MASSACHUSETTS TRAIL SURFACE ONDITION STUDY

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This study was directed by the interagency MassTrails team. Rival Solutions provided tools to support the study.

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EXECUTIVE SUMMARY

This purpose of this study was to assess the existing surface conditions of major trails across the Commonwealth with the goal of informing a roadmap for future trail maintenance and modernization opportunities. This study had three main objectives:

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Measure the surface condition of trails

Identify major assets along trail segments, including trailheads, bathroom facilities, and other amenities

Capture extensive reference imagery along trails

While many jurisdictions regularly monitor the surface condition of their roadways, it is not common practice to assess the conditions of walking and biking facilities to the same degree. This is especially important because trail users are typically more sensitive to surface irregularities on a path than cars are to bumps on a road. For these reasons, MassDOT felt it was important to study the conditions of the Commonwealth's

non-motorized transportation infrastructure and to assess the needs for maintenance and modernization on a statewide scale.

This study captured data on **345 miles of trails**, of which **89% were paved** and **11% were unpaved**. The study network was selected based on meeting one or more of the following criteria:

- Relation to the MassTrails Priority Vision Network
- Ability to provide connections between three or more communities
- Length of three or more miles
- Other factors that make trails significant regional or local assets

As trail rehabilitation and modernization funding becomes available, this study and the resulting data can help MassDOT prioritize improvements for the trails that need them the most. Furthermore, this study will help shed light on the conditions experienced by people walking, biking, and rolling in Massachusetts and demonstrate the positive impact that investments in trail infrastructure can have on these users. In the future, this study can be replicated on additional trails or repeated on trails in the original network to understand the change in trail surface condition over time.



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This summary report includes the following study outputs:

- Statewide Report Card
- Miles by Condition
- Sections of Significant Roughness
- Top Five Smoothest Trails
- Statewide User Experience Rating Map
- Interval Rating Map, Amenities, and Miles by Condition for five select trails:
 - Ashuwillticook Rail Trial
 - Northampton Bikeway
 - Bruce Freeman Rail Trail
 - Southwest Corridor Park
 - Cape Cod Rail Trail



DATA BIKE OVERVIEW

All of the data for this study were collected using the MassTrails Data Bike - an electric bicycle outfitted with special data collection equipment to capture trail conditions. The Data Bike was ridden for over 600 miles between May 2022 and October 2022, capturing measurements and images all along the way. There were four main data collection devices installed on the Data Bike:



UNDERSTANDING RATINGS

The surface condition rating is broken into five categories and is derived from the amount of vertical displacement measured by the rRuf sensor over a certain distance. This rating is intended to capture the quality of the user experience along a trail and is referred to as the Trail Roughness Index or "TRI". A trail that has root uplift, potholes, and other depressions or bumps will record a higher total vertical displacement - and therefore a higher rating - than a trail that is smooth and has minimal or isolated cracking.

The following sections will report ratings at two levels:

- 1. User experience rating: this provides a high-level assessment of the surface condition and user experience along a trail. Rough sections are given more weight than smooth sections in developing this rating.
- 2. Average TRI per 10-meter trail segment: this is used to calculate miles by condition and to visually highlight specific areas featuring poor surface conditions that may not come through in the user experience rating.

Excellent (TRI \leq 2)

Trail is consistently smooth and lacks significant cracks or bumps. Small imperfections may be present but do not negatively impact the user experience.

Good (TRI 2-3.5)

Trail is in generally good condition but may have cracking or other imperfections here and there. Rehabilitation may be needed in isolated areas but the user experience is overall positive.

Fair (TRI 3.5 - 5.5)

Trail shows increased wear and tear through intermittent bumps, cracks, and depressions. Inconsistencies are generally tolerable to users but can reduce the quality of the experience. Rehabilitation is recommended in several areas.

Poor (TRI 5.5 - 7)

Trail is uncomfortable to ride for many users due to consistent bumps and depressions. Major rehabilitation is required to increase the quality of the user experience.

Very Poor (TRI > 7)

Trail has significant unavoidable bumps or depressions that cause discomfort to users and may pose safety concerns. Reconstruction is likely necessary to improve conditions.

It is important to note that these ratings do not measure any part of the user experience beyond the smoothness of the trail. The rating does not take into consideration path width, separation, short-term upkeep (e.g. debris on the trail), crossings, ADA accessibility, shade, or the condition of surrounding features, including signs, parking areas, or access points.



Ashuwillticook Rail Trail



Norwottuck Rail Trail



Northern Strand Community Trail



Charles River Greenway



Wellington Greenway

REPORT CARD

This report card summarizes the results for each trail in the study, beginning with the longest trail system. The user experience rating is a weighted average of the TRI across the full length of each trail. It can range from A to F, with A being the smoothest rating. It is meant to summarize the overall quality of the user experience and since poor sections have a greater effect on users, these were given more weight in developing the average¹. While this rating can provide a high-level indication of surface condition, it may not reflect all sections of the trail, especially if it is a longer trail. Trails rated as excellent often have stretches of poor pavement, and vice versa. Sometimes, rough crossings, bridges, and short sections of alternative surface types, such as bricks, can contribute to a higher rating. The miles by condition provide context to the user experience rating by showing the distribution of surface condition along each trail system. See the Detailed Results Highlights beginning on page 16 to see examples of how user experience ratings compare to detailed interval data for five trails.

Trail	Length* (Miles)	User Experience Rating	Miles by Condition
1 Cape Cod Rail Trail	28.4	B+	
2 Charles River Trails	23.6	B-	
3 Bruce Freeman Rail Trail	15.2	A-	
4 Correllus State Forest Paths	14.6	B-	
5 Ashuwillticook Rail Trail	13.9	А	
6 Cape Cod Canal Bike Paths	13.5	A-	
7 Upper Charles Trail	13.4	B+	
8 Norwottuck Rail Trail	11.9	В	
9 Nashua River Rail Trail	11.1	В	
10 Assabet River Rail Trail	11.0	B+	

¹ Intervals weighted as follows: Excellent = .5; Good = 1.5; Fair = 2.5; Poor = 3.5; Very Poor = 4.5

*Length has been generated via available spatial data and may differ from values posted elsewhere.

Trai	1	Length* (Miles)
11	Shining Sea Bikeway	10.7
12	Border to Boston Trail	10.7
13	Minuteman Bikeway	9.9
14	Mystic River Trails	9.8
15	Northern Strand Community Trail	8.7
16	Southwick Rail Trail	8.5
17	Mass Central Rail Trail (West)	8.4
18	Manhan Rail Trail	8.4
19	Polpis Road Path	8.1
20	Edgartown-Vineyard Haven Road Path	6.6
21	Madaket Road Path	5.6
22	Milestone ('Sconset) Road Path	5.6
23	Old Colony Rail Trail	5.3
24	Northampton Bikeway	5.3
25	Southern New England Trunkline	5.3
26	Neponset River Greenway	5.2
27	Mass Central Rail Trail (East)	4.8



Trail	Length* (Miles)	User Experience Rating	Miles by Condition
28 Independence Greenway	4.6	В	
29 Edgartown-Oak Bluffs Road Path	4.3	B+	
30 Southwest Corridor Park	3.9	C+	
31 Old Eastern Marsh Trail	3.8	A-	
32 County Road Path	3.2	В	
33 Hummock Pond Road Path	3.2	A-	
34 Narrow Gauge Rail Trail	3.1	C+	
35 Clipper City Rail Trail	2.9	B+	
36 Edgartown-West Tisbury Road Path	2.7	В	
37 Katama Road Path	2.6	B+	
38 Alewife Brook Greenway	2.4	B-	
39 East Boston Greenway	2.3	B+	
40 Surfside Road Path	2.2	B+	
41 Salisbury Point Ghost Trail	2.1	C+	
42 Herring Creek Road Path	2.1	A-	
43 William Lloyd Garrison Trail	1.9	A-	
44 Old South Road	1.8	В	

Trail	Length* (Miles)
45 Cliff Road Path	1.6
46 Somerville Community Path	1.3
47 Bartlett Road Path	1.1
48 South Shore Road Path	1.0
49 Nobadeer Farm Road Path	1.0
50 Alewife Linear Park Trail	1.0
51 Fairgrounds Road Path	0.9
52 Beach Road Shared Use Path	0.9
53 Eel Point Road Path	0.9
54 Fitchburg Cutoff	0.8
55 Bay Circuit Feeder Trail	0.6
56 Community Path of Lynn	0.4
57 Prospect Street Path	0.3
58 Eastville Ave Path	0.3
59 Seikinnow Place Path	0.3
60 Airport Road Path	0.3
61 Rugged Road Path	0.1



MILES BY CONDITION 0.4% 0.7% 5.2% 71.0% 22.7% Excellent Very Poor Poor Good

Total mileage may not be exact due to rounding and small lapses in data coverage

When taken together, almost three-quarters of Massachusett's trail miles are in excellent condition. However, it is important to remember that excellent trail segments are not always consistent along the full length of a trail, and segments of fair, poor, or very poor conditions - even if short - have a greater impact on the user experience. In some cases, poor segments can pose safety threats that may negate the benefits of nearby excellent segments.

WHERE ARE THE BEST AND WORST TRAIL SURFACE CONDITIONS IN THE COMMONWEALTH?

The following trails received the highest overall ratings, making them the smoothest trails in the Commonwealth. It is not a coincidence that several of these were constructed or resurfaced in the past five vears.



Ashuwillticook Rail Trail

Rather than simply list the sections with the highest rated 10-meter intervals, the following sections represent where trails exhibit both peaks in TRI, as compared to the entire trail system, as well as consistent stretches of poor conditions. These sections do not include areas that received high ratings due to rough crossings, bridges, or sections of alternative surface type, such as brick. The approximate length of the rough section and peak TRI is reported alongside the trail name and section location.

Sections of Significant Roughness

- Correllus State Forest Paths south of Martha's Vineyard Airport (0.25 miles, 8 TRI)
- Narrow Gauge Rail Trail just south of Springs Road in Billerica (0.19 miles, 14.7 TRI)
- Charles River Trails just south of River Street in Cambridge (0.11 miles, 7.6 TRI) •

- 12.7 TRI)
- (360 feet, 22.1 TRI)

Honorable Mentions

- Norwottuck Rail Trail south of Station Road in Amherst (360 feet, 10.5 TRI)
- Border to Boston Trail near the Barehill Road Crossing (290 feet, 9.8 TRI)
- Independence Greenway west of Lowell Street in Peabody (390 feet, 8.9 TRI)





Correllus State Forest Paths

Torbert Macdonald Park (Mystic River Trails)

- Ashuwillticook Rail Trail
- William Lloyd Garrison Trail
- Herring Creek Road Path
- Southwick Rail Trail
- Northern Strand Community Trail





Southwick Rail Trail

Northern Strand Community Trail

Border to Boston Trail just south of Pye Brook Lane in Boxford (0.15 miles, 9.9 TRI) Southwest Corridor Park just north of Atherton Street in Jamaica Plain (0.11 miles, 7.5 TRI) Border to Boston Trail at the I-95 underpass in Peabody (530 feet, 10.9 TRI) Charles River Trails just north of Eliot Bridge in Lower Allston (490 feet, 9.2 TRI) Torbert Macdonald Park River Path in Medford (Mystic River Trails) (490 feet, 20.2 TRI) Mystic River Trails between Mystic Valley Parkway and South Street in Medford (450 feet,

• Wellington Greenway on the west side of Dana Bridge in Medford (Mystic River Trails)

• Mass Central Rail Trail (West) just north of Miles Road in Rutland (230 feet, 10.3 TRI)



Charles River Trails



LEGEND

Α
 A-
B+
 В
 B-
 C+

This map displays the user experience rating for each trail across all segments, including both paved and unpaved sections. See the Appendix for more information on these ratings and a visualization of roughness along the extent of each trail.

The following section highlights detailed results for five select trails.



DETAILED RESULTS HIGHLIGHTS

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ASHUWILLTICOOK RAIL TRAIL

DETAILED RESULTS HIGHLIGHTS

NORTHAMPTON BIKEWAY



Note: Ratings do not measure any part of the user experience beyond the smoothness of the trail.

USER EXPERIENCE FEATURES: RATING

General Scenery

• Signage

»

- » User Etiquette »
- Wayfinding Regulatory
- Warning
- » Gateway »







Total mileage may not be exact due to rounding and small lapses in data coverage

Note: Ratings do not measure any part of the user experience beyond the smoothness of the trail.

DETAILED RESULTS HIGHLIGHTS

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BRUCE FREEMAN RAIL TRAIL



Note: Ratings do not measure any part of the user experience beyond the smoothness of the trail.

DETAILED RESULTS HIGHLIGHTS

SOUTHWEST CORRIDOR PARK

MILES BY CONDITION 2% 5% 23% 23% 46%

Total mileage may not be exact due to rounding and small lapses in data coverage



Note: Ratings do not measure any part of the user experience beyond the smoothness of the trail.

DETAILED RESULTS HIGHLIGHTS

CAPE COD RAIL TRAIL



Note: Ratings do not measure any part of the user experience beyond the smoothness of the trail.

ASSESSSING UNPAVED TRAILS

This study assessed the surface condition of both paved and unpaved trails. While it is expected that unpaved trails will naturally have more "texture" than paved trails, this assessment was meant to capture larger variations in trail surface condition caused by significant bumps, cracks, or depressions. Even so, unpaved trail segments generally received higher ratings than paved trails. These results do not suggest that all unpaved trails should be paved, rather that unpaved trails have different maintenance requirements and can be more vulnerable to natural effects such as erosion. These factors should be considered when planning for trail maintenance and modernization, particularly on trail systems that include



4	0.3%— 0.6%——	
	18.2%	

76.2%

These maps show how the user experience ratings can differ between paved and unpaved segments and how those compare to the overall trailwide rating.

CHARLES RIVER TRAILS





While unpaved segments are generally not as smooth as paved segments, some paved segments can have worse or equivalent roughness ratings as their unpaved counterparts. On trails of mixed surface type, the overall user experience rating can be brought down by unpaved segments.

NARROW GAUGE RAIL TRAIL





HOW WILL THIS BE USED?

The outputs of this study will serve many purposes for trail users, state agencies, and other groups.

The images collected on <u>Google Street View</u> open up a much-needed window into off-road trail segments, helping users plan visits and offering practitioners a way to easily reference sections of the trail.

The asset data shed light on which trails include amenities such as bathroom or water facilities and can help identify where new amenities can make the greatest impact.

The surface condition ratings will allow agencies and municipalities to asses the conditions of trails much in the same way they do with roadways. The user experience ratings will provide a high-level overview of entire trail systems while the detailed interval ratings will be used to hone in on specific segments in need of resurfacing. Then, as trail rehabilitation and modernization funding becomes available, MassDOT and other agencies can use these results to prioritize those trails that require the most attention.

In addition to those uses identified above, the data can be used to provide a greater understanding of trails and how they are used. For instance, volume or demand data can be compared to condition, amenity, and trail surface data to understand how these characteristics affect decision making around trail use.

In the future, this study can be repeated and expanded to assess trail conditions over time or to assess conditions on additional trails.



Unpaved segments can vary widely in their roughness and therefore the user's experience.

APPENDIX

Trail	Length* (Miles)	Overall User Experience Rating	Paved User Experience Rating	Unpaved User Experience Rating	Overall TRI	Paved TRI	Unpaved TRI	Line Chart **
1 Cape Cod Rail Trail	28.4	B+	B+	-	2.29	2.29	-	لمنابط أراد معاصل المناف
2 Charles River Trails	23.6	B-	B-	C+	3.19	3.14	3.60	When the ball of the stand of t
3 Bruce Freeman Rail Trail	15.2	A-	A-	C+	2.00	1.85	4.11	Munderland wear
4 Correllus State Forest Paths	14.6	B-	B-	-	3.04	3.04	-	مىرىيى مەربىيە يەربىيە
5 Ashuwillticook Rail Trail	13.9	A	A	-	1.29	1.29	-	
6 Cape Cod Canal Bike Paths	13.5	A-	A-	-	1.66	1.66	-	witherand the formation of the second state of the
7 Upper Charles Trail	13.4	B+	A-	B+	2.12	1.87	2.29	water back between the contraction
8 Norwottuck Rail Trail	11.9	В	В	-	2.52	2.52	-	بالتلبين والمسالية
9 Nashua River Rail Trail	11.1	В	В	-	2.68	2.68	-	ไปในสามันหมู่ได้เป็น ^ไ ด้เพิ่มหาวิที่ของ
10 Assabet River Rail Trail	11.0	B+	B+	-	2.34	2.34	-	when ald Mr. Reason and
11 Shining Sea Bikeway	10.7	B+	B+	В	2.19	2.18	2.83	windly the the internet
12 Border to Boston Trail	10.7	B-	-	B-	3.15	0.00	3.15	Human with a bald bit a said
13 Minuteman Bikeway	9.9	B+	B+	-	2.39	2.39	-	hundendelkandensondel

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Trail	Length* (Miles)	Overall User Experience Rating	Paved User Experience Rating	Unpaved User Experience Rating	Overall TRI	Paved TRI	Unpaved TRI	Line Chart **
14 Mystic River Trails	9.8	C+	C+	C+	3.71	3.73	3.51	-heller while Muchan
15 Northern Strand Community Trail	8.7	A-	A-	-	1.61	1.61	-	بسيب ساليه فالمعاليه وسائدان
16 Southwick Rail Trail	8.5	A-	A-	-	1.60	1.60	-	
17 Mass Central Rail Trail (West)	8.4	B-	-	B-	3.34	0.00	3.34	Minkhawkani
18 Manhan Rail Trail	8.4	B+	B+	-	2.17	2.17	-	s
19 Polpis Road Path	8.1	B+	B+	-	2.36	2.36	-	Hadaasiinda dhadhadhadhaan dhaasa
20 Edgartown-Vineyard Haven Road Path	6.6	B+	B+	-	2.41	2.41	-	hellen marchille and marchille
21 Madaket Road Path	5.6	A-	A-	-	1.84	1.84	-	and and a second a sector s
22 Milestone ('Sconset) Road Path	5.6	A-	A-	-	1.87	1.87	-	harrathena Librahassain
23 Old Colony Rail Trail	5.3	В	В	-	2.51	2.51	-	United March Sector Sector Sector
24 Northampton Bikeway	5.3	В	В	-	2.90	2.90	-	benuterenthand techning
25 Southern New England Trunkline	5.3	B+	A-	B+	2.07	1.95	2.29	
26 Neponset River Greenway	5.2	B+	B+	-	2.27	2.27	-	prelamentes presentes at
27 Mass Central Rail Trail (East)	4.8	A-	A	C+	1.83	1.31	3.53	malitan and and and and and and and and and a

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Trail	Length* (Miles)	Overall User Experience Rating	Paved User Experience Rating	Unpaved User Experience Rating	Overall TRI	Paved TRI	Unpaved TRI	Line Chart **
28 Independence Greenway	4.6	В	В	-	2.96	2.96	-	
29 Edgartown-Oak Bluffs Road Path	4.3	B+	B+	-	2.41	2.41	-	xomeninalenoguoretuoriu
30 Southwest Corridor Park	3.9	C+	C+	-	3.94	3.94	-	million
31 Old Eastern Marsh Trail	3.8	A-	A-	B-	1.67	1.65	3.39	w
32 County Road Path	3.2	В	В	-	2.87	2.87	-	nolamore molecul
33 Hummock Pond Road Path	3.2	A-	A-	-	1.61	1.61	-	
34 Narrow Gauge Rail Trail	3.1	C+	В	C+	3.89	2.74	3.96	Lowenshitemanner
35 Clipper City Rail Trail	2.9	B+	B+	-	2.07	2.07	-	~
36 Edgartown-West Tisbury Road Path	2.7	В	В	-	2.73	2.73	-	
37 Katama Road Path	2.6	B+	B+	-	2.15	2.15	-	unade a -sal stand
38 Alewife Brook Greenway	2.4	B-	B-	В	3.02	3.46	2.68	un shall a start
39 East Boston Greenway	2.3	B+	B+	-	2.20	2.20	-	deferment and a second
40 Surfside Road Path	2.2	B+	B+	-	2.19	2.19	-	all
41 Salisbury Point Ghost Trail	2.1	C+	A-	C+	3.55	1.85	3.70	under and a second

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Trail	Length* (Miles)	Overall User Experience Rating	Paved User Experience Rating	Unpaved User Experience Rating	Overall TRI	Paved TRI	Unpaved TRI	Line Chart **
42 Herring Creek Road Path	2.1	A-	A-	-	1.55	1.55	-	
43 William Lloyd Garrison Trail	1.9	A-	A-	-	1.50	1.50	-	
44 Old South Road	1.8	В	В	-	2.62	2.62	-	when the when a second
45 Cliff Road Path	1.6	B+	B+	-	2.43	2.43	-	~~~~
46 Somerville Community Path	1.3	C+	C+	-	3.53	3.53	-	mm
47 Bartlett Road Path	1.1	В	В	-	2.52	2.52	-	
48 South Shore Road Path	1.0	B+	B+	-	2.31	2.31	-	**** ******
49 Nobadeer Farm Road Path	1.0	B+	B+	-	2.10	2.10	-	~l
50 Alewife Linear Park Trail	1.0	B-	B-	-	3.37	3.37	-	Junihumm
51 Fairgrounds Road Path	0.9	B+	B+	-	2.47	2.47	-	
52 Beach Road Shared Use Path	0.9	В	В	-	2.62	2.62	-	
53 Eel Point Road Path	0.9	A-	A-	-	1.88	1.88	-	
54 Fitchburg Cutoff	0.8	A-	A-	-	1.71	1.71	-	
55 Bay Circuit Feeder Trail	0.6	C+	C+	-	4.04	4.04	-	menne

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Trail	Length* (Miles)	Overall User Experience Rating	Paved User Experience Rating	Unpaved User Experience Rating	Overall TRI	Paved TRI	Unpaved TRI	Line Chart **
<b>56</b> Community Path of Lynn	0.4	В+	B+	-	2.25	2.25	-	
58 Prospect Street Path	0.3	В+	B+	-	2.20	2.20	-	
<b>59</b> Eastville Ave Path	0.3	A-	A-	-	1.97	1.97	-	
<b>57</b> Seikinnow Place Path	0.3	C+	C+	-	3.57	3.57	-	
<b>60</b> Airport Road Path	0.3	В	В	-	2.94	2.94	-	
<b>61</b> Rugged Road Path	0.1	В	В	-	2.86	2.86	-	

*Length has been generated via available spatial data and may differ from values posted elsewhere.

**Line charts visualize TRI from south to north and/or west to east. For the Cape Cod Canal Bike Paths, Charles River Trails, Correllus State Forest Paths, and Mystic River Trails, line charts visualize ratings clockwise beginning from the northwest and only include main pathways.

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