COMPASS
COMMUNITY PLANNING ASSOCIATION
of Southwest Idaho

Working together to plan for the future

2020 Data Bike Pilot Report

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Table of Contents

Background

Pavement condition analysis is not a new concept. There are a plethora of practices used to measure roadway pavement conditions, but means of analyzing off-street facilities, such as pathways, is lacking.

With the ever-growing number of off-street pathways in Ada and Canyon Counties, Idaho, the Community Planning Association of Southwest Idaho (COMPASS) recognized the need to be able to analyze pathway conditions to aid in understanding and prioritizing pathway maintenance needs, just as roadway pavement conditions are used to prioritize roadway maintenance projects.

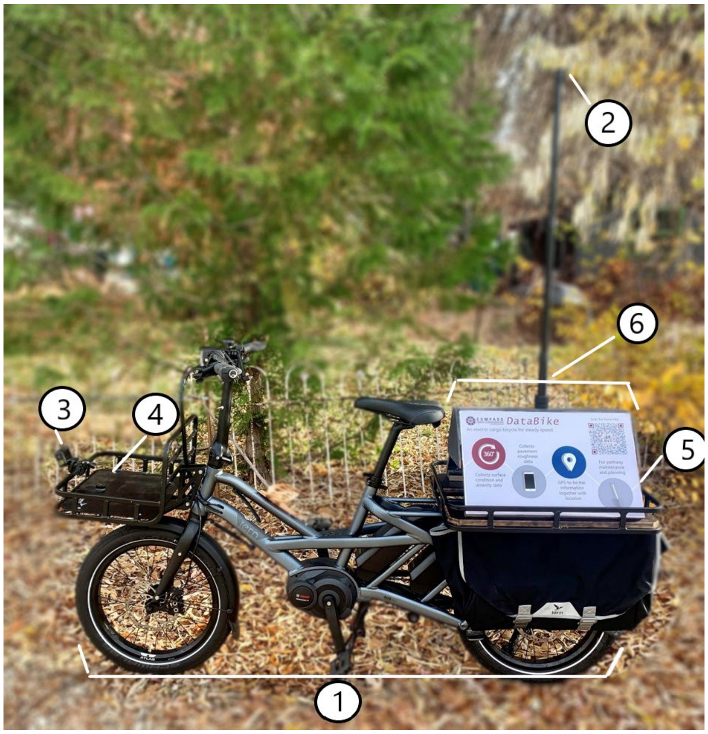
In 2018, COMPASS applied for, and received, a "Technology Transfer" grant from the Federal Highway Administration to develop a measurement tool to generate quantitative pavement condition data for pathways and other off-street facilities within its planning area of Ada and Canyon Counties. The COMPASS Data Bike was purchased and outfitted with this funding.

The data collected by the COMPASS Data Bike is intended to complement field inspections performed by local agency staff and is not meant as a replacement for thorough physical inspections. While the primary metric reported from the data bike is trail roughness, this measure alone is only one component among many used in a holistic assessment of trail conditions.

This document reports on the inaugural year of COMPASS Data Bike usage (2020); its focus is on the background and process, rather than the data itself, to provide the foundation to begin full data collection in 2021.

How it Works

The COMPASS Data Bike includes multiple pieces of equipment that work in tandem to collect roughness and other data as the bike is ridden (Figure 1).



1. Tern GSD Electric Cargo Bike
   - The electric-motor component of the bike is critical in order to keep the bike as close to a vertical orientation as possible, which is vital in the roughness app’s measurement process. It is also outfitted with panniers for hauling gear.
2. Samsung 360° Camera
   - Used to photograph the surrounding environment; in the future, these photos will be imported to Google Maps.
3. Go Pro Hero 7 Camera
   - Used to photograph the pavement immediately below the bike. Photos can be compared to the measured roughness.
4. iPhone 7
   - Used to host the rRuf roughness measurement app (Figure 2).
5. Power Bank
   - Used as external power source for cameras and the iPhone in the field. This component isn’t used for each deployment, but can be relied upon for longer deployments that could deplete battery levels.
6. Canopy
   - Used to stabilize the 360° camera.

Figure 1. COMPASS Data Bike

The bike measures trail roughness using the iPhone’s accelerometer data, which indicate significant changes in roughness of trail segments. Using this data, the trails are then categorized into five roughness categories, ranging from “very smooth” to “very rough” (Figure 3).

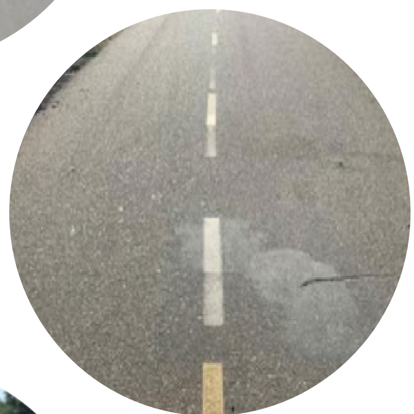
The rRuf app scores the condition of trails by using the iPhone’s internal accelerometer and gyroscope to produce a standardized condition rating. The app includes an automated intelligent map that matches the data to the trail segment. Through a dashboard on the app, data collection can be monitored to identify gaps. The app is also able to produce averages and other statistics if a section of the trail is ridden multiple times. This helps alleviate any minor inconsistencies in the roughness data.

Figure 2. rRuf roughness measurement app

Once returning from the field, pavement and environmental photos are uploaded to a database, while the roughness information is transferred to a dashboard where the data are displayed on maps for ease of use.

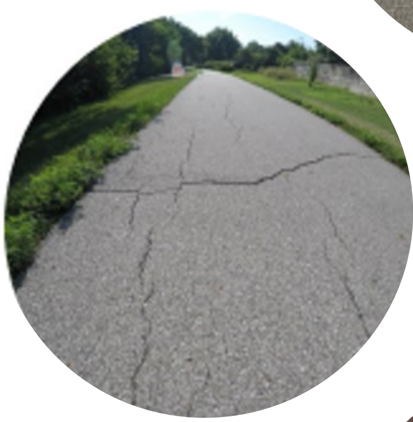
Very Smooth

Very smooth trails have nearly no cracking or vegetation growing on them. Variations in smoothness can be due to seams between concrete sections or other material spread across the trail.



Smooth

Smooth trails are typically in good condition, but are beginning to show signs of cracking. Cracking on smooth trails generally does not create discomfort for the rider.



Fair

Fair trails are beginning to show increased wear and typically have more cracking. Cracking on trails in fair condition can cause minor discomfort for riders.

Rough

Rough trails show minor buckling or advanced cracking, with vegetation growing through the surface. These cracks are typically wider and deeper than cracks along fair condition trails and can cause discomfort for riders.

Very Rough

Very rough trails have cracking similar to trails in rough condition, but also have buckling of the trail surface. Very rough conditions on trails, if traversed, can cause discomfort for riders.

Figure 3. Roughness categories

Pilot Deployment

At the time of this project's conception, the COMPASS Data Bike was one of only two of its kind in the United States.[1] As a new concept, errors and the need for troubleshooting were to be expected. This pilot was an opportunity to refine proper deployment processes and develop standard operating procedures to facilitate future deployments.[2]

This pilot began in early 2019 with a short deployment on a 400-meter stretch of trail. This was done to gain an understanding of basic functions (i.e., technology usage, camera mounting, etc.). After a basic understanding was gained, larger-scale pilot deployments were undertaken in the summer and fall of 2020 to fine-tune the data bike's functionality. These deployments were focused on three miles of the Boise River Greenbelt. Since this pathway is bidirectional, each segment required at least two "passes" of the data bike (one for each side). For data verification, this process was repeated for a total of four passes on each pathway segment (two on each side).

From this pilot, COMPASS was able to create a map showing the roughness along the pilot segment (Figure 4). It is important to note that the roughness data alone do not tell the full story, but they do provide insight into where problem sections may lie. For example, two different sections were rated as "rough" (orange), but based on visual inspection it was clear that the reasons for the "rough" ratings were very different – one section was impacted by tree roots while the other was a wooden bridge. These differences can be very important when using the data for decision-making.

In addition, the dashboard was used to produce a simple graphic showing the percentages of the pathway segment falling into each of the five categories (Figure 5). This graphic can be useful to gain understanding of each pathway segment's relative quality. It can also be used as a tool to compare different study areas. Among other things, these comparisons can be used to prioritize sections for improvements.

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[1] The Des Moines Area Metropolitan Planning Origination's Iowa Data Bike (https://dmampo.org/data-bike/) was the first "data bike" in the nation and served as the impetus and model for the COMPASS Data Bike.

[2] The standard operating procedures are a "living" document and not included here. To request a copy, contact info@compassidaho.org.

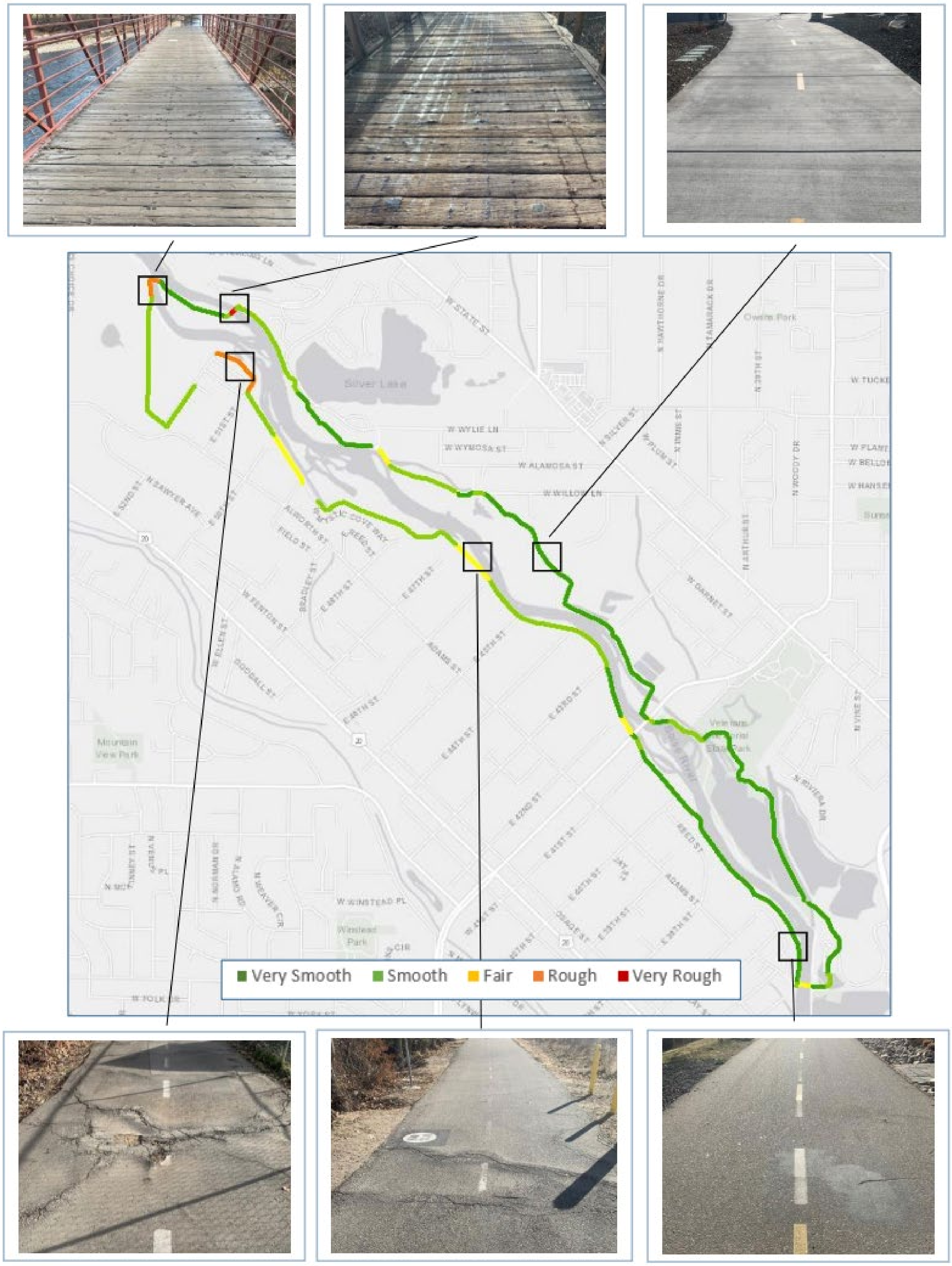

Figure 4. Roughness map of pilot segment

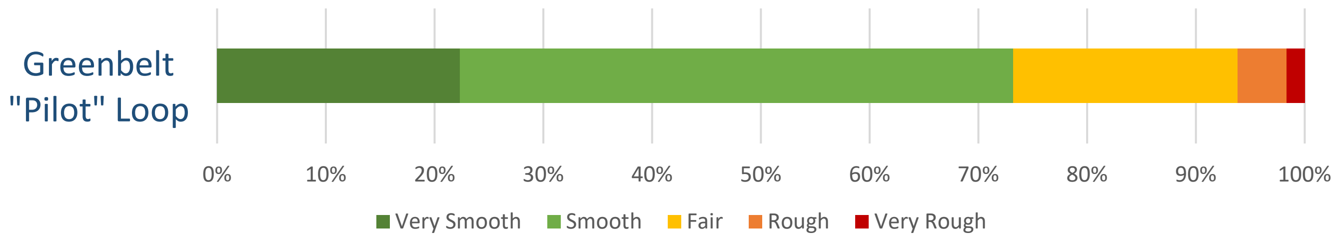

Figure 5. Percentages of pathway, by roughness, for pilot segment

Using the Data

While this pilot deployment and report have value for asset management, their primary value is as a reference point for future deployments. With this starting point, agencies are able to begin assessing pavement condition trends for the segment included in the pilot.

In the future, as the data bike is deployed more widely, there will be burgeoning opportunities to identify trends for individual pathway segments. In addition, the data can be used to assist in prioritizing funding for pathway maintenance.

Next Steps

The 2020 data collection pilot laid the groundwork to begin using the COMPASS Data Bike to collect pathway data in earnest in 2021. The pilot allowed data bike users to become familiar with all aspects of the equipment and app and develop standard operating procedures to guide future deployment.

Beginning in 2021, COMPASS plans to use the data bike to collect data on all paved sections of the Boise River Greenbelt, as well as other agency-requested areas of interest. For each deployment area, the data will be shared with the associated agencies within approximately three weeks of deployment. A compilation of the data from 2021 will be presented in a document similar to this and on the COMPASS website.