Wild Animal Benefit-to-Cost Spreadsheet

This Excel spreadsheet was developed using CDOT resources and provides the assumptions, methodologies, and backup calculations for the benefit-to-cost analysis for the Wildlife Prioritization Study. This spreadsheet should be utilized for planning only. The calculations do not provide automatic approval for grant funding and/or safety funding. Requests for grant funding and safety funding will still need to be completed through the process governed by DTD and the Traffic & Safety Engineering Branch, respectively.

Editable cells

User Form

Project Location

The scope of work be... completed along State Highway **Example** ...ginning at mile post **0.00** and ending at mile post **5.00** .

Project Scope & Estimated Costs

☐ Manually enter estimated cost(s)

Mitigation Item	span/length/count	Service Life (years)	Unit Cost	Estimated Cost ($)	Maintenance Cost
Bridge or Large Arch Underpass	66x42 (span (ft) by width (ft))	75	$ 225.00 (Unit Cost ($/ft2))	$623,700.00	$ 6,237.00
Arch or Bridge Overpass	66x60 (span (ft) by width (ft))	75	$ 225.00 (Unit Cost ($/ft2))	$891,000.00	$ 8,910.00
Fencing per lane mile	4 (length (mi))	...	$ 98,900.00 (Unit Cost ($/mi))	$395,600.00	$ 3,956.00
Mitigation Item	count	Service Life (years)	Unit Cost ($ each)	Estimated Cost ($)	Maintenance Cost

$ 1,910,300.00	Mitigation Subtotal
$ 573,090.00	Contingencies Multiplier (30%)
$ 548,829.19	Construction Engineering & Indirect Chrages (22.10%)
$ 3,032,219.19	**Total Costs**
$ 19,103.00	Maintenance Costs (assumed at 1% of the mitigation subtotal)

Construction

The construction of the proposed improvements will begin in **2022** (Year) and will be completed in **one (1) year** (Choose one)

Effectiveness (Crash Reduction Factor)

☐ Manually enter CRF

Based on the scope of the project provided above, the best fit Mitigation Item & Target Specifics (see 'Effectiveness (CRF)' tab) is: **Wildlife Crossing Structures and Countinuous Fencing.**

The crash reduction factor is as follows:

87.0%	87.0%	87.0%
Fatal	Injury	Property Damage Only (PDO)

Crash History

The crash history for the location above was reviewed from **January 1, 2015** (From Date) to **December 31, 2019** (To Date) and the observed crash counts are as follows:

Fatal	0
Injury	2
PDO	83

Deer	71
Elk	12
Pronghorn	0
Bighorn Sheep	2

Traffic & Safety Engineering

Disclaimer: This Excel spreadsheet provides the assumptions, methodologies, and backup calculations for the benefit-to-cost analysis for the Wildlife Prioritization Study. This spreadsheet should be utilized for planning only. The calculations do not provide automatic approval for Highway Safety Improvement Program (HSIP) nor FASTER Safety Mitigation (FSM) program funding. Requests for funding will need to be completed as outlined by each program. Please contact the Traffic & Safety Engineering Branch for additional information.

Based on the national consumer price index (CPI) and employer cost index (ECI), the Traffic & Safety Engineering Branch developed crash costs values for economic analysis. These values are updated annually. The following costs per severity level are effective as of: **July 1, 2021**

Fatal	$ 1,820,600
Injury	$ 101,800
PDO	$ 11,100

☑ View Calculations

The Traffic & Safety Engineering Branch method for calculating benefit-to-cost for safety projects is as follows:

Interest Rate (**i**):	5%	The Traffic & Safety Engineering Branch assumes an interest (or discount rate) of 5%.
Annual Daily Traffic Growth Rate (**a**):	2%	The Traffic & Safety Engineering Branch assumes an annual daily traffic growth rate of 2%.
Weighted Service Life (**L**):	20 years	$= \dfrac{\sum_i (Service\,Life)_i \times (Cost)_i}{\sum (Cost)_{Total}}$ NOTE: The Traffic & Safety Engineering Branch uses a maximum useful service life of 20 years.
Year Factor (**N**):	5 years	The number of years of crash history reviewed/analyzed.
Capital Recovery Factor (**β**):	0.080243	$= \dfrac{i(1+i)^L}{(1+i)^L - 1}$
Average Annual Fatal Crash (**F**):	0	$= \dfrac{(Fatal)(1+a)^{L/2}}{N}$
Average Annual Injury Crash (**I**):	0	$= \dfrac{(Injury)(1+a)^{L/2}}{N}$
Average Annual PDO Crash (**P**):	20	$= \dfrac{(PDO)(1+a)^{L/2}}{N}$
Annual Maintenance Cost (**AMC**):	$ -	$= \sum \dfrac{Maintenance\,Cost}{Service\,LIfe}$
Benefit-to-Cost Ratio (**B/C**):	**0.98**	$= \dfrac{(\$PDO)(P)(PDO\,CRF) + (\$Injury)(I)(Injury\,CRF) + (\$Fatal)(F)(Fatal\,CRF)}{\beta(Cost) + (Annual\,Maintenance\,Cost)}$

Development (DTD)

Disclaimer: This Excel spreadsheet provides the assumptions, methodologies, and backup calculations for the benefit-to-cost analysis for the Wildlife Prioritization Study. The methodology follows TIGER and FASTLANE guidance. This spreadsheet should be utilized for planning only. The calculations do not provide automatic approval for any grant funding. Requests for grant funding will still need to be completed through the process governed by DTD.

Benefit-Cost Analysis Guidance Publication: **2021**

The monetized crash costs (below) were developed based on the 2021 U.S. Department of Transportation's Benefit-Cost Analysis Guidance for Discretionary Grants.

Fatalitiy Value	$ 12,071,000
Injury Value (severity unknown)	$ 284,100
PDO cost per vehicle	$ 4,500

The monetized value of wildlife are as follows:

Value of Deer	$ 2,178
Value of Elk	$ 2,537
Value of Pronghorn	$ 2,106
Value of Bighorn Sheep	$ 7,533

☑ View Calculations

Discount Rate (**i**):	7%	The Division of Transportation Development uses a 7% discount rate per grant application.
Annual Daily Traffic Growth Rate (**a**):	1.2%	The Division of Transportation Development assumes an annual daily traffic growth rate of 1.2%.
Weighted Service Life (**L**):	30 years	$= \dfrac{\sum_i (Service\,Life)_i \times (Cost)_i}{\sum (Cost)_{Total}}$ NOTE: The Traffic & Safety Engineering Branch uses a maximum useful service life of 20 years.
Year Factor (**N**):	5 years	The number of years of crash history reviewed/analyzed.

Note: The following calculations assumes that construction will begin in FY 2019 and take 1 year to complete.

Predicted Fatal Crash Counts in 2023 (F):	0	$= (Fatal)(1+a)^{(Year\,Construction\,Ends)+1-(Last\,Year\,of\,Crash\,History)}$

Predicted Injury Crash Counts in 2023 (I):	2	$= (Injury)(1+a)^{(Year\ Construction\ Ends)+1-(Last\ Year\ of\ Crash\ History)}$
Predicted PDO Crash Counts in 2023 (P):	87	$= (PDO)(1+a)^{(Year\ Construction\ Ends)+1-(Last\ Year\ of\ Crash\ History)}$
Predicted Deer Deaths in 2023 (W1):	74	$Predicted\ Wildlife\ Deaths = (Wildlife\ Deaths)(1+a)^{(Year\ Construction\ Ends)+1-(Last\ Year\ of\ Crash\ History)}$
Predicted Elk Deaths in 2023 (W2):	13	
Predicted Pronghorn Deaths in 2023 (W3):	0	
Predicted Bighorn Sheep Deaths in 2023 (W4):	2	
Undiscounted Crash Reduction Benefit (UB):	$ 6,165,563.44	
Undiscounted Benefit Value of Wildlife (UB_w):	$ 1,310,422.84	$= \dfrac{(1+a)^L - 1}{a} \times \dfrac{\sum_n (W_n)(\$W_n)(CRF_{PDO})}{N}$
Discounted Crash Reduction Benefit (DB):	$ 2,292,223.54	$= \sum_n \dfrac{UB_n}{(1+i)^n}$
Discounted Benefit Value of Wildlife (DB_w):	$ 450,514.30	$= \sum_n \dfrac{UB_{Wn}}{(1+i)^n}$
Discounted Residual Cost:	$ -	
Total Discounted Benefit:	$ 2,742,737.84	[PDF] Benefit Cost ysis Guidance 202
Undiscounted Construction Costs (UC):	$ 3,032,219.19	
Undiscounted Maintenance Costs (UM):	$ 19,103.00	
Discounted Construction Costs (DC):	$ 2,833,849.71	$= \sum_n \dfrac{UC_n}{(1+i)^n}$
Discounted Maintenance Costs (DM):	$ -	$= \sum_n \dfrac{UM_n}{(1+i)^n}$
Total Discounted Costs:	$ 2,833,849.71	
Benefit-to-Cost Ratio (B/C):	0.97	$= \dfrac{Total\ Discounted\ Benefits}{Total\ Discounted\ Costs}$

Disclaimer: This Excel spreadsheet provides the assumptions, methodologies, and backup calculations for the benefit-to-cost analysis for the Wildlife Prioritization Study. The methodology follows TIGER and FASTLANE guidance. Cost are in alignment with the Traffic & Safety Engineering Branch values as calculated. This spreadsheet should be utilized for planning only.

This research will utilize the crash values developed by the Traffic & Safety Engineering Branch.

Fatalitiy Value	$	1,820,600
Injury Value (severity unknown)	$	101,800
PDO cost per vehicle	$	11,100

The monetized value of deer and elk are as follows:

Value of Deer	$	2,178
Value of Elk	$	2,537
Value of Pronghorn	$	2,106
Value of Bighorn Sheep	$	7,533

☑ View Calculations

Discount Rate (i):	5%	
Annual Daily Traffic Growth Rate (a):	1.2%	
Weighted Service Life (L):	30 years	$= \dfrac{\sum_i (Service\ Life)_i \times (Cost)_i}{\sum (Cost)_{Total}}$ NOTE: The Traffic & Safety Engineering Branch uses a maximum useful service life of 20 years.
Year Factor (N):	5 years	The number of years of crash history reviewed/analyzed.

Note: The following calculations assumes that construction will begin in FY 2019 and take 1 year to complete.

Predicted Fatal Crash Counts in 2023 (F):	0	$= (Fatal)(1+a)^{(Year\ Construction\ Ends)+1-(Last\ Year\ of\ Crash\ History)}$
Predicted Injury Crash Counts in 2023 (I):	2	$= (Injury)(1+a)^{(Year\ Construction\ Ends)+1-(Last\ Year\ of\ Crash\ History)}$
Predicted PDO Crash Counts in 2023 (P):	87	$= (PDO)(1+a)^{(Year\ Construction\ Ends)+1-(Last\ Year\ of\ Crash\ History)}$
Predicted Deer Deaths in 2023 (W1):	74	$= (Wildlife\ Deaths)(1+a)^{(Year\ Construction\ Ends)+1-(Last\ Year\ of\ Crash\ History)}$
Predicted Elk Deaths in 2023 (W2):	13	
Predicted Pronghorn Deaths in 2023 (W3):	0	
Predicted Bighorn Sheep Deaths in 2023 (W4):	2	
Undiscounted Crash Reduction Benefit (UB):	$ 7,365,023.16	
Undiscounted Benefit Value of Deer & Elk (UB_w):	$ 1,310,422.84	$= \dfrac{(1+a)^L - 1}{a} \times \dfrac{\sum_n (W_n)(\$W_n)(CRF_{PDO})}{N}$
Discounted Crash Reduction Benefit (DB):	$ 3,456,668.13	$= \sum_n \dfrac{UB_n}{(1+i)^n}$
Discounted Benefit Value of Deer & Elk (DB_w):	$ 568,732.38	$= \sum_n \dfrac{UB_{Wn}}{(1+i)^n}$
Discounted Residual Cost:	$ -	
Total Discounted Benefit:	$ 4,025,400.51	[PDF] Benefit Cost ysis Guidance 202
Undiscounted Construction Costs (UC):	$ 3,032,219.19	
Undiscounted Maintenance Costs (UM):	$ 19,103.00	
Discounted Construction Costs (DC):	$ 2,887,827.80	$= \sum_n \dfrac{UC_n}{(1+i)^n}$
Discounted Maintenance Costs (DM):	$ -	$= \sum_n \dfrac{UM_n}{(1+i)^n}$
Total Discounted Costs:	$ 2,887,827.80	
Benefit-to-Cost Ratio (B/C):	1.39	$= \dfrac{Total\ Discounted\ Benefits}{Total\ Discounted\ Costs}$