



# Benefit Analysis of the Proposed Belgrade-Bozeman Frontage Path

Headwaters Economics | Updated August 2018<sup>1</sup>

## Introduction

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This report describes the potential benefits of a proposed paved, multi-use pathway connecting the cities of Belgrade and Bozeman along an approximately ten-mile stretch of Frontage Road (U.S. Highway 10) in Gallatin County, Montana. The proposed path has been discussed by community members, transportation officials, and elected leaders for decades. It would provide non-motorized transportation options for travel to and from work, school, the airport, parks, and business, as well as recreational trail opportunities for nearby residents.

This report describes the proposed path benefits and their monetization where possible, in five broad categories: public health and safety, economic benefits, environmental sustainability, quality of life, and community planning priorities.

This report was produced on behalf of the Galla10 Alliance for Pathways using standard statistical methods approved by the U.S. Department of Transportation.<sup>1</sup>

## Summary Findings

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- The proposed path would provide many benefits to local residents, including increased safety, improved public health from increased physical activity, increased property values, business attraction and growth, reduced carbon emissions, and improvements in quality of life, socioeconomic opportunity, and social cohesion.
- The proposed pathway would create benefits estimated at more than \$22.9 million during the first 20 years, although this number underestimates the benefits since many important values cannot be quantified.
- These benefits are worth approximately twice the cost of path construction and maintenance, estimated at \$8.9 to \$11.7 million.<sup>2</sup>

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<sup>1</sup> This report was originally published in April 2018 and was updated in August 2018 to reflect updated crash data, to correct a typo in Table 2, and to correct an error in a previous calculation under “improved community health.” The total benefit value changed from \$22,821,000 to \$22,989,000.

**Table 1. Summary of Benefits  
Proposed Path from Belgrade to Bozeman**

<b>Category</b>	<b>Indicator</b>	<b>Net Present Value (7% discount rate)</b>
Public Health & Safety	Increased safety for pedestrians and bicyclists; reduction in injuries and death.	\$21,305,000
	Improved community health due to increased physical activity; reduction in mortality.	\$625,000
Economic Benefits	Increased property values.	Numerous peer-reviewed analyses show proximity to trails can increase property values an average of five to ten percent.
	Business attraction and growth.	Providing safe bicycle and pedestrian routes has positive impacts on merchants and businesses.
Environmental Sustainability	Reduced greenhouse gas emissions due to increased non-motorized commuting.	\$978,000
Quality of life	Improved bicycle/pedestrian experience.	\$81,000
	Socioeconomic opportunity & equity.	Trails create economic, health, and quality of life benefits and opportunities for the people who live near them, especially for the most vulnerable populations.
	Increased social cohesion.	Research shows that residents near trails highly value opportunities to meet neighbors, recreate with families, and engage in social interaction.
Community Planning Priorities	Alignment with community goals articulated in public planning documents.	The proposed pathway is explicitly mentioned and ranked as a high priority in nearly every community transportation and trail planning document for Gallatin County and cities of Belgrade and Bozeman.
<b>Total</b>		<b>\$22,989,000</b>

## Methods and Assumptions

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Throughout this analysis, all dollar values are reported in 2018 figures. We assume the project life will be 20 years, a conservative estimate since proper maintenance of asphalt paths can extend the lifespan much longer. For the purposes of economic modeling, we also assumed the path would be constructed in 2020 and start creating benefits at that time.

Where monetization was possible, the net present values of the benefits are reported with discount rates of seven percent. A discount rate of seven percent means that benefits are valued seven percent less every year, to account for people's preference for benefits today compared to benefits in the future. Discounting future benefits and costs is a standard practice in benefit-cost analysis. Federal guidelines recommend a seven percent discount rate as a conservative approach.

Where monetization is not possible, benefits are described and listed as "qualitative" and not included in the total monetary estimate. Therefore, it is worth noting that the total monetized benefits, while impressive, significantly underestimate the total value to the community because many of the benefits cannot be quantified in dollars.

For several components of the analysis we use demographic numbers representing Belgrade but not Bozeman, although residents of both cities likely will use the proposed pathway. Because Belgrade is a smaller community, this choice results in conservative figures.

In several categories we use statistics related to bicycle use rather than pedestrian use because no pedestrian usage data exist for the proposed route. Additionally, since the proposed path is close to ten miles long, it is likely that bicyclists will use it most frequently. Pedestrians will certainly use the pathway for exercise and access to neighborhoods and businesses along the proposed pathway route. The unavailability of pedestrian data likely underestimates the total benefits of the path.

The following sections describe the specific results and methods for each benefit category.

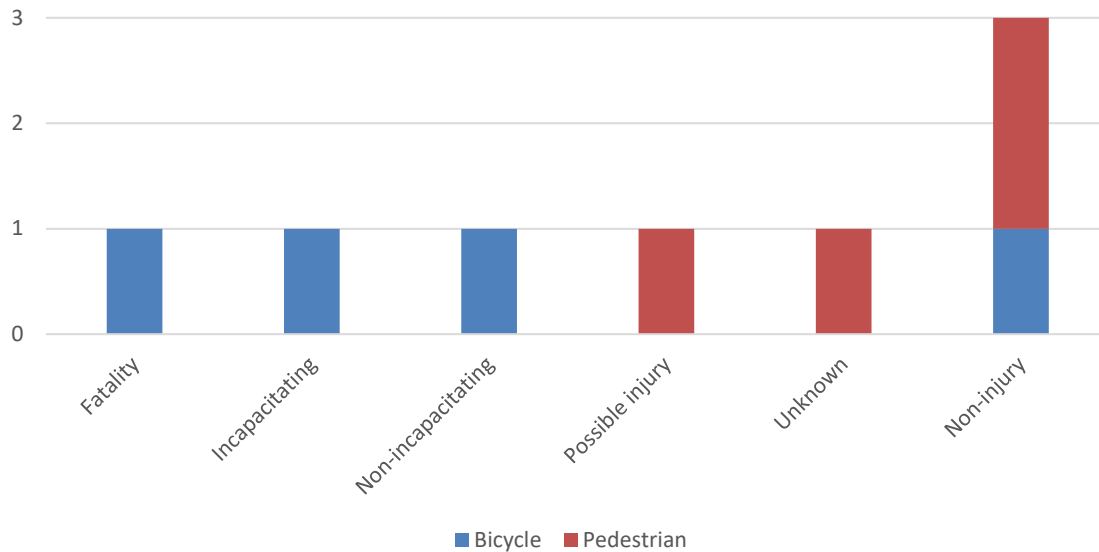
## Public Health & Safety

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### **Increased safety for pedestrians and bicyclists; reduction in injuries and death.....\$21,305,000**

Currently, bicyclists and pedestrians travel alongside motor vehicles on Frontage Road where the posted speed limit is 50 mph and shoulders are extremely narrow or non-existent. During the eight-year period from 2010-2017, eight crashes involved bicycles and pedestrians along the proposed corridor. Four crashes involved pedestrians and four involved bicycles, including one fatality (Figure 1).<sup>3</sup>

Figure 1: Crashes Involving Bicyclists and Pedestrians along Frontage Road, 2010 - 2017



Source: MT Department of Transportation<sup>3</sup>

U.S. Department of Transportation guidance governs how to estimate the impact of crashes using the “value of a statistical life.”<sup>4</sup> This value is currently set at \$10,176,000 (adjusting for inflation). Fatal injuries are estimated as the total value of a statistical life. Nonfatal injuries result in loss of quality of life—including pain and suffering and reduced income—and are estimated as a fraction of the value of a statistical life, scaled in proportion to injury severity.

Based on historical crash records, we assumed the pathway would help avoid an average of 1 crash per year (Table 2). For each injury severity, we multiplied the value of a statistical life by injury severity type, as shown in the table below. This results in \$2,205,648 in avoided costs per year. During the project lifespan, this equates to a net present value discounted at 7 percent of \$21,305,000 through 18 crashes avoided over the lifespan of the project.

**Table 2. Benefits of Avoided Crashes**

Frontage Road Crash Type	Average Number Per Year <sup>a</sup>	Relative Disutility Factors by Injury Severity Level		Avoided Cost Per Year
Fatal	0.125	Unsurvivable	1.0	\$1,272,000
Incapacitating injury	0.125	Critical	0.593	754,296
Non-incapacitating injury	0.125	Moderate	0.047	\$59,784
Possible injury	0.125	Moderate	0.047	\$59,784
Unknown	0.125	Moderate	0.047	\$59,784
No injury	0.375	None	0	\$0
<b>Total</b>	<b>1</b>			<b>\$2,205,648</b>

<sup>a</sup> 2010-2017, from Montana Department of Transportation.

While these are accepted methods for monetizing the value of injuries avoided, injury or death resulting from crashes are human tragedies with far-reaching and long-lasting impacts to a community. It is impossible to place a value on the pain, suffering, and loss experienced by the victim, his/her family, and friends after a crash resulting in death or incapacitating injury.

**Improved community health due to increased physical activity; reduction in mortality.....\$625,000**

Public health research indicates that living closer to trails is associated with increased physical activity, which translates into lower mortality rates and lower health care costs for a community.<sup>5</sup>

Belgrade was estimated to approximately 7,874 residents last year,<sup>6</sup> and approximately 14 percent of Gallatin County residents do not have access to exercise opportunities.<sup>7</sup> We assume that the pathway will facilitate increased physical activity among 639 residents based on research that found 58 percent of inactive residents increased their physical activity due to the construction of a nearby trail.<sup>8</sup>

Using the Health Economic Assessment Tool,<sup>9</sup> the value of the expected mortality risk reduction and reduced health care expenses associated with 639 residents walking two additional miles per week is \$64,713 per year. The net present value of these benefits during 20 years at seven percent discount rate is approximately \$625,000.

This figure is likely a significant underestimate because it only accounts for mortality risk reductions for Belgrade residents, while residents from Bozeman and neighborhoods between Belgrade and Bozeman are likely to increase their physical activity as well. To keep the estimate conservative, this portion of the analysis also accounts only for residents using the pathway for exercise and recreation—not for commuting or transportation.

## **Economic Competitiveness**

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**Increased Property Values.....Qualitative**

Numerous peer-reviewed analyses demonstrate the value of nearby trails for homeowners who see property values increase from five to ten percent.<sup>10</sup> Trails create an amenity that commands a higher price for nearby homes. Trails are valued by those who live nearby as places to recreate, convenient opportunities for physical activity and improving health, and safe corridors for walking or cycling to work or school. When trails increase property values, local governments also receive more property tax revenue.

**Business Attraction and Growth.....Qualitative**

The economic impact of trails often is described in terms of increases in tourism and associated spending, but local pathways and trails can be important factors for attracting and retaining local businesses that employ and serve residents.

Commercial areas along the proposed path route will likely soon be developed.<sup>11</sup> Providing safe bicycle and pedestrian access to commercial nodes will increase access for customers and provide non-motorized commute options for workers.

Many communities find positive impacts on businesses when bicycle routes are installed. Improvements to bicycle and pedestrian access help provide opportunities for people to slow down and notice businesses more

often. In San Francisco, two-thirds of merchants found positive impacts when bike lanes were installed on their streets.<sup>12</sup> Several studies find that people who arrive by bicycle or walking spend more money in the area during longer periods of time than when they drive.<sup>13</sup>

Non-motorized access to the airport is also important for workers and travelers. Bicycling routes to airports around the world are becoming more common. Salt Lake City (Utah) International Airport has installed a bicycle path for commuters and travelers, along with free bicycle parking.<sup>14</sup> Vancouver (Canada) International Airport is approximately ten miles from the city center and has several programs dedicated to encouraging cycling by both employees and travelers, including installation of bike paths.<sup>15</sup> Bozeman Yellowstone International Airport is Montana’s busiest airport, with more than 700 employees serving more than 600,000 passengers each year.<sup>16</sup> Non-motorized transportation options would benefit both airport employees and passengers.

Due to the uncertainty associated with forecasting additional jobs and income associated with the trail, this new economic activity is included as a qualitative benefit only.

## Environmental Sustainability

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### **Reduced Greenhouse Gas Emissions Due to Increased Non-Motorized Commuting..... \$978,000**

The proposed pathway will create a safe, scenic, non-motorized transportation option for commuters in the cities of Belgrade and Bozeman and the neighborhoods in unincorporated Gallatin County. Research shows that proximity to off-road infrastructure increases bicycle commuting, especially when connecting population centers with employment centers and when it is separated from roadways.<sup>17</sup> The more paths available, the greater the increase in non-motorized commuting.<sup>18</sup> Cyclists across all demographics and abilities prefer dedicated cycling facilities and are opposed to riding with high-speed traffic and high-volume traffic.<sup>19</sup>

To estimate the savings in greenhouse gas emissions attributable to the proposed path, we estimate the value of avoided carbon emissions due to reduced vehicle miles traveled (VMT).

Currently, one percent of Belgrade residents report commuting by bicycle.<sup>20</sup> We estimate that after the path is built, the share of Belgrade’s residents commuting by bicycle will be 5.6 percent, the same as neighboring Bozeman’s current share.<sup>21</sup>

This is likely an underestimate because research has found that new trails can have much larger effects on bicycling when the trails create an important connection in a network.<sup>22</sup> In Bozeman, an instantaneous increase of 256 percent of bicycling and walking was observed in 2007 after the installation of bicycle and pedestrian facilities that connected to existing bike lanes and sidewalks on West Babcock Street.<sup>23</sup>

In addition, the pathway also will be accessible to neighborhoods between Belgrade and Bozeman that are not accounted for here. For this analysis, we quantify changes to commuting patterns by Belgrade residents only.<sup>24</sup> However, it is important to note that many Bozeman residents also commute to work in Belgrade, and many Belgrade residents travel into Bozeman for shopping and other amenities.

Based on average fuel consumption and fair-weather working days per year under average climatic conditions, we estimate the proposed path will avoid 34,545 metric tons of CO<sub>2</sub> emissions during the next 20 years. Using the current and projected social cost of carbon,<sup>25</sup> the net present value of these savings discounted at seven percent is approximately \$978,000.

We do not quantify the relatively small quantity of other emissions such as NO<sub>x</sub>, SO<sub>x</sub>, and particulate matter, nor do we monetize the benefits of these reductions. However, the reduction in these emissions is also beneficial for air quality. Further, increasing the mode share of bicycle commuting has other advantageous environmental outcomes, including reduced traffic congestion and associated emissions from vehicles still on the road, and less land necessary for roadways and parking.

## Quality of Life

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### **Improved Bicycle and Pedestrian Experience..... \$81,000**

By creating a new pathway and connecting Belgrade and Bozeman—two communities that are vitally, economically connected—the pathway will significantly improve trail user experiences. The proposed pathway will also connect important recreational resources such as Cherry River Fishing Access Site and Lewis & Clark Park in Belgrade.

To determine a likely increase in trail use, we use the example from Durham, North Carolina: after a bridge was constructed to connect two dead-end trails, trail use increased by 133 percent.<sup>26</sup>

Based on current data showing an average of 13.25 bicycle trips per day on Frontage Road during fair-weather season,<sup>27</sup> we estimate that annual trail use will increase by approximately 3,216 new users.

Research estimates that improved trail user experience is worth \$0.26 per non-motorized mile traveled due to improved social experiences and physical and mental health.<sup>28</sup> Assuming the new users travel 10 miles round trip—roughly half the path length, we estimate the annual benefits to new users will be \$8,040. The net present value of benefits discounted at seven percent during the next 20 years is approximately \$81,000. This likely underestimates the total benefit, as many users would travel the entire 20-mile round trip.

### **Socioeconomic Opportunity & Equity.....Qualitative**

Trails create public health, property value, and quality of life benefits for the people who live closest to them. For example, research shows that the gap in mortality rates between low- and high-income people decreases with proximity to green space, and people across all income levels have improved health when they live closer to trails.<sup>29</sup> Having safe non-motorized transportation options also improves economic opportunities for people who do not own cars. However, with few trails near the city, Belgrade residents currently have less access to these benefits.

### **Increased Social Cohesion..... Qualitative**

The proposed pathway will provide opportunity for improved social connection and community pride in Belgrade and Bozeman. Research has found that residents near trails highly value opportunities to meet neighbors, recreate with families, and engage in other social interaction.<sup>30</sup>

## Community Planning Priorities

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### **Alignment with Community Goals..... Qualitative**

The proposed pathway is explicitly mentioned and ranked as a high priority in community transportation and trail planning documents, including the following.



#### Gallatin County:

- Trails Plan<sup>31</sup> (2001). The path is ranked as “the highest priority proposed trail in Gallatin County.”
- Greater Bozeman Area Transportation Plan<sup>32</sup> (2007), currently adopted by Gallatin County. Bicycle and pedestrian connections between Belgrade and Bozeman were ranked first in requested new projects by more than 2,000 survey respondents, and “lack of dedicated bicycle facilities along high profile routes such as Bozeman-Belgrade” was identified as a main problem of bicycle transportation.

#### City of Bozeman:

- Parks, Recreation, Open Space, and Trails (PROST) Plan<sup>33</sup> (2007). Supporting the effort to construct a safe path between Belgrade and Bozeman was specifically listed as a strategy in this plan.
- Transportation Master Plan<sup>34</sup> (2017). A path along Frontage Road is identified as a recommended improvement, and is currently listed as a “level 4” roadway with a “not comfortable” level of traffic stress roadway for roadway bicycling.
- Strategic Plan<sup>35</sup> (2018). Articulated goals include enhancing non-motorized transportation choices and supporting the maintenance and expansion of an interconnected system of trails.

#### City of Belgrade:

- Long-Range Transportation Plan<sup>36</sup> (2018). The path is identified as a priority, and the current lack of dedicated bicycle facilities on high profile routes, including Frontage Road, is shown as a significant barrier for bicycle travel. The plan also includes goals to improve opportunities for active transportation by increasing pedestrian and bicycle connections and promoting transportation projects that reduce fuel consumption.
- Growth Policy<sup>37</sup> (2006). The plan includes a goal of establishing pedestrian and bike paths, including the specific task of developing “bike/pedestrian paths to connect to Bozeman.”

#### Montana Department of Transportation:

- Belgrade to Bozeman Frontage Road Corridor Study<sup>38</sup> (2017). The proposed path is included as a recommended improvement for Frontage Road. The Corridor Study also notes that while improved eight-foot shoulders may be an alternative to a separated, shared-use path, the latter would further enhance safety and mobility. While paved, walkable shoulders are often considered adequate for walking and bicycling on rural highways, development around Frontage Road is no longer rural, and studies show that users of all ages and abilities prefer dedicated bicycle facilities to riding on shoulders.<sup>39</sup>

## Cost

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The costs for this project have not been analyzed in detail in this report. Using recent estimates from transportation planning documents, we estimate the total project cost, including construction and annual maintenance, to be \$8,860,000 to \$11,660,000 during the 20-year lifespan of the path.

We estimate construction of the path to be between \$820,000 to \$1,100,000 per mile.<sup>40</sup> Additional land or easement acquisition would likely be necessary on the north side of Frontage Road to complete the path corridor, and acquisition costs are not included here.

Based on information in the Bozeman Transportation Master Plan, the total undiscounted maintenance costs during a 20-year project lifespan are estimated to be \$660,000. Annual maintenance costs include a 5-year seal coat cycle (\$9,000 per mile per 5-years) and routine maintenance like sweeping and plowing (\$1,500 per mile year).<sup>41</sup>



## Summary

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The proposed path would provide many benefits to residents, including increased safety, improved public health, rises in property values, business attraction and growth, reduced carbon emissions, and improvements in quality of life, socioeconomic opportunity, and social cohesion. The benefits that can be monetized are valued at more than \$22.9 million during the first 20 years of the project, and likely significantly underestimate the total value of the path. The monetized benefits are approximately twice the estimated cost of the path construction and maintenance.

## Contact

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## About Headwaters Economics

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Headwaters Economics is an independent, nonprofit research group whose mission is to improve community development and land management decisions. With expertise in trails and pathways, Headwaters Economics maintains the [Trail Benefits Library](#)—a collection of studies on the impacts of trails, especially in small- and medium-sized towns and rural areas. <https://headwaterseconomics.org/>

## End Notes

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- <sup>1</sup> U.S. Department of Transportation. TIGER Benefit-Cost Analysis (BCA) Resource Guide. <https://www.transportation.gov/policy-initiatives/tiger/tiger-benefit-cost-analysis-bca-resource-guide>
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