

Mammoth Cave National Park Bikeway Trail



• • • • • Mammoth Cave, Kentucky • • • • •
March 2004



Bikeway Trail



Mammoth Cave National Park

Mammoth Cave, Kentucky

March 2004



Acknowledgements

FROM MAMMOTH CAVE NATIONAL PARK:

Ronald Switzer Superintendent
Bruce Powell Deputy Superintendent
Henry Holman..... Superintendent's Office
John Beaver Contracting Officer
Steve Kovar..... Facility Management
Mike Adams..... Chief of Interpretation
Jim Carroll External Programs
Joe McGown Fee Management
Bob Ward Science & Resource
Management
Mary Jo Veluzat..... Facility Management
John Fry Science & Resource
Management
Leslie Lewis..... Fee Management
Bob Kirch Park Ranger

FROM PARK CITY:

Honorable Gary Madison..... Mayor, Park City
Charles Hogan..... Park City

FROM PARSONS BRINCKERHOFF:

Doug Mynear, PE PB Project Manager,
Engineer
David Hafley, AICP Planner
Molly Davis, RLA Landscape Architect
Traci Severe, AICP Planner
Katie Pentecost Graduate Landscape
Architect
Kristin Baker Intern



Table of Contents

Acknowledgments

I. Introduction.....	1
<i>Mission Statements.....</i>	<i>3</i>

II. Planning Process	4
-----------------------------------	----------

A. <i>Needs Assessment.....</i>	<i>5</i>
<i>Partner Needs and Goals.....</i>	<i>7</i>
B. <i>Goals Development</i>	<i>8</i>
C. <i>Strategies Development</i>	<i>10</i>
D. <i>Existing Conditions Inventory</i>	<i>13</i>

 Associated Maps:

Existing Conditions - Northern Area

Existing Conditions - Southern Area

III. Alternatives Development & Evaluation	14
---	-----------

A. <i>"Choosing by Advantages" Methodology.....</i>	<i>14</i>
B. <i>Descriptions of Bikeway Segments</i>	<i>16</i>
C. <i>Alternatives Evaluation</i>	<i>18</i>

 Associated Maps:

Alternatives - Northern Area

Alternatives - Southern Area

Segment 1 19

Segment 2 21

Segment 3 25

Segment 4..... 28



Table of Contents

<i>D. Preferred Alternative Selection</i>	30
---	----

Associated Maps:

Preferred Alternative - Northern Area

Preferred Alternative - Southern Area

Preferred Alternative - Northern Area

Kiosks & Waysides

Preferred Alternative - Southern Area

Kiosks & Waysides

IV. Cost Estimates	31
---------------------------------	-----------

<i>Alternative HC-B</i>	31
-------------------------------	----

<i>Alternative A/B/C/D</i>	32
----------------------------------	----

<i>Alternative B</i>	33
----------------------------	----

<i>Alternative A/B/C</i>	34
--------------------------------	----

<i>Alternative E-1</i>	35
------------------------------	----

<i>Alternative H</i>	36
----------------------------	----

<i>Summary</i>	37
----------------------	----

V. Appendices

<i>A: NPS Priority Setting Process: Choosing by Advantage</i>	<i>A-1</i>
---	------------

<i>B: Wayside Cost Estimate Information</i>	<i>B-1</i>
---	------------

<i>C: Typical Cross Sections</i>	<i>C-1</i>
--	------------



I. Introduction

The Mammoth Cave Bikeway, from the Visitor's Center to the southern park boundary, is a major part of Mammoth Cave National Park's drive to provide for development and sustainable use of recreation resources and opportunities. However, the proposed bikeway and its associated facilities must be developed in a manner consistent with the need to preserve unimpaired the natural and cultural resources of the park.

As part of the bikeway development, a planning charette was held in April 2001. Although the ultimate destinations of the bikeway were known, the route between these termini was not. The purpose of the charette was to gather together all the existing data, and those people with an interest in the bikeway, in order to decide upon the goals to be used in the development of the bikeway. An agreed common set of goals is a necessary tool to provide a framework for an objective evaluation of the bikeway alternatives.

The charette process entailed a needs assessment, existing conditions review, additional opportunities and constraints identification, goals development, and alternatives development.

At the conclusion of the charette, the goals and objectives were recorded and some possible alternatives were studied and evaluated using the goals. The evaluation compared the alternatives against each other for each goal.

Subsequent to the planning charette, additional alternatives were developed and evaluated. The evaluation process incorporated the National Park Service's (NPS) "Choosing by Advantages" (CBA) rating system. Using this methodology for scoring and evaluation resulted in a clearly identifiable preferred alternative that best meets the goals and objectives for the proposed bikeway. The bikeway will provide a trail from the Visitor Center to the future Cavelands Heritage Center just south of the park in Park City. The bikeway



will vary in width from six to eight feet, with wider sections where possible and appropriate. The trail will traverse different landscape types and incorporate wayside exhibits that explain many of the historic and natural resources within the park and along the trail. Several parking areas will be provided for visitors to park and cycle.

This document provides a summary of the planning process, a description of the selection of a preferred alternative, a Level C cost estimate, and concept level cross sections of the proposed bikeway.



National Park Service

Mission Statement

The National Park Service preserves unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with Partners to extend the benefits of natural and cultural resources conservation and outdoor recreation throughout this country and the world.

Mammoth Cave National Park

Mission Statement

The mission of Mammoth Cave National Park is to protect and preserve for the future the extensive limestone caverns and associated karst topography, scenic riverways, original forests, and other biological resources, evidence of past and contemporary lifeways; to provide for public education and enrichment through scientific study; and to provide for development and sustainable use of recreation resources and opportunities.

Mission Statements

The National Park Service and Mammoth Cave National Park mission statements were first presented at the planning charette and served as a reminder throughout the process of the overall vision for Mammoth Cave. Both statements emphasize the protection and preservation of cultural and natural resources, and the education of visitors. Mammoth Cave National Park's mission statement emphasizes providing recreation opportunities as well.



Park City Needs

- Develop partnership between Mammoth Cave and Cave City.
- Develop appropriate zoning ordinance.
- TEA-21 funding.

Park City Goals

- Strengthen connection between Park City and Mammoth Cave.
- Establish Park City as a gateway to Mammoth Cave.
- Improve and control economic development.
- Improve livability and health of residents and visitors.
- Provide authentic heritage experience for visitors.

Cave City Needs

- None identified at this time.

Cave City Goals

- Connect Cave City to Chaumont via a bikeway along KY 70.

II. Planning Process

The planning process for the bikeway began with a planning charette to assess needs and goals, and to document and graphically depict the existing conditions within the project area. In addition, the nearby towns of Park City and Cave City were seen as possible partners in the development of the bikeway beyond the boundaries of the park and representatives were invited to attend. Park City is in the planning process of developing a bikeway within the community. When completed, it will terminate at the Cavelands Heritage Center off Interstate 65. Cave City has been working with the Kentucky Transportation Cabinet's Division of Highways to create a bikeway along KY 70. This bike trail will end near Chaumont and, therefore, should be considered during the planning process.

As noted already, while the northern and southern termini (the Visitor Center and the Caveland Heritage Center, respectively) were known, the route to connect these two points was not determined.

Aerial photography was flown to create topographic mapping for the project area. The project area was then inventoried to locate historical, cultural, and natural resources such as churches, cemeteries, and wetlands, within the project area.

During the charette, John Fry, NPS, presented an existing conditions map developed by the Science and Resource Management Division that highlighted archaeological sites, endangered species (flora and fauna), and cultural features within a 500-meter buffer area on either side of the existing road from Park City to the Mammoth Cave Visitor Center. Much of the information is sensitive in nature and cannot be released to the public.

The inventory assessment is more thorough from Chaumont north, and has not been updated to the same level for the area south of Chaumont. Since some of the information cannot be released, the



alignment will be evaluated for these areas after it has been submitted.

A. Needs Assessment

A needs assessment exercise was conducted early in the charrette process. This allowed park officials to inventory needs and categorize them into the five assessment areas:

- 1) Visitor Experiences
- 2) Visitor Support
- 3) Park Needs and Regulations
- 4) Community Needs and Opportunities
- 5) Other Needs

1) Visitor Experience Needs

Visitor experiences include anything necessary to provide a positive experience for visitors to Mammoth Cave and, specifically, those using the bikeway. They are:

- Staging areas (intermediate stops), multiple destinations
- Controlled access
- Parking
- Family-oriented, leisure bikeway
- Feeling of security along bikeway
- Safety (5% maximum grade)
- Cultural and natural resource interpretation

2) Visitor Support Needs

Visitor Support includes all support activities or facilities that may be necessary for the bikeway.

- Water and restroom facilities
- Signage (roadway and bikeway oriented, wayfinding, directional)



- Universally accessible
- Adequate line of sight for safety
- Trash receptacles
- Emergency access (removable bollards)

3) Park Needs and Regulations

Mammoth Cave National Park has both regulations that must be followed, and desirable qualities that should be considered in the planning process and future design of the bikeway.

- Sustainable design – timeless
- Low maintenance
- Safety (minimize road crossings, separate from roadway)
- Capacity level
- Legal compliance

4) Community Needs and Opportunities

In addition to the needs of the National Park Service, the surrounding communities expressed needs and opportunities related to the development of the bikeway.

- Trail spurs
- Concessions and other associated business development

5) Other Needs

Other needs not included in the above categories have been included below.

- Provide an authentic experience
- Connection between Park City and Cave City



Partner Needs and Goals

The main purpose of Park City's bikeway is to link the historic sites of the community and provide alternative transportation throughout the downtown. Park City is developing their bikeway for residents, visitors/tourists, and children. It will go past the elementary school, through alleys in downtown, and past historic Bell's Tavern. A portion of the bikeway will be universally accessible and the city plans to place several pieces of art along the path. Three routes have been developed – all named for railroads that once passed through the area – *Pan-American*, *Southwind* and *Hummingbird*.

Although no representative from Cave City attended the Charette on April 3rd and 4th, 2001 at Mammoth Cave National Park, the project team contacted Mayor Bob Hunt to discuss concerns and questions. At that time, Cave City had no immediate concerns regarding the new bikeway in the national park.



B. Goals Development

During the charette, a list of goal categories was developed. These goal categories are:

- 1) Safety;
- 2) Resource protection;
- 3) Visitor experiences;
- 4) Education and visitor services;
- 5) Access and circulation;
- 6) Maintenance and operations;
- 7) Partnerships;
- 8) Compatibility with other park and community projects.

These goals were used in the "Choosing by Advantages" rating system to evaluate the alternatives. Each of the goals is described more fully below:

1) Safety

Design, construct and operate bikeway facilities that provide for user safety.

2) Resource Protection

Preserve unimpaired resources and values of Mammoth Cave National Park and surrounding communities by minimizing visual, cultural and natural impacts.

3) Visitor Experiences

Provide for family recreation and enjoyment of cultural and natural features of Mammoth Cave National Park and gateway communities.

4) Education and Visitor Services

Provide access to Mammoth Cave National Park emphasizing a historically significant railroad corridor, and enhance visitor understanding of cultural and natural resources focusing on historic use of the railroad corridor.



5) Access and Circulation

Provide for safe access for hiking and biking between Park City and Mammoth Cave National Park that is not in conflict with other uses.

6) Maintenance and Operations

Provide for low-impact, in-house maintenance within a framework of sustainability and available funds.

7) Partnerships

Strengthen overall community relations by re-establishing historical and cultural connections, and continue building upon partner relationships for construction and maintenance support.

The team decided that the eighth goal, compatibility with other park and community projects, is accomplished within the other goals and was eliminated as a separate goal.



Bikeway design and operating strategies link goal statements with the final route and alignment decisions.

C. Strategies Development

Strategies for achieving the bikeway goals are important for its planning and implementation phases. Strategies may help to define appropriate design, construction and operation phases of the bikeway as well.

Several strategies - methods of achieving specific goals - were discussed and are listed below for each of the seven goals.

1) *Safety*

- Vegetation management;
- Provide for appropriate signage, equipment, trail surface, width of path/trail tread and grade;
- Adequate sight lines and distances;
- Development of a standard operating procedure for safety;
- Development of an emergency operations plan for the bikeway (addressing response time, trail markers, dispatch and staffing responsibilities, access, etc.);
- Minimize road crossings;
- Mitigate conflicts with public/private partnerships.

2) *Resource Protection*

- Preserve Viewsheds;
- Design to minimize excavation and filling, preserve aesthetics of area, encourage compliance with the trail, and provide drainage headwalls constructed from natural cut stone where necessary;
- Accommodate natural drainage;
- Identify, screen and monitor potential resources near the corridor in Mammoth Cave Park and Park City;
- Provide for appropriate signage;



- Maintain historic integrity of railroad bed;
- Comply with appropriate legislation, prepare an Environmental Assessment (for Mammoth Cave and Park City portions of the trail).

3) *Visitor Experiences*

- Design for grade less than 5% (where feasible), a variety of experiences, educational opportunities, security for self and property (bikeway patrol);
- Preserve Viewsheds;
- Integrate parking with bikeway (consider expansion opportunities and needs);
- Provide for appropriate signage with maps, length of trail, difficulty levels;

4) *Education and Visitor Services*

- Provide for adequate user information and education;
- Provide for appropriate equipment (bike racks), rest spots, security, concessions/permits, and possible group use areas;
- Provide wayside and directional signage at both termini (Cavelands Heritage Center and visitor center) to highlight the heritage experience through educational literature and video station;
- Assure that educational information is complementary at the two termini (specific educational information may relate to caves and transportation in the region over time).

5) *Access and Circulation*

- Provide access to other Mammoth Cave services from the Cavelands Heritage Center (tours, campground reservations, etc.);
- Provide adequate access to parking;



- Emphasize connections to sites throughout the park (nodes), including:
 - Chaumont;
 - Sloan's Pond/Crossing;
 - Doyle's Valley;
 - Visitor Center;
 - Diamond Caverns;
 - Campground;
 - Cavelands Heritage Center;
 - Park City trails.

6) *Maintenance and Operations*

- Management of vegetation;
- Minimize cut slopes;
- Provide maintainable trail, tread/surface, vegetation, aesthetics;
- Provide adequate surface and sub-surface drainage;
- Provide for lowest lifecycle costs / high design standards;
- Provide access for maintenance;
- Develop annual maintenance plan.

7) *Partnerships*

- Integrate MACA and Park City bikeways, specifically aesthetics, information and design;
- Acknowledge the differences between MACA and Park City;
- Accommodate other potential partners, including:
 - Park Mammoth;
 - South Central Cave Owners Association;
 - Kentucky Arts Council;
 - Kentucky Heritage Council;
 - County Governments;
 - Corporations (Target Store employees, etc.);



- Diamond Caverns;
- Bowling Green League of Bicyclists;
- Kentucky Rails to Trails;
- US 31W / US 31 E.

It was decided that the partnerships goal was included within the other goals, and was eliminated from the goals list.

D. Existing Conditions Inventory

The existing conditions inventory consisted of locating and ground verifying cultural, historic and natural features within the project area. A preliminary list included:

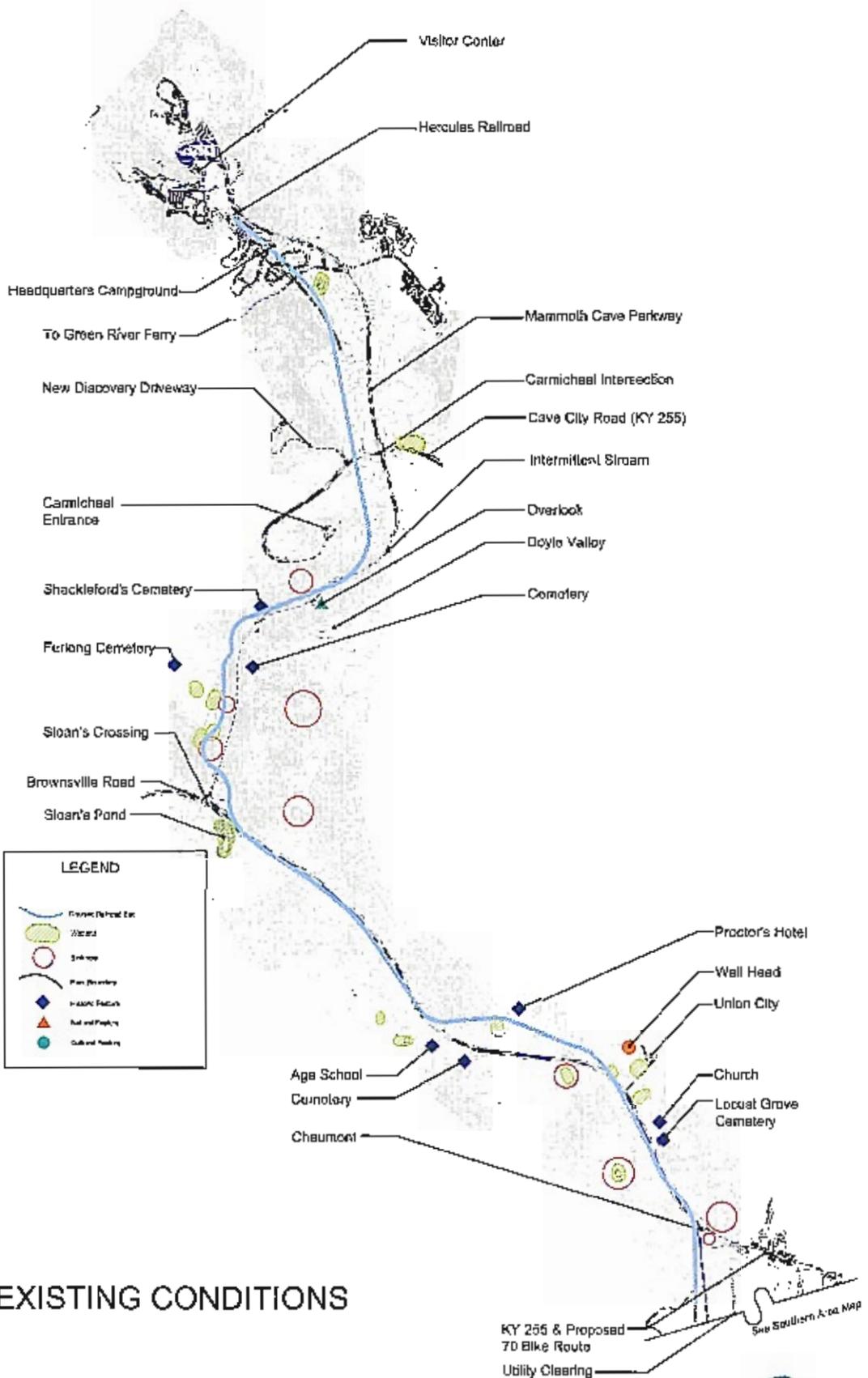
Opportunities

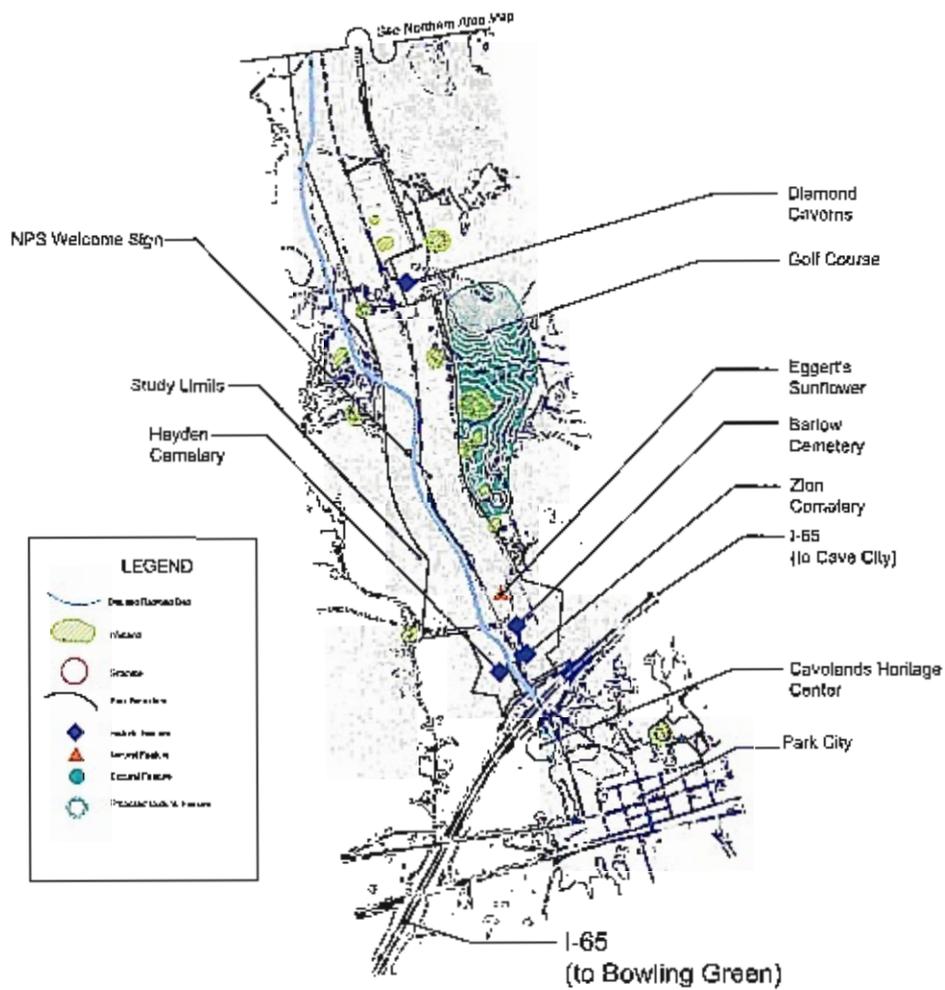
- Proctor's Hotel;
- Age School;
- Out migration of settlers to Park City;
- Wetland at Sloan's Pond;
- Stands of prairie grass.

Constraints

- Wellheads;
- Wetlands;
- Sinkholes;
- Topography;
- Dynamic ephemeral;
- Stands of prairie grass;
- Golf course.

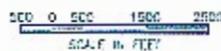






EXISTING CONDITIONS

Southern Area
Mammoth Cave National Park
Bikeway Plan



III. Alternatives Development & Evaluation

As the project progressed, the goals first developed in the planning charette were incorporated into the "Choosing by Advantages" (CBA) rating system and referred to as "factor groups". The factor groups served as a tool to compare bikeway routes in a consistent manner. The factors are:

- 1) Safety;
- 2) Resource protection;
- 3) Visitor experiences;
- 4) Education and visitor services;
- 5) Access and circulation;
- 6) Maintenance and operations;
- 7) Partnerships.

A. "Choosing by Advantages" Methodology

The National Park Service uses the CBA ranking system to evaluate alternatives and to select the alternative with the best relative advantages and costs to accomplish Servicewide goals and objectives.

In the NPS document "Priority Setting Process: Choosing by Advantages" (see Appendix A in this document), it is stated that the CBA process considers:

- "What and how are the advantages of each project" proposed for consideration;
- "How important are the advantages of the projects";
- "Are those advantages worth their associated cost"?

The factor groups described above were divided into two sub-groups: "attributes" and "advantages". Attributes are objective information about each alternative related to the factor group/goal. Advantages are a summation of the factual



information, and an evaluation about the ability of each alternative to meet the stated goal.

Values were assigned to each of the seven factor groups by the bikeway team by a consensus process. A higher value (e.g. 100) indicates there was consensus among park officials that this factor was very important in the selection of an alternative. A lower assigned value (e.g. 30) indicated this factor was judged as less critical to the overall success of the alternative, and thus the project. The values assigned to each of the factor groups were:

- 1) Safety 95
- 2) Resource protection..... 100
- 3) Visitor experiences 70
- 4) Education and visitor services 60
- 5) Access and circulation 80
- 6) Maintenance and operations..... 85
- 7) Partnerships..... 30

Resource protection was universally acknowledged as being the single most important factor, in keeping with both the NPS and Mammoth Cave National Park mission statements, while safety was ranked second with a score of 95. In descending order, the factors and scores were as follows:

- 1) Resource protection 100
- 2) Safety 95
- 3) Maintenance and operations..... 85
- 4) Access and circulation 80
- 5) Visitor experiences..... 70
- 6) Education and visitor services..... 60
- 7) Partnerships..... 30

Scoring in the CBA system operates from the premise that at least two alternatives will be evaluated in each factor group. Each alternative is scored, based upon its ability to meet the criteria of the goal or factor group. One alternative will receive a score equal to the factor group, i.e. 100, 95, 80, etc., while the other alternative may also receive the same score (i.e. 100, 95, 80, etc.) or



zero. When three or more alternatives are evaluated, scoring becomes more complex. All alternatives may receive scores equal to the factor group, or they may receive a score between zero and the highest score, or they may score zero; scoring is dependent of the alternative's ability to meet the criteria of the goal.

Upon completion of scoring, each alternative is given a combined score. The combined score is the individual vertical score of all the advantages or the total "importance of advantages" score. This total is then added to figures estimating the cost to construct each of the different alternatives. All of these factors are weighed to produce final scores for the individual alternatives. The alternative with the highest score meets the most goals of the project. Each of the four segments and the "choosing by advantages" methodologies are described in the following sections.

B. Descriptions of Bikeway Segments

The corridor proposed for the bikeway trail begins at the Visitor Center and traverses approximately eight miles of varying landscape, ending at the area designated for the Cavelands Heritage Center in Park City. The corridor was divided into four discrete segments based upon the potential of each to provide visitor amenities such as parking and restrooms, and the physical terrain; segmenting the corridor also enabled the planning team to better develop and evaluate alternatives. A physical description of each of the four segments is provided below.

Segment 1: Area around Headquarters Campground

The first segment begins at the Visitor Center, traverses to the east side of the campground, and ends soon after the road crossing that leads to the Green River Ferry. This segment sets the tone for



the bikeway trail, as it will begin in the vicinity of the Visitor Center, the hub of visitor activities at Mammoth Cave. The terrain in this area is characterized by gentle slopes on a landscape previously disturbed by construction of the Visitor Center and Headquarters Campground. This segment is approximately 4,000 feet long.

Segment 2: Area Crossing Doyle Valley

The second segment of the bikeway begins where Segment 1 stops, and ends at the potential parking area below Sloan's Crossing. The terrain between these two points is a complex landscape of steep karst topography, a unique natural feature, and yet one sensitive to development. Doyle Valley contains many cultural and historical features. This segment measures approximately 16,000 feet in length, using the Mammoth Cave Parkway current road alignment as the basis of measurement.

Segment 3: Area from Potential Parking below Sloan's Crossing to Potential Parking at Chaumont

Segment 3 begins where Segment 2 concludes, traverses the park through an area with a number of historic and cultural features, and ends at the potential parking area at Chaumont. This segment incorporates parking areas at both north and south end, thus allowing bikeway users to park at either end of the segment and cycle a short distance or take advantage of the entire bikeway route. Segment 3 is approximately 9,000 feet in length.



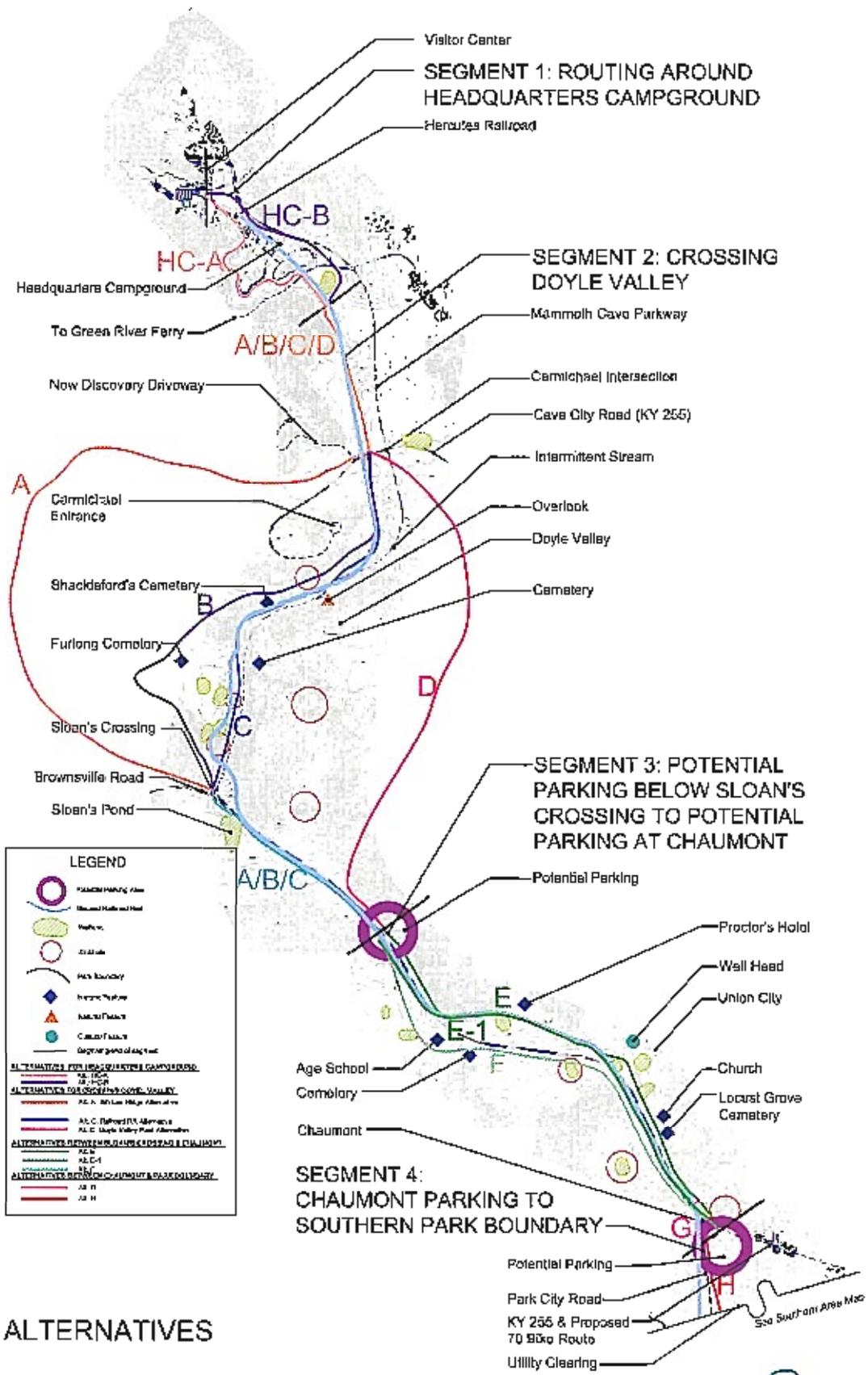
Segment 4: Area from Potential Parking at Chaumont to Southern Park boundary.

Segment 4 begins where Segment 3 ends and extends to the southern park boundary. The terrain in this area is relatively easy to cross, and there are a number of historic, natural and cultural features in the area that may be interpreted for visitors. Segment 4 measures approximately 13,000 feet in length.

C. Alternatives Evaluation

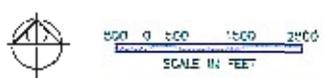
Once the corridor was divided into segments, routing alternatives were developed for each segment. Two alternatives each were evaluated for Segments 1 and 4; evaluation of Segment 3 considered three alternatives; and evaluation of Segment 2 involved four alternatives. The maps on the following two pages show the locations of alternatives in the northern and southern areas of the park, respectively. An evaluation of the alternatives in each segment occurs after the maps.

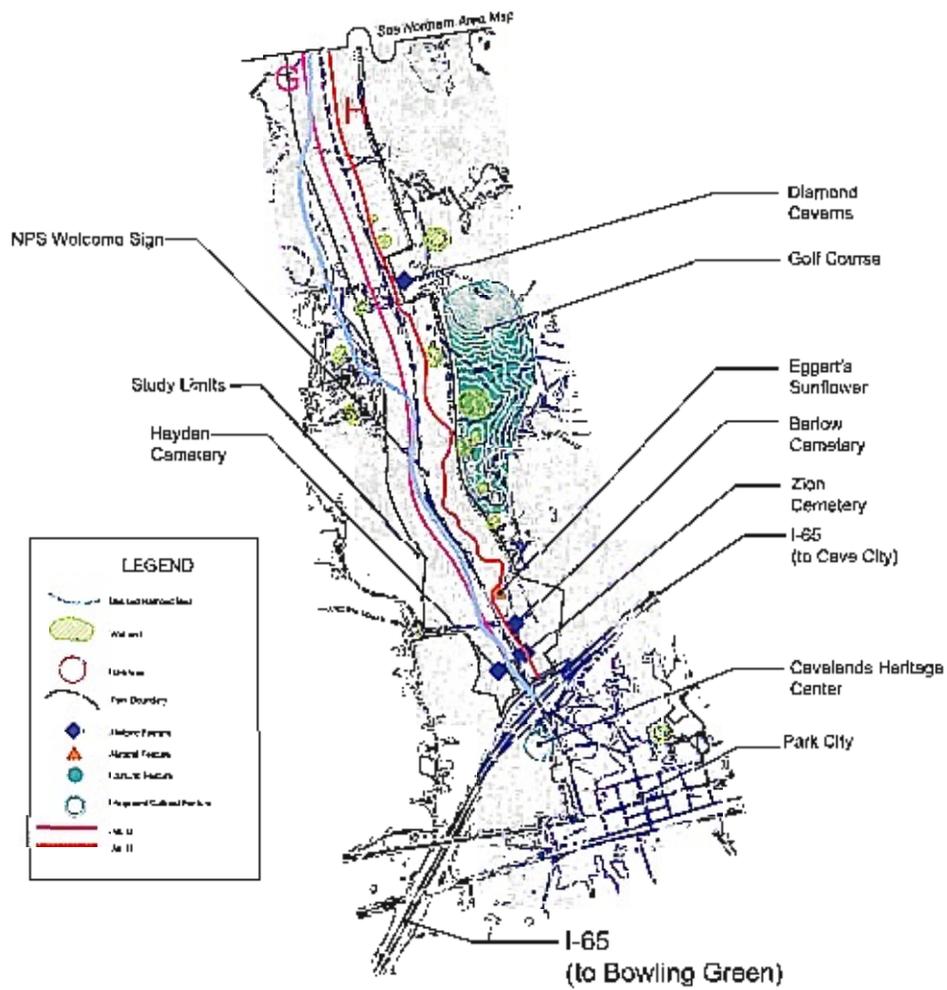




ALTERNATIVES

Northern Area
 Mammoth Cave National Park
 Bikeway Plan





ALTERNATIVES

Southern Area
Mammoth Cave National Park
Bikeway Plan



500 0 500 1000 2500
SCALE IN FEET



Segment 1: Routing Around Headquarters Campground

As described earlier, Segment 1 begins at the Visitor Center at the hotel parking area. Currently, an existing bike trail begins in the Mammoth Cave Headquarters Campground and bisects one campsite loop. During the planning phase, it was identified as a desirable characteristic to separate bicycle traffic from the campground. Another objective identified was to provide the opportunity to view the Mammoth Cave Railroad exhibit adjacent to the park amphitheater.

Two alternatives were developed to meet these objectives. The first alternative, Alternative HC-A, has located the bike trail to the west of the campground along the edge of the Mammoth Cave ridge, while Alternative HC-B places the bike trail to the east of the campground and beside the Mammoth Cave Parkway.

The CBA matrix following this section compares the two alternatives in the seven factor groups mentioned previously. Alternative HC-B is the preferred alternative.

Alternative HC-A (West of Campground)

The primary advantage of the western route is the separation of the trail from the Mammoth Cave Parkway, the campground entrance road, and the service area parking. This alternative is the longer of the two routes in this segment. There is a limited amount of space between campground loops C and D, and the slope of the ridge. This will impact the western end of both loops, and encourage social trails from the campground sites. This alternative will also require an unguarded crossing of the Green River Ferry Road.



Alternative HC-B (East of Campground)

The eastern alternative is shorter and improves safety by crossing the Green River Ferry Road at the intersection of Green River Ferry Road and Mammoth Cave Parkway. Additional crossings at the campground and service area entrances are also guarded. Conflict with pedestrian traffic between the campground and amphitheater is avoided. It offers an opportunity to view the wetland south of the Green River Ferry Road, and access to the train display from a turnout on the proposed hotel parking access road. The greatest disadvantage of this alternative is the cycling experience would be almost entirely within the developed area of Mammoth Cave Parkway corridor.

Evaluation

Alternative HC-B, the route east of the campground along the Mammoth Cave Parkway, provides significantly greater benefits with a total importance of advantages score of 450 compared to 130 for Alternative HC-A. The safety achieved with controlled road crossings, the reduction of resource impact by staying within the developed Mammoth Cave Parkway corridor, and the more intuitive wayfinding far outweighed the advantages of a more woodland path along the west side of the campground. The CBA rankings of the alternatives were:

- Alternative HC-A: West of HQ Campground
Total Ranking: 130
- Alternative HC-B: East of HQ Campground
Total Ranking: 450

The matrix on the following three pages depicts the CBA scoring of each alternative in Segment 1.



MAMMOTH CAVE NATIONAL PARK

Extend Bicycle Trail

Choosing by Advantages: Segment 1: Routing around Headquarters Campground

COMPONENT:		FUNCTION:		
FACTOR	ALTERNATIVES			
	Alternative HC-A		Alternative HC-B	
	<ul style="list-style-type: none"> • West of Campground 		<ul style="list-style-type: none"> • East of Campground 	
FACTOR 1 - SAFETY				
Attributes	<ul style="list-style-type: none"> • Less than 5% • Crosses Green River Ferry Road 		<ul style="list-style-type: none"> • Less than 5% • Cross Green Ferry Road and Campground access road 	
Advantages	Meets grade criteria and crosses one primary road w/o stop	0	Meets grade criteria and crosses one primary road at stop and campground access road at stop	9.5
FACTOR 2 – RESOURCE PROTECTION				
Attributes	<ul style="list-style-type: none"> • Less new disturbance than HC-B • More impact on forest community • More potential for social trails from campground 		<ul style="list-style-type: none"> • 4,000 ft. new disturbance • Less impact on Forest Community • Less potential for social trails from campground 	
Advantages	Most new disturbance and most potential for social trails	0	Less disturbance and lower potential for social trails	100

COMPONENT:		FUNCTION:	
FACTOR	ALTERNATIVES		
	Alternative HC-A		Alternative HC-B
	<ul style="list-style-type: none"> • West of Campground 		<ul style="list-style-type: none"> • East of Campground
FACTOR 3 – VISITOR EXPERIENCES			
Attributes	<ul style="list-style-type: none"> • Longest with no difference in grade • Most separation • Less likely to require dismount 		<ul style="list-style-type: none"> • Shorter Ride • Next to Primary Road most of route • More likely to require dismount
Advantages	<ul style="list-style-type: none"> • More separation with less chance of dismount 	70	<ul style="list-style-type: none"> • Less separation with greater chance of dismount
FACTOR 4 - EDUCATION & VISITOR SERVICES			
Attributes	<ul style="list-style-type: none"> • Off RR berm • Passes RR display • <i>Away from road, more in woods;</i> 		<ul style="list-style-type: none"> • Off RR berm • Passes RR display • Close to wetland
Advantages	<ul style="list-style-type: none"> • Wooded - away from the berm 	60	<ul style="list-style-type: none"> • Access to wetland area
FACTOR 5 – ACCESS & CIRCULATION			
Attributes	<ul style="list-style-type: none"> • Wayfinding, further from road • Enters rear of Service Center parking lot • Less opportunity to switch to roadway • Longer route 		<ul style="list-style-type: none"> • Close to road • Connects directly to front of Service Center • More opportunity to switch to roadway • Shorter route
Advantages	<ul style="list-style-type: none"> • Less visible, more signage required; enters rear of service center, requires detour around campground. 	0	<ul style="list-style-type: none"> • More intuitive wayfinding; access to front of service center; shorter.

Segment 2: Crossing Doyle Valley

The alternatives in Segment 2 were developed to cross Doyle Valley in a manner that satisfies the project's goals. Doyle Valley presented a unique challenge in the planning of the bikeway trail because of its steep terrain. In order to adhere to the goal deemed most important, resource protection, the former railroad bed was incorporated as the actual bikeway trail as much as possible. There is an opportunity in the first 3,000 linear feet of Segment 2 (from the beginning of the segment to the Carmichael intersection) to incorporate a substantive amount of the former railroad bed as the bikeway trail. This "segment within a segment" was identified as a common element amongst the four alternatives subsequently developed. It is identified on the mapping as A/B/C/D.

The remainder of Segment 2 is comprised of four alternate bikeway routes (A, B, C, and D) that traverse Doyle Valley on the eastern and western sides of Mammoth Cave Parkway. Alternatives B and C face steep grade changes, while Alternatives A and D bypass the steep terrain and veer sharply west and east, respectively, into less steep terrain, thus creating considerably longer, but less steep, trails. Alternatives A, B, and C merge and form one alternative at Sloan's Crossing. From this juncture, the alternative is labeled A/B/C to indicate the three incorporate the same corridor to the potential parking area below Sloan's Crossing. Alternative A/B/C incorporates a large portion of railroad berm as the bike trail. Alternative D, meanwhile, has traversed terrain far to the east of Mammoth Cave parkway, joining Alternatives A, B, and C at the potential parking area.

The alternatives are explained in greater detail on the following pages, while the matrix following the explanation of Alternative D compares Alternatives A, B, C, and D using the Choosing by Advantages methodology.



Alternative A: Jim Lee Ridge Route

Alternative A is shown as An orange line on the *Alternatives - Northern Area* map. The first approximately 300 feet of this trail run parallel with Mammoth Cave Parkway on the western edge of the road, varying 40 to 80 feet from the roadway. The route runs perpendicular to the KY255 bicycle route at the Carmichael Intersection, and then curves 90 degrees to the west. The route then continues past the New Discovery driveway and continues in a large half-circle loop for approximately 15,400 feet, almost three miles in length. The Lee Ridge option continues until Sloan's Crossing.

The primary advantages of Alternative A are that it meets grade criteria, crosses one drive and one primary road at a stop sign, and crosses two primary crossings without a stop. These advantages indicate it meets the safety goal in an exemplary manner. This alternative is also better suited than other alternatives for volunteer assistance. A substantive disadvantage of this route is the lack of resource protection; Alternative A would have the potential for the most new disturbance upon the existing landscape.

Alternative B: Furlong Cemetery Route

The Furlong Cemetery Route is shown as a purple line on the *Alternatives - Northern Area* map. It runs parallel to Mammoth Cave Parkway, albeit at quite a distance away, for the first half of the trail. At the point where the potential trail comes to a sinkhole, the route veers southwest around Shackelford's Cemetery. The route veers further to the southwest to avoid the Furlong Cemetery. The route is approximately 10,000 feet in length, about two miles. The middle and end sections of this route encounter steep grade changes and run partially along ridgelines. Alternative B eventually converges with Alternatives A and C at Sloan's Crossing.

One of the biggest advantages of Alternative B is that it has minimal disturbance to natural



resources. In addition, while it is a more difficult trail in terms of visitor experiences than Alternative A, it is less difficult than Alternatives C and D. Alternative B's other advantages include passing by cemeteries, Sloan's Pond, and Doyle Valley, thus creating many opportunities for interpretation of these features. Alternative B compared favorably to Alternatives A, C, and D in all factors.

Alternative C: Railroad Route

Alternative C is depicted in blue on the *Alternatives - Northern Area* map and is located primarily on the railroad berm. It passes in close proximity to Shackleford's Cemetery, but on the eastern side of the cemetery, rather than on the western side as Alternative B does. Alternative C also passes in close proximity to the interpretive area at Sloan's Pond.

The primary advantages of Alternative C are that it would have the least new disturbance and impact on cultural resources, and it would also be the easiest to maintain, compared to other alternatives. Its primary disadvantages are that it does not meet grade criteria and crosses the roadway in two separate locations without a stop, and once with a stop, a great safety concern; it also has less volunteer opportunities.

Alternative A/B/C

As mentioned earlier, Alternatives A, B, and C merge at Sloan's Crossing. Visitors may take advantage of the boardwalk and interpretive opportunities associated with Sloan's Pond in this general location.



Alternative D: Doyle Valley East Route

Alternative D is shown in a red line on the *Alternatives - Northern Area* map. This route begins in the same location as Alternatives A, B, and C, a short distance west of the Carmichael intersection. It runs southeast for a distance, and then changes to a southwesterly direction, eventually ending at the potential parking area below Sloan's Crossing. The length of Alternative D is approximately 11,000 feet, approximately two miles.

The primary advantages of Alternative D are that it meets grade criteria and crosses one secondary road and two primary roads not at a stop sign. The major disadvantage is that this route (similar to Alternative C) is the most difficult for visitors to traverse. Alternative D passes no points of interest without incorporating long uphill spurs. It was also noted it would be the most difficult to maintain because of its remote location.

Evaluation

Using the Choosing by Advantages methodology, Alternative B, the Furlong Cemetery Route, was ranked as having the most advantages. The alternatives were ranked in the following order:

- Alternative D-Doyle Valley East Route:
Total Ranking: 155
- Alternative A-Jim Lee Ridge Route:
Total Ranking: 215
- Alternative C-Railroad Bed Route:
Total Ranking: 325
- Alternative B-Furlong Cemetery Route:
Total Ranking: 485

The matrix on the following five pages depicts the CBA scoring of each alternative.



MAMMOTH CAVE NATIONAL PARK

Extend Bicycle Trail

Choosing by Advantages:
Segment 2: Crossing Doyle Valley

COMPONENT; FACTOR	FUNCTION: ALTERNATIVES			
	Alternative A • Jim Lee Ridge	Alternative B • Furlong Cemetery	Alternative C • Railroad Berm	Alternative D • Doyle Valley East
FACTOR 1 - SAFETY				
Attributes	<ul style="list-style-type: none"> Less than 5% Crosses New Discovery entrance drive 	<ul style="list-style-type: none"> Less than 5% Crosses Carmichael Road 	<ul style="list-style-type: none"> 1,400 feet above 5% Crosses Carmichael Road 	<ul style="list-style-type: none"> Less than 5% Crosses Carmichael and Mammoth Cave Pkwy.
Advantages	<p>95</p> <p>Meets grade criteria and crosses one drive and one primary road at stop and two primary crossing w/o stop</p>	<p>85</p> <p>Meets grade criteria and crosses one secondary road and one primary road at stop and two primary w/o stop</p>	<p>0</p> <p>Does not meet grade and crosses one secondary and one primary road at stop and two primary w/o stop</p>	<p>95</p> <p>Meets grade criteria and crosses one secondary and two primary not at stop</p>

COMPONENT; FACTOR	FUNCTION: ALTERNATIVES			
	Alternative A	Alternative B	Alternative C	Alternative D
	<ul style="list-style-type: none"> • Jim Lee Ridge 	<ul style="list-style-type: none"> • Furlong Cemetery 	<ul style="list-style-type: none"> • Railroad Berm 	<ul style="list-style-type: none"> • Doyle Valley East
FACTOR 2 – RESOURCE PROTECTION				
Attributes	<ul style="list-style-type: none"> • 15,000 ft. new disturbance • Most impact on ginseng • Least erosion • impact and least social trails • Most new exotics • Less cultural impact • No visible cave entrances 	<ul style="list-style-type: none"> • 5,000 ft. new disturbance • Less impact on ginseng • Less erosion • impact and less social trails • Less new exotics • Most cultural impact at Furlong Cemetery • No visible cave entrances 	<ul style="list-style-type: none"> • 4,000 ft. new disturbance • Least impact on ginseng • Most erosion • impact and social trails • Least new exotics • Least impact on cultural resources • Three cave entrances visible 	<ul style="list-style-type: none"> • 9,000 ft. new disturbance • Most impact on ginseng • Least erosion • impact and least social trails • Most new exotics • Less cultural impact • No visible cave entrances
Advantages	<p>Most new disturbance and less cultural impact</p> <hr style="border: 2px solid orange;"/>	<p>Minor disturbance and erosion and most cultural impact</p>	<p>Most erosion potential but least new disturbance and least impact on cultural</p>	<p>Major disturbance but less than A with most impact on ginseng and new exotics</p>
	0	100	100	30

FUNCTION: ALTERNATIVES				
COMPONENT;	Alternative A	Alternative B	Alternative C	Alternative D
FACTOR 3 – VISITOR EXPERIENCES	<ul style="list-style-type: none"> • Jim Lee Ridge 	<ul style="list-style-type: none"> • Furlong Cemetery 	<ul style="list-style-type: none"> • Railroad Berm 	<ul style="list-style-type: none"> • Doyle Valley East
Attributes	<ul style="list-style-type: none"> • Longest with least grade • More accessible than D • Most separation 	<ul style="list-style-type: none"> • More grade than A but less than C & D but 2nd shortest • More accessible than D • Less separation than A & D but more than C 	<ul style="list-style-type: none"> • Most grade but shortest • More accessible than D • Least separation • Least convenient 	<ul style="list-style-type: none"> • 2nd longest with more grade • Least access to Sloan's Pond • Most separation
Advantages	50 Easiest	70 More difficult than A	25 More difficult	0 Most difficult
FACTOR 4 - EDUCATION AND VISITOR SERVICES				
Attributes	<ul style="list-style-type: none"> • Alignment away from RR Berm • Less geology • Passes Sloan's Pond • Away from road, more in woods 	<ul style="list-style-type: none"> • Furlong Cemetery with Sloans and Doyles • Good Access to sinkhole • Passes Sloan's Pond • Away from road, more in woods 	<ul style="list-style-type: none"> • Closer Alignment with Railroad • Good Access to sinkhole • Passes Sloan's Pond • Closest to road, less in woods 	<ul style="list-style-type: none"> • Alignment away from RR Berm • Least geological value • Has to backtrack to Sloan's Pond • Away from road, more in woods
Advantages	10 Wooded away from the berm	60 Cemetery, Sloan's, Doyle Valley	50 Trestle, best connection to RR	0 Same as A but shorter

COMPONENT;		FUNCTION:			
		ALTERNATIVES			
FACTOR	Alternative A	Alternative B	Alternative C	Alternative D	
	<ul style="list-style-type: none"> • Jim Lee Ridge 	<ul style="list-style-type: none"> • Furlong Cemetery 	<ul style="list-style-type: none"> • Railroad Berm 	<ul style="list-style-type: none"> • Doyle Valley East 	
FACTOR 5 – ACCESS & CIRCULATION					
Attributes	<ul style="list-style-type: none"> • Wayfinding, further from road • Connects directly to Sloans • Needs lengthy spurs to reach Doyle Valley Overlook 	<ul style="list-style-type: none"> • Wayfinding, middle distance from road • Connects directly to Sloans • Passes by all points of interest 	<ul style="list-style-type: none"> • Wayfinding, closest to road • Connects directly to Sloans • On RR Berm, spurs not convenient 	<ul style="list-style-type: none"> • Wayfinding problem crossing Parkway near Carmichael • Indirect connection to Sloans • Needs lengthy uphill spurs to reach points of interest 	
Advantages	Less	30 Passes all points of interest	80 Most direct, passes many points of interest	65 No points of interest without long uphill spurs.	
FACTOR 6 – MAINTENANCE & OPERATIONS					
Attributes	<ul style="list-style-type: none"> • Hardest to access 	<ul style="list-style-type: none"> • Easiest to maintain • Required structures would increase maintenance cost 	<ul style="list-style-type: none"> • Most development • Required structures would increase maintenance cost 	<ul style="list-style-type: none"> • Hardest to access 	
Advantages	Most difficult	80 Less difficult than A & D but more than B	85 Easiest to maintain	0 Most difficult	

COMPONENT; FACTOR	FUNCTION: ALTERNATIVES			
	Alternative A	Alternative B	Alternative C	Alternative D
	• Jim Lee Ridge	• Furlong Cemetery	• Railroad Berm	• Doyle Valley East
FACTOR 7 - PARTNERSHIPS				
Attributes	• Better suited for volunteer assistance	• Less opportunity for volunteers	• Less opportunity for volunteers	• Better suited for volunteer assistance
Advantages	30 Better suited for volunteer assistance	10 Less opportunity for volunteers	0 Less opportunity for volunteers	30 Better suited for volunteer assistance
TOTAL IMPORTANCES OF ADVANTAGES	215	485	325	155
Initial Cost (Net)	\$361,600	\$233,980	\$278,235	\$209,190
Re-design Cost				
Compliance				
Life Cycle Cost (Net)				
TOTAL				
Version 12/11/98				

***Segment 3: Potential Parking Below
Sloan's Crossing to
Potential Parking at
Chaumont***

Segment 3 extends from the potential parking area below Sloan's Crossing to the potential parking area at Chaumont. Alternatives E, F, and E-1 were developed for this segment: E, running north of Mammoth Cave Parkway; F, running south of the parkway; and E-1, alternating on the north and south sides as it follows the former railroad grade.

Alternative E

Alternative E is shown in a green line on the *Alternatives - Northern Area* map, running parallel to the north side of Mammoth Cave Parkway. The route then turns east, following the route of the former railroad grade and within the vicinity of Proctor's Hotel, a historic feature. Alternative E then veers east of the area identified as wetlands on the mapping, finally passing Locust Grove Cemetery and an associated church. Alternative E ends at the area identified for potential parking at Chaumont.

Alternative E has the advantage of being located entirely on the north side of Mammoth Cave Parkway, which provides a high degree of safety, and it makes greater use of the existing railroad berm than Alternative F, but not as great as Alternative E-1.

One road crossing would be required with Alternative E, greatly increasing the potential safety of cyclists, compared to the other alternatives.



Alternative F

Alternative F is depicted by a turquoise line on the *Alternatives - Northern Area* map. The route is located on the south side of Mammoth Cave Parkway and incorporates several historic features, such as the Age School and a cemetery. Alternative F also passes through terrain where wetlands are located. As the route approaches Chaumont, visitors must cross Mammoth Cave Parkway to access the parking area there.

The trail crosses Mammoth Cave Parkway two times, once at Sloan's Crossing and once at Chaumont to reach the parking area. While this route provides more safety than Alternative E-1, it is not as safe as Alternative E.

Because of drainage issues along this section, maintenance of this section of the trail would be harder than Alternative E-1, but not as difficult as Alternative E.

This alternative would have some new disturbance and some impact on the park's natural resources.

Alternative E-1

Alternative E-1 is shown by a light green line on the *Alternatives - Northern Area* map and is located entirely on former railroad grade. As illustrated on the mapping, the railroad grade crosses Mammoth Cave Parkway several times. Thus, in order to follow the railroad grade, the bikeway would also have to cross the parkway several times (once at Sloan's Crossing, once at Chaumont, and once between Sloan's Crossing and Chaumont). Mitigating measures would have to be undertaken to ensure the safety of park visitors using the trail.

While this alternative is not as safe as alternatives E and F in terms of numbers of road crossings, it does provide the greatest degree of resource protection and protection of the historic railroad berm. Most of the bike path would be on the railroad berm and there would be little new disturbance. Consequently, the impact to the park's natural resources would be minimized when compared to the other alternatives.



Where the bike trail is located on the railroad right-of-way, the width of the trail would be limited to the width of the railroad berm. Construction methods in this area would be utilized that would minimize the impact to the berm, while providing a safe, cost effective bike route.

Access to the railroad berm is relatively easy along this section; maintenance of the trail would also be relatively easy.

Evaluation

Alternative E-1 scored highest in the CBA ranking exercise. While it has the lowest degree of visitor safety, the other advantages of this alternative, in terms of resource protection, visitor experiences, and maintenance and operations, outweigh the low degree of visitor safety. The scores below depict the total scores of each alternative:

- Alternative E - North of Mammoth Cave Parkway:
Total Ranking: 95
- Alternative F - North of Mammoth Cave Parkway:
Total Ranking: 215
- Alternative E-1 - Remain on Railroad Grade:
Total Ranking: 425

The CBA matrix on the following three pages depicts the scoring of each alternative.



MAMMOTH CAVE NATIONAL PARK

Extend Bicycle Trail

Choosing by Advantages: Segment 3: Sloan's Crossing to Chaumont

COMPONENT;		FUNCTION:			
FACTOR	ALTERNATIVES				
	Alternative E • North of Mammoth Cave Parkway		Alternative F • South of Mammoth Cave Parkway		Alternative E-1 • Remain on RR Berm
FACTOR 1 - SAFETY					
Attributes	<ul style="list-style-type: none"> Main trail crosses Mammoth Cave Park only at Chaumont. Side trail to Sloan's pond crosses MCP. 		<ul style="list-style-type: none"> Crosses Mammoth Cave Park at Sloan's Crossing and Chaumont 		<ul style="list-style-type: none"> Crosses Mammoth Cave Park at Sloan's Crossing, between Sloan's and Chaumont, and at Chaumont
Advantages	Provides highest degree of safety	95	Safer than Alternative E-1	50	Provides lowest degree of safety
FACTOR 2 - RESOURCE PROTECTION					
Attributes	<ul style="list-style-type: none"> Most new disturbance Does little to protect RR grade Difficult terrain to cross at Sloan's 		<ul style="list-style-type: none"> Creates new disturbance Provides some protection of historic railroad grade 		<ul style="list-style-type: none"> Protects historic railroad grade
Advantages	Most new disturbance and most potential for social trails	0	Less disturbance and lower potential for social trails	50	Provides highest level of resource protection

COMPONENT;		FUNCTION:				
FACTOR	ALTERNATIVES					
	Alternative E		Alternative F			Alternative E-1
	<ul style="list-style-type: none"> North of Mammoth Cave Parkway 		<ul style="list-style-type: none"> South of Mammoth Cave Parkway 		<ul style="list-style-type: none"> Remain on RR Berm 	
FACTOR 3 – VISITOR EXPERIENCES						
Attributes	<ul style="list-style-type: none"> Difficult and unsafe access to Sloan's 		<ul style="list-style-type: none"> Easy access to Sloan's 		<ul style="list-style-type: none"> Easy access to Sloan's Remains on historic RR grade 	
Advantages	<p>None</p> 	0	Uses some of historic RR grade to access Sloan's	20	Has highest level of visitor enjoyment with great variety	60
FACTOR 4 - EDUCATION AND VISITOR SERVICES						
Attributes	<ul style="list-style-type: none"> None 		<ul style="list-style-type: none"> Access to Sloan's Limited access to historic RR grade 		<ul style="list-style-type: none"> On RR grade Access to Sloan's 	
Advantages		0	Limited visitor education opportunities	20	Best visitor education opportunities	60
FACTOR 5 – ACCESS & CIRCULATION						
Attributes	<ul style="list-style-type: none"> Difficult to access 		<ul style="list-style-type: none"> Easy access 		<ul style="list-style-type: none"> Easiest access Potential for more access points 	
Advantages	<p>None</p> 	0		40	Best opportunities for access & circulation	80

COMPONENT;		FUNCTION:				
FACTOR	ALTERNATIVES					
	Alternative E		Alternative F		Alternative E-I	
	<ul style="list-style-type: none"> North of Mammoth Cave Parkway 		<ul style="list-style-type: none"> South of Mammoth Cave Parkway 		<ul style="list-style-type: none"> Remain on RR Berm 	
FACTOR 6 – MAINTENANCE & OPERATIONS						
Attributes	<ul style="list-style-type: none"> Hardest to access Difficult terrain 		<ul style="list-style-type: none"> Parts on established grade Will have continuing drainage issues on new alignment 		<ul style="list-style-type: none"> Easiest to maintain Located on long-established grade 	
Advantages	<p>Most difficult to maintain</p>	0	<p>Less difficult to maintain</p>	20	<p>Easiest to maintain</p>	85
FACTOR 7 - PARTNERSHIPS						
Attributes	<ul style="list-style-type: none"> No potential for Rails to Trails funding 		<ul style="list-style-type: none"> Potential for Rails to Trails funding 		<ul style="list-style-type: none"> Greatest potential for Rails to Trails funding 	
Advantages		0		5		30
TOTAL IMPORTANCES OF ADVANTAGES		95		215		425
Initial Cost (Net)	\$233,101		\$285,360		\$270,200	
Re-design Cost						
Compliance						
Life Cycle Cost (Net)						
TOTAL						
Version 12/11/98						

Segment 4: Chaumont Parking to Southern Park Boundary

Segment 4 connects the proposed parking area at Chaumont with the Park City bicycle trail system at the park boundary. However, the alternatives developed for this segment extend to the park's southern boundary only.

This segment is located in the Park City Road corridor. The corridor is slightly wider at a few locations, and narrower at Diamond Caverns. Two alternatives (G and H) were developed for this segment, G on the west side of Park City Road, and H on the east side. Other alternatives were discussed but eventually eliminated from further consideration because it was deemed desirable to avoid a location on adjoining private property.

Alternative G

Alternative G is shown in a hot pink line on the *Alternatives - Southern Area* map and is located west of Park City Road. The primary advantages of Alternative G are 1) it more closely follows the historic route of the Mammoth Cave Railroad, and 2) it has better access for maintenance and operations. The primary disadvantages are 1) the route crosses Park City Road twice, which provides ease of access but greatly increases the conflict with vehicular traffic on a primary route; 2) wayfinding is more difficult because of the crossings; and 3) Alternative G is approximately 0.2 miles longer than Alternative H.



Alternative H

Alternative H is shown in a red line on the *Alternatives - Southern Area* map and is located east of Park City Road. The primary advantages associated with Alternative H are 1) it has fewer road crossings, and specifically does not cross Park City Road; 2) it has better separation from the highway; 3) it is about 0.2 miles shorter than Alternative G; and 3) it has a direct connection to Diamond Caverns (an important partner in development of the bicycle trail).

The disadvantages of Alternative H are that it uses less of the historic railroad grade and has fewer access points for maintenance and operations as a function of fewer road crossings.

Evaluation:

Alternative Route H provides significantly greater benefits with a total importance of advantages score, as shown below.

- Alternative G-Follows Former Route:
Total Ranking: 245
- Alternative H-East Side of Park City Road
Total Ranking: 375

The evaluation matrix on the following three pages shows that Alternative H better provides safety for visitors and a better visitor experience. These two advantages were the primary factors that resulted in Alternative H having a higher score.



MAMMOTH CAVE NATIONAL PARK

Extend Bicycle Trail

Choosing by Advantages:

Segment 4: Chaumont Parking Area to Park City

COMPONENT;	FUNCTION		
FACTOR	ALTERNATIVES		
	Alternative G		Alternative H
	<ul style="list-style-type: none"> Follows Former Route 		<ul style="list-style-type: none"> Trail Entirely on East Side of Park City Road
FACTOR 1 - SAFETY			
Attributes	<ul style="list-style-type: none"> Less than 5% Crosses Park City Road 2 times (primary) Crosses Doyle Road (secondary) Crosses Campground Access Road (secondary) 		<ul style="list-style-type: none"> Less than 5% Does not cross Park City Road (primary) Crosses Doyle Road (secondary) Crosses Diamond Caverns Access Roads (2 ca. secondary)
Advantages	Meets grade criteria and crosses <u>primary route twice not at stop.</u>	0	Meets grade criteria and does not cross primary road. 95
FACTOR 2 – RESOURCE PROTECTION			
Attributes	<ul style="list-style-type: none"> 2.5 miles No visible cave entrances Area heavily impacted by previous road construction 		<ul style="list-style-type: none"> 2.3 miles No visible cave entrances Area heavily impacted by previous road construction
Advantages	Longer 100	100	Shorter 100
FACTOR 3 – VISITOR EXPERIENCES			
Attributes	<ul style="list-style-type: none"> Longer with more grade More road crossings Direct connection to Diamond Caverns 		<ul style="list-style-type: none"> Shorter with less grade Fewer road crossings Indirect connection to Diamond Caverns
Advantages	More road crossings, less <u>separation from highway</u>	0	Fewer road crossings with better separation from highway 70

COMPONENT:		FUNCTION:		
FACTOR	ALTERNATIVES			
	Alternative G		Alternative H	
	<ul style="list-style-type: none"> Follows Former Route 		<ul style="list-style-type: none"> Trail Entirely on East Side of Park City Road 	
FACTOR 4 EDUCATION & VISITOR SERVICES				
Attributes	<ul style="list-style-type: none"> Follows alignment of RR Berm although not visible Passes Sloan's Pond Closer to highway 		<ul style="list-style-type: none"> Alignment away from RR Berm except at Chaumont Some prairie remnants Away from highway, more in woods 	
Advantages	<p>Follows RR Berm to greater extent. Better connection to story</p>	60	<p>Less use of RR Berm</p>	0
FACTOR 5 – ACCESS & CIRCULATION				
Attributes	<ul style="list-style-type: none"> Wayfinding, more difficult with more road crossings Connects directly to parking at Chaumont On wrong side of road to connect to Entrance Sign Parking Area 		<ul style="list-style-type: none"> Wayfinding, easier with fewer road crossings Connects directly to parking at Chaumont Could connect to Entrance Sign Parking 	
Advantages	<p>More road crossings & more confusing</p>	0	<p>Fewer road crossings & less confusing</p>	80
FACTOR 6 – MAINTENANCE & OPERATIONS				
Attributes	<ul style="list-style-type: none"> More access points because of more road crossings Minimum number of structures to maintain 		<ul style="list-style-type: none"> Fewer access points Minimum number of structures to maintain 	
Advantages	<p>Easier Access</p>	85	<p>Fewer Access Points</p>	0

D. Preferred Alternative Selection

The preferred location for the bikeway, as determined using the CBA methodology, was the former railroad berm and track bed at all possible locations. By using the railroad bed, the bikeway will adhere to the goal deemed most important: resource protection.

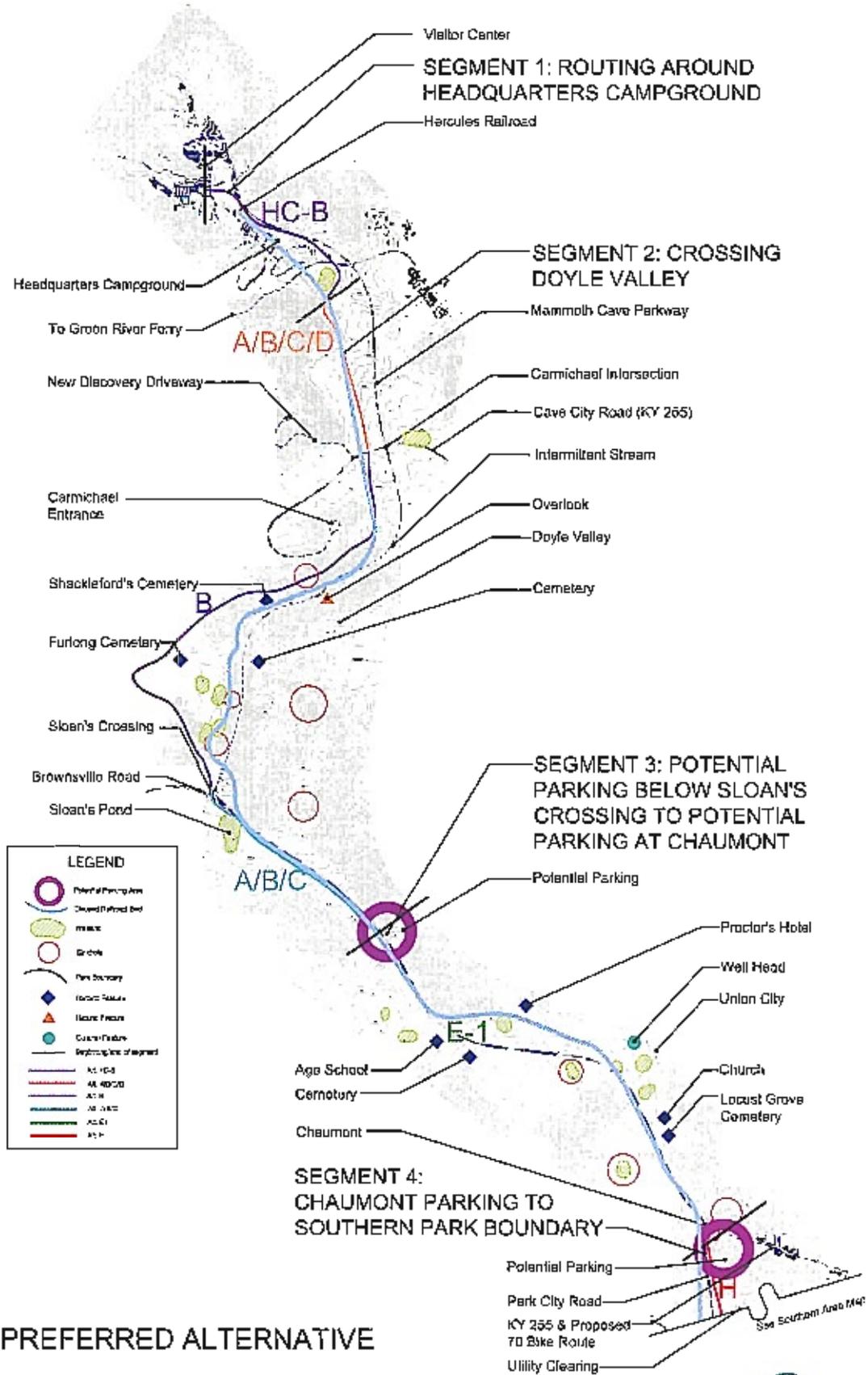
The preferred alternative is composed of the following alternative routes:

- Alternative HC-B;
- Alternative A/B/C/D;
- Alternative C;
- Alternative A/B/C;
- Alternative E-1;
- Alternative H.

The preferred alternative is graphically depicted on the following pages. Following the preferred alternative maps are two maps showing the locations of kiosks and waysides throughout the bikeway. These features were developed to provide bikeway users and other visitors with information about the park and its natural, cultural and historic features. Detailed information regarding the assumptions and costs to develop kiosks, in-ground and wall-mounted wayside signs are provided in Appendix B of this document.

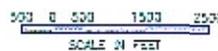
Cross section drawings of the various conditions that the planning team expects to encounter on the ground are included in Appendix C of this document.

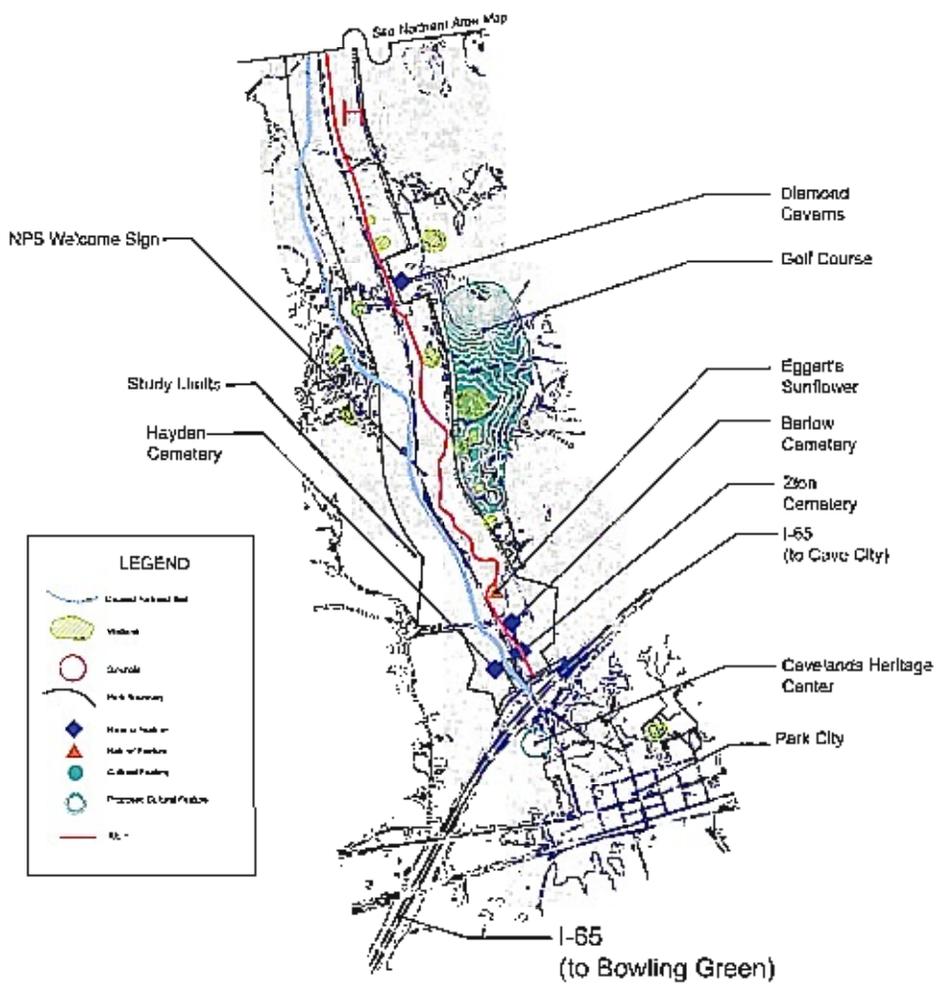




PREFERRED ALTERNATIVE

Northern Area
Mammoth Cave National Park
Bikeway Plan

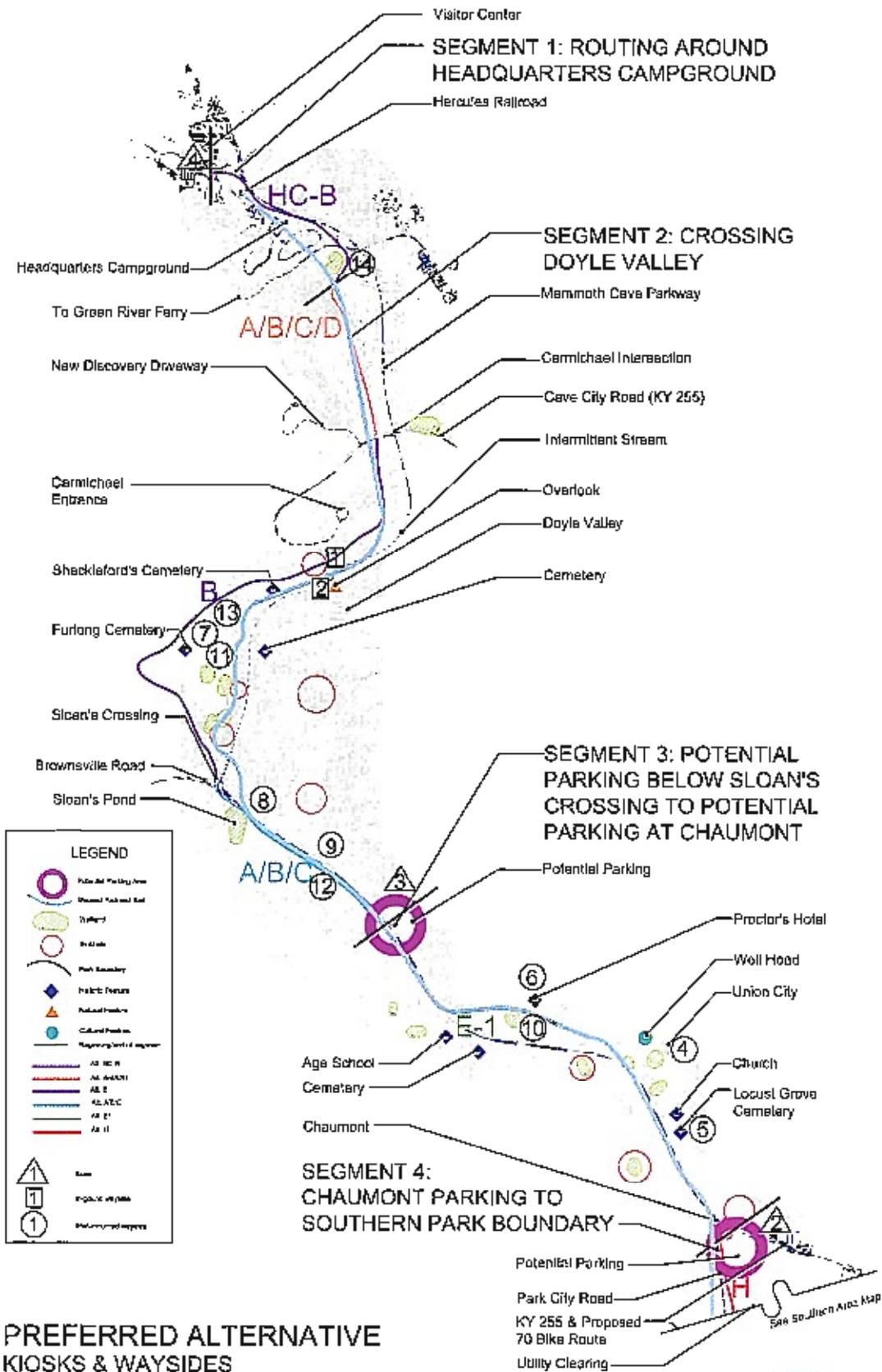




PREFERRED ALTERNATIVE

Southern Area
Mammoth Cave National Park
Bikeway Plan





PREFERRED ALTERNATIVE KIOSKS & WAYSIDES

Northern Area
 Mammoth Cave National Park
 Bikeway Plan



V. Cost Estimates

A level "C" cost estimate is provided on the following pages; prices include materials only. All assumptions incorporated into the cost estimate and formulas used to calculate acre, square yard, cubic yard, square feet, and linear feet measurements are provided on page 37.

Segment 1: Routing around Headquarters Campground				
ALTERNATIVE HC-B: EAST OF CAMPGROUND (4,000 lf)				
<i>Assume 0% of trail on railroad berm</i>				
Item	No.	Unit	Price	Cost
Site preparation	1.6	ac	9500	\$15,200
Excavation	1310	cy	15	\$19,650
Fill	655	cy	15	\$9,825
Culverts	88	lf	50	\$4,400
Geotextile fabric	5870	sy	3	\$17,610
Stone	655	cy	20	\$13,100
Seeding	36	msf	50	\$1,800
Structures		lf	200	\$0
Signage	1	ls	10000	\$10,000
Wayside displays	1	ea	4000	\$4,000
Kiosk	1	ea	10000	\$10,000
Bike racks	5	ea	2000	\$10,000
Benches	5	ea	1000	\$5,000
Lighting	1	ls	15000	\$15,000
			<i>Subtotal</i>	\$135,585



Segment 2: Crossing Doyle Valley

ALTERNATIVE A/B/C/D (3,150 lf)

Assume 22% of trail on railroad berm

Item	No.	Unit	Price	Cost
Site preparation	1.3	ac	9500	\$12,350
Excavation	1030	cy	15	\$15,450
Fill	515	cy	15	\$7,725
Culverts	66	lf	50	\$3,300
Geotextile fabric	4620	sy	3	\$13,860
Stone	515	cy	20	\$10,300
Seeding	28	msf	50	\$1,400
Structures		lf	200	\$0
Signage	1	ls	5000	\$5,000
Wayside displays		ea	4000	\$0
Kiosk		ea	10000	\$0
Bike racks		ea	2000	\$0
Benches		ea	1000	\$0
Lighting		ls	15000	\$0
			<i>Subtotal</i>	\$69,385



Segment 2: Crossing Doyle Valley (continued)				
ALTERNATIVE B: (10,300 lf)				
<i>Assume 20% of trail on railroad berm</i>				
Item	No.	Unit	Price	Cost
Site preparation	4.2	ac	9500	\$39,900
Excavation	3,360	cy	15	\$50,400
Fill	1,680	cy	15	\$25,200
Culverts	200	lf	50	\$10,000
Geotextile fabric	15,110	sy	3	\$45,330
Stone	1,880	cy	20	\$33,600
Seeding	91	msf	50	\$4,550
Structures	400	lf	200	\$80,000
Signage	1	ls	5000	\$5,000
Wayside displays	5	ea	4000	\$20,000
Kiosk		ea	10000	\$0
Bike racks		ea	2000	\$0
Benches		ea	1000	\$0
Lighting		ls	15000	\$0
			<i>Subtotal</i>	\$313,980



Segment 2: Crossing Doyle Valley (continued)

ALTERNATIVE A/B/C (4,400 lf)

Assume 77% of trail on railroad berm

Item	No.	Unit	Price	Cost
Site preparation	1.8	ac	9500	\$17,100
Excavation	1440	cy	15	\$21,600
Fill	720	cy	15	\$10,800
Culverts	88	lf	50	\$4,400
Geotextile fabric	8480	sy	3	\$19,380
Stone	720	cy	20	\$14,400
Seeding	39	msf	50	\$1,950
Structures		lf	200	\$0
Signage	1	ls	5000	\$5,000
Wayside displays	3	ea	4000	\$12,000
Kiosk	1	ea	10000	\$10,000
Bike racks	3	ea	2000	\$6,000
Benches	5	ea	1000	\$5,000
Lighting	1	ls	15000	\$15,000
			<i>Subtotal</i>	\$125,530



Segment 3: Potential parking below Sloan's Crossing to potential parking at Chaumont

ALTERNATIVE E-1 (9,000 lf)

Assumes 98% of trail on railroad berm

Item	No.	Unit	Price	Cost
Site preparation	3.6	ac	9500	\$34,200
Excavation	3000	cy	15	\$45,000
Fill	1500	cy	15	\$22,500
Culverts	198	lf	50	\$9,900
Geotextile fabric	13,200	sy	3	\$39,600
Stone	1500	cy	20	\$30,000
Seeding	80	msaf	50	\$4,000
Structures		lf	200	\$0
Signage	1	ls	5000	\$5,000
Wayside displays	4	ea	4000	\$16,000
Kiosk	2	ea	10000	\$20,000
Bike racks	4	ea	2000	\$8,000
Benches	6	ea	1000	\$6,000
Lighting	2	ls	15000	\$30,000
			<i>Subtotal</i>	\$270,200



Segment 4: Chaumont Parking to Southern Park Boundary**ALTERNATIVE H (13,000 lf)***Assume 0% of trail on railroad berm*

Item	No.	Unit	Price	Cost
Site preparation	5.3	ac	9500	\$50,350
Excavation	4240	cy	15	\$63,600
Fill	2120	cy	15	\$31,800
Culverts	264	lf	50	\$13,200
Geotextile fabric	19,100	sy	3	\$57,300
Stone	2120	cy	20	\$42,400
Seeding	114	msf	50	\$5,700
Structures		lf	200	\$0
Signage	1	ls	5000	\$5,000
Wayside displays	3	ea	4000	\$12,000
Kiosk	1	ea	10000	\$10,000
Bike racks	2	ea	2000	\$4,000
Benches	3	ea	1000	\$3,000
Lighting	1	ls	15000	\$15,000
			<i>Subtotal</i>	\$313,350



SUMMARY SHEET			
Item	No.	Unit	Cost
SEGMENT 1:			
Alternative HC-B	4,000	lf	\$135,585
Total Length, Segment 1:	4,000	lf	
SEGMENT 2:			
Alternative A/B/C/D	3,150	lf	\$69,365
Alternative B	10,300	lf	\$313,960
Alternative A/B/C	4,400	lf	\$125,530
Total Length, Segment 2:	17,850	lf	
SEGMENT 3:			
Alternative E-1	9,000	lf	\$270,200
Total Length, Segment 3:	9,000	lf	
SEGMENT 4:			
Alternative H	13,000	lf	\$313,350
Total Length, Segment 4:	13,000	lf	
Total Length, All Alternatives:	43,850	lf	\$1,228,030
		10% Contingency:	\$122,803
		Grand Total:	\$1,350,833

ITEM	ASSUMPTIONS	FORMULA
Site preparation:	Assume 15-foot wide cleared area & 3-foot bike trail.	$\frac{\text{Trail length} \times 18\text{ft.}}{43,560\text{ft.}} = \text{acres}$
Excavation:		$\frac{\text{Trail length} \times 1\text{ft.} \times 8\text{ft.}}{27} = \text{cubic yards}$
Fill:		Excavation - Stone = Fill
Culverts:	Assume 5 culverts per mile; 1 mile divided by 5 = 1 culvert per 1056lf. Assume 20lf per culvert.	$\frac{\text{Trail length}}{1056\text{lf}} = \text{no. culverts} \times 20\text{lf} = \text{length of culverts}$
Geotextile fabric:	Assume 8ft. trail + 1ft. both sides of trail + 1ft wrap	$\frac{12\text{ft.} \times \text{Trail length}}{9} = \text{square yards}$
Stone:		$\frac{\text{Trail length} \times 8\text{ft.} \times 0.5\text{ft.}}{27} = \text{cubic yards}$
Seeding:	Assume 4lf. Either side of trail	$\frac{\text{Trail length} \times 8\text{ft.}}{1000} = \text{mf}$



VI. Appendices

Appendix A:

NPS Priority Setting Process: Choosing By Advantage (CBA)

In determining its line-item construction program, NPS uses a selection and ranking process that is based on the relative advantages and costs of the each project in accomplishing Servicewide goals and objectives. This process is called Choosing By Advantage (CBA). In using the CBA process, the National Park Service asks itself "what and how large are the advantages of each project" proposed for consideration, "how important are the advantages of the projects", and finally "Are those advantages worth their associated cost".

The CBA priority setting process begins with the identification of a problem or a need in a park, which becomes a request for a line-item construction project. Projects are identified by park superintendents, reviewed by the regions, and submitted for review by a NPS assessment team. Projects then compete against each other in the CBA process that evaluates all the projects relative to the following factors, which reflect the NPS mission:

PROTECTING CULTURAL AND NATURAL RESOURCES

- Prevent loss of resources
- Maintain and Improve the conditions of resources

PROVIDE FOR VISITOR ENJOYMENT

- Provide Visitor Services and Educational and Recreational Opportunities
- Protect Public Health, Safety and Welfare



IMPROVE EFFICIENCY OF PARK OPERATIONS

- Improve Operational Efficiency and Sustainability
- Protect Employee Health, Safety and Welfare

PROVIDE COST-EFFECTIVE ENVIRONMENTALLY RESPONSIBLE, AND OTHERWISE BENEFICIAL DEVELOPMENT FOR THE NPS

- Other Advantages

CBA does not "weight" factors in advance, so that some factors are automatically more important than others. Rather, CBA focuses on the differences between alternatives, and determines how important are those advantages. The process establishes a single scale that compares the importance or benefits of all the submitted line item projects to the National Park System. The results reflect total benefits to the NPS, of the submitted projects, toward achieving the NPS mission. Cost is then introduced to the priority setting process, establishing an importance to cost ratio. The resulting priorities represent those projects that provide the greatest benefit to the NPS for each dollar spent.

If a policy decision is reached to emphasize and fund projects that have higher importance in a particular category (such as health and safety), policy decision-makers are aware of the consequences of projects that do not then receive funding. For example, a project that scores high on health and safety might not score as highly in other areas, such as resource protection. But a resource protection project might receive strong points in preventing loss and improving condition, as well as safety and operational efficiency, resulting in a higher total score than a project that is primarily health and safety in nature.

Prepared by: Sue Masica 2/24/99



Appendix B:

Outline of Exhibits for the Mammoth Cave Bikeway

TYPE 1: INFORMATION KIOSKS AT PARKING AREAS

ASSUMPTION:

Three sided 36" x 48" panels with roof: one side with map of bike trail; one side with safety information on use of the trail; one side bulletin board case.

COST ESTIMATE:

- Design of 2 panels @ \$1,000 ea. = \$2,000
- 36"x 48" fiberglass embedded panels 6 @ \$3,200 ea. = \$25,600
- Triangular kiosk bases with 1 bulletin board case, 2 panels and roof structure
- 4 @ \$1,800 = \$5,400
- LS cost for 4 = \$33,000

Cost per each = \$8,250

Appears on map as:

1 (in triangle) Park City Terminus

2 (in triangle) Chaumont Parking/Trailhead

3 (in triangle) Potential Parking below Sloan's Crossing

4 (in triangle) Mammoth Cave Hotel Parking



TYPE 2: WAYSIDES

ASSUMPTIONS:

- Unless specified otherwise, the following wayside will be fiberglass embedded 24" x 36" panels with a standard in-ground low profile base.
- The cost of shipping is included, but installation is not included.
- The cost for wall-mounted panels is somewhat less than inground installed waysides (\$3,480 v. \$3,690).

COST ESTIMATE:

Panel design = \$1,000

Panel fabrication = \$2,200

Base \$490

Cost per each = \$3,690

THEME 1: RAILROAD AND HISTORY OF TOURISM

Appears on Map as:

1 (in circle) Park City, Glasgow Junction, as main railroad connection	\$3,690
2 (in circle) Zion Cemetery	\$3,690
3 (in circle) Diamond Cavern	\$3,690
4 (in circle) Union City	\$3,690
5 (in circle) Locust Grove Cemetery	\$3,690
6 (in circle) Proctor Cave and Hotel	\$3,690
7 (in circle) Furlong Cemetery	\$3,690
1 (in square) Doyle Valley Trestle (wall mount)	\$3,480
<i>Not noted on drawing</i> Steam Engine exhibit 2 exist	\$0



THEME 2: GEOLOGY

Appears on Map as:

8 (in circle) The Dripping Springs Escarpment	\$3,690
9 (in circle) Epikarst?(Depending upon the trail alignment)	\$3,690
10 (in circle) Sinkhole between Chaumont and Sloan's	\$3,690
11 (in circle) Sinkhole by Furlong Cemetery	\$3,690
2 (in square) Karst Valley, Doyle Valley Overlook (wall mount)	\$3,480

THEME 3: FOREST

Appears on Map as:

12 (in circle) Second growth forests in old fields	\$3,690
13 (in circle) Older growth forests areas if available along trail	\$3,690

THEME 4: FOREST PERCHED UPLAND WETLANDS

Appears on Map as:

Not noted on drawing Two already exist at Sloan's Crossing Pond	\$0
14 (in circle) Campground Wetland area	\$3,690

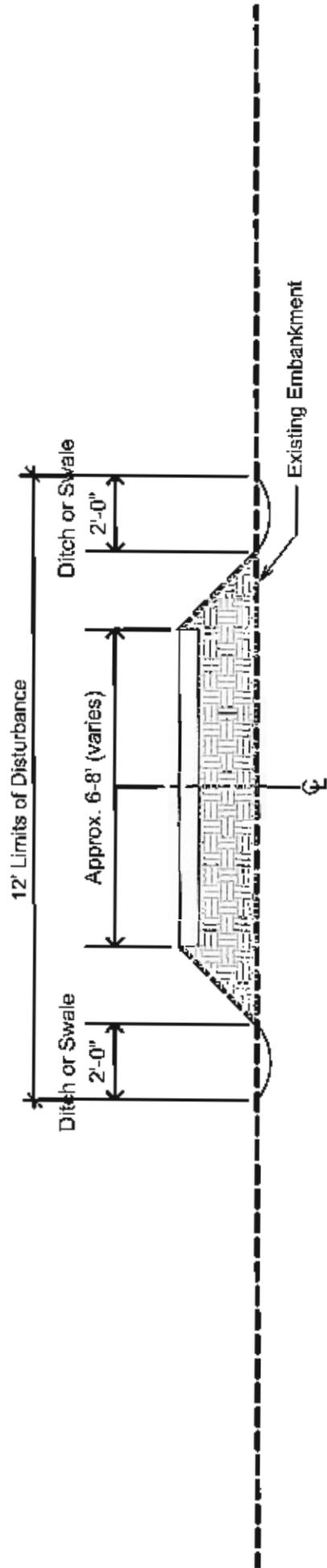


Appendix C:

Typical Cross Sections

The typical cross section drawings on the following pages represent four types of conditions that the planning team expects to encounter on the bikeway. Each drawing shows what the existing conditions are likely to be, and how the bikeway should be fitted into the landscape.

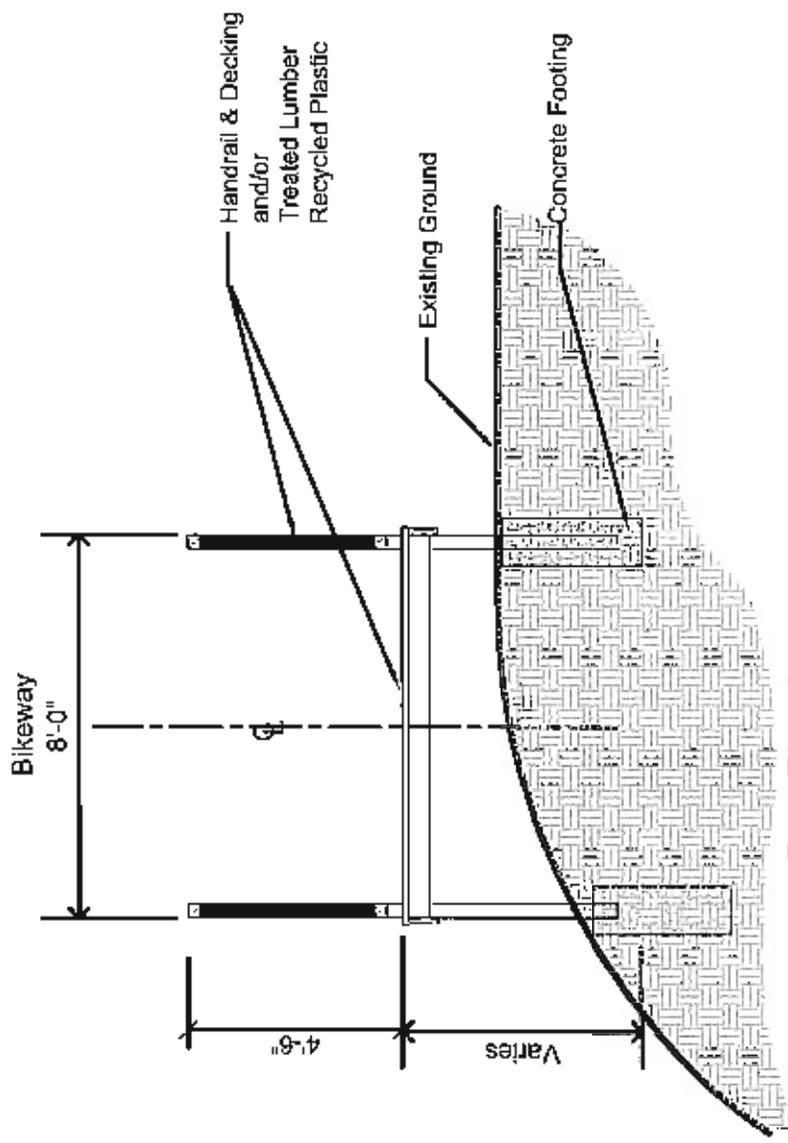




Existing Railbed with New Bikeway



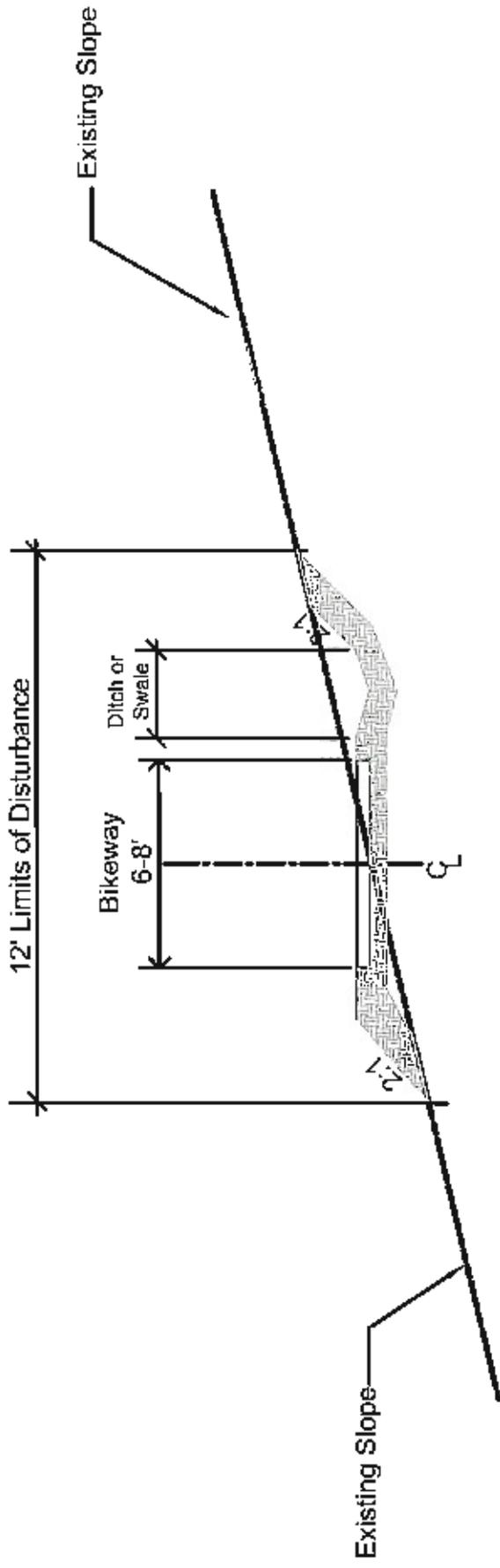
Mammoth Cave Bikeway



Front Elevation
Raised Crossing

Mammoth Cave Bikeway

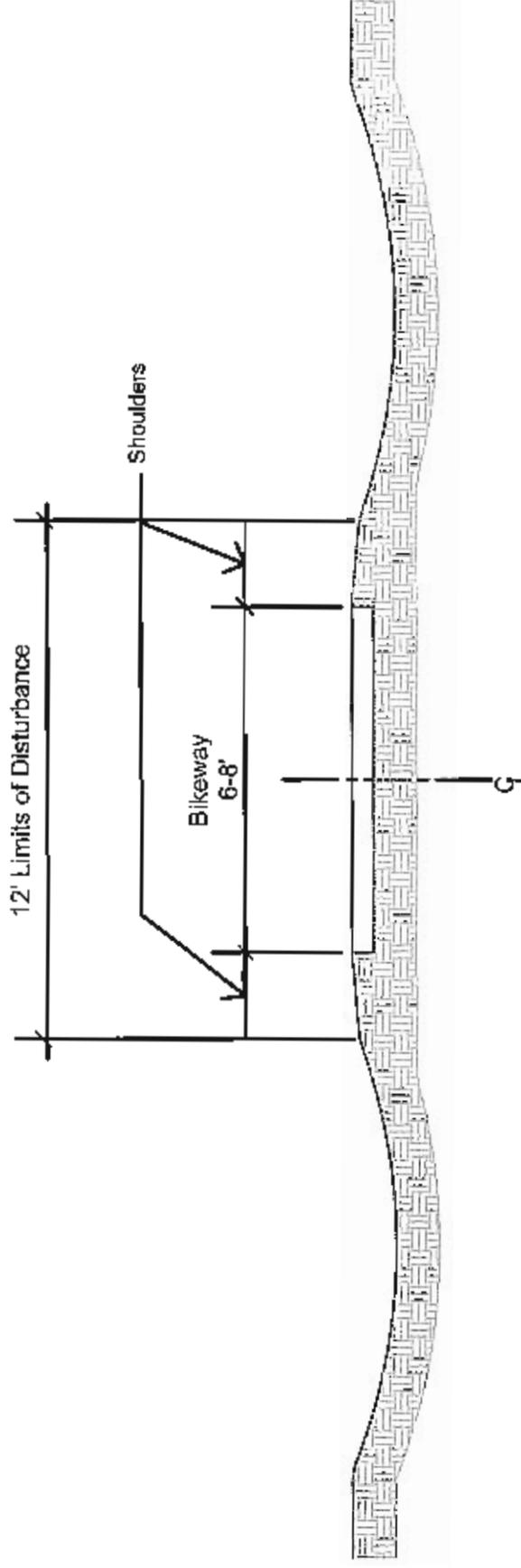




Cross Slope: Bikeway not on Railbed

Mammoth Cave Bikeway





Bikeway not on Railbed

Note: Not typical when slopes occur.



Mammoth Cave Bikeway