

existing utilities. NPS personnel expressed a willingness to relocate the utilities, possibly by directional boring under the river, but no alternate utility corridor was identified in this study. If a temporary bridge converted to a permanent pedestrian bridge or a phased girder bridge replacement is selected, the existing utilities could be moved to the new structure in lieu of boring under the river to reduce project costs.

## 3 Study Issues Identified

### 3.1 Project Limitations and Requirements

Based on conversations with various stakeholders before and during the design charrette the following project requirements and limitations were identified:

- Route 19 must remain open to traffic at all times in some fashion. It is the primary north / south route through this part of the state and the potential detour route around a closure is excessive and cannot be tolerated. This route serves several local industries including logging and tourism and connects a NPS ranger station to the remainder of the Ozark National Scenic Riverways.
- Any proposed design must meet the current EPG and AASHTO standards for highway design and safety features. Included in these standard requirements are vertical and horizontal curve limitations for site distance, roadway superelevation requirements and travel lane and shoulder width. Design exceptions are possible but should be considered sparingly and their acceptance is not guaranteed.
- Any proposed design must meet the current EPG and AASHTO standards for bridge design or rating requirements if a rehabilitation is considered. Design exceptions may be possible however most structural design is driven by safety requirements and design exceptions will likely not be granted.
- Carr's Store and Canoe Rental on the northwest corner of the Current River Bridge must not be disturbed and access must be maintained in some fashion. The location of this store limits the consideration of a temporary or permanent bridge offset to the west at the Current River.
- No impact is allowed to Round Spring which is east of Route 19 between the Current River and Spring Valley bridges. The location of the spring limits consideration of a temporary or permanent alignment that is offset to the east at Spring Valley.
- The Round Spring Cave, NPS ranger station and NPS residences are accessed by an NPS service road beneath the existing Spring Valley Bridge. Access to this area must be maintained. Limited road closures for demolition or construction activities could be tolerated but will require close coordination with NPS.
- The utilities carried on the existing pedestrian bridge must remain in service. If relocation of the utilities is needed, limited outages to make new connections could be tolerated.
- An allowance must be made for river traffic on the Current River to traverse the project site during the majority of construction. Limited closure of the river may be

possible but will require close coordination with NPS including advanced notification to river outfitters and the general public.

- The entrance to the NPS river access point on the north bank of the Current River must remain open. Similarly, the entrance to the NPS campgrounds and river access points south of the Current River must also remain open.
- Traffic must be maintained at the county road intersection with Route 19 south of the Current River Bridge.

## 3.2 Constructability Concerns

The existing pedestrian bridge downstream of the bridge over the Current River may limit the construction envelope for an offset temporary or permanent bridge. A phased replacement option for the Current River Bridge is presented in Alternative 6 but may be difficult to construct with the pedestrian bridge in place. The pedestrian bridge carries several utilities that are buried beyond the bridge limits. Options to locate a temporary or permanent bridge downstream of the existing pedestrian bridge will require the roadway to cross the buried utilities on both sides of the river. The existing utility lines are likely not designed for the weight of vehicular traffic and are likely not buried deep enough to negate the effect of traffic. It may be possible to expose the existing utilities to sleeve them and reinforce the crossings, but this includes additional project risk and cost.

The horizontal curves used in the proposed alignments are generally flatter and the roadway cross slope varies to include the correct superelevation for the curve radius. In addition, traveled way widening for the curves approaching the bridges have been accounted for in the roadway design. These curve superelevation and widening transitions will extend onto the Current River Bridge and require a change of bridge configuration. Additionally, the new roadway will require stable side slopes that may extend beyond the existing right-of-way. To limit the impact of these side slopes, retaining walls or reinforced steepened slopes will be needed south of Spring Valley to avoid impacting the NPS buildings and rock benching will likely be needed north of the Current River to avoid impacting the NPS water storage tank. Depending on the alternative selected, excavation on the east side of the highway north of the Current River, especially rock benching, has the possibility to impact the buried utilities crossing this area.

Both bridge sites have relatively shallow bedrock, but the bedrock is not at the surface and will require cofferdams if spread footings are constructed. Shallow cofferdams for excavations that extend to rock will be difficult to construct and will likely require drilling of structural steel piles to support the cofferdam walls. Installation of the cofferdams will increase the area of impact on the streambed. At the bridge over Spring Valley, the stream has migrated to the north and is now adjacent to the existing arch thrust block. The current placement of the stream would make it difficult to replace the arch span in its current location and a shift to the north is presented in the alternatives considered.

Bridge construction, especially removal of the existing bridges, will have a temporary adverse impact on the use of the park and will require coordination with NPS. Construction activities at the Current River site could affect boaters on the river and special removal methods such as bracing the arch span over the main channel may be needed to limit the impact. The existing fill inside the Current River Bridge will also require special removal

to avoid depositing the material directly into the river. Similarly, construction and demolition activities for the Spring Valley Bridge over the NPS service road will require coordination and may require special methods to limit the impact to access under the bridge.

### 3.3 Hydraulic Uncertainties

Hydrologic and hydraulic modeling was not included in the scope of work for either bridge site. The Design High Water elevations noted on the as-built plans were considered valid for the purposes of this study. The proposed bridge openings were set to match or exceed the existing openings to maintain similar hydraulic performance. The flow velocity through each bridge opening is unknown and therefore the expected local and contraction scour is unknown. The proposed permanent bridge configurations use drilled shafts socketed into rock or mass footings on rock similar to the existing bridges which would withstand most scour conditions. The stream though Spring Valley has migrated to the north since the construction of the existing bridge causing a shift in the channel for the ordinary high water. The current stream location is adjacent to the existing arch footing and thrust block.

### 3.4 Subsurface Concerns

This region of the state is known to have karstic bed rock conditions. The Round Spring Cave entrance is west of the existing Spring Valley Bridge and the extents of the cave are not known at the time of this study. NPS personnel may have a shape file of the cave limits available for review during following portions of the project. The extents of the known cave may limit the use of driven piles or drilled shafts and should be considered during project approach selection.

### 3.5 Cultural and Environmental Considerations

A known archeological site has been identified near Carr's Store and additional archeological sites may be in the area. The known archeological site should not be disturbed. The bridges in this study along with the bridge over Sinking Creek make up the Three Bridges Historic District and the bridge over the Current River is eligible for the National Register of Historic Places and the bridge over Spring Valley is possibly eligible for the register. This designation will need to be considered during the evaluation of the rehabilitation options considered.

Construction of temporary and permanent bridges or rehabilitations will disturb the bridge surroundings. The streambed is considered environmentally sensitive and disturbance of large rocks will be detrimental to sensitive aquatic life. Six protected species have been identified in Shannon County including Gray Bat, Indiana Bat, Northern Long-eared Bat, Red-cockaded Woodpecker, Ozark Hellbender and Virginia Sneezeweed. The area around the project site is known to contain critical habitat for the Indiana Bat and may contain critical habitat for other species. Additional work by the US Fish and Wildlife Service may be requested as the project progresses. The impacts of multiple bridges in the channel should be avoided if possible and the reduction of bridge foundations within the ordinary stream banks should be considered. The selected alternative should minimize impacts to the adjacent river bluffs and streambed.

The use of the Current River for boating and fishing is a legitimate use of the river and construction activities that restrict river access should be avoided. Navigation along the river should be maintained to the maximum extent possible. The selected project should avoid the acquisition of park land for highway right-of-way if possible.

## 3.6 Aesthetic Considerations

The existing arch profile of the bridge over the Current River can be viewed from the north approach roadway as the road descends and curves onto the bridge presenting a dramatic view of the existing structure. The elevation of the arched bridge can be viewed by boaters on the river as well as from Carr's Store and adjacent river access area. The existing bridge is a filled arch and therefore has a heavy, massive appearance. In addition to the general aesthetic of the filled arched bridge, the Current River Bridge contains some specific architectural elements including a geometric relief on the upstream and downstream face of each pilaster between the arches, an open spindle bridge rail with heavy posts and a curving approach barrier at the bridge ends.

The existing open spandrel arch bridge over Spring Valley can be viewed from the NPS service road leading to the ranger station and Round Spring Cave. The bridge can also be viewed from the parking lot and trail to Round Spring. The existing bridge presents a slender open arch and the offset arch placement due to the 45 degree skew adds visual complexity to the elevation view of the bridge. The spans approaching the arch have a curved bottom flange adding visual interest as the bridge crosses the NPS service road. Additional architectural elements include small decorative features at the tops of both thrust blocks and an open spindle rail with heavy posts.

## 4 Conceptual Alternatives Studied

The general description of the alternatives considered are presented below. Descriptions of specific sub-alternatives are also included. Descriptions of the alignments and profiles as well as the bridge types and configurations considered are included in the following sections. Details of the alignments, profiles and bridge configurations can be seen in Appendix A. Prior to the design charrette, Alternatives 3 and 4 were subdivided to include a possible retrofit of the existing highway bridge for reuse as a pedestrian crossing. These options would only be possible if the NPS was willing to take ownership of the bridge after construction. During the design charrette it was made clear that the NPS was not willing to take ownership of the existing bridge and further consideration of these options was halted and those options are not included in the final study report.

Alternatives 1 and 2 at the Current River that stay on alignment can use either a two lane or a single lane temporary bridge. The alternatives with a two lane temporary bridge are designated with an "A" suffix while the single lane alternatives use a "B" suffix. Additionally, the two lane temporary bridge can be placed on two different alignments show in the details as Option 1 which removes the existing pedestrian bridge and Option 2 located downstream of the pedestrian bridge. Similarly, the offset alignment Alternatives 3 & 4 can be placed on two different alignments and Option 1 removes the existing pedestrian bridge while Option 2 is located downstream of the pedestrian bridge. The Current River Bridge rehabilitation shown in Alternative 5 considers only a two lane temporary bridge,