Maintenance of Recreational Trails

Presented by: SRF Consulting Group, Inc.
2011RIC05, November 2011
Local Road Research Board (LRRB)
Mission

The LRRB serves local road transportation practitioners through:

• Development of new initiatives,
• Acquisition of and application of new knowledge, and
• Exploration and implementation of new technologies.
Technical Advisory Committee

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Bruce Holdhusen, Mn/DOT Research Services Section
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Tom Struve, City of Minnetonka
Tom Wood, Mn/DOT
Mike Marti, SRF Consulting Group
Renae Kuehl, SRF Consulting Group
Stewart Crosby, SRF Consulting Group
Presentation Objectives

1. Understand the importance of planning for trail corridor maintenance
2. Identify trail corridor maintenance activities
3. Provide insight about asset management for trails
4. Provide information and tools to city and county staff that will assist in educating decision makers on the importance of this issue
Presentation Outline

- Operational Maintenance Activities
- Trail Pavement Management
- Asset Management
- How to Build a Trail Maintenance Schedule
- Multi-Use Trail Maintenance Recap
- References
Why is Trail Management Important?

- Trail user safety
- Trail preservation
- Maintenance is cost-effective in the long run
- Community expectation- comparable level of service to other public amenities
- Requirement of all federally funded trails
Example of a Cross-Section for a “Designed” Trail

- Vertical Clearance: 10'-0"
- Clear Zone: 2'-3"
- 2'-0"
- Boulevard Width Varies, 2'-0" Min.
- Shoulder to Signs: 3'-0"
- Base Material - Extends 1'-2' Beyond Pavement
- Sub Grade
- Trail
- Clearance to Signs

- Boulevard Width Varies, 2'-0" Min.
Presentation Outline

• Operational Maintenance Activities
• Trail Pavement Management
• Asset Management
• How to Build a Trail Maintenance Schedule
• Multi-Use Trail Maintenance Recap
• References
Operational Maintenance Activities

Section Overview

• Maintenance Schedule
• Inspection Form
• General Maintenance
• Vegetation
• Drainage
• Structures
• Amenities
• Spring/Fall
• Winter
## Operational Maintenance Activities

### Trail Maintenance Schedule

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Optimal Frequency</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Safety inspection</td>
<td>Weekly: X, Monthly:</td>
<td>X</td>
</tr>
<tr>
<td>2 General debris and trash pickup</td>
<td></td>
<td>X</td>
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<tr>
<td>3 Vandalism inspection</td>
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<td>X</td>
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<tr>
<td>4 Encroachments</td>
<td></td>
<td>Ongoing</td>
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<tr>
<td><strong>Pavement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>Weekly: X</td>
<td>X</td>
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<td>2 Crack sealing</td>
<td>Monthly: X</td>
<td>X</td>
</tr>
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<td>3 Patching</td>
<td>Quarterly: X</td>
<td>Reactionary</td>
</tr>
<tr>
<td>4 Fog seal</td>
<td>Annually: X</td>
<td>As needed</td>
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<tr>
<td>5 Sealcoat</td>
<td>Spring/Fall: X</td>
<td>As needed</td>
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<td>6 Slurry seal</td>
<td>After Storm: X</td>
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<td>7 Overlay</td>
<td>Other: X</td>
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<td>8 Reconstruct</td>
<td></td>
<td>Lifespan approximately 8-10 years</td>
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<tr>
<td>9 Inspect pavement markings</td>
<td></td>
<td>Lifespan approximately 15 years</td>
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<td>10 Repaint pavement markings</td>
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</table>

Notes:
- X indicates activity is performed at specified frequency.
- Reactionary: Conduct Spring and Fall surveys.
- As needed: Lifespan approximately 4-6 years, Lifespan approximately 6-10 years, Lifespan approximately 8-10 years, Lifespan approximately 15 years.
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</tr>
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</tbody>
</table>
# Operational Maintenance Activities

## Trail Inspection Template

<table>
<thead>
<tr>
<th>Inspection Items:</th>
<th>✓ if &quot;Yes&quot;</th>
<th>Inspection Comment/Location</th>
<th>✓ if Maintenance Is Complete</th>
<th>Follow Up Comments</th>
<th>Photos Taken During Inspection: Y/N</th>
</tr>
</thead>
</table>
| 1 Pavement condition  
a. Are there cracks, surface pitting, potholes, heaves or other deficiencies in the trail surface condition? | | | | | |
| 2 Pavement markings  
a. Are pavement markings fading or chipping? | | | | | |
| 3 Overhead tree/brush trimming  
a. Is there less than 10-feet of vertical clearance across the trail and clear zones?  
b. Do the trail clear zones need to be cleared of woody vegetation? | | | | | |
| 4 Intersection sight lines (road, driveway, other trail, sidewalk)  
a. Does vegetation within the trail corridor need to be cleared to maintain sightlines from/to trail? | | | | | |
| 5 Rain gardens  
a. Is there standing water more than 48 hours after a rain event?  
b. Are there weeds/volunteer plants growing in the rain garden?  
c. Is sediment accumulating anywhere in the rain garden?  
d. Do any rain garden plants need to be replaced?  
e. Is more mulch needed?  
f. Is there erosion or gullying?  
g. Is there trash or debris in the rain garden? | | | | | |
| 6 Erosion evidence/damage  
a. Is there any erosion damage to the trail or shoulders? | | | | | |
| 7 Drainage structures & culverts  
a. Are any culverts clogged with debris?  
b. Are any catch basins clogged or blocked? (trailhead parking lots)  
c. Is there any erosion near culverts? | | | | | |
| 8 Ditch clearing  
a. Is there debris in the ditches? (trash, branches, sediment, etc.)  
b. Is there standing water in the ditches?  
c. Do ditches need mowing? | | | | | |
Operational Maintenance Activities

General Trail Maintenance

• Non-programmed activities
• Check for unsafe conditions
  – Trip hazards, etc.
• General debris and trash pickup
• Vandalism inspection
• Encroachments
  – Private uses on public property such as equipment storage
Operational Maintenance Activities

Vegetation Maintenance

- Mowing (clear zones, trailhead areas)
- Overhead trimming
- Tree removal
- Weed control

Courtesy of Three Rivers Park District
Operational Maintenance Activities

Vegetation Maintenance

- Rain garden maintenance
- Maintain sightlines (intersections, signs, other trails)
- Sweeping/blowing
- Root cutting
- Know what to mow
Operational Maintenance Activities

Drainage
• Clean culverts & catch basins
• Standing water repair
• Ditch maintenance
• Rodent damage repair
• Erosion repair
• BMP maintenance
  – Infiltration basins, vegetated filter strips, etc.

Courtesy of Three Rivers Park District
Operational Maintenance Activities

Structures

- Bridge/boardwalk inspection (non-engineering visual inspection)
- Other structures inspection (tunnels, railroad crossings, retaining walls)
- Structural inspection by a licensed engineer at regular intervals (for example, every 2 years)
Operational Maintenance Activities

Amenities

• Inspect rest stops
  o Concrete pads
  o Benches
  o Bike racks
  o Waste receptacles
  o Picnic tables

• Inspect kiosks
Operational Maintenance Activities

Amenities

• Refill pet stations
• Inspect lighting
• Inspect fencing

Courtesy of Three Rivers Park District
Operational Maintenance Activities

Spring/Fall
- Blowing/sweeping the trail
- Inspect for winter-use damage
- Turn on/off seasonal water
- Erosion repair

Snowmobile tread damage on a bituminous trail
Operational Maintenance Activities

Winter

• Install winter-use signage
• Install snowmobile protection on bridge decks and trail crossings
• Plow trails and trailheads
• Groom winter-use trails (if applicable)
Presentation Outline

- Operational Maintenance Activities
- Trail Pavement Management
- Asset Management
- How to Build a Trail Maintenance Schedule
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Trail Pavement Management

Section Overview

- Build it Right the First Time
- Pavement Life Cycle
- Causes of pavement failure
- Typical trail pavement failure types & treatments
Trail Pavement Management

“Build it Right the First Time”

- Proper initial construction saves money over the life of a trail
- Review plans for trail construction by developers or other agencies to confirm the proper specifications are being followed
- Inspect trail construction

[Diagram of trail pavement section showing sub-base, base, and asphalt surface]
Trail Pavement Management

Pay Now or Pay More Later

**Condition**
- Excellent
- Good
- Fair
- Poor
- Very Poor

**Time**

- Preventive Maintenance $1.50/sy
- Minor Rehabilitation $19/sy
- Major Rehabilitation $32/sy
- Reconstruction $95/sy

Source: LRRB
Trail Pavement Management

Pavement Life Cycle

- Critical Condition
- Cost-effective time for preventative maintenance
- Cost-effective time for minor rehabilitation
- Costly treatments needed

Source: LRRB
Trail Pavement Management

Causes of Trail Pavement Failure

• Environmental
  o Damage caused by sunlight, oxidation, water and/or thermal cycling, age of trail, vegetation

• Traffic (Type & Frequency)
  o Maintenance equipment, emergency vehicles, utility vehicles, wear, seasonal weaknesses

• Improper Trail Construction
  o Designed trail vs. built-up trail
  o Quality of materials and/or construction
Trail Pavement Management

Issue #1: Cracking

Problems

• Longitudinal cracks
  o Cracks parallel to the direction of traffic typically caused by heavy loading or by lateral movement of the sub-grade.

• Transverse cracks
  o Cracks perpendicular to the direction of traffic often caused by thermal cycling.

• Edge cracks
  o Cracks parallel to the outer trail edge or scalloped which are typically caused by loading or insufficient width of sub-grade support under trail edge

• Cracks from vegetation
  o Cracks caused by root growth or sprouting seeds.
Trail Pavement Management
Issue #1: Cracking

Treatments

• Crack filling/sealing
  A maintenance procedure that involves placing an elastic material (for sealing) and a rigid material (for filling) into cracks to prevent infiltration of water and other substances into the pavement structure. Overbanding should be less than 1” wide, less than 1/16” thick and routing, if done, should be less than ½” wide.
  o Lifespan: 3-5 years
  o Cautions: Application dependent, soft in hot weather
  o Benefits: Reduce pavement deterioration, extend pavement life
  o Cost: $$ $$

Courtesy of LRRB and Mn/DOT Office of Materials and Road Research.
Trail Pavement Management

Issue #1: Cracking (Caused by Vegetation)

Treatments

• Root barriers
  Placing a physical barrier in the ground to block roots from getting under the trail pavement

• Full-depth patching
  A pavement repair treatment that involves saw cutting and removing damaged asphalt and filling with a hot-mix bituminous mixture
Trail Pavement Management
Issue #2: Surface Deterioration

Problems

• Aging surface
  o The asphalt surface is several years old and the process of oxidation has started.

• Raveling
  o Progressive disintegration of the surface downward caused by the loss of binder and dislodged aggregate.
Trail Pavement Management
Issue #2: Surface Deterioration

Treatments

• Fog seal
  Diluted asphalt emulsion without a cover aggregate which is used to seal and protect the asphalt pavement surface.
  o Lifespan: 4-6 years
  o Texture: Smooth
  o Benefits: Seals asphalt from oxidation and wear, improved aesthetics
  o Open for users: One day after application
  o Cost: $$$$ 
  o For product information, see LRRB Report 2009-25 (http://www.lrrb.org/pdf/200925.pdf)
Trail Pavement Management
Issue #2: Surface Deterioration

Treatments

• Sealcoat (chip seal)

An application of asphalt emulsion followed immediately with an aggregate cover which seals the asphalt pavement, provides additional protection from wearing and increases the frictional characteristics of the surface.

  o Lifespan: 6-10 years
  o Texture: Dependent on aggregate size (a small aggregate size is more suitable for multi-use trails)
  o Benefits: Seals asphalt, improved aesthetics
  o Open for use: After sweeping (24-48 hours after application)
  o Cost: $$$$$
  o For product information, see LRRB Report 2009-25 (http://www.lrrb.org/pdf/200925.pdf)
Trail Pavement Management
Issue #2: Surface Deterioration

Treatments

• Slurry seal
  A mixture of liquid asphalt emulsion, aggregate and additives applied in a liquid form to provide a new pavement surface.
  o Lifespan: 8-10 years
  o Texture: Typically smoother than chip seal but it is dependent on aggregate size
  o Benefits: Provides new surface, fills small cracks and depressions, improved aesthetics
  o Open for use: 24 hours after application
  o Cost: $$$
  o For product information, see LRRB Report 2009-25 (http://www.lrrb.org/pdf/200925.pdf)
Trail Pavement Management

Issue #2: Surface Deterioration

Treatments

• Micro surfacing

A mixture of asphalt emulsion, aggregate and chemical additives applied in a liquid form to provide a new pavement surface. Faster cure time than slurry seal.

- Lifespan: 8-10 years
- Texture: Similar surface to a slurry seal
- Benefits: Provides new surface, fills small cracks and depressions, improved aesthetics
- Open for use: 1 hour after application
- Cost: $$$$  
- For product information, see LRRB Report 2009-25 (http://www.lrrb.org/pdf/200925.pdf)
Trail Pavement Management
Issue #2: Surface Deterioration

Treatments

• Overlay
  A layer of hot-mix asphalt typically two inches or greater placed over the existing pavement surface to improve the non-structural condition of the pavement.
  o Lifespan: 15 years
  o Texture: Smooth
  o Benefits: Fills small depressions and cracks, new trail surface
  o Open for use: Typically 24 hours after application
  o Cost: $$$$
Trail Pavement Management

Issue #3: Potholes & Depressions

Problems

• Potholes
  o Deformation in the pavement usually caused by moisture intrusion or heavy loads

• Depressions
  o Low points or settling in the pavement which may be caused by water infiltration, a failed patch, an improperly compacted base or settlement
Trail Pavement Management

Issue #3: Potholes & Depressions

Treatments

Two bituminous patch types, 1 of 2:

• Temporary
  A cold mix repair that will eventually crumble or pull out and may not be flush with the trail.
  - Lifespan: Less than one-year
  - Texture: May be uneven
  - Benefits: Temporary patch option when something needs to be done for a short-term fix.

Courtesy of Three Rivers Park District
Trail Pavement Management
Issue #3: Potholes & Depressions

Treatments
Two bituminous patch types 2 of 2:
• Permanent
  A pavement repair treatment that involves saw cutting and removing damaged asphalt and replacing with a high quality bituminous mixture.
    o Lifespan: 15 years with proper preparation and installation
    o Texture: Smooth
    o Benefits: Replaces problem areas with surface that should last as long as original asphalt
Presentation Outline

• Operational Maintenance Activities
• Trail Pavement Management
• Asset Management
• How to Build a Trail Maintenance Schedule
• Multi-Use Trail Maintenance Recap
• References
Asset Management is an Industry Trend That is Now Being Applied to Trails

- Proactive maintenance improves trail safety, extends life of trail surface
- Helpful for projecting current and future maintenance costs for budgeting
- Potential to incorporate trails into existing asset management program
Asset Management

An Asset Management System Should:

• Provide a systematic, consistent approach to evaluate the present condition of each asset

• Identify and prioritize maintenance and rehabilitation needs

• Provide information to the public and elected officials

• Can remove biases and political decisions
Asset Management

Benefits of an Asset Management System:

• More accurate and accessible information on assets
• Ability to monitor performance
• More efficient use of available resources
• Ability to justify funding needs
Asset Management

Asset Management is a Dynamic Process

- Initial cost of the software
- Initial cost of the pavement inventory and data entry
- Periodic cost of pavement inventory to keep the database current and valid
Asset Management Software

- ICON (Goodpointe Technology)
- PASERware (WisDOT)
- Micropaver (APWA/Corps of Engineers)
- PAVEMENT View Plus (Cartegraph)
- In-house Spreadsheet or database
# Asset Management Software

<table>
<thead>
<tr>
<th>1.0 COST</th>
<th>Micropaver (APWA / Corps of Engineers)</th>
<th>PAVEMENTview Plus (Cartègraph)</th>
<th>ICON (Goodpointe Technology)</th>
<th>PavePRO Manager (IMS)</th>
<th>RoadMatrix (Stantec)</th>
<th>PASERWARE (WITC LTAP)</th>
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</thead>
<tbody>
<tr>
<td>1.1 Initial Cost of Software</td>
<td>$995 for APWA members&lt;br&gt;$1095 for non-APWA members</td>
<td>$1,000 - $5,000</td>
<td>$1,000 - $10,000+</td>
<td>$10,000+</td>
<td>$5,000-$8,000</td>
<td>Free for WI agencies&lt;br&gt;$100 for non-WI agencies</td>
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<tr>
<td>1.2 Annual Technical Support Costs</td>
<td>● First year&lt;br&gt;○ Renewable annually for $500 for APWA members&lt;br&gt;$650 for non-APWA members</td>
<td>•</td>
<td>● for one authorized user&lt;br&gt;○ $250 for each additional user&lt;br&gt;○ Value-added infrastructure management consulting services, cost varies with number of hours ($1,000 - $4,000)</td>
<td>•</td>
<td>● $2,500-$5,000</td>
<td>○</td>
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<tr>
<td>1.3 Vendor Data Collection Costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1.3.1. Automated</td>
<td>○</td>
<td>○</td>
<td>$25 - $215/mile</td>
<td>$300+/mile&lt;sup&gt;1&lt;/sup&gt;</td>
<td>$50 - $200/mile</td>
<td>○</td>
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<tr>
<td>1.3.2. Manual</td>
<td>○</td>
<td>○</td>
<td>$25 - $250/mile</td>
<td>Included in cost for Automated</td>
<td>$100 - $200/mile</td>
<td>○</td>
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<tr>
<td>1.3.3. Hand-held/PDA/Tablet PC</td>
<td>○</td>
<td>$20 - $50/mile</td>
<td>$100 - $250/mile</td>
<td>Included in cost for Automated</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

## 2.0 DATA INPUTS

| 2.1 Segment, Begin and End Points | • | • | • | • | • | • |
| 2.2 Spatial location (GPS Location) | • | • | • | • | • | ○ |
| 2.3 Segment Width and/or Area | • | • | • | • | • | • |
| 2.4 Pavement (Layer) Data | • | • | • | • | • | • |
| 2.5 Age | • | • | • | • | • | • |
| 2.6 AADT | ○ | • | • | • | • | • |
| 2.7 ESAL’s | ○ | • | • | • | • | • |

- • Standard – Included in Standard Software Cost<br>○ Optional – Available for an Additional Cost<br>○ Not Available<br><sup>1</sup> Data collection includes surface data, deflection testing, digital images, and GIS linkage.
Asset Management Software

Types of Data

- Section identification
- Construction, maintenance and rehabilitation history
- Pavement characteristics
- Pavement condition data
- Others
Asset Management Software

Additional information on asset management and asset management software can be found at: www.lrrb.org
Asset Management
Trail Maintenance Case Studies

• Three Rivers Park District
• Stearns County Parks
• Eden Prairie Parks & Recreation
Asset Management
Trail Maintenance Case Studies

Three Rivers Park District

• Miles of trails: 150

• Asset management software: PASER rating system combined with an in-house GIS database

• Pavement preservation treatments: Slurry seal, crack sealing and filling

• Surface treatment rationale:
  1. Chip sealing was too rough for in-line skaters
  2. Slurry seal is not perfect but it protects the pavement and is smooth enough for their users
  3. Prolongs the life of the trail
Stearns County Parks

- Miles of trails: 60
- Asset management software: Excel spreadsheet
- Pavement preservation treatments: Crack filling
- Surface treatment rationale:
  1. Increase user safety
  2. Preserve the pavement
- Additional information: Stearns County Parks will be starting a program of fog sealing trails every five years to protect the trail surface and prolong the life of the trail.
Asset Management
Trail Maintenance Case Studies

Eden Prairie Parks & Recreation

• Miles of trails: 128

• Asset management software: ICON system

• Pavement preservation treatments: Chip seal, crack sealing and crack filling

• Surface treatment rationale:
  1. More durable trail surface to handle winter maintenance equipment
  2. Extends useful life of trail
  3. Coordinate trail and roadway chip sealing for cost savings

• Additional Information: 1/8” trap rock is used for the chip seal
Asset Management

What are Your Trail Priorities?

• Reduce long-term trail maintenance costs
• Allocate trail expenditures over life of trail (reduce frequency of reconstruction cost spikes)
• Provide a user-friendly surface for users
• Maintain durable surfaces for use during multiple seasons
• Extend the life of the trail
Asset Management

What is the Best Management Tool for Your Trail System?

• Factors to Consider:
  o Available funding
  o Staff resources
  o Trail system size
  o Cost of software
  o Initial and routine data collection costs and staff requirements
Presentation Outline

• Operational Maintenance Activities
• Trail Pavement Management
• Asset Management
• How to Build a Trail Maintenance Schedule
• Multi-Use Trail Maintenance Recap
• References
How to Build a Trail Maintenance Schedule

- Examples of:
  - Slurry seal schedule
  - Fog seal schedule
  - Crack seal, overlay and reconstruct schedule

- Schedules based on:
  - General industry estimates for life spans
  - Trail specific environment, usage and desired level of service
  - Requires on-going monitoring and adjustments
How to Build a Trail Maintenance Schedule

Primary Asphalt Treatment Example:
Slurry Seal
How to Build a Trail Maintenance Schedule

Primary Asphalt Treatment Example:
Fog Seal and Sealcoat (chip seal)
How to Build a Trail Maintenance Schedule

Primary Asphalt Treatment Example:
Crack Seal
Presentation Outline

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• Multi-Use Trail Maintenance Recap
• References
Multi-Use Trail Maintenance Recap

Trail Development
- Proper Design
- Correct Construction

Administration
- Approve Trail Funding
- Maintenance Budgeting

Inspection
- User Safety
- Surface Condition
- Trail Corridor
- Collect Data

Maintenance
- Trail Repairs
- Amenity Upkeep
- Corridor Enhancements

Data Management
- Data Analysis
- Maintenance Priorities
Presentation Outline

- Operational Maintenance Activities
- Trail Pavement Management
- Asset Management
- How to Build a Trail Maintenance Schedule
- Multi-Use Trail Maintenance Recap
- References
Literature and Internet Reference List

Literature:


Minnesota Department of Transportation, “Preventive Maintenance for HMA Recreational Trails”. Minnesota Department of Transportation, St. Paul, MN. October 2009.


Literature and Internet Reference List

Websites:


American Trails: Maintenance Checklist for Greenways and Urban Trails website – www.americantrails.org/resources/ManageMaintain/MaintCheck.html


Literature and Internet Reference List

Local Road Research Board
LRRB – www.lrrb.org

Minnesota Department of Transportation Materials and Road Research
Mn/DOT – www.mrr.dot.state.mn.us/research/mnresearch.asp

Minnesota Local Technical Assistance Program
MN LTAP – www.mnltap.umn.edu

National Center for Pavement Preservation
NCPP – www.pavementpreservation.org

Pavement Interactive Website – www.pavementinteractive.org

DVDs:
Local Road Research Board, Pavement Management Systems DVD.
Produced by Greer and Associates, January 2011.
Maintenance of Recreational Trails