



# Off-System Bridge Study and Implementation Plan

## INITIAL PHASE DELIVERABLES

### Summary of Work Completed

HDR is contracted with MDT to analyze the current state of off-system bridge needs and to develop a strategic plan for prioritizing projects and investments for the Off-System Bridge Program with the goals of improving condition, increasing mobility, and promoting economic development. The initial phase of the Off-System Bridge Study and Implementation Plan (project) was initiated in June 2022 with a focus on understanding issues, evaluating the current condition of off-system bridges, engage and inform counties and stakeholders, and identify potential quick fixes for bridges in poor condition.

The initial phase of the Off-System Bridge Study and Implementation plan has been completed and attached are documents that summarize the work performed to date. Below is brief description of each document produced.

### Off-System Bridge Scoring Tool Introduction

This document describes the evaluation tool the project team developed in partnership with MDT to prioritize bridges. All of the off-system bridges included in this study were assigned a numerical score based on the condition of the structure and how well it serves the intended purpose. With this information that is primarily quantitative based, the Off-System bridges were categorized as low, medium, and high priorities.

### Off-System Bridge Inventory Summary

This document summarizes key information for the off-system bridges in each county including how many of a county's bridges are currently considered low, medium, or high priority as determined by the scoring tool described above. The project team also coordinated individually with each county to identify specific bridges that are considered priorities to the county. To date, 124 bridges have been identified as key priorities for the counties and municipalities. In most cases, the bridges deemed as a priority to the county were also categorized as a high priority based on the scoring tool quantitative analysis. In other situations, some bridges were classified as priorities by the counties but did not score as a high priority using the scoring tool. This is due to some county priorities being driven by factors other than the physical condition of a bridge, such as size of structure. Determining bridge priorities is an on-going effort that will involve additional coordination with the counties to verify critical priorities, identification of key economic routes that could benefit by addressing deficient bridges, and evaluation of funding opportunities.



## **Off-System Bridge Replacement Cost Scenarios**

Several scenarios were prepared to help understand possible funding needs for addressing Off-System bridge infrastructure. The funding scenarios are not intended to be precise estimates as there are many factors that would need to be resolved to determine the actual bridge replacement costs. Rather, these are planning level numbers that help with managing the program funding opportunities.

## **Public Involvement Summaries**

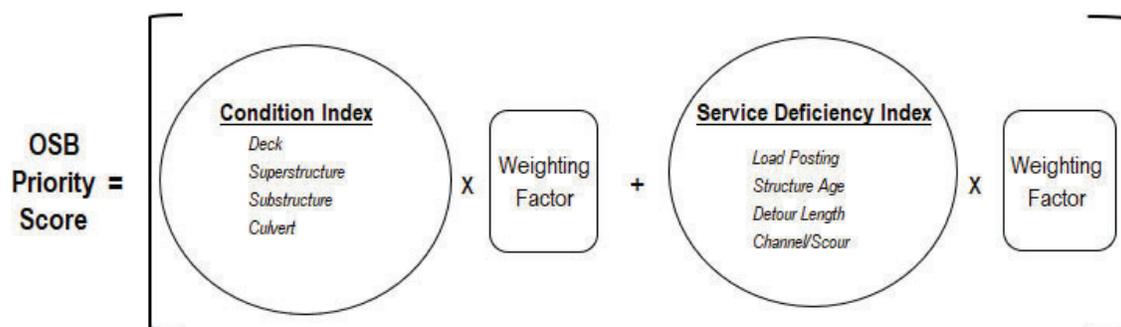
As this project has progressed, the project public involvement team has provided information to key stakeholders and the public. Additionally, they have captured comments and questions from the public and stakeholders to help inform the project team. A document is included that summarizes the general questions heard through the public outreach and the key messaging developed to help respond to various comments and topics of discussion.



# Off-System Bridge Scoring Tool

## EVALUATION TOOL

An evaluation tool was developed to index active, county and city/municipal owned off-system bridges. The tool combines a condition score and a service deficiency score to calculate an Off-System Bridge (OSB) Priority Score to rank the off-system bridges across the state of Montana. A bridge in poor condition results in a low score and bridges in good condition have a higher score.



## Condition Score

The condition score uses data collected from bi-annual bridge inspections for each of the bridge's main components, the superstructure, substructure and deck, multiplied by weighting factors. The data collected is given a score between 0 and 9, with 0 being a failed condition and 9 representing an excellent condition per the National Bridge Inventory (NBI) manual. Our OSB score development assigned a point value between 100 and 0 to the NBI scores as shown in Table 1 below.

**Table 1: Bridge Condition Score Values**

Deck Condition			Superstructure Condition			Substructure Condition		
NBI Condition (NBI 58)			NBI Condition (NBI 59)			NBI Condition (NBI 60)		
N	N/A	100	N	N/A	100	N	N/A	100
9	Excellent	100	9	Excellent	100	9	Excellent	100
8	Very Good	95	8	Very Good	95	8	Very Good	95
7	Good	90	7	Good	90	7	Good	90
6	Satisfactory	75	6	Satisfactory	75	6	Satisfactory	75
5	Fair	55	5	Fair	55	5	Fair	55
4	Poor	35	4	Poor	35	4	Poor	35
3	Serious	20	3	Serious	20	3	Serious	20
2	Critical	10	2	Critical	10	2	Critical	10
1	Imminent fail	5	1	Imminent fail	5	1	Imminent fail	5
0	Failed	0	0	Failed	0	0	Failed	0

In the case of culverts, because it is a single element, the NBI condition state was used to determine the score as shown in Table 2.



**Table 2: Culvert Condition Score Values**

Culvert Condition		
NBI Condition (NBI 62)		
N	N/A	100
9	Excellent	100
8	Very Good	95
7	Good	90
6	Satisfactory	75
5	Fair	55
4	Poor	35
3	Serious	20
2	Critical	10
1	Imminent fail	5
0	Failed	0

### Service Deficiency Score

The Service Deficiency Score represents how well the bridge serves its purpose. The score includes the bridge's age, load posting status, detour length and scour critical index. ADT was initially included in the service deficiency score but due to the remote location and low traffic volumes on a substantial amount of these off-system bridges, it was removed from the score. The service deficiency scores are weighted similar to the condition based scores by assigning a point value to the NBI conditions, see Table 3.

**Table 3: Service Deficiency Score Values**

Scour Score		
NBI Scour (NBI 113)		
N	N/A	100
9	Dry Land	100
8	Stable	100
7	Countermeasures	100
6	No Eval.	100
5	Scour within footing	75
4	Action Req.	55
3	Scour Critical	15
2	Extensive Scour	2
1	Failure Imminent	0
0	Failed	0

Bridge Posting (NBI 70)	Score
5	100
4	90
3	80
2	70
1	60
0	50

If bridge is closed, score = 0

Detour Length (NBI 19)	Score
0	100
1.99	80
9.99	60
49.99	40
99	20

Structure Age	Score
0	100
20	90
40	80
75	70
120	50



## Weighting Factors

The condition and service deficiency scores are weighted according to Table 4. Weighting factors were set based on coordination with MDT and the relative importance of a particular bridge element and service deficiency. For example, a bridge with a failing substructure requires more investment than a bridge with a poor deck, and a higher weighting factor has been assigned to the substructure condition score. Similarly, a scour critical bridge is at a higher risk of failure and a load posted bridge presents a greater immediate impact to travelers than a bridge that has service deficiencies related to age or detour length

**Table 4: Bridge Priority Score Weighting Factors**

		Weighting Factors	
Condition	Deck		25%
	Superstructure		35%
	Substructure		40%
Service Deficiency	Scour		35%
	Load Rating		30%
	Age		20%
	Detour		15%

Off-System bridge appraisal values for channel characteristics and whether or not a bridge has fracture critical elements were not used in the scoring evaluation. There is potentially some overlap in a bridge scour and channel appraisal if both are considered in the Service Deficiency score. For the specific goal of prioritizing bridges as part of this study, the scour appraisal alone was determined adequate in capturing the most relevant characteristic pertaining to channel hydraulics. Whether or not a bridge has fracture critical elements was determined to be irrelevant as a service deficiency and was not included in the scoring.

## Bridge Priority Score

As mentioned above, the Condition and Service Deficiency Scores are combined into the OSB Priority Score. The score is calculated for the ~1,900 county and municipal owned off-system bridges in the state. Currently, the scores range from a value of ~20 to ~99. The lower the score, the greater need for rehabilitation or replacement whereas a higher score represents a bridge in good or satisfactory condition with minimal service deficiencies.



The OSB scoring system will continue to be evaluated and evolve as the program develops to reflect the current state of the inventory and needs of the counties.

A bridge with an OSB Priority Score of less than 65 is a higher priority and will usually have an element with an NBI Condition Rating of four or less. An NBI Condition Rating of four denotes poor condition (advanced section loss, deterioration, spalling, or scour). Bridges with a score of 65 to 85 are classified as a medium priority and typically have elements with a condition score between five (fair condition) and seven (good condition). An OSB Priority Score of 85 or greater represents a low priority and had elements with a condition rating of seven or higher.

### Bridge Priority Score

#### Bridge Score

- Low (>85)
- Medium (65 - 85)
- High (<65)

The goal is to use the OSB Priority Score to help support recommendations from the counties on which bridges should be prioritized, help support replacement of bridges on critical economic corridors, and to identify possible bundles of bridges for replacement to maximize economy and funding opportunities.



# MDT Off System Project - Bridge Summary

## County Owned Bridge Summary

County	County Owned	Total Deck Area (SF)	Scour Critical	Closed	Load Posted	Bridge Score Priority			County Priority Bridges
						High	Medium	Low	
Beaverhead	88	140,360	2	0	33	10	43	34	2
Big Horn	27	47,238	1	0	5	2	14	11	4
Blaine	49	89,839	1	1	21	4	26	19	4
Broadwater	14	20,234	0	1	0	1	7	6	2
Carbon	45	104,030	3	2	4	4	24	16	0
Carter	26	49,550	1	0	6	1	10	15	1
Cascade	73	110,901	0	1	11	2	42	29	3
Chouteau	19	38,180	2	0	5	1	9	9	2
Custer	25	69,013	1	0	5	3	17	5	1
Daniels	11	24,679	2	0	4	3	3	5	2
Dawson	35	46,714	5	0	13	5	26	4	3
Deer Lodge	17	28,293	1	0	5	3	4	10	1
Fallon	21	22,137	0	0	1	1	7	13	0
Fergus	90	102,704	2	0	28	2	53	31	7
Flathead	56	169,120	0	0	2	1	29	26	2
Gallatin	67	95,773	1	3	22	9	33	25	2
Garfield	4	15,273	0	0	0	0	2	2	0
Glacier	9	21,342	1	0	1	1	2	6	0
Golden Valley	6	25,531	0	0	1	1	3	2	2
Granite	18	31,976	0	0	2	0	6	12	3
Hill	18	30,171	1	0	2	1	7	10	1
Jefferson	28	37,362	0	0	4	2	13	13	2
Judith Basin	20	29,471	1	0	2	1	6	13	2
Lake	65	87,389	2	0	26	12	19	34	1
Lewis and Clark	78	123,808	0	0	18	4	16	57	0
Liberty	5	15,545	1	0	1	1	1	3	1
Lincoln	38	60,708	2	0	6	1	17	20	5
Madison	43	93,088	3	0	3	3	14	26	5
McCone	6	10,210	1	0	2	1	3	2	1
Meagher	15	15,711	1	0	4	2	10	3	0
Mineral	12	32,796	1	0	1	0	6	6	2
Missoula	52	146,334	3	0	8	2	23	27	2
Musselshell	13	46,184	1	0	2	1	4	8	2
Park	56	107,651	6	3	19	12	31	11	10
Petroleum	14	19,104	1	2	4	6	1	7	4
Phillips	44	69,746	1	1	29	14	24	6	4
Pondera	48	60,422	2	0	24	1	26	21	7
Powder River	9	26,839	1	0	2	2	3	3	1
Powell	36	81,863	0	0	4	3	14	19	4
Prairie	10	30,833	1	0	3	2	6	2	3
Ravalli	58	95,811	2	1	4	2	31	24	2
Richland	64	112,467	2	0	5	2	27	35	1
Roosevelt	14	30,344	1	0	3	2	10	2	2
Rosebud	26	48,240	0	1	7	4	18	4	2
Sanders	43	126,853	2	0	4	0	22	21	2
Sheridan	49	58,771	2	0	6	2	36	11	0
Silver Bow	6	24,291	0	0	1	0	2	4	1
Stillwater	23	60,814	0	0	0	0	10	13	1
Sweet Grass	36	66,611	0	1	4	4	16	15	7
Teton	47	70,027	0	0	13	2	23	22	2
Toole	3	2,557	0	0	0	0	2	1	0
Treasure	8	7,787	1	0	6	5	2	1	2
Valley	54	118,848	2	0	24	11	30	13	2
Wheatland	15	24,110	1	0	1	1	10	4	3
Wibaux	5	17,154	0	0	1	0	2	3	1
Yellowstone	114	229,569	3	0	2	0	39	74	0

	County Owned	Total Deck Area (SF)	Scour Critical	Closed	Load Posted	Bridge Score Priority			County Priority Bridges
						High	Medium	Low	
<b>Statewide Totals</b>	<b>1875</b>	<b>3,472,376</b>	<b>68</b>	<b>17</b>	<b>414</b>	<b>160</b>	<b>884</b>	<b>818</b>	<b>126</b>



# MDT Off System Project - Bridge Summary

## City/Municipal Owned Bridge Summary

County	City Owned	Total Deck Area (SF)	Scour Critical	Closed	Load Posted	Bridge Score Priority			City Priority Bridges
						High	Medium	Low	
Cascade	1	870	0	0	0	0	1	0	
Fergus	7	7,131	0	0	4	0	0	0	
Flathead	1	6,625	0	0	0	1	0	0	
Gallatin	3	3,666	0	0	0	2	1	0	
Lewis and Clark	1	2,417	0	0	0	0	1	0	
Missoula	6	16,235	0	0	0	3	3	0	
Park	1	1,600	0	0	0	0	1	0	
Petroleum	1	936	0	0	1	0	0	1	
Silver Bow	1	3,035	0	0	0	1	0	0	
Yellowstone	17	62,065	1	0	0	0	6	11	

	City Owned	Total Deck Area (SF)	Scour Critical	Closed	Load Posted	Bridge Score Priority			City Priority Bridges
						High	Medium	Low	
Statewide Totals	39	104,580	1	0	5	2	19	18	1



# Off-System Bridge Funding Scenarios

## INTRODUCTION

Below are bridge replacement costs for various scenarios with the opportunity to develop into funding packages or grants. Based on MDT and county bid data, we're using a bridge replacement cost of \$325/SF plus an additional 10% to account for roadway approach work, channel improvements and other miscellaneous work at each site to calculate the Total CN cost. A PE cost of 15% of the Total CN was determined based on past county bridge replacement costs. This includes survey and geotechnical engineering.

- For MDT funded and administered projects, the total project cost will include CN, PE, CE, and IDC
- For county funded and administered projects, the total project cost would not include IDC or full CE amounts

For the scenarios listed below, the replacement bridge costs utilize a minimum bridge width of 28-ft to account for 2 – 12-ft lanes and 2 – 2-ft shoulders. An additional 10-ft has been added to each bridge length, 5-ft at each abutment to avoid any existing substructure foundations, account for any potential grade raises and updated hydraulic openings.

## POTENTIAL BRIDGE FUNDING COST SCENARIOS

### Scenario 1 – Replacement of all county priority off-system bridges

- Number of bridges – 124 (123 county owned bridges, and one municipal owned bridge)
- County priorities identified based on county outreach

<b>TOTAL CN</b>	<b>\$124,600,000</b>
<b>PE (15%)</b>	<b>\$18,700,000</b>
<b>CE (11.5%)</b>	<b>\$14,300,000</b>
<b>IDC (10.71% CN+CE)</b>	<b>\$14,900,000</b>
<b>Scenario TOTAL</b>	<b>\$172,500,000</b>

### Scenario 2 – Replacement of all county priority bridges classified as high priority using the OSB Priority Scoring

- Number of bridges – 47
- County priorities identified based on county outreach
- High priority identified based on an OSB Priority Score less than 65

<b>TOTAL CN</b>	<b>\$49,000,000</b>
<b>PE (15%)</b>	<b>\$7,400,000</b>
<b>CE (11.5%)</b>	<b>\$5,600,000</b>
<b>IDC (10.71% CN+CE)</b>	<b>\$5,900,000</b>
<b>Scenario TOTAL</b>	<b>\$67,900,000</b>



### Scenario 3 – Replacement of all high priority off-system bridges

- Number of bridges – 162
- High priority identified based on an OSB Priority Score less than 65

<b>TOTAL CN</b>	<b>\$160,300,000</b>
<b>PE (15%)</b>	<b>\$24,100,000</b>
<b>CE (11.5%)</b>	<b>\$18,400,000</b>
<b>IDC (10.71% CN+CE)</b>	<b>\$19,100,000</b>
<b>Scenario TOTAL</b>	<b>\$221,900,000</b>

### Scenario 4 – Replacement of all posted and closed off-system bridges

- Number of bridges – 436
- All posted and closed county and municipal owned off-system bridges

<b>TOTAL CN</b>	<b>\$317,800,000</b>
<b>PE (15%)</b>	<b>\$47,700,000</b>
<b>CE (11.5%)</b>	<b>\$36,600,000</b>
<b>IDC (10.71% CN+CE)</b>	<b>\$38,000,000</b>
<b>Scenario TOTAL</b>	<b>\$440,100,000</b>

### Scenario 5 – Replacement of all posted and closed off-system timber bridges

- Number of bridges – 170
- All posted and closed county and municipal owned off-system bridges with a timber superstructure for their main span

<b>TOTAL CN</b>	<b>\$95,200,000</b>
<b>PE (15%)</b>	<b>\$14,300,000</b>
<b>CE (11.5%)</b>	<b>\$11,000,000</b>
<b>IDC (10.71% CN+CE)</b>	<b>\$11,400,000</b>
<b>Scenario TOTAL</b>	<b>\$131,900,000</b>

### Scenario 6 – Replacement of all off-system timber bridges

- Number of bridges – 291
- All county and municipal owned off-system bridges with a timber superstructure for their main span

<b>TOTAL CN</b>	<b>\$159,300,000</b>
<b>PE (15%)</b>	<b>\$23,900,000</b>
<b>CE (11.5%)</b>	<b>\$18,300,000</b>
<b>IDC (10.71% CN+CE)</b>	<b>\$19,000,000</b>
<b>Scenario TOTAL</b>	<b>\$220,500,000</b>



## Scenario 7 – Replacement of all high priority bridges (OSB <65) and the remaining county priority bridges

- Number of bridges – 239
- All county and municipal owned high priority off-system bridges with a OSB scores less than 65 plus the remaining county high priority bridges

<b>TOTAL CN</b>	<b>\$235,900,000</b>
<b>PE (15%)</b>	<b>\$35,700,000</b>
<b>CE (11.5%)</b>	<b>\$27,100,000</b>
<b>IDC (10.71% CN+CE)</b>	<b>\$28,200,000</b>
<b>Scenario TOTAL</b>	<b>\$326,900,000</b>



# County Outreach Summary

As part of the Off-System Bridge Study and Implementation Plan, the project team solicited input from every Montana County to collect qualitative data on how bridges impact local critical services or economic vitality. Stahly Engineering was tasked with interviewing each county to determine off-system bridge priorities, off-system route importance, and understand the needs and challenges each county faces concerning their off-system bridge infrastructure. With the use of individual county maps and the MDT Off-System Bridges GIS map, both provided by HDR, Stahly Engineering documented specific information for each Montana County.

## DATA GATHERING

### Question 1: What, if any, planning documents do you have in place?

Type of Planning Document	No. of Counties with Document in Place	Percent of Counties with Document in Place
Capital Improvement Plan	27	48.2%
Growth Policy	44	78.6%
Other Planning Documents	8	14.3%

### Question 2: Does your County have road and bridge standards?

No. of Counties with Standards	Percent of Counties with Standards
35	62.5%

### Question 3: What is your County bridge budget?

Budget Range	# of Counties in Budget Range	% of 56 Counties in Budget Range	Average Budget per Range
\$0-\$499,000	33	58.9%	\$209,471
\$500,000-\$999,999	12	21.4%	\$675,850
\$1,000,000 and above	11	19.6%	\$1,639,933

Data gathered indicates that, particularly for counties with small budgets, the majority of the funds are used for payroll and benefits of bridge employees.

### Question 4: What is your County's capacity to perform bridge maintenance? (Includes materials, equipment and labor)

Capacity	No. of Counties	Percent of Counties
No Capacity	16	28.6%
Capacity for minor repairs & maintenance	29	51.8%
Capacity for major repairs & replacements	11	19.6%



### Question 5: What is your County bridge priority or priorities and why?

The data table lists individual county priorities, but common reasons for a bridge to be a priority for a county include:

- Bridge is posted with a load limit.
- Bridge is too narrow for agricultural equipment, which forces ag traffic onto state highways.
- Sufficiency rating, or data provided in the MDT Inspection Report.
- Average daily traffic (ADT).
- Impact to the economy (oil & gas, agriculture, wind farms, recreation).
- Continuity with neighboring counties (primarily in Eastern Montana).
- Bridges that are too large or complex to replace themselves.
- Bridges that provide a route for the most people.
- Bridges that provide a single point of access.

### Question 6: What are your county route priorities?

Primarily backbone and feeder roads.

### Question 7: Does your County currently use the MDT Bridge Management System? If not, are you interested in learning how to use the system?

Capacity	No. of Counties	Percent of Counties
Currently Using	9	16.1%
Interested in Learning	33	58.9%
Not Interested	14	25.0%

### Question 8: What are the primary needs and challenges your county faces regarding Off-System bridges:

Common themes that were discussed during the county interviews include:

- Low tax base due to public lands.
- Hunting/block management lands (roads get overused and the county does not have the tax base or funding to fix the damage).
- Material source and contractor availability.
- Permitting regulations, particularly process for historic bridges (Section 106).
- Variable property tax based on usage.
- Significant inventory of bridges less than 20-ft in length (funds spent on this bridge maintenance does not leave funds available for off-system bridges).



## RECOMMENDATIONS

### What qualitative/subjective measures may be worked into the off-system prioritization?

- Route priority (yes/no)
- Concurrence that NBI inspection is primary factor
- Biggest impact to geographic area (square miles/bridge, critical infrastructure (ww, hospital, feed lot, oil field, etc.)
- Economic impact – job creation or support of industry for tax base
- Route continuity
- Capacity of county to match MDT materials with in-kind services or other funding
- Financial need



# Non-County Stakeholder Engagement Report

## OVERVIEW

As part of the Off-System Bridge Study and Implementation Plan, the project team conducted interviews with several non-county stakeholders to gather their input about the impacts of off-system bridges on industries and the economy in Montana. Participants were provided with an overview of the project, given a chance to ask questions, and asked about impacts on their organizations.

## THEMES

A few common topics emerged throughout the meetings with stakeholders, including funding and financing, process, and construction.

### Funding and Financing

Stakeholders had several questions about how bridge projects would be funded. Additionally, stakeholders were interested in potential grant funding strategies.

### Process

Several stakeholders were interested in the specific processes around the project, including prioritization, implementation, and construction.

### Construction

Construction topics came up frequently during this outreach process. Stakeholders had questions about who would be doing the construction, what early construction projects could be expected, and what materials would be used.

## MEETING SUMMARIES

### Montana Contractors Association

On November 17, 2022, the project team met with David Smith, Executive Director of the Montana Contractors Association. Following the project overview, David provided input and asked several questions that included the following topics.

- What kinds of bridges are rising to the top of prioritization, such as timber bridges, seasonal creek bridges, farm to market/market to farm bridges?
- The process around testing and inspections of bridges, including who would be doing that work.
- Funding and Financing.
- Who is expected to complete work once construction projects begin?
- Materials – source of materials, standards.
- Priority weighting.
- Future Opportunities for input and information sharing.

### Montana Trucking Association

The project team met with Duane Williams, Executive Director of the Montana Trucking Association, on November 17, 2022, and asked him several questions, including the following.



- Which challenges does the trucking industry see with off-system bridges?
- Have bridges been load posted without notification?
- How can the finalized Priority List and Implementation Plan be shared with the association and their members?

## Montana Logging Association

The project team met with Jason Todhunter from the Montana Logging Association on December 7, 2022. Conversation topics included the following.

- A U.S. Forest Service (USFS) grant and any future grant opportunities that the Montana Department of Transportation (MDT) might pursue.
- Load posted bridges and potential quick fixes.
- Load posting processes.

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