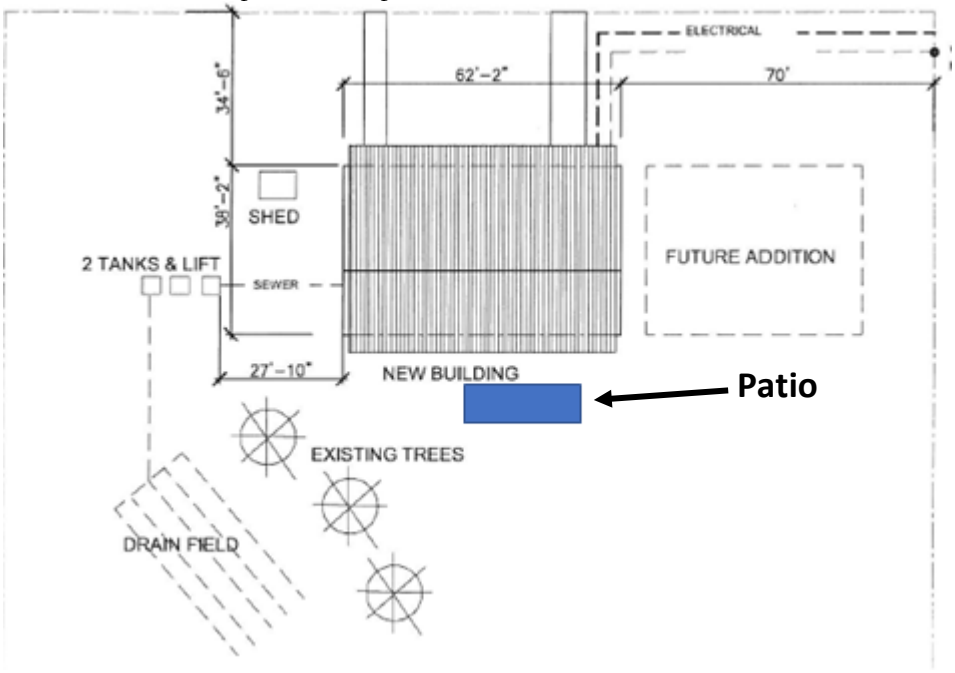
PROPOSAL DETAILS/ANALYSIS:

Land Trust Review:
Being that the Land Trust has some jurisdiction over the park, the Nature Center needed to run their proposal past them and receive approval as well. They submitted their proposal to the Land Trust and have received approval from the Land Trust. The approving letter has been included as an attachment. The Land Trust believes that the improvement to the property is in line with their values and does not conflict with the conservation easement over Area 2.

City Review:
From Staffs perspective, the City Code doesn't necessarily provide specific language to indicate one way or another as to if a patio a patio should or should not be allowed. Because of this, Staff is reviewing it from the perspective that it would be allowed because a patio is allowed in any other district so long as the setbacks could be maintained and the impervious surface allowance is not exceeded. The portion of the park that the patio will go on is 151 acres and the percentage of impervious surface that is being applied to the property is a severely small number. The proposal consists of a 15 ft. by 35 ft. patio area which measures out to 525 sq.ft.

Regarding the setbacks, the graphic that has been provided is not necessarily helpful in obtaining an accurate setback distance but Staff can reasonably deduce that there is a sufficient setback. The code for the Public Facility setback is listed as 50 ft. for accessory buildings. Staff was able to reasonably figure out that the patio would be +/-160 ft. from the property line.

The next item that Staff would review is the distance to the septic tanks and drain field. Washington County requires a 5 ft. setback from sewage tanks and a 10 ft. setback from drainfields. The patio is setback a sufficient amount from both features. The blue represents the patio.



Staff recently visited the site and noticed there was still some landscaping/site work around the building that needed to be finished. Touching up site work can be expected following a new build but Staff will be recommending that the site work, primarily on the north side (entrance) and the east side of the building be finished up.

FISCAL IMPACT:
Staff does not foresee a fiscal impact for the City.

OPTIONS:

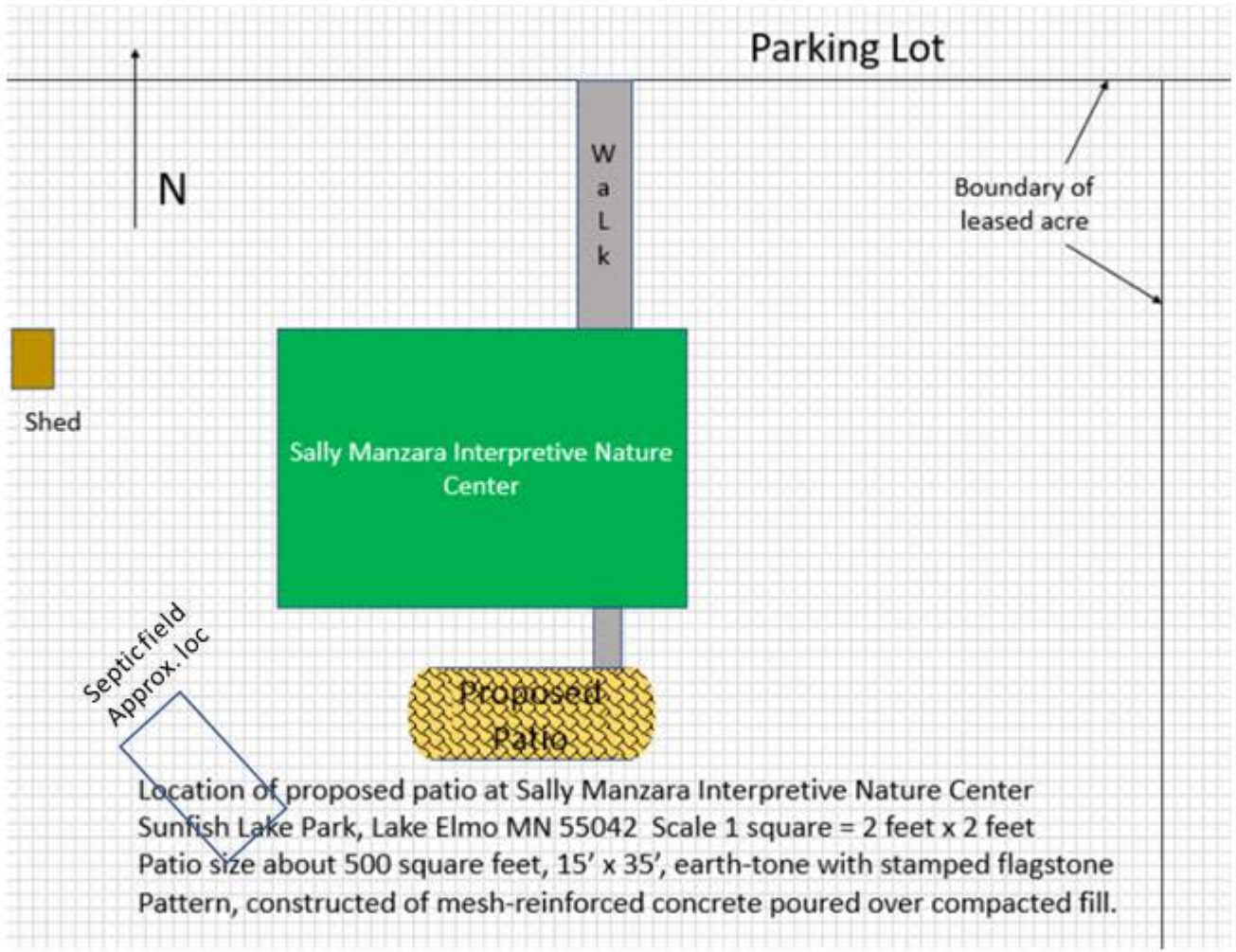
1) Recommend approval of the Sally Manzara Nature Center patio.
2) Recommend denial of the Sally Manzara Nature Center patio.

RECOMMENDATION
Staff views the patio as an improvement to the Nature Center and the park but will be recommending that the remaining to finish the remaining site work prior to the release of the permit for the patio.

"Motion to recommend approval of the patio as presented subject to the site work being completed"

ATTACHMENTS:

- Patio Proposal
- Land Trust Letter


Parking Lot
N
W
a
L
k
Boundary of
leased acre
Shed
Sally Manzara Interpretive Nature
Center
Septicfield
Approx. loc
Proposed
Patio
Location of proposed patio at Sally Manzara Interpretive Nature Center
Sunfish Lake Park, Lake Elmo MN 55042 Scale 1 square = 2 feet x 2 feet
Patio size about 500 square feet, 15' x 35', earth-tone with stamped flagstone
Pattern, constructed of mesh-reinforced concrete poured over compacted fill.

MINNESOTA LAND TRUST

April 15, 2019

Kristina Handt, City Administrator
City of Lake Elmo
3800 Laverne Avenue North
Lake Elmo, MN 55042

Re: Sunfish Lake Park (City of Lake Elmo)
Washington County
Our Project File ID #: 2009-387
Patio plan for Sally Manzara Interpretive Nature Center

Dear Ms. Handt:

The Minnesota Land Trust has reviewed the plan submitted by Tony Manzara to construct a new stamped concrete patio measuring 15 feet by 35 feet, to be located on the south side of the existing Sally Manzara Interpretive Nature Center building at Sunfish Lake Park. The plan for the patio is described in an exchange of emails between the City, the Land Trust, and Mr. Manzara.

Both the nature center and the proposed patio are in "Area 2," as described in Section 3.5 of the conservation easement protecting Sunfish Lake Park held by the Land Trust.

The proposed patio is consistent with the conservation easement and by this letter, the land trust hereby approves the plan to construct the patio.

Thanks very much.

Sincerely,

Kris Larson
Executive Director

cc: Ben Prchal, City Planner
Tony Manzara