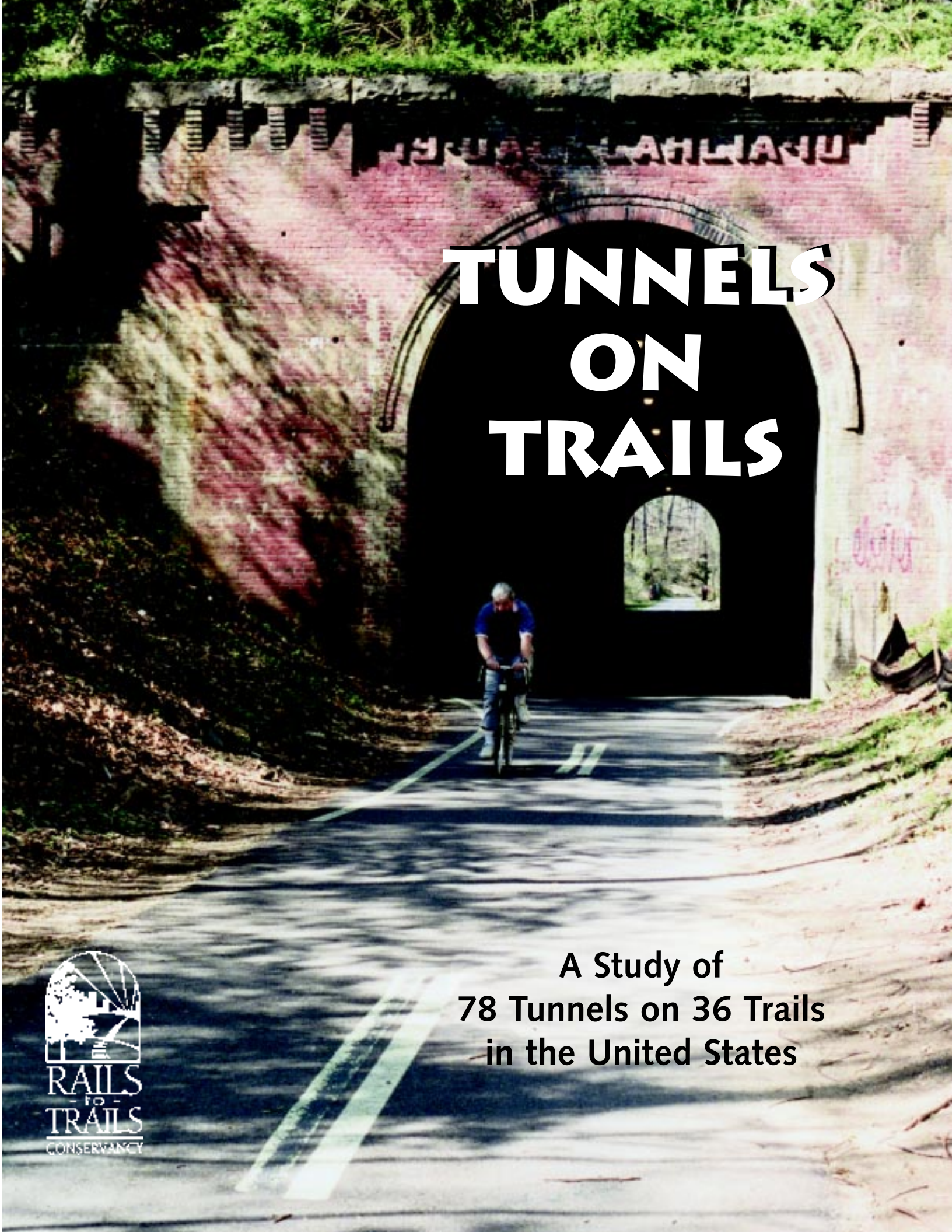

TUNNELS ON TRAILS

A Study of 78 Tunnels on 36 Trails in the United States

RAILS TO TRAILS CONSERVANCY

ACKNOWLEDGEMENTS

We would like to thank the County of Marin for their interest in this topic and for making a grant available to conduct this study. Many people contributed time to this project and because of their generous assistance we were able to locate numerous tunnels around the country, and discover how they fit into adjacent communities. We are tremendously grateful to Angie Tornes and the staff members from the Rivers and Trails Conservation Assistance Program of the National Park Service who provided us with contacts for the managers of many of the tunnels in this study. Thanks also to Bill Archibald of Trails British Columbia and Brian Springinotic of the Canadian Land Use Coordination Office who were instrumental in providing information on non-motorized tunnels in Canada.

We very much appreciate the help of Jacobs Associates Engineering and Consulting, especially Rich Coffin and Victor Romero who provided technical assistance on structural and engineering issues, and were invaluable resources regarding geological impacts on tunnel design. In addition, Anne Lusk, a Ph.D. candidate at the University of Michigan, provided us with detailed information about tunnel design, and in particular how to design these structures to be attractive assets to the communities in which they exist. As always, Hugh Morris, research director at RTC, provided great wisdom and insight to the research process.

Finally, we would like to extend a special thank you to all the tunnel managers and their staffs who spent many hours tracking down operations and maintenance costs, tunnel dimensions, and various other pieces of information related to the history of their tunnels. In particular, the managers of tunnels that were subjects of the in-depth case studies went out of their way to provide us with detailed descriptions of the conversion or construction process as well as anecdotes from the communities where the tunnels are located. Special thanks to: Tim Schmidt of the Iron Horse State Park, Tim Bustos from the City of Davis, Dennis Bigler from the City of St. Clairsville, Phil George of the Washington State Department of Transportation, and John Dugger, vice chair of the Coalition for the Capital Crescent Trail. You all helped us see the light at the end of the tunnel!

MARIN COUNTY

This report was sponsored by the County of Marin, which lies just north of San Francisco, across the Golden Gate. Beginning in the 1870s, the County was served by ferry and rail service. A suburban electric line was in place throughout southern Marin by 1904. This line helped create numerous bedroom communities for San Francisco. These towns, nestled between ridges extending from the dominant land mass, Mount Tamalpais, were connected by flat routes via tunnels. After rail use was discontinued about 1970, some of the valley alignments were converted to bicycle/pedestrian paths. The County's Bicycle and Pedestrian Master Plan lists a series of gap closure alternatives, which include the use of these railroad tunnels. Six of these tunnels are identified as potential bicycle/pedestrian routes. Two tunnels, the Alto and the Cal Park Hill, are being examined closely because of their location along the highway 101 corridor, which is experiencing significant auto congestion. In February of 2001, Marin committed $100,000 to an engineering and feasibility study of the Alto Tunnel between Corte Madera and Mill Valley.

RAILS-TO-TRAILS CONSERVANCY

This report was produced by Rails-to-Trails Conservancy (RTC), founded in 1986. RTC is the nation's largest trails organization with more than 100,000 members and donors dedicated to connecting people and communities by creating a nationwide network of public trails from former rail lines and connecting corridors. Rails-to-Trails Conservancy is a 501(c)(3) nonprofit organization.

Tunnels on Trails

A Study of 78 Tunnels
on 36 Trails in the United States

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Produced by Rails-to-Trails Conservancy
Sponsored by Marin County

RAILS to TRAILS CONSERVANCY

April 2001

CONTENTS

Message from Harold C. Brown Jr.
President, Marin County Board of Supervisors

Marin County, which prides itself for being a leader in many areas, has recently adopted an ambitious Bicycle and Pedestrian Master Plan. Of particular prominence within this master plan is the idea of restoring various abandoned tunnels, formerly used by trains.

The present study detailing the national experience in reopening abandoned tunnels for pedestrian and bicycle use is both illuminating and encouraging. Clearly, the idea has been successfully executed in many communities, providing numerous benefits. These benefits include:

- ☐ Increased walking and bicycling through the provision of direct, relatively flat, travel corridors
- ☐ Cleaner air through lesser dependence on the automobile
- ☐ Better health and increased physical fitness
- ☐ Safer neighborhoods

I highly recommend this report to the attention of all professional land use and transportation planners, as well as concerned citizens who take an interest in transportation alternatives and the enhanced vitality of their communities.

Sincerely,

Harold C. Brown, Jr.

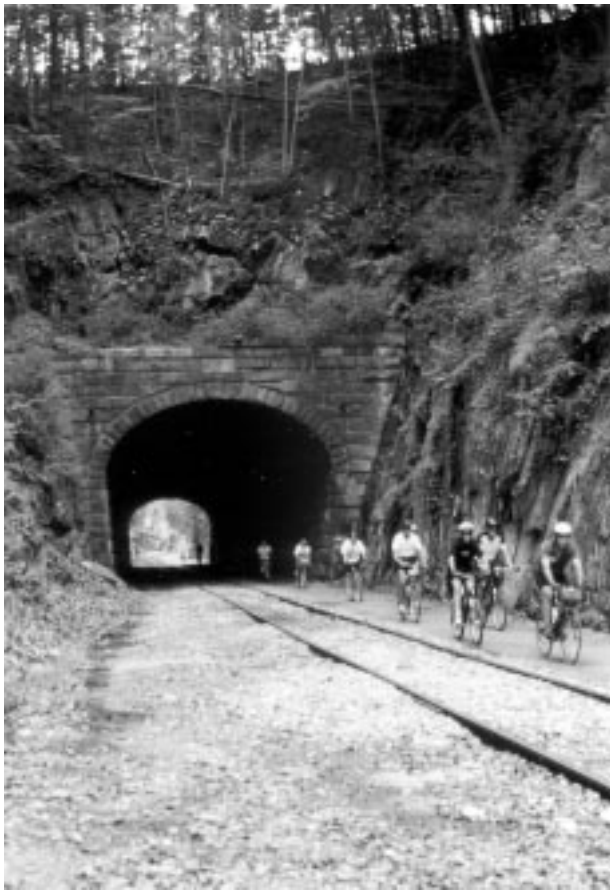
INTRODUCTION

Over the past several years, Americans have become more aware of the social, environmental, health and economic benefits of bicycle and pedestrian activity, whether for transportation or recreation purposes. Every day, millions of people in communities across the country enjoy the multiple benefits of traveling by foot or on two wheels. The last decade has seen a significant increase in the development of new trails, sidewalks and on-road bicycling facilities that have made non-motorized transportation both safer and more appealing.

The importance of these facilities has become even more apparent given trends of increasing traffic congestion, pollution and poor public health. Each year Americans spend almost twenty percent of their income on automobile trips.[1] More than one quarter of all morning commute trips in the San Francisco Bay Area are school related.[2] One in five of the country's adults and more than 11 percent of children are clinically obese.[3] Many cities are losing millions of dollars in funding because they cannot meet federal clean-air standards. Being hit by a car while walking is the second leading cause of death for children aged 5 to 12 in California.[4] Creating safe systems of interconnected trails, sidewalks and bike lanes improves people's ability to use non-motorized ways to get around, and can help address all of these problems.

For bicycle and pedestrian facilities to be truly functional as routes between work, home, school, libraries, parks and shopping areas, they must be part of an interconnected network. While access to these facilities has improved tremendously in recent years, many gaps remain. Some of the most daunting and important gaps to close are those that involve physical barriers such as freeways, roads, rivers and hills. In these cases, opening tunnels or using bridges is often the most effective and efficient way to close these gaps and make the trail a truly functional and safe part of the transportation network. Where tunnels or bridges already exist, usually on abandoned railroad rights-of way, they represent a tremendous asset to communities looking to create comfortable and continuous facilities for walking and bicycling.

While trails, with their tunnels and bridges, are extremely popular once they open, they face significant obstacles in the planning phases. One of the most important issues arises around the perception held by local residents that these new facilities will have a negative impact on the surrounding neighborhood. Concerns most commonly voiced by local residents include fears that new trails will lead to nuisances such as increased traffic and loss of



Howard Tunnel, York County Heritage Trail, Penn. This is the only rail-with-trail tunnel that was identified for this report. Tourist trains must wait for tunnel users to exit the tunnel before proceeding. Credit: York County Parks.

Opening up the tunnel with the trail effectively stopped the elements we didn't want. We've had a 180-degree turn-around since opening. Now, proximity to the trail is used as a selling point, people get attached to the trail, and they keep an eye on it.

— Bill Kunz, Bureau of Land Management
Sacramento River Rail-Trail, Redding, Calif.

privacy. Also, communities may worry that crimes such as graffiti, trespassing, littering, loitering, muggings, rape and even murder will result. Numerous studies have concluded that trails do not generate crime.[5] Many studies show that, in fact, these facilities usually result in improvements in safety and overall neighborhood aesthetics. Despite this wealth of evidence, concerns continue to surface, especially when relatively "novel" facilities such as tunnels are being considered. Thus, it is very important for those planning new bicycle and pedestrian facilities to address these concerns.

Recognizing the need to address community concerns regarding the potential opening of unused railroad tunnels, as identified in the Marin County Bicycle and Pedestrian Master Plan, county officials approached the Rails-to-Trails Conservancy (RTC) California field office to get more information on the impacts of open tunnels in the communities where they exist. At that time, the authors knew of only a few tunnels that were open for non-motorized use along trails or bikeways. This existing information was found in RTC's database of open rail-trails in the United States, a short report produced by RTC in 1989, and through the personal accounts of those who had used tunnels.

In order to provide more information to Marin County residents about the impact of tunnels on local communities and their role in facilitating bicycle and pedestrian activity, the County of Marin provided a small grant to RTC to conduct a broader study. This study had three goals: 1) to provide information on the basic design, structural, planning and management issues associated with tunnels on trails, 2) to provide information that would help answer community questions about the potential impact of open trail tunnels on their neighborhoods, and 3) to provide perspective on the overall debate about the costs versus the benefits of proposed new tunnel facilities.

During the fall of 2000, RTC identified open trail tunnels across the United States, and conducted an extensive survey of the managers of these tunnels. This report presents information about the experiences of 78 tunnels on 36 trails in the United States open only to non-motorized traffic. It covers many aspects of these tunnels, focusing on typical community concerns which include safety, liability issues, costs of tunnel restoration, construction, maintenance, and the impact of a tunnel on the existing transportation network and surrounding communities.

This report is intended to help Marin County residents, agency staff, elected officials and people in other communities make informed decisions about the overall benefits and costs associated with proposed new trail tunnel projects. As a result of the work on this report, the authors are convinced that tunnels used to close gaps that impede bicycle and pedestrian travel represent a valuable resource that can help a community achieve its transportation goals. For more information about other issues and concerns associated with trail development and management, please see RTC's other studies on trail-related liability, community sentiment and safety. These reports and references to studies conducted by other organizations are presented in Appendices F and G and are available on the Trails and Greenways Clearinghouse, accessible by visiting www.railtrails.org.

II. BACKGROUND ON TUNNELS AND TRAILS

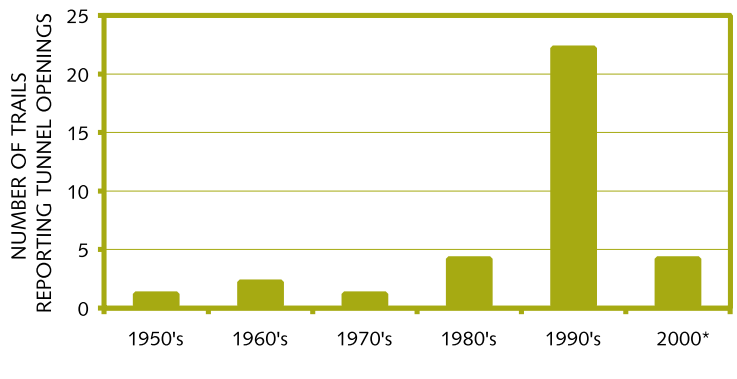
Tunnels built on railroad corridors required enormous investments of money and labor by the railroad companies that created them. When the nation's active railroad network began its decline in the 1950s and 1960s, many of these tunnels were abandoned, remaining only as idle and forgotten monuments to the great railroad age. In the last twenty years, many of these tunnels have found new life as key components of transportation corridors for cyclists and pedestrians. Sixty-five percent of the tunnels included in this report were opened for trail use since 1990. These new tunnels represent a significant and growing trend that parallels the rapid growth in rail-trail conversions nationwide.

In hilly areas, tunnels and trestles are at the very heart of a rail-trail, providing the consistency, continuity and flat grade that have made rail-trails famous for their accessibility and broad appeal. The majority of tunnels identified along trails were found clustered in the Mid-Atlantic and Midwestern States, Northern California and the Pacific Northwest where mountainous terrain made them necessary for the safe and efficient passage of trains. The original "Milwaukee Road" corridor that connected Chicago to Seattle through the Rocky and Cascade mountain ranges required the construction of some of the longest and most ambitious tunnels built in the early part of the 20th century. The North Bend Railroad, traveling 72 miles through the Appalachians, included 22 tunnels, prompting Mark Twain to dub it the "Appalachian Subway."

Tunnel #13 along the North Bend Trail in West Virginia. Mark Twain referred to the original railroad corridor as the "Appalachian Subway." Credit: West Virginia State Parks.

Unfortunately, many rail-trails often end at the portals of a tunnel, severing the continuity of the trail. Although there may be alternative ways to get around the hills that tunnels go through, these routes are often prohibitive to all but the most experienced, fit and motivated bicyclists and pedestrians. Maintaining a continuous, flat grade ensures that a trail is accessible to people of all ages and ability levels, especially children, senior citizens and people with disabilities, who are among the most appreciative of these structures.

Figure 1: Date tunnels opened as part of trails



*Tunnels opened between January 1, 2000 thru December 31, 2000

III. METHODOLOGY

Authors of this report reviewed RTC databases, consulted with the National Park Service and trail managers from other agencies, and searched the Internet to develop a contact list of tunnels open exclusively to non-motorized traffic in the United States. From this research, 50 trails, including 111 tunnels, were identified. It became clear early in the research that there are hundreds (and perhaps thousands) of short underpasses that have different characteristics and issues than longer tunnels. Since this study was intended to help answer questions about longer tunnels, similar to those in Marin County, the authors decided to exclude tunnels under 100 feet in length.

The authors then developed a five-page survey designed in part to answer questions that were raised at several public meetings in Corte Madera, Mill Valley and Larkspur, Calif. in the summer and fall of 2000. The survey (Appendix E) asked questions about various aspects of tunnel development and maintenance including financial impact, planning and design, structural and engineering issues, impact on local communities, types and frequency of use, and management issues. The survey was mailed to the managers of the 50 trails with 111 tunnels identified in the research. In subsequent discussions with trail managers, it became clear that of these, 33 tunnels on 14 trails did not meet the criteria of the study because the tunnels were closed, were under 100 feet, or were shared with motor vehicle traffic. After identifying the tunnels that met the criteria, 78 tunnels on 36 trails remained. In a few cases, trail managers did not have as much information on the tunnel as a local nonprofit group associated with the trail. In these cases the individual most familiar with the tunnel completed the survey. Appendix A lists contact information for all survey respondents.

Responses to the surveys were entered into a database. In some cases, trail managers did not answer every question. In these cases, RTC staff contacted trail managers by phone to complete surveys to the extent that was possible. For each question, percentages were calculated using only the number of responses to that question. Thus, some results are based on fewer responses than others. This occurred primarily in responses to questions about overall costs of tunnel acquisition and management, because some trail managers were unable to separate the cost of the tunnel from the overall trail planning, development or management costs. If trail managers provided a range for a cost associated with the tunnel, the authors used the higher estimate, and where managers provided a range for a particular dimension, the calculations included the median value.

In addition to the survey, the authors conducted in-depth case studies of tunnels on five trails. These studies were conducted by telephone. Each tunnel situation is unique, so these case studies show important aspects of tunnel planning, design, operation and function that may not otherwise have been revealed through the written survey.

The (Elroy- Sparta) Trail is known for its tunnels. Norwalk, Wisconsin bills itself as 'the gateway to the tunnels.' Without tunnels, users would have to take back roads as far as 6–7 miles out of their way to re-connect with the trail, and probably the project as a continuous trail would not have happened.

— Jim Moorehead, manager of the Elroy-Sparta Trail, Wis.

IV. FINDINGS

RTC received surveys reporting on 78 open tunnels on 36 trails. Eighty-six percent (67) of the open tunnels were originally built for railroad, canal or road purposes and 14 percent (11) were newly constructed specifically for the trail.

Figure 2: Location of bike/pedestrian tunnels[7]

LOCATION

Trail tunnels were found in 20 states throughout the continental United States, with the South and Southwest having the fewest tunnels of any region. The locations of these tunnels can be attributed to a region's geography, rail mileage and local trail advocacy.

Trail tunnels also exist in the context of a variety of land uses. The largest number of tunnels were found in rural areas (48 percent), followed by agricultural areas (15 percent), small towns (9 percent), residential areas (6 percent), and mixed commercial/residential neighborhoods (6 percent).[6]

TUNNEL INTENSIVE TRAILS

While most trails surveyed had one or two tunnels, the authors designated three as "tunnel intensive" trails because they had six or more tunnels open to trail users. The Iron Horse State Park Trail in Washington State and the Route of the Hiawatha Trail crossing from Idaho into Montana, have six and eight open tunnels respectively. The North Bend Trail in West Virginia, following the old CSX route from Parkersburg to Grafton through the Appalachian Mountains, goes through 10 of its 22 original tunnels.

Looking out of Tunnel #24 along the Route of the Hiawatha Rail Trail in Idaho. This is a "tunnel intensive" trail. Credit: U.S. Forest Service.

DIMENSIONS AND TYPES OF TUNNELS

Tunnels come in a wide variety of shapes and sizes. Tunnels included in this study varied in length from 100 feet (the Des Plaines River Tunnel, Ill.) to 2.3 miles (Snoqualmie Tunnel, Iron Horse State Park, Wash.), with an average length of 915 feet for rehabilitated tunnels and 301 feet for newly constructed tunnels. The widest tunnel was the 60-foot wide Paw Paw Tunnel along the C&O Canal Trail in Maryland. The narrowest tunnel was the 10-foot wide Coots Lake Tunnel along the Silver Comet Trail in Georgia. The average tunnel width was 20 feet. Tunnel height ranged from 10 feet (the I-90 tunnel in Washington and the Coot's Lake Tunnel in Georgia) to 42 feet (the National Road Bikeway Tunnel in Ohio), with an average height of 22 feet. See Appendix D for a list of all tunnel dimensions.

Tunnels fall into two main categories: "mined" tunnels and "cut and cover" tunnels. The majority of the rehabilitated tunnels are "mined tunnels," originally bored through large hills or mountains, requiring considerable planning, geologic investigation and cost to construct. Mined tunnels use a variety of reinforcement methods including wood sets, steel sets or ribs, steel liner plates, precast concrete segments, cast-in-place concrete, pipe canopies or shotcrete.[8]

Most of the newly constructed tunnels are "cut and cover" tunnels created by excavating a trough from the surface, installing a structure, and backfilling over the tunnel to grade. This type of tunnel is typically used to provide grade separation where a trail crosses a road or highway.

CASE STUDY A

I-80 UNDERCROSSING, DAVIS, CALIF.

ARRIVING IN DAVIS, CALIFORNIA, for the first time, you will notice signs welcoming you to the city that proudly display the city's logo—the bicycle. There are no traditional school buses in Davis. Instead, "buses" and "trains" of school children walk or ride their bikes to school using the 46 miles of off-road, multi-use paths and 47 miles of bike lanes that constitute the area's vast bicycle network. The city estimates that a minimum of 20 percent of all commute trips are made by bicycle, and that 60–70 percent of all children walk or bike to school. Many consider Davis (population 58,000) to be the most bicycle-friendly city in the United States.

One of the major north-south commuter routes for non-motorized traffic is the 1.75-mile Putah Creek Path. It connects the primarily residential south Davis to the university and other centers of commerce and employment in the northern part of the city. Interstate 80, the major east-west freeway in northern California, runs through the center of Davis, bisecting the northern and southern parts of the city. Bicycle commuters had to detour along Richardson Avenue, a major four-lane north-south automobile arterial, with merging high-speed traffic and sharp on and off-ramps. Despite the fact that there are bike lanes on Richardson Avenue, they are badly broken up, and it is a dangerous crossing even for skilled cyclists. Tim Bustos, bicycle coordinator and planner for the City of Davis, says, "For years people told me, 'I would bike except for the Richardson Avenue freeway overpass.' " Apparently this short treacherous crossing alone was sufficient to deter potential bicycle and pedestrian traffic.

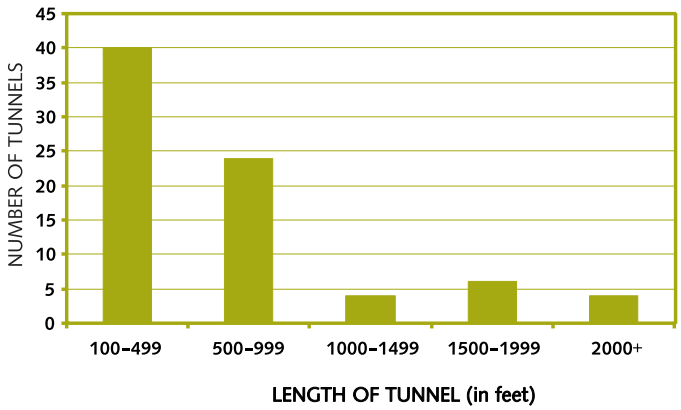
This desire for a better freeway crossing eventually translated into a groundswell of support for a separated bike and pedestrian path underneath the freeway. In planning the tunnel, adjacent communities raised concerns about crime, occupation by vagrants, increased traffic and loss of privacy. Enhanced police patrols, bright lighting, solar powered emergency phones and a special flared design give the tunnel a distinct sense of security (see photo). Anticipating a high volume of commuters and planning especially for night use, the city designed the tunnel to be very bright and open with long clear sight distances, with virtually nowhere for vagrants to loiter.

The construction of the tunnel was an impressive feat. Interstate 80 had to be raised one direction (3 lanes) at a time, and a bridge had to be built beneath each side. The total cost of the project was $4.2 million, which included engineering, planning, design, construction, lighting, fencing, benches, water fountains and landscaping.

The results have been extremely encouraging and community feedback has been very positive, according to Tim Bustos. He notes that bicycle commuting has increased fourfold since the tunnel opened. Further, he notes, "There was, and continues to be much latent demand for bicycling facilities. As soon as you make it easy and safe for people, you witness a tremendous increase in use." The tunnel has indeed facilitated an increase in bicycling between north and south Davis. At a ribbon-cutting event to celebrate the opening of the tunnel, elected officials and city planners had a hard time stringing the ribbon across the trail because of all of the bicycle traffic going in and out of the tunnel. Before the facility had even been officially opened to the public, Davis bicyclists were celebrating the safe and convenient commuting option provided by their new tunnel, in the best of ways—by using it!

I-80 Undercrossing, Davis, Calif. which opened in 2000. Credit: City of Davis, Calif.

Figure 3: Length distribution of U.S. trail tunnels



The Austinville Tunnel along the New River State Trail in Virginia is an example of a "mined" tunnel. Credit: Virginia State Parks.

USERS

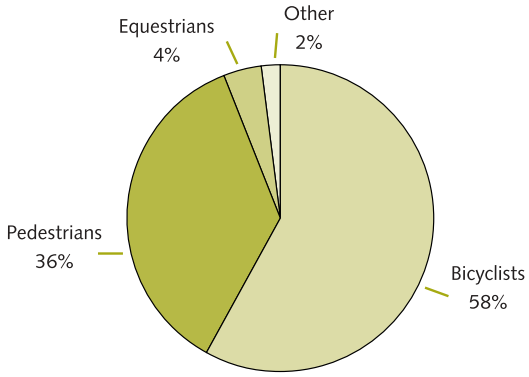
Geography and location influence trail and tunnel use. Rural trail managers reported fewer users than trails in urban areas. For all tunnels reporting, the average peak-season use was 10,200 people per month.[9] Survey results showed that a wide range of people regularly use tunnels along trails, including children, men, women, families and groups. Trail managers reported bicycling as the primary travel mode through tunnels (58 percent) and walking as the second most popular activity (36 percent). Other uses were much less frequent. Equestrians made up 4 percent of tunnel users, mainly on rural trails, and 2 percent of trail traffic was defined as "other," mostly in-line skaters and foot powered "Razor"™ scooters.

Managers of urban trails with tunnels reported that these facilities are especially well used when they connect people to destinations as part of a daily commute or recreation route. For example, the Capital Crescent Trail, D.C. serves more than 100,000 people a month. Members of the Coalition for the Capital Crescent Trail, D.C. have counted more than 560 people passing through the Dalecarlia Tunnel every hour at peak times. John Dugger, the vice chair of Coalition for the Capital Crescent Trail, reports that the Wisconsin Avenue Tunnel, the second tunnel on the trail that opened in 1998, has had a positive impact on the number of people who use the trail (see Case Study D).

Trail managers were asked if there had been an increase in trail use since their tunnel(s) opened. Of 36 trails surveyed, 69 percent said their trail and tunnel(s) were opened simultaneously, so the question did not apply. In the remaining eleven cases, trail managers reported that tunnel construction

This is an example of a "cut and cover" tunnel. Tony Knowles Coastal Bike Trail,[10] Anchorage, Alaska. Opened 1987. Credit: Jack Mosby.

Figure 4: Average modal percentage reported by tunnel managers



CASE STUDY B

SNOQUALMIE TUNNEL, IRON HORSE STATE PARK, WASH.

THE IRON HORSE STATE PARK TRAIL is built on the Chicago, Milwaukee, St. Paul and Pacific Railroad Corridor that once brought passenger and freight trains from Chicago to Seattle. This former railroad corridor currently features 16 open trail tunnels, the most of any single corridor in the United States. They can be found as part of three trails built on the old rail alignment. There are six tunnels along the section in Washington State referred to as the Iron Horse State Park Trail, including the longest trail tunnel in the country, the 2.3-mile Snoqualmie Tunnel. Two additional tunnels are found east of the Columbia River on the Milwaukee Road Trail. Farther east in Idaho, the Route of the Hiawatha Trail boasts eight open tunnels, and will soon re-open the 1.6-mile St. Paul Pass Tunnel that crosses the border between Idaho and Montana. Trail advocates and park planners have an ambitious vision that one day, utilizing dozens of original railroad tunnels and trestles, the trails will connect to each other to form a single, seamless route from the Pacific Ocean to Montana.

The Snoqualmie Tunnel is truly an impressive structure. Blasted through the basalt rock of Snoqualmie Pass between 1912 and 1915, the finished tunnel provided a direct connection for trains to reach Seattle from the east. The tunnel features large wooden doors on either end that were kept closed in the winter, except when a train came through, to prevent ice formation.

After trains stopped running and the corridor was abandoned in 1980, Washington State purchased the line for utility rights and to develop a non-motorized trail. The Snoqualmie Tunnel was sealed shut until 1994, when the agency made the decision to re-open the tunnel to the public. A dedicated team made up of Washington Youth Conservation Corps, a local prison crew, volunteers and state parks staff rehabilitated 4.6 miles of worn drainage structures, called scuppers, that ran alongside each wall. They also resurfaced the tunnel with crushed granite.

The ribbon-cutting ceremony for the tunnel took place in September 1994. Attending were elected officials, state parks staff, other dignitaries and hundreds of members of the public who patiently waited on mountain bikes for the tunnel doors to open. The elected officials and state parks staff had the opportunity to catch a first glimpse of the restored tunnel before the doors were opened to the public. According to Tim Schmidt, park manager, when the group arrived at the end of the tunnel, "the state senators, congressmen and local mayors all had huge grins on their faces."

The Snoqualmie tunnel has been an enormous attraction since its opening. People travel from all over the country, and even around the world, to pedal or hike through the tunnel, which is perpetually pitch black, cold and damp. Trail users are required to use headlights on their bikes or carry flashlights, and warm clothing is recommended. It takes roughly 20 minutes to bike through the tunnel and 45 minutes to walk it. It's a unique feeling, according to those who have traveled through it, to be one mile inside a mountain. The tunnel has provided public access to areas that were previously inaccessible and has resulted in a huge influx of cash into the local economy. The people who live in the towns surrounding the tunnel are grateful that it's now a part of their community.

Snoqualmie Tunnel, Iron Horse State Park, Wash. Credit: Washington State Parks.

Trail managers reported that bicycling is the most common mode of transportation through tunnels. These cyclists are enjoying the Dalecarlia Tunnel along the Capital Crescent Trail in D.C. Credit: Coalition for the Capital Crescent Trail.

or renovation projects provided key links between existing segments of the trail that were not connected prior to the tunnel opening. Of these eleven trails, nine reported an increase in use immediately following the tunnel opening. These nine attributed the increase to the convenience and direct route provided by the new tunnel.[11] The other two trail managers did not provide data regarding trail use since opening their tunnels.

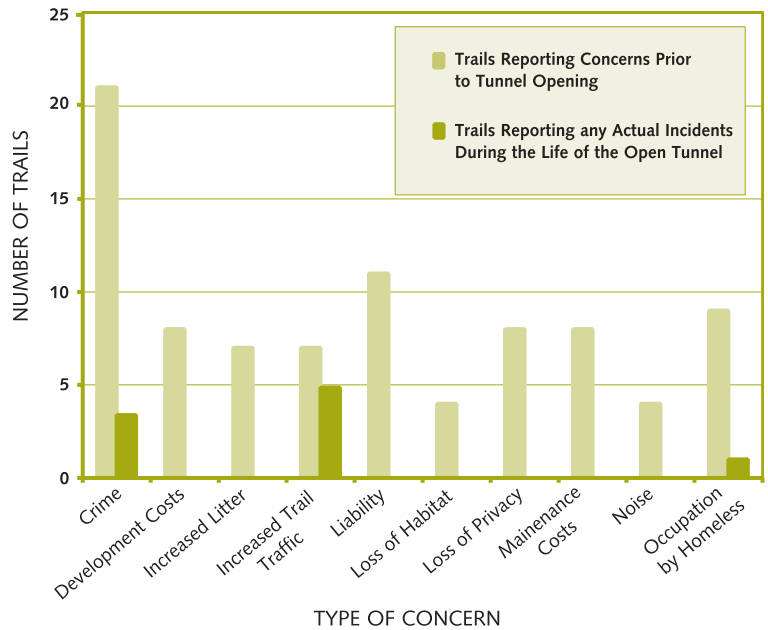
IMPACTS ON ADJACENT COMMUNITIES

All trail managers responded that the local community had concerns prior to opening their tunnels, yet 97 percent (35/36) reported overwhelmingly positive community feedback after the tunnel(s) opened. In response to specific survey questions, managers reported that their tunnels facilitated transportation (79 percent) and recreation (100 percent). Trail managers also provided unsolicited comments regarding the benefits of their tunnels. These included improvements in safety (11 percent), generation of community pride (11 percent), increased tourism with its associated economic benefits (22 percent), and reductions in noise, crime, and litter in the area surrounding the tunnel (8 percent). Twenty-eight percent reported that the tunnel was a special attraction, often cited by users as the main destination on the trail. In virtually all cases, managers of trails reported that opening a tunnel resulted in an improvement to the surrounding neighborhoods.[12]

Community concerns voiced prior to opening tunnels are similar to those raised by communities before the opening of trails in general. People have understandable concerns about the potential negative impacts of any new transportation facility in their neighborhood. Still, 67 percent (24) of surveyed managers did not report any negative impacts on the communities once tunnels were opened. Trail managers reported that only rarely did concerns raised by local residents materialize once the tunnel opened, and the negative impacts were minor, or were outweighed by the benefits of opening the tunnel.

Twelve of 36 trail managers did report some negative impacts associated with the tunnel. Incidences reported by managers included increased hunting activity in a rural area (1), increased trail traffic (5), minor graffiti (5), barricades removed for motorized use (1), one light broken, one scratched railing, use of alcohol/controlled substances (1), occupation by homeless (1), and one crime against a person—an attempted robbery.[13] This attempted purse snatching occurred in the I-90 Tunnel in Seattle, Wash., and was immediately interrupted by the guard monitoring the security cameras. The

Figure 5: Major community concerns about tunnel opening



victim was not harmed and her purse was recovered immediately. This was the only crime associated with the tunnel since it opened in 1989 and the only serious crime reported in all of the 78 tunnels surveyed. The homeless occupancy of the I-80 Undercrossing in Fairfield, Calif. was attributed to the fact that the tunnel was built under a freeway in an area with a pre-existing homeless problem. Improved lighting and police patrols seem to have improved the situation. Fred Beiner, park planner for the City of Fairfield, reports no incidences of homeless presence in the tunnel in the last two years. While five of the managers specifically noted increased trail traffic as an impact, the associated problems of increased noise and loss of privacy did not materialize. In the twelve communities that experienced the aforementioned negative impacts, each of the trail managers reported that both they and local residents still considered the tunnels to be assets to their communities.

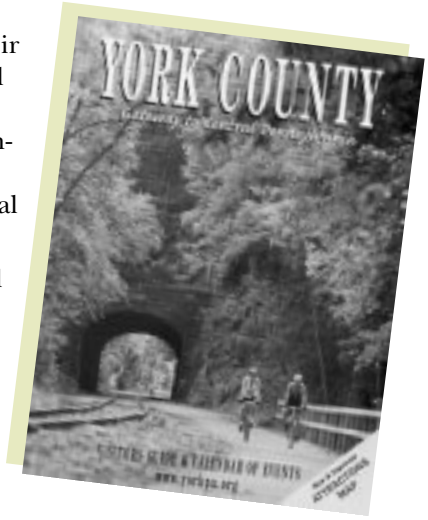
For bicycle and pedestrian advocates it can be tempting to dismiss concerns about these kinds of problems as extreme. However, as with the development of any public project, the creation of bicycling and pedestrian facilities moves forward more smoothly if it has community support. Recognizing people's concerns and taking steps to address them are important to generate support and to ensure the safe and successful operation of a new tunnel facility.

It is also important to put these incidences of illicit activity into context. Given the fact that some crime and illicit activity will occur in most places at some time, it is important to weigh concerns against the potential benefits that a fully functional trail provides to local communities. There are 287 million people in the U.S. and no community is 100 percent safe all of the time. When examined in light of illicit activity in a variety of community settings, trails have an excellent safety record. As an example, 1995 statistics from the FBI Uniform Crime Report show a person is more likely to be the victim of a crime in a parking lot or garage, on the street, or inside of his/her own home than in a park, field or on a playground.[14]

The results of this study indicate that when trail managers take steps to address concerns, they often do not materialize once the tunnels are opened. Trail managers reported a variety of strategies used to ensure the personal safety of trail users and adjacent residents and businesses. These included: installing gates at the entrances of tunnels and at the end of trails to prevent motorized use; initiating police and volunteer security patrols; installing bright lights,[15] security cameras,[16] reflectors[17] and solar-powered emergency telephones;[18] requiring helmets and individual lights for bikers;[19] and making sure neighbors know who to contact in the event of a problem. To address environmental concerns, some trail managers conducted wildlife habitat studies and initiated "Adopt-a-Trail" programs to help with litter control.[20]

Other strategies included installing a log book to record names and comments, using graffiti-resistant paint on tunnel walls,[21] permitting an on-site concessionaire to provide informal monitoring of the tunnel,[22] maintaining vegetation, and, in some cases, re-routing the trail by a few feet to improve long-distance sight lines.[23] All trail managers were able to incorporate their tunnels into the overall liability policy for the trail, thus resolving concerns about expenses associated with potential lawsuits.[24]

In many cases, trail managers reported that increased use of the trail, sometimes due to the tunnel, brought informal patrolling that made the corridor safer.



Reflectors are used in the Howard Tunnel on the York County Heritage Trail in Pennsylvania to show users the boundary between the trail and rails. This was the only tunnel in our study to feature a "rail-with-trail." The Howard Tunnel is also the oldest continuously operating railroad tunnel in the U.S. Credit: York County Parks. Above: York County Tourist Guide. Credit: York County Convention and Visitors Bureau and Genesis Publishing.

The manager of the National Road Bikeway in St. Clairsville, OH, reported that some property owners living adjacent to the trail's tunnel were apprehensive about the tunnel opening due to its proximity to their homes. Today, these landowners believe that living next to an active and open tunnel is preferable to living near the abandoned tunnel. They are now frequent users and brag of their proximity to this resource (see Case Study E).

A majority (79 percent, 27/34) of trail managers reported that their tunnels facilitated bicycle and pedestrian transportation in their communities and all (100 percent, 35/35) reported that tunnels facilitated the recreational use of their trails. Those managers who did not indicate a transportation benefit were reporting on trails located in rural areas or state parks.

Tunnels facilitate transportation by closing gaps and making a trail usable by everyone. Tunnels can connect two major areas of town, providing a route from residential areas to commercial and employment centers (I-80 tunnel in Davis, Calif.). They can also provide a safe alternative to a busy and confusing intersection (Wisconsin Avenue Tunnel, Capital Crescent Trail, D.C.). According to the bicycle/pedestrian coordinator in Davis, Calif., the opening of the I-80 Undercrossing tunnel has led to a fourfold increase in bicycling on the Putah Creek Path that runs through it (see Case Study A). Trail managers reported that many users cite the tunnels as the primary reason for visiting the trails. It was consistently reported that people enjoy bicycling or walking through abandoned railroad tunnels and learning the history associated with these structures.

The tunnels have been a benefit for the whole community, especially for the wheelchair bound.

— Thomas Thwaites, president
Mid-State Trail Association, Penn.

Many in the community use the trail and tunnel…the concerns expressed have not materialized.

— Mollie Oliver, site superintendent
Tunnel Hill State Trail, Ill.

Tunnel Design and Aesthetics

The design of a tunnel affects perceived and actual safety as well as aesthetic impact on the local community and the trail with which it is associated. Ideally, tunnel design should reflect the character, values and uses determined by the tunnel's geographic location. The Snoqualmie Tunnel, managed by the Washington State Parks and Recreation Department, is 2.3 miles long, unlit and largely used for recreation. It offers a sense of adventure and mystery appropriate for such a trail (see Case Study B). However, tunnels that are near population centers should be welcoming and inviting to the families and commuters who use them on a regular basis. There are many ways to make almost any tunnel suitable to the type of users it will attract.

Landscaping and the addition of amenities such as benches or water fountains near tunnel entrances signal that the facility is cared for by the community and has a significant human presence. Warm, bright lighting in the tunnel also creates a welcoming environment. The I-90 Tunnel in Washington state features bright lighting in combination with murals on its concrete walls, adding an element of human interest.

I-90 Tunnel, Seattle, Wash. Credit: Washington State Department of Transportation.

Another crucial aspect of tunnel design is providing long sight lines. To ensure both perceived and actual safety, one should be able to see the far end of the tunnel when one enters. This is not always possible, especially in curved or lengthy tunnels. In these cases, other design elements should be emphasized, including placing some sort of landmark in the middle of the tunnel to let people know when they've reached the midpoint.

The Brushy Mountain Tunnel on the Silver Comet Trail in Paulding County, Ga., provides an excellent example of both an attractive portal and long sight lines. Credit: PATH Foundation.

Any recesses in the tunnel walls that might provide a hiding place should be eliminated.

Often when railroad or highway tunnels are being rehabilitated for trail use, designers strive to remain true to the historic contours of the original structure. In the St. Paul Pass Tunnel along the Route of the Hiawatha Rail-Trail in Idaho, park planners successfully replicated the original poured concrete form as they replaced sections of the tunnel's walls. They also replicated the original tunnel doors, and even brought in an aggregate surface that was similar in color to the original railroad ballast used. Other communities choose to refurbish their tunnels to match more contemporary surroundings. In St. Clairsville, Ohio (see Case Study E), the city chose to rebuild the portals of the National Road Bikeway Tunnel in a simple, industrial style that matched the design of the entire bikeway corridor. A staircase and an overlook were installed on the exterior entrances and the interior was designed to replicate a cave with recessed lights and a rough surface.

An example of a corrugated metal drain pipe tunnel can be found along the Contra Costa Canal Trail in Concord, Calif. Credit: East Bay Regional Park District.

New grade separation tunnels such as this one on the Cardinal Greenway in Marion, Ind., use classical architecture to create an appealing aesthetic. Credit: Cardinal Greenway, Inc.

Due to cost constraints, newly built "cut and cover" tunnels on trails have tended to be utilitarian and aesthetically unpleasant. However, good design can make them quite appealing. One designer approached a concrete company that sells pre-fabricated arched concrete tunnels for trail use and designed a tunnel face that would welcome trail users and include elements of classical architecture. The results of her effort included a keystone, cornice returns and trim around the arches. Her tunnel designs have now been applied to many new tunnels, including the Cardinal Greenway in Marion, Ind.[25]

PLANNING AND DEVELOPMENT

COSTS OF ACQUISITION, PLANNING AND DEVELOPMENT

The cost associated with opening and maintaining tunnels is an important consideration for most communities. Survey responses on acquisition-related questions were often not definitive. No trail managers were able to identify a cost for tunnel acquisition because they were acquired with the rest of the right-of-way (49), they were already in public ownership (10), or because they were donated (6).[26] In fact, the existence of tunnels on abandoned railroad corridors can provide an important leverage point for communities seeking to acquire the corridor. For railroad operators seeking to abandon a corridor, tunnels, bridges and trestles represent a liability that the railroad must address by filling, closing or dismantling as a condition of abandonment. These activities cost the railroad money. For those considering purchase of one of these facilities (alone or as part of a larger corridor), it is useful to remember this during negotiations with the railroad.[27]

The average cost to retrofit or re-open a railroad, road or canal tunnel was $121,830 (38 tunnels),

Table 1: A comparison of the costs of re-used versus newly-built tunnels

Type of Tunnel	Average Cost to Renovate/Construct	Average Cost per foot to Renovate/Construct	Most Expensive/ Least Expensive
Re-used Railroad	$121,830 (38 tunnels reporting)	$456	**Least Expensive:** $3,500 to open 500' tunnel, Sacramento River Rail-Trail, Redding, Calif. **Most Expensive:** $3,738,147 to re open two tunnels (493') along the Historic Columbia River Highway State Trail, Hood River, Ore.
Newly Constructed	$1,277,500 (6 tunnels reporting)	$9,017	**Least Expensive:** $60,000 to construct 123' tunnel on Little Traverse Wheelway, Mich. **Most Expensive:** $4,200,000 to build 225' Interstate-80 Undercrossing in Davis, Calif.

a fraction of the cost to bore new tunnels, averaging $1,277,500 (6 tunnels). The most expensive project, a newly constructed tunnel, was the 225-foot Interstate-80 Undercrossing along the Putah Creek Path in Davis, Calif. that cost $4,200,000 to open.[28] The least expensive project was a 500-foot railroad tunnel on the Sacramento River Rail-Trail in California that cost $3,500 to renovate.

Planning and development costs for re-opening abandoned railroad tunnels, including costs for land acquisition, retrofit or structural upgrade, lighting, fencing and other costs was an average of $456 per foot. Newly constructed tunnels cost managers an average of $9,017 per foot. Even though new tunnels were more expensive to open, trail managers felt costs of the new tunnels were justified and represented a worthwhile investment in their communities because of the large number of users served by the tunnel (see Case Study A). New tunnels were funded as part of larger highway projects, through a variety of federal, state and local funds; air quality grants; private donations; and bicycle transportation funding.

OPERATIONS AND MAINTENANCE

Tunnel maintenance was not reported as an undue burden by any of the trail managers. Thirteen trail managers reported estimates for total monthly operations and maintenance costs. The average monthly maintenance cost per trail for these 13 trails was $4,032, with the average cost per tunnel for each of the 38 tunnels at $2,305. Overall cost of operation and maintenance was minimal because the tunnels tended to be included as a part of regular trail maintenance. Twenty-three survey respondents were unable to provide a cost estimate for tunnel maintenance, either because the costs were so minimal that they did not bother to track them, or because maintaining the tunnel imposed no more burden than maintaining adjacent sections of trail. Maintenance tasks most frequently reported were resurfacing the trail and providing trail patrols. Both of these tasks are critical to the safe operation of any trail, regardless of whether it has a tunnel. Other maintenance tasks included checking structural soundness periodically, replacing light bulbs, painting over minor graffiti, replacing and maintaining security cameras, and trimming vegetation at tunnel entrances.

Management of trails and associated structures, such as tunnels and bridges, can be a concern for some communities. Most of the tunnels and/or trails in this survey are managed by local parks or public works agencies. Occasionally, a special management arrangement was required because the trail crosses several jurisdictions or because the facility was used for more than one purpose. For example, some trails along utility corridors are managed jointly by the utility and a parks agency. A Joint Powers Agreement (JPA) is an arrangement whereby multiple agencies agree to jointly manage and operate a public facility that falls under multiple jurisdictions. Most trails included in this survey (28/36) have not used joint managing arrangements, such as JPAs, because they are owned and operated under a single jurisdiction. Eight trail managers reported some kind of special partnership agreement between managing agencies. In these cases management partners included Bureaus

of Reclamation and Land Management, the U.S. Army Corps of Engineers, townships, cities, counties, nonprofit trail advocacy groups, trail councils, private developers, state departments of transportation, state parks agencies, water districts and local transit operators. In the case of the two-tunnel Montour Trail in Pennsylvania, one tunnel is owned and operated by the Montour Trail Council, while the county owns the other, which the council manages under contract to the county. A separate clause of the agreement arranges for a nearby township to maintain the lights. A sample Tunnel Lighting Agreement from the Montour Trail is attached (see Appendix C).

CASE STUDY C

I-90 TUNNEL, BELLEVUE, WASH.

THE MT. BAKER RIDGE BIKE/PEDESTRIAN TUNNEL, also referred to as the "I-90 Tunnel," is the country's most impressive example of an urban tunnel constructed specifically for non-motorized transportation. The 1,500-foot long tunnel was built in the mid-1980s as the top level of a three-tiered tunnel project connecting Seattle with the neighboring city of Bellevue. In addition to the trail, the project included a reversible roadway for carpools and transit on the bottom level and three lanes for general highway traffic in the middle. This is also one of the few tunnels built through a soft earth ridge, a type of geology that is notoriously challenging to tunnel engineers.

The bicycle/pedestrian tunnel is open 24 hours, is fully lighted and features two closed circuit TV cameras that are monitored 24 hours a day as part of the Washington Department of Transportation's traffic management system. To add some character to the tunnel and to discourage graffiti, the state DOT allowed locally sponsored school children to paint murals on the tunnel walls.

During the community planning process, people expressed fears that there would be increased crime and litter as a result of the project. According to Phil George, maintenance and operations superintendent at the Washington State Department of Transportation, "Most had never heard of tunnels for bicycles and pedestrians before, and had negative reactions to the concept." Several expressed fears that homeless people would sleep in the tunnel and that tunnel users would fall victim to violent crime.

The I-90 tunnel in Washington utilizes two security cameras, one of which is visible on the ceiling of the tunnel. Credit: Washington State Department of Transportation.

In the 12 years since the tunnel opened, for the most part these fears have not materialized. The only incident in the tunnel's history was an attempted purse snatching. The technician who was monitoring the CCTV at the time noticed that something was awry, and rushed down the stairs to the tunnel. His shouts scared the assailant off and the woman with her purse went on her way. Incidentally, this is the only attempted violent crime reported in any of the 78 tunnels surveyed.

The Washington State DOT has had far more trouble maintaining its highway tunnels than the bike/pedestrian tunnel. In the motorized tunnel, it has had to deal with a serious graffiti problem, as well as occasional vandalism of the emergency phones and theft of fire extinguishers in the tunnels. According to Mr. George, the problems they face with the highway tunnels are a result of the easy escape provided by cars. In the middle of the night, hooligans are free to tag the walls with graffiti and then hop back in their vehicles to make a quick getaway. It is much harder for a criminal to escape on bike or foot after a crime.

Mr. George has observed that "prior to the tunnel opening, people were dissuaded from bicycling because of the difficulty of the route. We've seen a significant increase in walking and especially bicycling since the tunnel went in." After witnessing firsthand the success of the I-90 bike and pedestrian tunnel, Mr. George believes that infrastructure improvements are the most effective method to get people out of their cars and onto their feet and bikes. He notes, "The Mt. Baker Ridge Bicycle/Pedestrian Tunnel has been a tremendous success and is an asset to the entire community."

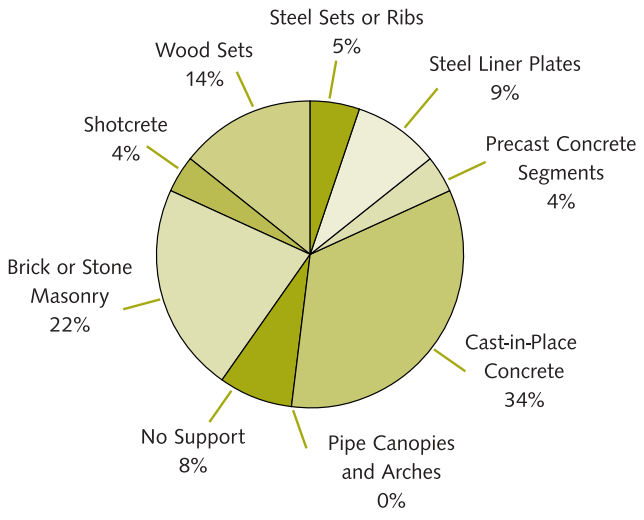
STRUCTURAL AND ENGINEERING ISSUES

There is an entire profession dedicated to the design, physics, construction and rehabilitation of tunnels. Most tunnel engineering firms work on rail, road or water tunnel projects, but an increasing number are being hired to work on non-motorized tunnels. The primary structural issues that arise when building or rebuilding tunnels for bicyclists and pedestrians are similar to those for motorized tunnels. These include ensuring proper drainage or waterproofing, preventing rock falls and ensuring overall structural stability.

Most tunnels require some method of supporting the weight above them. In the 19th century, brick or timber supports were used extensively. Current construction design uses concrete and steel, which are stronger and more durable. The type of structural support used depends on local geology. Most tunnels are bored through rock, but some, like the I-90 Tunnel in Washington state (see case study C), are built in soft soil. Tunnels bored through hard types of rock such as granite frequently need no additional support.

Of the trails with "mined" tunnels, the largest number (nine) used concrete linings for support. Seven used brick or stone masonry linings, five used timber supports including the Bizz Johnson Trail's tunnels in Northern California, and three used no supports at all. The remaining tunnels used steel sets, steel liner plates or shotcrete lining.

Figure 6: Types of support systems used by "rehabilitated" tunnels



Drainage is an important engineering issue in tunnels. Engineers may seek to avoid buildup of water by installing drainage pipes behind the tunnel lining or waterproofing of the tunnel lining as a more aggressive solution. When a railroad tunnel is converted for bicycle and pedestrian use, poor drainage can also create puddles that damage the trail surface. Engineers cope with unwanted water on the tunnel surface in several ways. The primary method for channeling water is to raise the trail surface in the middle and have drainage channels along one or both walls. In rural tunnels, trail managers often use a higher content of sand and larger sized gravel for the surface to facilitate drainage.

Of greatest concern to engineers seeking to ensure the safety of the public is determining the overall soundness of the tunnel structure. A structural analysis typically starts with a visual inspection of the tunnel to assess geology and the condition of the tunnel's support and lining. In some cases, engineers will conduct a geotechnical investigation to assess ground conditions, which can involve drilling and sampling test holes, performing laboratory tests and sometimes conducting geophysical surveys to "see" the ground behind the tunnel lining and/or evaluate the structural integrity of the lining.

Falling rocks are of primary concern when planning a non-motorized tunnel. There are several effective methods to prevent rock falls. The most commonly used method is the application of a wire mesh to the unstable areas, followed by an application of shotcrete, which sets loose rocks in place. Other solutions include the use of rock bolts in conjunction with wire mesh or steel straps to stabilize loose rock between rock bolts.

Tunnels in seismically active areas have special engineering factors to consider. Interestingly, tunnels are not known for their vulnerability in earthquakes. They resist rolling and shaking to a much greater extent than other structures such as bridges and buildings, because they are "flexible" and tend to move with the ground. The presence of an active fault area near a tunnel or the vulnerability of a tunnel due to extreme shaking during an earthquake can be accommodated by certain types of tunnel support/lining systems.[29]

CASE STUDY D

CAPITAL CRESCENT TRAIL, WASHINGTON, D.C.

PICK A SUNNY SUMMER DAY to visit the Capital Crescent Trail in the Georgetown section of Washington, D.C., and you may see as many as 560 pedestrians, baby carriages, cyclists, wheelchair users, in-line skaters and joggers pass a given point on the trail *every hour.*

The 11-mile Capital Crescent Trail, which gets its name from its shape, connects downtown Washington, D.C. with the Maryland suburbs of Bethesda and Silver Spring. This urban and suburban greenway, once an active railroad corridor, is an integral part of a growing network of trails and pathways allowing residents to easily traverse the D.C. metropolitan area via "muscle-powered means." The CSX railroad carried coal and building materials along this line from 1910 until its abandonment in 1985. At that time the Coalition for the Capital Crescent Trail (CCCT) formed to promote its conversion to a rail-trail. Heavily used for commuting and recreation, this corridor links residents with parks, trails, centers of employment and commerce. In addition to its heavy use, this trail is remarkable for its interesting managing arrangement and its two tunnels, the Wisconsin Avenue and the Dalecarlia, which facilitate travel along the corridor.

Three management agencies jointly own and govern operations of the trail: the National Park Service maintains the trail from Georgetown to the D.C.-Maryland line; the Montgomery County Department of Parks has jurisdiction from that line to central Bethesda, Md.; and the Montgomery County Department of Public Works and Transportation oversees operations from Bethesda to Silver Spring, Md. The U.S. Army Corps of Engineers also paid for a bridge and fencing to separate trail users from land in their jurisdiction. The Coalition for the Capital Crescent Trail contributed funds to the development of the Wisconsin Avenue tunnel.

The Dalecarlia Tunnel along the Capital Crescent Trail. Credit: Coalition for the Capital Crescent Trail.

In 1997, a cyclist traveling eastbound on the Capital Crescent Trail arriving in downtown Bethesda would have found locked gates at the tunnel under Wisconsin Avenue, requiring a detour through several busy streets to rejoin the trail. Opening this tunnel had been a long-standing objective of the CCCT, who recognized the importance of this safe and convenient connection between trail segments. Ellen Jones, executive director of the Washington Area Bicyclist Association, anticipating the positive effects of an open tunnel, remarked, "With the separation of trail users from motorized vehicle traffic, the comfort level will go up for everybody."

Opening the Wisconsin Avenue tunnel was controversial for a few reasons. Running the length of two full city blocks, this 800-foot tunnel passes under a 6-lane road and two buildings. After the railroad became inactive, vagrants occasionally occupied the tunnel, forcing Montgomery County to erect gates at both ends. As a result, the re-opening process involved a number of measures designed to make the tunnel a safe and attractive facility.

Due to the tunnel's width (35 feet), users feared that the space on either side of the 14-foot trail would provide a haven for homeless people or criminals. In response, the County provided lighting, installed high grade fencing to section off the extra width of the tunnel, and enforced hours of operation: 6 a.m. to 10 p.m. (except for commuting cyclists) via a security firm. In a display of the group's dedication, the CCCT put 2/3 of its budget[30] into funding the installation of "globe" lights that would illuminate the wide tunnel more fully than the lights originally chosen by the county. Further, they funded the costs of running the trail along the outside of the curve in the tunnel, in order to provide longer sight lines. As a result, it became possible to see nearly the full length of this 800-foot curved tunnel, largely relieving concerns about personal safety. Said Henri Bartholomot, a member of the CCCT, "This is a huge commitment for us. We are spending the money because we want this tunnel to be well-lit and well-designed."

Since its completion in 1910, the Dalecarlia Tunnel had never been closed, but it officially opened as a part of the Capital Crescent Trail in 1996, when the 2.7 miles of trail between the district line and Bethesda were completed. Like adjacent sections of the right-of-way, conversion of this tunnel to trail use was limited to removing the rails and ties and laying down pavement. As a result, the cost was similar to that of adjacent trail segments. This beautifully crafted brick and stone tunnel passes under MacArthur Boulevard, a heavily trafficked six lane road. As this tunnel is closer to downtown Washington than the Wisconsin Avenue tunnel, it receives a higher number of users, especially commuters. As a telling measure of the transportation value of the trail and of both tunnels, a special dispensation has been arranged to permit commuting cyclists to use the entire trail between Georgetown and Silver Spring after hours.

Opening Day for the Wisconsin Ave. Tunnel along the Capital Crescent Trail. The lamps on the walls promote safety and also create a welcoming environment. Credit: Coalition for the Capital Crescent Trail.

Both tunnels demonstrate the transformation in public opinion and the local benefits so common with rail-trail conversions. Dan Lewis, a Montgomery County resident, expressed fears about increased noise, loss of privacy and declining property values with the opening of the 2.7-mile section of trail including the Dalecarlia Tunnel. Contrary to his expectations, Lewis has become one of the trails greatest supporters, remarking, "The neighborhood loves the trail...instead of being a liability, the trail is viewed as a great amenity that has raised property values. People like to be near a trail." According to John Dugger, vice chair of the CCCT, "It is clearly easier for older kids to make the trip between downtown Bethesda, where there is a public library, shops and restaurants, to Chevy Chase by use of the tunnel. It is also easier for parents, with younger kids in tow, as they can avoid the uncomfortable crossing of the heavily trafficked Wisconsin Avenue." For all users, especially children, the tunnels facilitate transportation and recreation, providing a much-needed safe, flat and direct link along a very popular greenway.

CASE STUDY E

NATIONAL ROAD BIKEWAY, ST. CLAIRSVILLE, OHIO

"YOU'RE ASKING FOR TROUBLE," said some local residents when Dennis Bigler, the director of public services for the City of St. Clairsville, Ohio proposed building a trail on the abandoned Wheeling and Lake Erie right-of-way that runs through the 500-foot National Road Tunnel. Residents were worried that the trail, and especially the tunnel, would become a magnet for criminal behavior, attracting loitering teenagers, muggers, rapists and even murderers. Homeowners living close to either end of the tunnel also were concerned about less drastic consequences, such as loss of privacy and increased noise. "Opening this tunnel is nuts," said one vehement trail opponent at a public meeting.

Trail advocates worked with local landowners and presented ideas to help address their concerns. For example, providing 24-hour lighting was proposed as a way to help address worries about criminal activity and general safety. Eventually, the town decided to move forward with the project and secured a $1.2 million Transportation Enhancements grant from the Ohio Department of Transportation for planning and development.

The community had a broad vision to create a linear park that would be the centerpiece of the community, a place where neighbors could meet and chat and people could bike or skate in safety. The tunnel was the focal point of the trail and the bulk of the design and engineering went to ensur-

ing its structural integrity and improving its aesthetic quality. The re-design of the tunnel included an elaborate staircase and two overlooks above the portals of the tunnel, largely funded by the St. Clairsville Rotary Club.

The trail opened in June 1998 and soon became the pride of the entire town. Former trail opponents became some of the trail's biggest supporters. Criminal activity did not materialize: Since opening, there has not been a single reported incident of serious problem behavior on the trail or in the tunnel. There have only been minor isolated occurrences of vandalism, such as signs being stolen and a bench broken.

Women report that they feel safe using the tunnel even at night, because of the well-lit environment and, because others are often using the trail. The town ran conduits for video security cameras when they installed the lighting in the tunnel, but it quickly became obvious that cameras weren't necessary. The people who walk, bike or jog on the trail are respectful and quiet, say neighbors. Their presence helps deter less wholesome activities, such as teenage drinking, which has dried up since the tunnel opened. The National Road Bikeway is home to the only rail-trail tunnel in Ohio and tourists from all over the region flock to St. Clairsville just to see it. St. Clairsville's logo for the bikeway depicts a cyclist pedaling through the arch of the tunnel. To direct bicyclists and others to the bikeway, the town has stenciled the logo onto some of its streets, with an arrow indicating the direction of the bikeway.

Residential areas are located directly adjacent to the tunnel's portals and the downtown commercial district is several blocks away. A nature trail through a forested area provides a quiet "alternative route" for trail users. People living in the neighborhoods near the tunnel had always thought of the abandoned structure as a liability. Since the town renovated the tunnel, it has become an essential part of the neighborhood, with people of all ages strolling and pedaling through it. The lonely, abandoned feeling has disappeared completely and the town itself is experiencing a renaissance in large part due to the trail and its tunnel.

The only problems associated with the tunnel, according to Dennis Bigler, have been related to water drainage. In the winter, icicles form and can pose a threat to the people below. In addition, ice patches up to one foot thick form on the surface of the bikeway, creating a hazard. The town avoids the use of salt whenever possible because of its impact on the surrounding vegetation. To mitigate this problem, they have been spreading sand on the trail, and have made liberal use of warning signs and tape.

The man who thought that opening the tunnel was "nuts" is now a big fan of the entire bikeway. He regularly calls city hall to report on the condition of the trail, including which flowers need more water in the landscaped areas.

Strangely enough, the bikeway's greatest fans haven't been the young kids on in-line skates, the teenagers on bicycles, or the young parents pushing their babies along the trail in strollers. The most fervent praise has come from the town's senior citizens. Dennis Bigler describes an incident that occurred the day after the tunnel opening: "An 86-year-old woman who had lived in St. Clairsville her whole life climbed the steps of City Hall and handed me a twenty dollar bill as a contribution toward the trail. 'Thank you,' she said, her hands trembling and tears welling in her eyes. 'Thank you for building this bikeway. It is the best thing that has ever happened to our town.'"

National Road Bikeway prior to trail development. Credit: City of St. Clairsville, Ohio.

National Road Bikeway after reconstruction. Credit: City of St. Clairsville, Ohio.

V. CONCLUSION

Many people recognize the tremendous benefits that an open tunnel provides by linking important destinations. Yet for some, tunnels still evoke images of dark places where vagrants linger or illegal activities take place. The results of this study demonstate that contrary to the negative expectations of some residents, tunnels do not impose undue safety or financial burdens on local communities and that, in fact, tunnels on trails are quite safe. Of the 78 tunnels included in this study, crimes reported in or around the tunnels were extremely rare. The results suggest that with proper attention to design and management, tunnels become tremendous community assets that encourage and safely accommodate greater trail use.

Equally impressive is the degree to which tunnels facilitated non-motorized transportation. Managers reported that tunnels make bicycle and pedestrian networks equitable by creating routes that are direct and avoid steep hills making them easy for everyone—including children, the elderly, and people with disabilities—to use. They generate community pride and understanding of local history and draw increased trail user traffic with its associated economic benefits. Although it may seem daunting to reopen or build a tunnel, the dozens of open tunnels around the country demonstrate their great potential to link communities and help create sustainable transportation networks.

The tunnel is an attractive facilitator for the trail being used as a corridor through the city. A growing number use it daily to bike to work and to walk to school.

— Anthony Maidenburg
of Cardinal Greenway, Inc., Indiana

ENDNOTES

[1] *Driven to Spend*. Surface Transportation Policy Project. 2000.

[2] Metropolitan Transportation Commission, *San Francisco Bay Area Regional Travel Characteristics*. December 1994.

[3] Center for Disease Control. http://www.cdc.gov.

[4] *Mean Streets*. Surface Transportation Policy Project. 1998.

[5] *Rail-Trails and Safe Communities: The Experience on 372 Trails*. Rails-to-Trails Conservancy 1998. *Evaluation of the Burke-Gilman Trail's Effect on Property Values and Crime*. Seattle Engineering Department, 1987.

[6] The land use surrounding the remaining tunnels was described as: Agricultural/Residential (4 percent), Commercial (3 percent), Urban Greenbelt (3 percent), Multiple Use (3 percent), No data provided (3 percent).

[7] Tunnels meeting our criteria were not found in Hawaii or Alaska.

[8] Shotcrete, also known as Gunite, is a quick-drying concrete sprayed from a nozzle. In addition to being a very effective means of holding loose rock in place, it is also frequently used in amusement parks to simulate rock walls.

[9] Peak season, usually summer, was defined as the period during which the trail received the highest use. All use estimates reported in this study were for peak season use.

[10] The tunnels along the Tony Knowles Bike Trail were not included in this study because their lengths were less than one hundred feet.

[11] Capital Crescent Trail, Md., Des Plaines River Trail, Ill., Iron Horse State Park, Wash., I-80 undercrossing, Calif., North Shore Bike Trail, Ill., Route of the Hiawatha, Id., Little Traverse Wheelway, Mich., Silver Comet Trail, Ga., I-90 Undercrossing, Wash.

[12] In the single case where a manager did not report that the tunnel was a community asset, he attributed this to the fact that the tunnels were close to the end of the trail, and the beginning of private property. Trail users can utilize the tunnel as an in and out facility to a scenic lookout, but there is no transportation value provided by these tunnels. However, he reported no negative feedback from the community regarding the tunnels.

[13] Figure 5 includes only concerns and impacts information specifically solicited by the survey or mentioned as major concerns. All impacts reported are listed in the text. Increased trail traffic was only listed as a *negative* impact on three of the five trails, and this was only reported as negative by a minority of residents.

[14] FBI Uniform Crime Statistics as cited in *Rail-Trails and Safe Communities: The Experience on 372 Trails*.

[15] In the tunnel on the MC Trail, in Fairmont, WV motion-sensitive lights reduce monthly maintenance costs.

[16] I-90 Tunnel in Seattle, Wash.

[17] Howard Tunnel, York County, Penn.

[18] I-80 Tunnel in Davis, Calif.

[19] Route of the Hiawatha, Id.

[20] Adopt-a-trail program was successful along the Silver Comet Trail, Galif.

[21] Historic Columbia River Highway State Trail, Ore.

[22] Route of the Hiawatha Trail, Id.

[23] Capital Crescent Trail, Md.

[24] For more information on liability issues see the RTC study, *Rail-Trails and Liability*, September 2000 and the Bay Area Ridge Trail study titled, *California's Recreational Use Statute*. To receive these studies contact RTC (202) 331-9696 or the Bay Area Ridge Trail (415) 391-9300.

[25] Anne Lusk (annelusk@aol.com).

[26] No data were provided for the remaining 13 tunnels.

[27] Acquiring Rail Corridors, RTC, 1996.

[28] The cost of this project included rerouting a major interstate highway, and these costs were included with the actual construction costs of the tunnel itself.

[29] Jacob's Associates, an engineering firm, provided background information on engineering aspects of bike/pedestrian tunnels. For more information contact: Richard Coffin, PE, Jacobs Associates, 500 Sansome Street, 7th Floor, San Francisco, Calif., 94111.

[30] The CCCT put $45,000 into lighting and re-aligning the trail in the Wisconsin Avenue Tunnel.

APPENDIX A: CONTACT INFORMATION

CALIFORNIA

Bizz Johnson Trail
Stan Bales, Outdoor Recreation Planner, BLM
Eagle Lake Field Office
2950 Riverside Drive
Susanville, CA 96130
530-257-0456 • sbales@ca.blm.gov

Contra Costa Canal Trail
Den Calkins, Park Ranger
East Bay Regional Park District
2335 B Whitman Road
Concord, CA 94518
925-687-3419 • cctrails@ebparks.org

Fairfield Linear Park
Fred Beiner, Park Planner
Community Services Department
City of Fairfield
1000 Webster Street
Fairfield, CA 94585
707-428-7431 • fbeiner@ci.fairfield.ca.us

I-80 Undercrossing
Tim Bustos, Bicycle/Pedestrian Coordinator
City of Davis
23 Russell Blvd.
Davis, CA 95616
530-757-5669 • bikeczar@dcn.davis.ca.us

Sacramento River Rail-Trail
Bill Kuntz, Recreation Planner
BLM- USDI
355 Hemstead Drive
Redding, CA 96002
530-224-2157 • wkuntz@ca.blm.gov

South Folsom Canal Trail
Gale Moginic, Realty Specialist
U.S. Bureau of Reclamation
7794 Folsom Dam Road
Folsom, CA 95630
916-989-7256 • gmoginie@mp.usbr.gov

CONNECTICUT

Hop River State Park Trail
Mike Reid, Park Supervisor
CT State Parks Division
209 Hebron Road
Marlborough, CT 06447
860-295-9523

GEORGIA

Silver Comet Trail
Ed McBrayer, Executive Director
PATH Foundation
P.O. Box 14327
Atlanta, GA 30324
404-875-7284 • pathf@ix.netcom.com

IDAHO

Route of the Hiawatha
Tracy Gravelle, Resource Forester
Avery Ranger Station
Panhandle National Forest HC
Box 1
Avery, ID 83802
208-245-6207

ILLINOIS

Des Plaines River Trail
Bruce D. Christensen
Transportation Coordinator
Lake County Division of Transportation
600 West Winchester Road
Libertyville, IL 60048-1381
847-362-3950 • bchristensen@co.lake.il.us

North Shore Bike Path
Bruce D. Christensen, Transp. Coordinator
Lake County Division of Transportation
600 West Winchester Road
Libertyville, IL 60048-1381
847-362-3950 • bchristensen@co.lake.il.us

Tunnel Hill State Trail
Mollie Oliver, Site Superintendent
Illinois Department of Natural Resources
P.O. Box 671
Vienna, IL 62995
618-658-2168

INDIANA

Cardinal Greenway
Anthony C. Maidenberg
Member of Board of Directors
Cardinal Greenway, Inc.
P.O. Box 1205
Marion, IN 46952
765-662-3175 • ebbets56@aol.com

MARYLAND

C & O Canal Towpath
Debbie Conway, Chief of Interpretation
C&O National Historical Park
P.O. Box 4
Sharpsburg, MD 21782
301-714-2214 • debbie_conway@nps.gov

Capital Crescent Trail
John Dugger, Vice Chair,
Coalition for the Capital Crescent Trail
5813 Rockmere Drive
Bethesda, MD 20816
301-229-5425 • JADugger@aol.com

MICHIGAN

The Little Traverse Wheelway
Melanie Chiodini, Executive Director
Top of Michigan Trails Council
445 E. Mitchell Street
Petoskey, MI 49770
231-348-8280 • tomtc@freeway.net

MISSOURI

Katy Trail State Park
Wallace Keck, District Interpreter
Missouri Department of Natural Resources
P.O. Box 166
Boonville, MO 65233-0166
660- 882-8196 • nrkeckw@mail.dnr.state.mo.us

NEVADA

Historic Railroad Trail
Jim Holland, Park Planner
Lake Mead National Recreation Area
601 Nevada Highway
Boulder City, NV 89005
702-293-8986 • jim_holland@nps.gov

OHIO

National Road Bikeway
Dennis Bigler, Director of Public Services
City of St. Clairsville
P.O. Box 537
St. Clairsville, OH 43950
740-695-0156 • dops@1st.net

OREGON

Historic Columbia River Highway State Trail
Diane McLay, Park Ranger
State of Oregon Parks & Recreation Department
P.O. Box 106
Hood River, OR 97031
541-387-4010 • diane.mclay@state.or.us

PENNSYLVANIA

Heritage Rail-Trail County Park
Gwen Loose, Development Coordinator
York County Parks Rail-Trail Office
400 Mundis Race Road
York, PA 17402
717-840-2360 • parks@york-county.org

Montour Trail
Dave Wright, Trail Development Chair
Montour Trail Council
c/o Allegheny County Public Works Department
501 County Office Building
Pittsburgh, PA 15219
412-350-6645 • dwright@county.allegheny.pa.us

Penns Creek Path/Mid-state Trail
Thomas Thwaites, President
Mid State Trail Association
P.O. Box 167
Boalsburg, PA 16827
814-237-7703 • ttt2@vicon.net

SOUTH DAKOTA

George S. Mickelson Trail
Harley Noem, Regional Sup Dist. 12
South Dakota Game, Fish, and Parks
Blackhills Trails Office HC 37
Box 604
Lead, SD 57754
605-584-3896 • harleynoem@state.sd.us

TEXAS

Caprock Canyon State Park Trailway
Clyde Dudley, Trailway Ranger (Ranger III)
Caprock Canyons State Park
P.O. Box 204
Quitaque, TX 79255-0204
806-455-1142 • clyde.dudley@tpwd.state.tx.us

VIRGINIA

New River Trail State Park
Mark Hufeisen, Park Manager
Department of Conservation and Recreation
Division of State Parks, VA
New River Trail State Park
176 Orphanage Drive
Foster Falls, VA 24360
540-699-6778 • m.hufeisen@drc.state.us.va

WASHINGTON

I-90 Trail
Phil George, Maintenance & Operations Supt.
Washington State Dept. of Transportation
10833 Northup Way NE
Bellevue, WA 98004
425-822-4161 • Georgep@wsdot.wa.gov

Iron Horse State Park Trail
Tim Schmidt, Park Manager
Iron Horse State Park
P.O. Box 26
Easton, WA 98925-0026
509-656-2586 • lkeaston@TELEVAR.com

Milwaukee Road Corridor
James Munroe, Public Use/Recreation Lands Manager
Washington Department of Natural Resources
713 E. Bowers Road
Ellensburg, WA 98926-9301
509-925-8510 • jim.munroe@wadnr.gov

WEST VIRGINIA

Greater Wheeling Trail
Tom Murphy, Planning Administrator
City of Wheeling
1500 Chapline Street, Room 305
Wheeling, WV 26003
304-234-3701 • tomurp@yahoo.com

Cranberry/Tri-Rivers Rail-Trail
Bruce Donaldson, Chairman
Richwood Area Chamber of Commerce
P.O. Box F
Richwood, WV 26261
304-846-2862
bruced@fourseasonsoutfitter.com

Greenbrier River Trail
Mark W. Wylie, Coordinator
Greenbrier River Trail
West Virginia Division of Natural Resources
Watoga State Park, HC 82
Box 252
Marlinton, WV 24954
304-799-4087 • watoga@neumedia.net

MC Trail
Tony Michalski, Assistant Director
Marion County Parks & Rec. Comm. (MCPARC)
P.O. Box 1258
Fairmont, WV 26554
304- 363-7037 • mcparc@access.mountain.net

North Bend Trail
Scott Fortney, Superintendent
North Bend Rail-Trail
West Virginia State Parks
Rt. 1 Box 221
Cairo, WV 26337
304-643-2931 • s_fortney@hotmail.com

WISCONSIN

Elroy-Sparta State Trail
Jim Moorhead, Park Ranger
Wisconsin Department of Natural Resources
c/o Wildcat Mountain State Park
P.O. Box 99
Ontario, WI 54656
608-337-4775 • moorhj@dnr.state.wi.us

Omaha Trail
Dale Dorow, Administrator
Juneau County Parks and Forestry
650 Prairie Street
Mauston, WI 53948
60-847-9389 • dotts1@yahoo.com

APPENDIX B: TRAIL TUNNELS OUTSIDE THE U.S.

INTERNATIONAL RAIL-TRAIL TUNNELS

Although they were excluded from this study, the authors did come across several tunnels along trails located in countries outside the United States. These are a mere sampling of the trail tunnels found in other countries. They are provided here for general interest:

- The Galloping Goose Trail near Hope in British Columbia features two open tunnels. One tunnel just north of the Selkirk Trestle has a Michaelangelo-like ceiling painted by a local artist.
- The Kelowna Trail along the old Kettle Valley Railway, also in British Columbia, passes through eight tunnels.
- The Coquihalla Canyon Provincial Park in British Columbia is home to the quintette tunnels named after Shakespearean characters: Jessica, Portia, Iago, Romeo and Lear.
- The Grand Forks Trail near Grand Forks, British Columbia goes through the two Fisherman Tunnels.

Two tunnels can be found along the Otago Central Rail-Trail in New Zealand: the Poolburn Gorge Tunnel and the Prices Creek Tunnel, at right.

Tunnels for nonmotorized transportation, such as this one, are common in the Netherlands.

AGREEMENT

THIS AGREEMENT, made as of this 28th day of February, 2000, by and between the MONTOUR TRAIL COUNCIL, a non-profit corporation under IRS code 501 (c)(3), P.O. Box 11866, Pittsburgh, Allegheny County, Pennsylvania ("MTC"); COUNTY of ALLEGHENY, a political subdivision in the Commonwealth of Pennsylvania ("County")

AND

THE TOWNSHIP OF FINDLAY, a Second Class Township, PO Box W, Clinton, Allegheny County, Pennsylvania ("Township")

WITNESSETH:

WHEREAS, County is owner of a perpetual trail easement on land owned by Montour Railroad Company and MTC is operator of said trail property (hereinafter "Property") located within the Township upon which the Enlow Tunnel is located (The Property is more fully described on Exhibit A attached hereto);

WHEREAS, the Township desires to provide lighting to the Enlow Tunnel to increase visibility when passing through the tunnel.

WHEREAS, the parties have engaged in discussions and desire to reach an agreement whereby the Township would spearhead the acquisition of lighting and the installation in conjunction with Duquesne Light Company;

WHEREAS, the Township has carefully considered the terms of this Agreement and considers them to be in the best interest of its residents; LIKEWISE, the MTC and County have carefully considered the terms of this Agreement and consider them to be in the best interest of their members and residents;

NOW THEREFORE, in consideration of the mutual covenants set forth herein and intending to be legally bound hereby, the parties hereto agree as follows:

1. The Township will be responsible for providing materials (light fixtures, conduit, meters, timers, wiring, etc.) and their installation;

2. The MTC and County will provide their complete endorsement of the project;

3. In addition, the MTC and County will provide all necessary rights-of-way/easements or existing MTC/County land for the proper location of poles and support equipment, at no expense to the Township; Provided, however, that such lands, rights of way or easements shall not in any way interfere with the ownership and operation of the Property and such location shall be first approved and authorized by the County

(Agreement for Lighting of Enlow Tunnel - Montour Trail) (Agreement for Lighting of Enlow Tunnel - Montour Trail)

4. Operational costs will be provided by the Township and/or appropriate third party And will not be a responsibility of the MTC or County;

5. Maintenance and repairs will be provided by the Township and/or appropriate third party and will not be a responsibility of the MTC or County;

6. This Agreement shall be recorded in the Recorder of Deeds office in Allegheny County, and is intended to run with the land and be binding on the successors and assigns of the MTC and County for so long as the Township continues to provide the lighting, and may not be revoked, modified or limited without express written agreement of the parties and/or their respective successors and assigns;

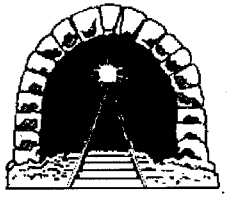
7. This Agreement shall be construed in accordance with laws of the Commonwealth of Pennsylvania.

APPENDIX D: TUNNEL DIMENSIONS

Trail Name	Name of Tunnel(s)	Location	Type of Former Use	Length in Feet	Width	Height
Bizz Johnson Trail	Tunnel 1	Lassen County, CA	railroad	400	17	18
	Tunnel 2	Lassen County, CA	railroad	800	17	18
C & O Canal Towpath	Paw Paw Tunnel	Cumberland, MD	canal	3118	60	30
Capital Crescent Trail	Dalecalia Tunnel	Montgomery County, MD	railroad	300	18	32
	Wisconsin Ave. Tunnel	Montgomery County, MD	railroad	800	35	40
Caprock Canyon St.Pk.Trailway	Clarity	Caprock Canyons State Park, TX	railroad	772	20	40
Cardinal Greenway	D Street Tunnel	Marion, IN	newly built	127	14	11.6
Contra Costa Canal Trail	Jones Rd. Tunnel	Contra Costa County, CA	newly built	102	16	20
	N. Main St. Tunnel	Contra Costa County, CA	canal	157	16	14
Cranberry/Tri-Rivers Rail-Trail	Sarah's Tunnel	Richwood to Allingdale, WV	railroad	620	24	30
Des Plaines River Trail	DPT 1	Mattawa, IL	newly constructed	100	12	14
	DPT 2	Mattawa, IL	newly constructed	100	12	14
Elroy-Sparta State Trail	Tunnel #1	Elroy, Sparta, WI	railroad	1694	15	18
	Tunnel #2	Elroy, Sparta, WI	railroad	1694	15	18
	Tunnel #3	Elroy, Sparta, WI	railroad	3810	15	18
Fairfield Linear Park	Linear Park Interstate 80 Undercrossing	Fairfield, CA	railroad	275	20	20
George S. Mickelson Trail	Tunnel A	Deadwood to Edgemont, SD	railroad	270	12	19
	Tunnel B	Deadwood to Edgemont, SD	railroad	228	12	19
	Tunnel C	Deadwood to Edgemont, SD	railroad	166	12	19
	Tunnel D	Deadwood to Edgemont, SD	railroad	270	12	19
Greater Wheeling Trail	The Murphy Tunnel	Wheeling, WV	railroad	500-600	15	35
Greenbrier River Trail	Sharps Tunnel	Lewisburg, WV	railroad	511	17	22
	Droop Tunnel	Lewisburg, WV	railroad	402	17	22
Heritage Rail-Trail County Park	Howard Tunnel	York County, PA	railroad	253	24	10 to 20
Historic Columbia River	Mosier Twin Tunnels	Mosier, OR	road	493 (both)	16'	18-22'
Highway State Trail	Cascade Locks Pedestrian Tun.	Mosier, OR	newly constructed	N/A	N/A	N/A
Historic Railroad Trail	Tunnel #1	Boulder City, NV	railroad	200-415	25	20
	Tunnel #2	Boulder City, NV	railroad	200-415	25	20
	Tunnel #3	Boulder City, NV	railroad	200-415	25	20

Trail Name	Name of Tunnel(s)	Location	Type of Former Use	Length in Feet	Width	Height
	Tunnel #4	Boulder City, NV	railroad	200-415	25	20
	Tunnel #5	Boulder City, NV	railroad	200-415	25	20
Hop River State Park Trail	Tunnel #1	Bolton, CT	railroad	250	n/a	n/a
I-80 Undercrossing	Interstate 80 Undercrossing	Davis, CA	newly constructed	225	top- 50', bottom- 16'	14
I-90 Trail	I-90 Tunnel	Bellevue, WA	newly constructed	1500	15	10
Iron Horse State Park Trail	Tunnel #45	Iron Horse State Park, WA	railroad	1973	16	26
	Tunnel #46	Iron Horse State Park, WA	railroad	496	16	26
	Tunnel #47	Iron Horse State Park, WA	railroad	1239	16	26
	Tunnel #48	Iron Horse State Park, WA	railroad	203	16	26
	Tunnel #49	Iron Horse State Park, WA	railroad	528	16	26
	Snoqualmie	Iron Horse State Park, WA	railroad	11,888 (2.3 mi.)	16	26
Katy Trail State Park	Rocheport Tunnel	Rocheport, MO	railroad	245	14	22
The Little Traverse Wheelway	Bay Harbor Tunnel	Petoskey, MI	newly constructed	123	11.8	12
MC Trail	MC Trail Tunnel	Fairmont, WV	railroad	1200	25	25
Milwaukee Road Corridor	Tunnel #43	Columbia River to Idaho Border, WA	railroad	761	20	20
	Tunnel #44	Columbia River to Idaho Border, WA	railroad	681	20	20
Montour Trail	National Tunnel	Cecil Township, PA	railroad	620	18	22
	Enlow Tunnel	Cecil Township, PA	railroad	560	18	22
National Road Bikeway	National Road Tunnel	St. Clairsville, OH	railroad	522	30	42
New River Trail State Park	Austinville	Austinville, VA	railroad	220	19	25+
	Gambetty	Austinville, VA	railroad	190	19	25+
North Bend Trail	Bristol Tunnel	Parkersburg, WV	railroad	1086	10	30
	Long Run Tunnel	Parkersburg, WV	railroad	846	10	30
	West Union Tunnel	Parkersburg, WV	railroad	2297	10	30
	Tunnel #7	Parkersburg, WV	railroad	779	10	30
	Tunnel #8	Parkersburg, WV	railroad	588	10	30
	Dick Bias Tunnel	Parkersburg, WV	railroad	377	10	30
	Tunnel #12	Parkersburg, WV	railroad	577	10	30
	Tunnel #13	Parkersburg, WV	railroad	353	10	30
	Silver Run Tunnel	Parkersburg, WV	railroad	1376	10	30
	Eaton's Tunnel	Parkersburg, WV	railroad	1840	10	30
North Shore Bike Path	Tunnel #1	Lake Bluff to Mundelein, IL	newly constructed	100	12	11

Trail Name	Name of Tunnel(s)	Location	Type of Former Use	Length in Feet	Width	Height
Omaha Trail	Tunnel #1	Mauston, WI	railroad	816	40	20-30
Penns Creek Path/	Paddy Mountian Tunnel	Boalsburg, PA	railroad	255	15	15
Mid-State Trail	Coburn Tunnel	Boalsburg, PA	railroad	255	15	15
Route of the Hiawatha	St. Paul Pass Tunnel *	Grand Forks, ID	railroad	8771	14	n/a
	Tunnel #21	Grand Forks, ID	railroad	790	14	n/a
	Tunnel #22	Grand Forks, ID	railroad	1516	14	n/a
	Tunnel #24	Grand Forks, ID	railroad	377	14	n/a
	Tunnel #25	Grand Forks, ID	railroad	966	14	n/a
	Tunnel #26	Grand Forks, ID	railroad	683	14	n/a
	Tunnel #27	Grand Forks, ID	railroad	470	14	n/a
	Tunnel #28	Grand Forks, ID	railroad	178	14	n/a
	Tunnel #29	Grand Forks, ID	railroad	217	14	n/a
Silver Comet Trail	Brushy Mountain Tunnel	Paulding County, GA	railroad	780	18	23
	Coots Lake tunnel	Polk County, GA	newly constructed	175	10	10
Sacramento River Rail-Trail	Tunnel #1	Redding, CA	railroad	500	17	30
South Folsom Canal Trail	South Canal/ Hwy. 50 Tunnel	Folsom, CA	newly constructed	400	12	11
Tunnel Hill State Trail	"the tunnel" at tunnel hill	Tunnel Hill, IL	railroad	543	15	24



RAILS to TRAILS CONSERVANCY

RTC National Trail Tunnel Survey

If you have more than one tunnel along your trail, we would like to gain information on all tunnels. Please answer all questions that apply for each tunnel you manage. Make extra copies of this survey if necessary. Please return the survey to us **by December 20, 2000** in the enclosed addressed stamped envelope at: You may also **fax** it to us at **(415) 397-2228.**

If you have any questions, please do not hesitate to contact Josh Hart or Amanda Eaken or Josh Hart at (415) 397- 2220.

Please include:

- any agreements between various agencies regarding tunnel operation and/or maintenance
- any newspaper articles or other media on the tunnel
- any first person accounts of the benefits or drawbacks of the tunnel
- photos of the tunnel that you may have or can acquire

Do you know of other trails with tunnels and their managers (aside from those in attached list)?

_____

_____

I. General Information

Your Name:_____

Title:_____

Agency:_____

Address:_____

Phone: _____ Fax:_____ Email:_____

Trail Name:_____ Trail Website:_____

Number of Tunnels on your trail:_____ Name(s) of Tunnel(s):_____

1

II. Financial Information

We are interested in financial information on the following that are directly related to the tunnel or in the immediate vicinity of the tunnel. Please answer the following questions to the best of your knowledge. If you do not know exact costs, please provide estimates.

A) Planning and Development:

Costs Associated with:

a) Land Acquisition for tunnel (if applicable): _____

b) Retrofit/Structural Upgrade:_____

c) Engineering/Planning:_____

d) Lighting:_____ ☐No lighting

e) Fencing:_____ ☐No fencing

f) If the tunnel was not always open, how was the opening of the tunnel funded? _____

_____

_____

_____

g) Are there any special additional costs associated with the opening of the tunnel? Please explain: _____

_____

_____

_____

B) Operations and Maintenance: Please provide ongoing monthly or yearly costs of tunnel maintenance:

h) Structural/ Seismic Upgrades: _____

i) Lighting: _____

j) Fencing: _____

k) Surface related costs:_____

l) Law enforcement: _____

m) Any additional ongoing maintenance costs: _____

_____

_____

_____

2

III. Planning and Design

a) When you were planning to open the tunnel as part of a trail, did any of the following concerns arise?

Please check all that apply:

Crime:____ Noise:_____ Occupation by vagrants:____ Increased Traffic:____ Loss of privacy: ____

Costs associated with development:_____ Costs associated with management:_____

Liability: _____ Habitat Degradation:_____ Increased Litter: _____

b) Please describe measures taken to mitigate these concerns (i.e. lights, gates, fences, security cameras, hours of operation, etc.): _____

c) Special Security Needs:_____

d) Liability protection (do you have a special indemnification/policy for the tunnel, or is it part of the overall liability coverage for the trail): _____

e) If there are different cities or managing agencies on either side of the tunnel, how are the maintenance or liability costs shared? _____

f) Is there a joint powers agreement or another legal entity that governs the tunnel? _____

3

IV. Structural and Engineering

a) Tunnel Dimensions: Length:_____ Width:_____ Height:_____

b) Is the tunnel newly constructed? Y_____ N _____

c) If you are reusing an old tunnel, what type of tunnel ? Railroad_____ Road_____

Other (please describe)_____

d) Has the tunnel always been open (for any use)?

e) Was the tunnel closed and then re-opened as part of trail planning efforts? Was it filled?

f) If it was closed, what year was it closed, what year was it opened? What year was it built?_____

g)Type of Support and Shell (concrete, steel brace, etc.):_____

h) Trail Surface (asphalt, limestone):_____

i) Does the trail section through the tunnel have a different surface than the rest of the trail? please describe:

j) Type of Geology in the area:_____

k) Is your trail/tunnel located in an area of significant seismic activity?_____ If so, has the tunnel been seismically retrofitted? _____

l) Were there any special design or construction needs? _____

m) Does the tunnel have special maintenance requirements:_____

4

V. Impact on Local Communities/User Information/ Management Information

If you don't have exact numbers, please provide estimates, and indicate by writing est. next to your answer

a) Number of users/month.:_____

b) %bike:_____ % ped.:_____ % equestrian: _____ other:_____

c) Type of users. Check all who use tunnel: Groups:_____ Individuals: _____ Adults:_____

Children/young people:_____ Families:_____ Men:_____ Women: _____

d) Special rules for users (lights/speed limits/ hours of operation, etc.)

_____

_____

e) Has the tunnel facilitated the use of the corridor/trail for transportation purposes? _____

_____

For recreation purposes? _____

f) Have you noticed a change in the number and/or type of users since the tunnel was opened? _____

_____

g) What has been the nature of community feedback since the tunnel was opened? _____

_____

h) Have you or any neighbors noticed an impact on adjacent communities in the form of increased noise,

traffic, crime, etc? (i.e. were community concerns justified)? _____

_____

i) If yes, what measures have been taken to mitigate these concerns? _____

_____

j) Description of communities and land uses on both ends of tunnels (commercial, agricultural, residential, industrial, etc):

_____

_____

k) Has the tunnel become an asset to the community and the trail? Yes: _____ No: _____ Some issues: _____

Please explain: _____

_____

_____

5

APPENDIX F: REFERENCES

Bay Area Ridge Trail Council, 1998. *California's Recreational Use Statute and Landowner Liability.* Bay Area Ridge Trail Council, San Francisco, California.

Centers for Disease Control. http://www.cdc.gov.

Evaluation of the Burke-Gilman Trail's Effect on Property Values and Crime. Seattle Engineering Department. Seattle, Washington, 1987.

Metropolitan Transportation Commission, *San Francisco Bay Area Regional Travel Characteristics.* Oakland, California, 1994.

Rails-to-Trails Conservancy, *Rail-Trails and Liability: A Primer on Trail-Related Liability Issues & Risk-Management Techniques.* Rails-to-Trails Conservancy in cooperation with the National Park Service. Washington, D.C., 2000.

Rails-to-Trails Conservancy, *Rail-Trails and Safe Communities: The Experiences on 372 Trails.* Rails-to-Trails Conservancy with the National Park Service. Washington, D.C., 1998.

Rails-to-Trails Conservancy, *Tunnels Along Trails: Are they a problem for Trail Managers?* Rails-to-Trails Conservancy. Washington, D.C., 1989.

Surface Transportation Policy Project, *Driven to Spend.* San Francisco, California, 2000.

Surface Transportation Policy Project, *Mean Streets.* Washington, D.C., 1999.

APPENDIX G: RESOURCES

An electronic version of this study is available online at: http://www.trailsandgreenways.org/TAG_Documents/OnlineReferences/Tunnels.pdf

http://www.traillink.com—An online database of existing rail-trails in the United States.

http://www.trailsandgreenways.org—An online resource of up-to-date information on acquiring, planning, developing and maintaining trails and greenways across the United States. Available to visitors are fact sheets, studies, and numerous useful links.

Anne Lusk, a member of the National Recreational Trails Advisory Committee contributed her extensive knowledge of tunnel design, and can be reached at annelusk@aol.com.

Jacob's Associates, an Engineering firm, provided significant background information on engineering aspects of non-motorized tunnels. For more information contact: Richard Coffin, PE, Jacobs Associates, 500 Sansome Street, 7th Floor, San Francisco, CA 94111.

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APPENDIX H: POTENTIAL PROJECTS/CLOSED TUNNELS

These are some of the many exciting tunnel projects in the United States.

ALASKA:

One tunnel along the Copper River Trail. (Contact: Bob Behrends, Cordova Ranger District with the USFS, 907-424-4729)

CALIFORNIA:

- 150-foot long tunnel under Highway 99 in Yuba City. (Contact: Jerry Orr 916-741-4626)
- Ten unused tunnels exist in Marin County along the old Northwestern Pacific Network. (Contact: Joe Breeze, jbleaux@aol.com). See below.
- Fort Mason Tunnel, San Francisco (Contact: Leah Shahum, shahum@sfbike.org)
- Tunnel from Moraga to Montclair District of Oakland. (Contact: Jamie Perkins, jperkins@ebparks.org)

GEORGIA:

The third tunnel (the Pumpkinvine Creek Tunnel) along the Silver Comet Trail will open in May 2001. See contact in list.

KENTUCKY:

There are three abandoned tunnels along the Cathy Crockett Memorial Trail where Kentucky Parks is looking at establishing a trail. (Contact: Rick Bates 606-677-6111)

PENNSYLVANIA:

- The Snowshoe Trail has a 1283 foot long tunnel that is in the process of being opened. (Contact: Ken Hendrickson 814-375-1372 ext. 4)
- The Pinkerton and Big Savage Tunnels along the Allegheny Highlands Trail are closed and advocates are seeking to re-open them. (Contact: Hank Parke 814-445-6431)

WASHINGTON:

- The Iron Goat Trail has several closed tunnels, one that is 2.5 miles long. (Contact: Tom Davis 360-677-2414)
- The Columbia Plateau Trail has 7 abandoned tunnels. (Contact: Gary Vierra 509-646-9218)

WEST VIRGINIA:

One 1000-foot tunnel has been closed for six years along the West Fork Trail. (Contact: Janet Miller, jmiller@fs.fed.us)

MARIN COUNTY RAILROAD TUNNELS OF THE NORTHWESTERN PACIFIC

The data below include: popular name of tunnel, between (at) districts/towns, length in feet, date originally built, last open. All are single-track tunnels with the exception of the Larkspur Tunnel, which is double track. All are closed except for the South Tomales Tunnel, and Puerto Suello Tunnel which is gated.

1) Tiburon Tunnel, Tiburon-Reed, 566', 1884, ca1970.

2) Corte Madera Tunnel, Reed-Meadowsweet , 1849', 1884, ca1970.

3) Alto Tunnel, Mill Valley-Corte Madera, 2183', 1884, ca1970.

4) Larkspur (or CalPark) Tunnel, Greenbrae-San Rafael, 1105', 1884, ca1992.

5) Puerto Suello Tunnel, San Rafael-Marinwood, 1350', 1879, open (gated).

6) Lower Whites Hill Tunnel, Fairfax, 370', 1874, 1904?

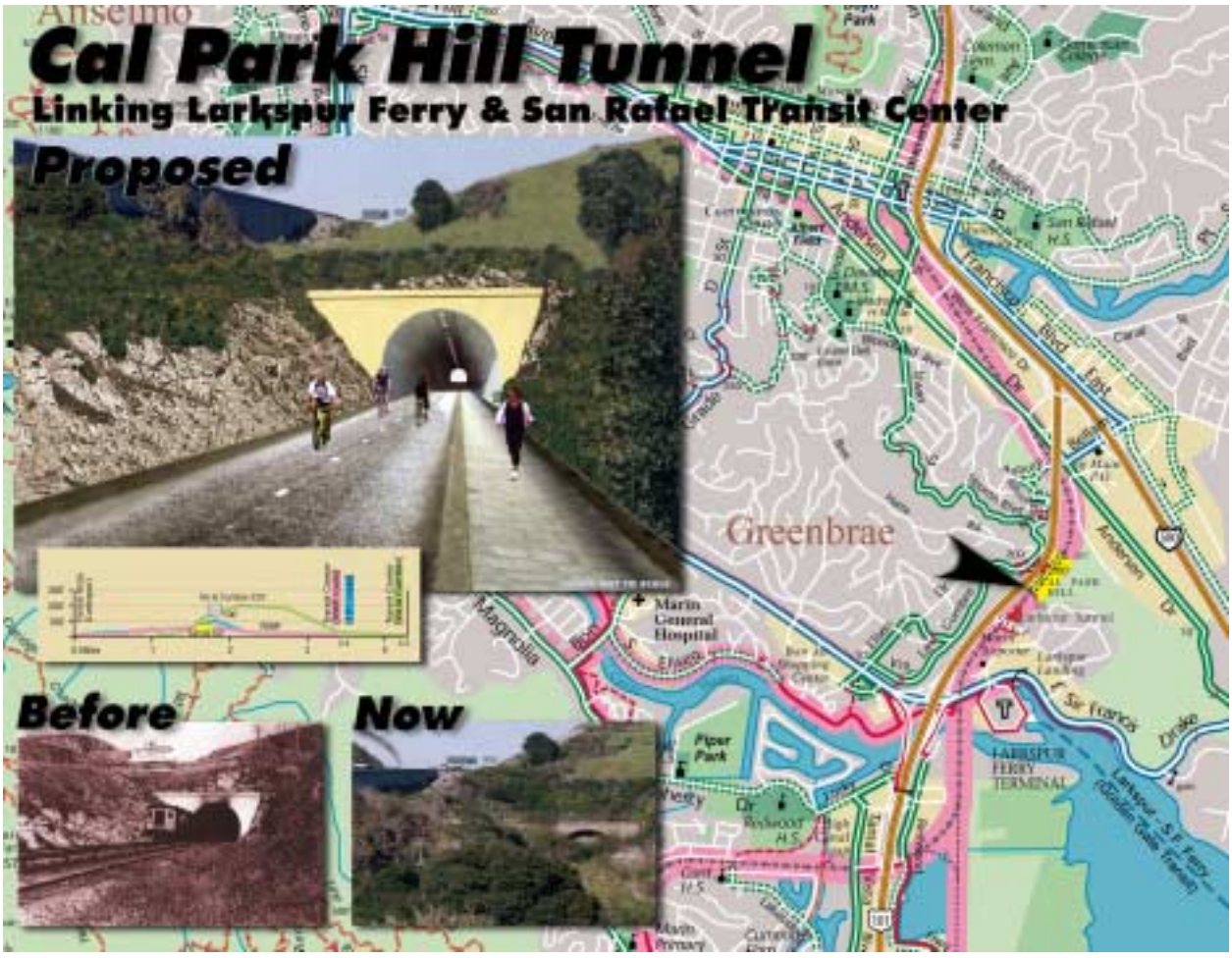
7) Upper Whites Hill Tunnel, Whites Hill, 1250', 1874, 1904?

8) New Whites Hill (or Woodacre) Tunnel, Whites Hill, 3190', 1904, ca1956.

9) South Tomales Tunnel, Camp Pistolesi-Tomales, 98', 1874, last used 1935?

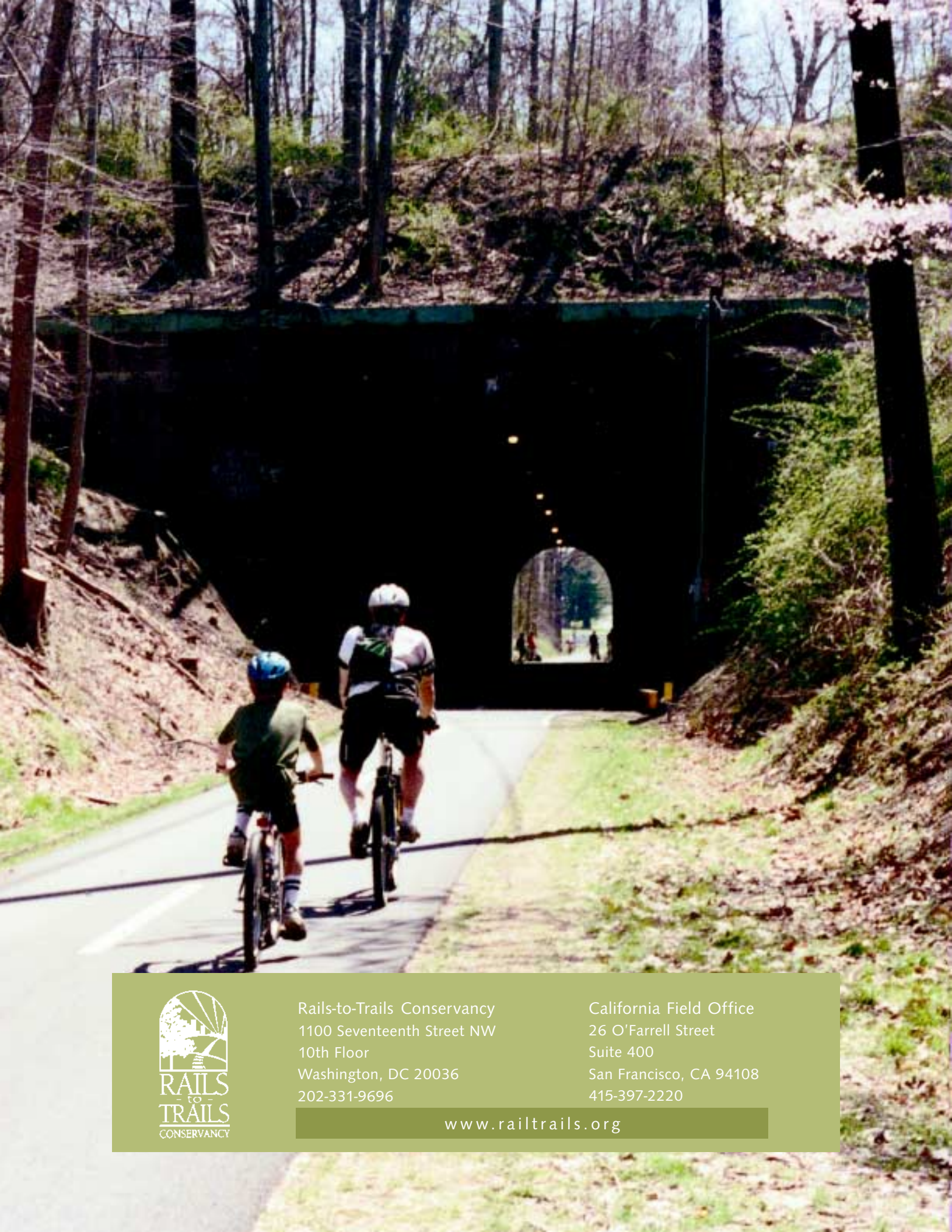
10) North Tomales Tunnel, Tomales-Fallon, 1706', 1875, 1935?

The south portal of the Alto tunnel (between Corte Madera and Mill Valley) is depicted above, circa 1930s. The Northwestern Pacific Railroad provided transportation to practically all of Marin's neighborhoods. Photo by Waldemar Sievers, from Electric Railway Pioneer: Commuting on the Northwestern Pacific*, 1903–1941, by Harre W. Demoro.*



The Marin County Bicycle Coalition (MCBC) has a Web site that includes photosimulations of railroad grades in Marin converted to greenways. Their Web site is: http://www.marinbike.org. Since the Cal Park Hill (Larkspur) Tunnel is 35 feet wide it would also be possible to have a multi-use path and transit share the right-of-way. Photosimulation credit: Steve Wyrostok. Copyright: MCBC.

Front and back covers: The north and south portals of the Dalecarlia Tunnel, Capital Crescent Trail, Washington, D.C. Credit: Coalition for the Capital Crescent Trail.



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