Flathead County
March 2024

Bridge Street Bridge Closure

Alternative Analysis for Interim Pedestrian Crossing Solutions

BACKGROUND

The Bridge Street Bridge crossing the Swan River in Bigfork, Montana was closed on Wednesday, January 31, 2024 due to structural concerns. The bridge was originally constructed in 1911 and served as a connection from downtown Bigfork to Montana Highways 209 and 35. The structure is owned and maintained by Flathead County. Flathead County applied for funding and project administration services to replace the aging bridge through the Montana Department of Transportation's off system bridge program. The County's application was successful and MDT is currently continuing with design development for the replacement bridge.

The new structure will be a steel through truss, similar to the existing bridge. The proposed superstructure type was selected based on community feedback that emphasized the importance of maintaining a similar aesthetic for the new structure. The new truss bridge is being designed as a one lane structure and will accommodate modern vehicular live loads. The new bridge will also include a sidewalk to facilitate pedestrian traffic. The replacement bridge is currently planned for construction in 2026; however, MDT continues to explore opportunities to expedite the project delivery schedule.

In response to the bridge closure, the community of Bigfork has expressed interest in implementing an interim solution to facilitate a pedestrian crossing at Swan River, until the new vehicular bridge can be constructed through the MDT project. Discussions with community members and business owners has indicated that a pedestrian access would help accommodate the seasonal traffic, local residents' daily commutes, commerce, and numerous social events in the Bigfork area, partially mitigating the impacts of the bridge closure.

This document summarizes Flathead County's findings on various alternatives that were evaluated for an interim pedestrian access at the Bridge Street crossing.

PROJECT CONSIDERATIONS

Included below is a summary of major challenges that influence the feasibility of implementing an interim pedestrian crossing at the subject location:

- **LIMITED STRUCTURAL CAPACITY** - Prior to closure, the existing bridge was posted at 3 tons, meaning that the largest vehicle able to use the bridge was a half-ton truck (e.g. Ford F150). The bridge has limited structural capacity and an advanced level of deterioration, which limits the opportunity to modify the existing bridge for pedestrian access, or use that structure as a work platform to construct a new pedestrian bridge. Since the bridge closure, MDT contracted with an engineering firm to complete a qualitative load rating review, which determined that numerous existing members have a zero-capacity rating based on the current bridge condition.

- **SITE CONSTRAINTS** - The crossing location has numerous on-site utilities that greatly impact the construction operations that are feasible at this site. Some of the key utilities include: overhead power and communications lines that are immediately adjacent to the existing bridge (see Figure 1), and a gas line that is suspended from the existing truss. These utilities will be relocated prior to constructing the new replacement bridge. While utility coordination is currently in progress, the relocation timeline is unknown. Until these utilities are moved outside the anticipated construction limits, the existing truss cannot be removed, and cranes and other large equipment cannot be used on-site due to safety requirements. (OSHA has established construction requirements for working adjacent to both gas and power.) The following Figure 1 illustrates the numerous overhead lines within the vicinity of the existing bridge.

  Beyond utilities, the Bridge Street crossing has further site limitations. With buildings and retaining wall structures located immediately north (lake side) of the existing bridge, there is no room to construct a parallel structure on that side of the existing truss. The most feasible location to construct a second bridge is immediately south / upstream of the existing truss, as shown in Figure 1 in red. Any new structure is assumed to be a single span +120-foot long bridge to reduce impacts to the underlying waterway and minimize preconstruction permitting.

  Crossing locations farther up river, closer to the power plant and away from the current crossing, would reduce concerns associated with the overhead lines that are situated so close to the existing bridge. However, an up-river crossing would increase the overall bridge length and require additional path construction to make the new bridge accessible. An upstream crossing is expected to increase project costs and require additional right-of-way easements to be secured during the preconstruction phase; and therefore, has not been further considered in this analysis.

  Some superstructure types considered in this alternative analysis could potentially be installed within the opening of the existing truss; however, given that the existing bridge is a single lane through truss with a limited opening space and structural capacity, this construction approach is very challenging to accommodate.

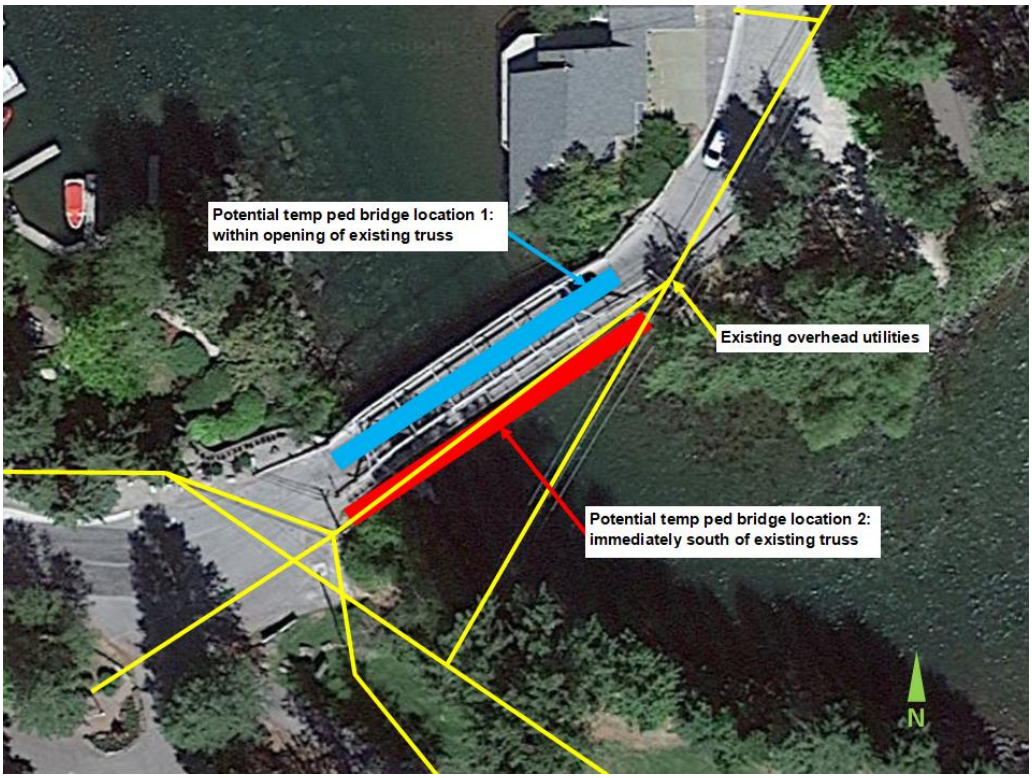


FIGURE 1: Overhead lines in proximity to the existing structure shown in yellow, potential ped bridge locations shown in blue and red.

- **PROJECT DELIVERY TIMELINE** - Implementation of an interim pedestrian crossing at Bridge Street is a significant project, regardless of form. As a public entity, Flathead County is obligated (per MCA 18-2-122) to utilize a professional engineer to develop project plans and specifications because any type of crossing facility has direct bearing on public health and safety. Procurement of professional services and design development time alone, could consume a significant duration of the timeframe that an interim solution would be in use.

  Additionally, construction of a new pedestrian structure is likely to require several preconstruction approvals from various resource agencies, which could further impact the project delivery timeline. While numerous permits would likely be required, the summary below highlights a couple of known approvals that would be required and have a significant acquisition time associated with them.
  - DNRC Navigable Waters Land Use Permit / Easement (Section 10 Permit) – 60 to 90-day review and approval time
  - Floodplain Development Permit – 60-day review and approval time, review begins once all other permits are received

  The construction industry as a whole continues to experience significant lead times for many materials, including steel and prestressed concrete elements, which are the most commonly used bridge building components. Depending on the selected bridge type, material procurement could also significantly impact the implementation timeline.

- **FUNDING** - Based on this investigation into potential alternatives, a temporary pedestrian crossing is expected to cost between $400,000 and $800,000. MDT assessed multiple opportunities to partner with the County on the interim solution effort. For example, funding allocated through Senate Bill 536 was considered for a temporary pedestrian crossing in Bigfork. However, independent of project funding considerations, the alternatives evaluated are unlikely to achieve implementation due to other project constraints.

ALTERNATIVE ANALYSIS DETAILS

1 – BAILEY/ACROW BRIDGE

DESCRIPTION:

Temporary Prefabricated Modular Truss Superstructure

This type of bridge comes in a "kit" form and is often utilized in emergencies, or for temporary access during construction. These superstructure systems can be rented or purchased from suppliers such as Bailey Bridges or Acrow. These structures are relatively lightweight and can be installed in about a week.

ESTIMATED COST:

$450,000 for 18-month bridge rental

CONSTRUCTABILITY CONSIDERATIONS:

- A Bailey or Acrow bridge could potentially be installed within the opening of the existing vehicular truss, reducing overall site impacts and limiting the need for some permits. The temporary bridge could be launched through the existing truss in one of three ways: using a crane to assist in supporting the structure as it is pushed across the existing bridge, by using a large excavator with a temporary launch nose attached to the new bridge to aid in installation, or by using the existing bridge as a work platform. All of the noted construction methods would be greatly challenged, given the site constraints and attributes of the existing bridge.
  - Acrow Bridge was contacted for information on their currently available bridge systems. Based on the rough dimensions of the temporary bridges available, it is unlikely that the opening of the existing truss is large enough to accommodate installation of the temporary bridge as an overlay structure.

PROS:

- This alternative is fairly cost effective compared to other options.
- This alternative could be implemented relatively quickly compared to other options.

CONS:

- Approach work would be required to make the structure ADA accessible.
- The relocation of overhead utility lines would likely still be required.
- With the largest width of all the bridge options considered, installing this structure type next to the existing truss would have increased site impacts.

2 – SUSPENSION BRIDGE

DESCRIPTION:

Suspension Superstructure

Suspension bridges are lightweight structures that rely on cables as the primary load carrying members. The structure pictured is the Kootenai Falls swinging bridge.

ESTIMATED COST: **$600,000**

CONSTRUCTABILITY CONSIDERATIONS:

- A pedestrian suspension bridge could potentially be constructed immediately upstream (power plant side) of the existing vehicular truss.
- There may be opportunity to construct a structure of this nature within the opening of the existing truss; however, additional design development would be needed to determine the feasibility of this construction approach.

PROS:

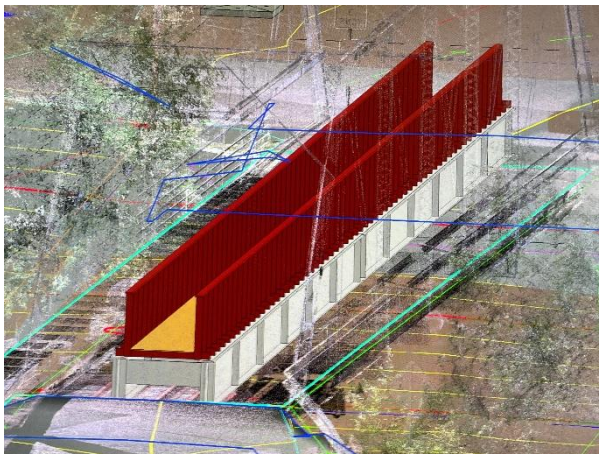
- This bridge alternative can be constructed with relatively small equipment and minimal materials, making it a good candidate for installation in remote or site-constrained locations.

CONS:

- Some types of pedestrian suspension bridges are not ADA compliant. The design could be modified to be ADA accessible; however, this would increase project costs over the estimated amount shown.
- If constructed immediately upstream of the existing bridge, overhead utility lines would likely have to be relocated prior to construction.

3 –STEEL GIRDER BRIDGE

DESCRIPTION: Contractor-Furnished Rolled Steel Girder Superstructure



MDT evaluated the feasibility of using contractor-furnished rolled steel girder members that are typically used for work bridges, to construct a temporary pedestrian bridge through the opening of the existing truss. The top photo shows these members in their typical application as a work bridge. The two images below are visualizations of the pedestrian concept at the Bigfork site.

ESTIMATED COST: **$400,000 for 18-month bridge rental**

CONSTRUCTABILITY CONSIDERATIONS:

- A Montana-based bridge contractor assisted MDT in development and review of this alternative. It was noted that the constrained work area, required span length, and inherent properties of the available bridge members present numerous constructability challenges to this alternative.

PROS:

- This bridge alternative could be implemented in a short duration, with minimal permitting, and would be relatively cost effective compared to other alternatives.

CONS:

- Based on preliminary analysis, the available bridge members may not be able to meet all the applicable design criteria. For example, deflection under pedestrian live load would likely be a concern. Further engineering analysis of this alternative would be needed to fully vet this option.
- The bridge members typically used in work bridge applications would require significant modifications for installation in this configuration, increasing project costs and delivery timeline.
- Approach work would be required to make the structure ADA accessible.

4 – PREFABRICATED STEEL TRUSS BRIDGE

DESCRIPTION: Prefabricated Steel Truss Superstructure

This superstructure type comes preassembled from the fabricator and can be installed in one day, once the site work and foundation are complete.

ESTIMATED COST: **$800,000**

CONSTRUCTABILITY CONSIDERATIONS:

- A pedestrian steel truss could potentially be constructed immediately upstream (power plant side) of the existing vehicular truss.
- This bridge superstructure would most likely be shipped to the site in two pieces. It would be lifted into place by either one or two cranes. Depending on the structure design, it may be feasible to erect a pedestrian truss within the opening of the existing truss.
    - A prefabricated modular steel I-girder bridge was also discussed with a local fabricator; however, that structure type is not thought to be cost effective for the span length being considered; therefore, a truss structure was the only alternative quoted. (See alternative #3 for more information on an I-girder option.)

PROS:

- This structure could be disassembled and reused in another application.

CONS:

- Overhead utility lines would likely have to be relocated prior to construction.
- These bridges are custom fabricated, which increases lead time.
    - The County was able to identify a surplus pedestrian steel truss structure at a local bridge fabricator that is consistent with the bridge dimensions and capacity that would be required for this crossing location. Utilizing this pre-assembled truss would reduce lead times and project costs; however, upon further investigation this single pre-assembled structure was determined to be infeasible based on the shipping and installation challenges associated with this long structure (~125-foot single piece bridge) in the constrained downtown area.

5 – TIMBER/GLULAM SUPERSTRUCTURE

DESCRIPTION:

Glulam Truss Superstructure

While glulam beams cannot efficiently span the channel without intermediate supports at the Bridge Street crossing, glulam members can be assembled in a truss configuration (pictured) that could span the required ~120-feet. A bowstring truss (top photo), is more cost effective for this span; however, it may be challenging to accommodate the vertical height of this structure. A pony truss (bottom photo) may fit the site better, but comes at an increased cost.

ESTIMATED COST:

$600,000 for bowstring truss

CONSTRUCTABILITY CONSIDERATIONS:

- A pedestrian glulam truss bridge could potentially be constructed immediately upstream (power plant side) of the existing steel truss.
- This bridge superstructure would most likely be shipped to the site in two pieces. It would be lifted into place by either one or two cranes. Given the structure height and equipment needed for install, it could not be erected within the opening of the existing truss.
  - A local timber company that manufactures glulam beams and cross laminated timber (CLT) panels was contacted regarding solutions for a crossing at Bridge Street and noted the following: they are not capable of producing glulam members that could span the required ~120-feet and very few fabricators in the US can produce members of that size. CLT panels may be an alternative considered for bridge decking; however, they are not typically well-suited for outdoor use.
  - A timber bridge company based in the Northwest was contacted regarding glulam bridge alternatives. They indicated that the most cost-effective glulam / timber structure to span the required ~120-feet would be a bowstring truss configuration, and noted that a glulam girder (solid wood beam) would not be an economical alternative for this location.

PROS:

- No perceived advantage.

CONS:

- Overhead utility lines would have to be relocated prior to construction.
- These bridges are custom fabricated, which increases lead time.
- Given the required span length for this site, timber alternatives become less efficient.

6 – PRESTRESSED CONCRETE GIRDER SUPERSTRUCTURE

DESCRIPTION:

Prefabricated Prestressed Concrete Girder Superstructure

Conventionally reinforced concrete sections (concrete with rebar reinforcing) are incapable of effectively spanning the channel at the Bridge Street crossing. However, prefabricated prestressed concrete girders (concrete members reinforced with tensioned high-strength steel tendons) similar to the photo shown, could be implemented to span the required ~120-feet.

ESTIMATED COST:

$600,000

CONSTRUCTABILITY CONSIDERATIONS:

- The substantial weight of prestressed concrete girder bridge members requires the use of large cranes to set the beams. Given the constrained site, it would be challenging to accommodate the large equipment needed to construct a bridge of this nature at this location.
- The prestressed concrete industry in Montana is currently experiencing unprecedented lead times for bridge girders.

PROS:

- No perceived advantages.

CONS:

- Due to the constructability considerations noted above, prestressed concrete is not considered a viable alternative for a temporary structure at this location.

7 – EXISTING STEEL TRUSS

DESCRIPTION:

Strengthen / Repair / Modify Existing Steel Truss

The existing steel truss has limited remaining ability to carry vehicular traffic; however, it may be possible to analyze, strengthen, repair, and modify the existing bridge for pedestrian-only loading.

ESTIMATED COST:

$200,000? – Unknown

CONSTRUCTABILITY CONSIDERATIONS:

- Analysis and modifications to the existing structure to accommodate pedestrian traffic has the potential to be completed with minimal permitting and while existing utilities remain in place.

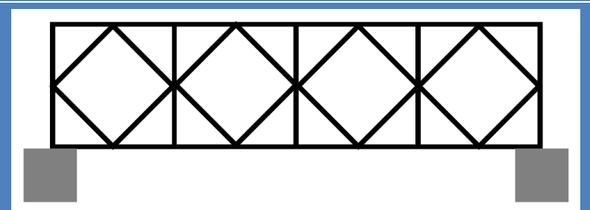
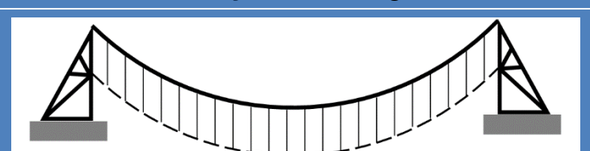
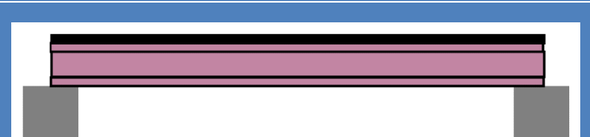
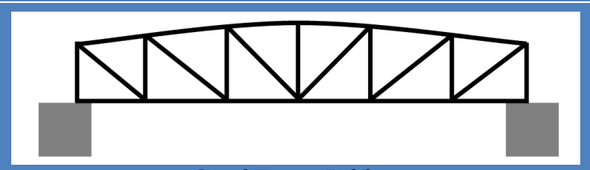
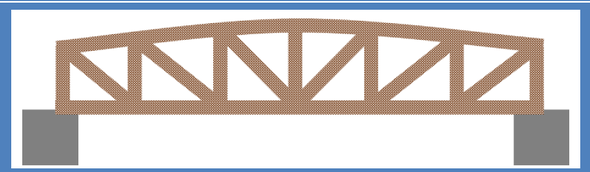
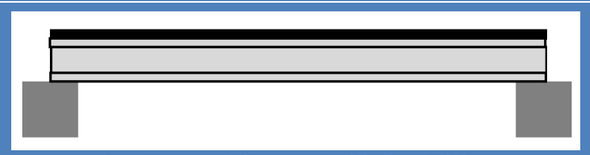
PROS:

- While there are still significant engineering and construction costs associated with this alternative, if feasible to implement, the construction cost of this concept could be relatively low compared to other alternatives.

CONS:

- Analysis may determine that it is not feasible to allow pedestrian traffic across the existing structure. Or, given the limited capacity of the existing bridge, analysis may determine that pedestrian access would have to be restricted, resulting in enforcement challenges to ensure that the structure is not over-loaded.
- Some inherent risks associated with the deteriorated condition of the existing bridge may not be fully mitigated through repairs, presenting a continued safety risk.
    - The County contacted two bridge consulting firms regarding engineering services to further pursue this alternative. Based on available inspection information, both companies declined work on the project and advised that the structure remain closed in the interest of public safety.

ALTERNATIVE ANALYSIS SUMMARY

ALTERNATIVE	PROS	CONS	CONSTRUCTABILITY	RELATIVE COST	FEASIBILITY
 **Bailey / Acrow Bridge**	• Rental option available • Rapid implementation timeline	• Challenging to construct with site constraints	~	$$	✗
 **Suspension Bridge**	• Can be constructed with minimal materials and equipment	• May not meet the needs of all users	~	$$$	✗
 **Steel Girder Bridge**	• More cost effective and improved constructability compared to other alternatives	• May not meet all design criteria	~	$$	✗
 **Steel Truss Bridge**	• Structure could be later reused in a different application	• Challenging to construct with site constraints	✗	$$$	✗
 **Glulam Truss Bridge**	• No perceived advantages	• Challenging to construct with site constraints	✗	$$$	✗
 **Prestressed Concrete Girder Bridge**	• No perceived advantages	• Current long lead times for fabrication of prestressed members • Challenging to construct with site constraints	✗	$$$	✗
 **Strengthen / Modify Existing Truss Bridge**	• Potentially most resource effective alternative • Improved constructability compared to other alternatives	• Determined to be not feasible due to advanced deterioration of primary members	✓	$	✗