Guideline for planning animal-vehicle collision mitigations

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Contents

Acronyms/Abbreviations	
ADS	Animal Detection System
AVC	Animal-Vehicle Collision
AVCPL	Animal-Vehicle Collision Prone Location
AWW	Alberta Wildlife Watch
BCR	Benefit Cost Ratio
ECR	Expected Collision Reduction
EPA	Alberta Environment and Protected Areas
KDE+	Kernel Density Estimate+
km	Kilometre
km/hr	Kilometres per hour
m	Metre
P.Biol.	Professional Biologist in good standing with the Alberta Society of Professional Biologists
WSSR	Wildlife Site Sensitivity Rating
≥	Greater than or equal to
<	Less than
%	Percent

Definitions

A-Level Cost Estimate: a high-level cost estimate of all mitigation components proposed. The cost estimate must reflect the level of detail appropriate for the conceptual design and benefit cost analysis. Land acquisition, project management and design, and contingency costs are not required at this planning stage.

Administrative Region: there are five provincial administrative regions within Alberta Transportation and Economic Corridors; Fort McMurray, Peace, North Central, Central, and Southern.

Animal-vehicle Collision (AVC) Mitigation Plan: a plan, developed by the Consultant, which describes the risk to motorist and wildlife safety, provides a conceptual mitigation design, and justifies mitigation spending.

Animal-vehicle Collision Prone Location (AVCPL): a highway location identified by the AWW website tool as having a high number of large-bodied animal carcass reports and thus, a high risk to motorist safety.

Animal Detection System (ADS): a complex system of sensors and warning signs to detect large-bodied animals in the road right-of-way and alert drivers. This mitigation is approved in Alberta as a trial only.

Annual Operating Costs: a standard annual cost to maintain a mitigation asset at a specified condition.

Capital Cost: the estimated cost to build all mitigation components (the sum of all construction costs). Excludes annual operating costs.

Construction Cost: the estimated cost to build each mitigation component. Excludes engineering costs, contingency estimates, or the costs associated with an already scheduled project (e.g., a bridge upgrade).

Escape Measure: escape ramps and or slope jump-outs to allow wildlife to safely exit from fenced highways.

Large-bodied Animal: are species that pose the highest risk of property damage and human fatalities/injuries when struck. They are selected based on their physical size and weight, and generally represent species the size of wolves and larger.

Life Cycle: a standard number of years the mitigation asset is expected to perform as designed.

Local Study Area: the highway right-of-way being evaluated for AVC mitigation and the surrounding habitat. This study area must fully encompass the AVCPL(s) and or area of potential AVC conflict along the highway right-of-way. At a minimum, the Local Study Area will span a 5 km highway length and a 1.5 km buffer on either side.

Mitigation Name: a name created by the Consultant that best describes the Local Study Area being evaluated for AVC mitigation. Names based on the nearest landmark are recommended.

Mitigation Zone Length: the overall extent of the highway that will be mitigated by the conceptual design (i.e., the total length of fenced highway, extent of ADS sensor detection).

Project AVCPL: an AVCPL of concern that requires mitigation planning as part of a highway/bridge project's Environmental Evaluation.

Provincial AVCPL: a critical AVCPL of provincial priority that requires mitigation planning either as a standalone project or as part of a highway/bridge project's Environmental Evaluation.

Purpose-built Mitigation: mitigation that is specifically designed and installed to reduce AVCs.

Regional Study Area: an area larger than the Local Study Area where the surrounding highway infrastructure and wildlife habitat and movement corridors may influence the AVC mitigation design. At a minimum, the Regional Study Area will span a 12 km highway length and a 6 km buffer on either side.

Removal and Replacement Costs: costs to remove and replace the mitigation asset at the end of its life cycle.

Repair and Maintenance Work: includes repairs, maintenance, and small retrofits to existing mitigation/infrastructure that can be completed under Alberta Transportation and Economic Corridor's existing contracts with highway maintenance contractors. An AVC mitigation plan is not required.

Retrofit Mitigation: improves existing infrastructure for the purpose of AVC mitigation such as enhancing wildlife habitat at an existing structure or extending an existing fence. Retrofits do not include structural changes to an existing bridge file. Retrofit mitigations require an AVC mitigation plan.

Wildlife Site Sensitivity Rating (WSSR): a rapid assessment, using Alberta Transportation and Economic Corridors' identified criteria, to evaluate if it is feasible to start the AVC mitigation planning process at and near an AVCPL.

1.0 Introduction

The primary goal of Alberta Transportation and Economic Corridor's (the Department's) Alberta Wildlife Watch (AWW) Program is to improve driver safety on provincial highways by reducing animal-vehicle collisions (AVCs) and minimizing the impacts of highways on wildlife. The Department's mandate is to provide safe and efficient transportation and the guidelines developed under the AWW Program help to achieve these goals.

The *Guideline for Planning AVC Mitigations* (this Guideline) is one of several departmental guidelines to offer a consistent approach to AVC mitigation planning in Alberta. It outlines the steps the Department's Consultant (a professional biologist; e.g., P.Biol.) must complete when preparing an AVC Mitigation Plan as:

- part of highway/bridge project: planning for mitigation at AVC-prone locations (i.e., Project and Provincial AVCPLs) is completed with the highway/bridge project's *Environmental Evaluation of Highway Infrastructure Projects*,
- a standalone project: a project delivery approach for critical AVC-prone locations (i.e., Provincial AVCPLs) when not included in a highway/bridge project, or
- requested by the Department.

The Department can direct the Consultant on which project delivery approach applies.

The AVC Mitigation Plan is a planning phase activity that results in the development of an identified mitigation that reduces, or eliminates, AVCPLs.

1.1 Organization of this Guideline

This Guideline is organized in steps to standardize the mitigation planning process. These steps are to help the Consultant to build their understanding of the AVC conflict at regional and/or local scales and to inform the most cost-effective mitigation design that can meet the mitigation objectives. Adjustment and or re-evaluation of earlier steps may be required in an iterative process for an effective mitigation plan.

Before starting, the Consultant must be sufficiently knowledgeable with this Guideline and the AVC mitigation design guidelines (refer to Section 1.2). The Consultant is encouraged to refer to the AWW Program documents available on the Government of Alberta's website and the AWW website's Help content for additional details regarding AWW.

1.1.1 The Mitigation Planning Process

The process for mitigation planning is outlined in Guidance Box 1 and detailed in Sections 2.0 – 7.0.

Guidance Box 1: Steps to Prepare an AVC Mitigation Plan

Step 1 **Define the Study Areas**	• Based on an identified AVCPL, choose local and regional study areas where highway infrastructure and known wildlife movement corridors may inform the AVC mitigation plan.
Step 2 **Complete a Wildlife Site Sensitivity Rating (WSSR)**	• Complete a desktop and field survey within the local study area to assess each WSSR criteria. • Final recommendation from the Consultant whether mitigation planning should proceed through Steps 3-6.
Step 3 **Create Study Area Map(s)**	• Create local and regional study area map(s) to visually emphasize any linkage between the AVCPL, wildlife habitat, infrastructure, and other factors relevant to the conceptual AVC mitigation design. • Desktop investigation to create the map(s).
Step 4 **Describe the Site Conditions**	• Collect site information to validate the desktop information and inform the conceptual mitigation design. • Desktop and field survey within local and regional study areas.
Step 5 **Define the Mitigation Objectives & Develop a Conceptual Mitigation Design**	• Clearly identify the objectives of the AVC mitigation design. • Develop conceptual mitigation design(s) that meet the mitigation objectives and are appropriate for the site conditions. • Design the mitigation following the Department's design guidelines.
Step 6 **Calculate the Benefit Cost** **(for Standalone Projects Only)**	• For standalone mitigation projects calculate the benefit cost of the conceptual mitigation design using the AWW Benefit Cost Model. • Adjust the conceptual design (Step 5) as required to optimize the benefit cost while maintaining the mitigation objectives. • **Step 6 is not required for AVC mitigation that is planned as part of a highway/bridge project's Environmental Evaluation.**

1.2 Other AWW Guidelines Relevant to AVC Mitigation Planning

Alberta Transportation and Economic Corridors, in collaboration with Alberta Environment and Protected Areas (EPA), developed guidelines to standardize the design of AVC mitigations in Alberta. These AVC mitigation design guidelines must be used during the conceptual and detailed design phases for all AVC mitigation projects and are available on the Government of Alberta's website.

The AVC mitigation design guidelines that are available to Consultants include the:

Guideline for Planning Wildlife Crossing Structures

Guideline for Planning Wildlife Exclusion Fencing

1.3 Integration with the Department's Project Delivery Approach

The Department uses two project delivery approaches to deliver AVC mitigation:

1. Project AVC mitigations that are identified through a highway/bridge project's *Environmental Evaluation of Highway Infrastructure Projects* and funded by the project; and
2. Standalone AVC mitigation projects that require capital funding when not included as part of planned highway/bridge projects.

The AVC Mitigation Plan, once approved as a funded project, is then assigned to the Region responsible for completing detailed design in accordance with the Department's specifications and standards with support from the Technical Standards Branch. Infrastructure installed as part of the AWW Program is routinely inspected under the Bridge Inspection and Maintenance Program or, for roadside appurtenances, through highway maintenance contracts. These inspections identify the condition of the asset as well as the need for necessary repair. Repairs and maintenance are funded through capital funding programs (bridge files) or risk and recovery/maintenance contracts (e.g., wildlife exclusion fencing). Environmental Regulation, Technical Standards Branch, maintains a complete list of the AVC mitigations located on the provincial network.

2.0 Step 1: Define the AVC Study Areas

The first step is to define the spatial boundaries of the study areas where relevant factors at and surrounding the collision-prone location are evaluated.

The Local Study Area must be at least 5 km in length and 3 km wide (1.5 km on either side of the highway right-of-way being evaluated) and include the known AVCPL(s) and/or areas of potential AVC conflict.

The Regional Study Area must be at least 12 km in length and 12 km wide (6 km on either side of the highway right-of-way) and include surrounding highway infrastructure, wildlife movement corridors (e.g., Key Wildlife and Biodiversity Zones), and high-quality habitat that are relevant to the AVC mitigation design (refer to Steps 3 and 4).

The Consultant may increase the size of the Local and or Regional study areas, as necessary, based on applicable site conditions.

3.0 Step 2: Complete a Wildlife Site Sensitivity Rating

The Wildlife Site Sensitivity Rating (WSSR) is a set of standard criteria to rapidly assess if it is feasible to start the AVC mitigation planning process. It ensures that planning does not proceed if repair and maintenance work would mitigate the AVCPL, a planned land use development could eliminate the AVCPL, or when a development could alter the performance of a mitigation once it's built. This is a rapid assessment tool that uses desktop and field assessments. The outcome is a final recommendation by the Consultant whether to proceed with AVC mitigation planning. Since WSSRs expire after five years, AVCPLs that do not pass to AVC mitigation planning this period may be re-assessed again if the AVCPL persists.

The WSSR is completed by a desktop investigation and verified during a field visit of the Local Study Area. Although the field investigation should only take a couple of hours, it may uncover attributes of highway infrastructure or adjacent land-uses that influence the WSSR outcome that were not obvious from the desktop review. For that reason, a site visit shall be performed by the Consultant.

For efficiency, when the desktop investigation is complete and the WSSR is expected to pass to AVC mitigation planning, the field investigations for Steps 2 and 4 may be completed together. Familiarity with the field requirements for each step is required prior to completing the field work.

Table 1 outlines the WSSR criteria to assess within the Local Study Area. A downloadable template of the WSSR criteria is available to the Consultant from the AWW website tool's ***WSSR tab***.

TABLE 1: WILDLIFE SITE SENSITIVITY RATING CRITERIA	
WSSR Criteria	**Result (choose all that apply)**
A. Repairs and Maintenance: **Would repairing and or maintaining[1] existing infrastructure change the AVCPL?**	☐ **Pass**: **No opportunity for repairs/maintenance** and thus, the AVCPL is likely to persist. ☐ **Pass**: **In need of repairs/maintenance**, but once carried out, the AVCPL is still likely to persist. ☐ **Fail**: **In need of repairs/maintenance**, that once carried out, would likely eliminate the AVCPL (i.e., not enough AVCs to develop an AVCPL).
B. Recent Land Use or Road Infrastructure Change: **In the past five years, was there a land use, highway, or bridge project[2] that has changed the number of AVCs?**	☐ **Pass**: The **number of AVCs stayed the same or increased** after a recent land use, highway, or bridge project and thus, the AVCPL is likely to persist. ☐ **Pass**: The **location of AVCs changed** after a recent land use, highway, or bridge project, **but the overall number of AVCs stayed the same or are increasing** and thus, an AVCPL is likely to persist. ☐ **Fail**: The **number of AVCs decreased** after a recent land use, highway, or bridge project and thus, the AVCPL is likely to be eliminated (i.e., not enough AVCs to develop an AVCPL).
C. Foreseeable Land Use or Road Infrastructure Change: **In the next five years, is there a foreseeable land use, highway or bridge project[3] that is likely to change the number of AVCs? Or change the performance of a built mitigation once the land use, highway or bridge project is developed?**	☐ **Pass**: The **number of AVCs will likely remain the same or increase** after the land use, highway, or bridge project and thus, the AVCPL is likely to persist. ☐ **Pass**: The **performance of an AVC mitigation, if built now, would be unaltered** by the upcoming land use, highway, or bridge project. ☐ **Fail**: The **number of AVCs will likely decrease** after the land use, highway, or bridge project and thus, the AVCPL is likely to be eliminated (i.e., not enough AVCs to develop an AVCPL). ☐ **Fail**: The **performance of an AVC mitigation, if built now, could be adversely affected** by the land use, highway or bridge project and this effect is unavoidable by planning or design.
Overall WSSR Assessment*:	☐ **Pass:** Proceed with AVC mitigation planning ☐ **Fail:** Withdraw from AVC mitigation planning until next review period

1. Repairs and maintenance (includes small retrofits, e.g., removing rip-rap, modifying an escape structure) are completed under the highway maintenance contracts and do not require an AVC Mitigation Plan.
2. Recent land use or road infrastructure change that could affect the AVCPL are highway twinning, bridge replacement, large-scale forest clearing, etc.
3. Foreseeable land use or road infrastructure change that could affect the AVCPL, or the performance of a built AVC mitigation, are a large industrial development, highway realignment, etc.

* A final recommendation by a professional consulting biologist (e.g., P.Biol.) is required.

3.1 WSSR Criteria A: Repairs and Maintenance to Existing Infrastructure

Existing infrastructure is repaired and maintained under the highway maintenance contracts and do not require an AVC Mitigation Plan. By using existing contracts, repair and maintenance work can be performed quickly once the need is identified. The Consultant shall report to the Department any repair and maintenance needs, that when carried out, could reduce AVCs and thus preclude AVC mitigation planning through this process.

A desktop investigation is used to identify existing infrastructure within the Local Study Area (e.g., existing AVC mitigation, watercourse bridge). The field investigation will verify any repair and maintenance needs. Results of the investigations are submitted to the Department including the details of any repair and maintenance work needed to reduce the number of AVCs and eliminate the AVCPL. Site photos and other details may be provided as an Appendix to the WSSR Record submission.

Table 2 outlines some example repair and maintenance works that are completed under the highway maintenance contracts and preclude AVC mitigation planning through this process.

TABLE 2: EXAMPLE REPAIR AND MAINTENANCE WORK THAT DOES NOT REQUIRE AN AVC MITIGATION PLAN

Fence Repair/Maintenance	▪ Repair a damaged exclusion fence and or escape structure
	▪ Add a buried guard to an exclusion fence to prevent species that dig from gaining access inside the exclusion zone
	▪ Add a top cable to an exclusion fence to minimize damage from fallen trees
	▪ Add and or modify escape structures
Bridge File Repair/Maintenance	▪ Remove excess rip-rap underneath a bridge to allow ungulate passage (i.e., wildlife pathway) when the rip-rap is not required for scour protection
	▪ Add sand or gravel on top of existing rip-rap to create a wildlife pathway under a bridge
	▪ Remove debris blocking wildlife passage through a crossing structure
	▪ Limit human use in and near the crossing structure to the extent possible
	▪ Remove unused livestock fencing near a crossing structure
Mowing and Clearing	▪ Clear beyond the existing highway maintenance practices (note, this may improve motorist visibility and may alter wildlife behaviour that can either increase or decrease AVCs)
Warning Sign Install/Repair	▪ Repair/install a warning sign

This WSSR criteria fails, i.e., does not proceed through this AVC mitigation planning process, when the Consultant identifies and describes repair and maintenance work that could reduce the number of AVCs and eliminate the AVCPL.

3.2 WSSR Criteria B: Recent Land Use or Road Infrastructure Changes

AVCPLs are calculated using a rolling 5-years of AWW large-bodied animal carcass data. As a result, an AVCPL can continue to be recognized by the AWW website analyses tool after land use/road infrastructure changes have reduced, moved, or eliminated the collision prone location. For this reason, it is important to assess the animal carcass records post-construction of a land use/ road infrastructure project.

Assess if a land use, highway or bridge project, which occurred in the past five years, may be affecting animal carcass records in the Local Study Area and evaluate if the AVCPL will persist as a result. Example land uses, highway or bridge projects that could affect an AVCPL evaluation are:

- Unfenced landfills, orchards, and other land uses that **attract wildlife** (excludes short-term land use changes such as annual crops, open grain piles, hay storage);
- Bridge rehabilitation or construction, exclusion fencing at elk/bison farms, highway twinning, and new AVC mitigation projects that **influence wildlife movement** (enhances, funnels, or impairs; excludes temporary construction periods);
- Ditch slope re-contouring, vegetation clear zone trimming, and other long-term changes that **obstruct or improve motorist visibility**; and
- Housing, commercial, and or industrial development, wetland creation/habitat restoration, clear cuts, and other projects that **reduce or enhance wildlife habitat**.

The desktop investigation shall:

1. Identify a recent land use/road project using available imagery (e.g., satellite imagery, aerial photography, videos) and consultation with the Department's operations staff;

2. Review available documents from municipalities and other local authorities to identify a recent land use/road project (e.g., Area Structure Plans); and

3. Assess whether the land use/road project has changed the number and or location of AVCs by reviewing the AWW carcass data, pre- and post land use/road project, and by consulting with EPA's local Senior Wildlife Biologist.

Confirm any new land uses, highway or bridge projects during the field investigation.

This WSSR criteria fails when the Consultant identifies that the number of AVCs are decreasing, post-construction of the land use/road project, to a level that an AVCPL is likely to be eliminated.

3.3 WSSR Criteria C: Foreseeable Land Use or Road Infrastructure Changes

Future land use and road infrastructure projects can also reduce, eliminate, move, or exacerbate the number of animal carcass records at an AVCPL and can compromise the function and performance of AVC mitigations once built. AVC mitigation projects are typically a longer-term solution, and thus, the effects from upcoming land use and road infrastructure projects must be considered.

Assess how a foreseeable land use/road infrastructure project (i.e., those easily ascertainable) could influence the AVCPL and any mitigations built as a result of this AVC Mitigation Plan. For this desktop investigation, consult with the Department's Regions and Technical Standards Branch for projects planned in the next five years. The Consultant shall also review available Municipal Development Plans, Area Structure Plans, Bylaws, and proposed Parks and Protected Areas, as applicable, to fulfill WSSR Criteria C.

If the Local Study Area overlaps with an upcoming highway/bridge project, the Consultant is also required to consult with the Regional Environmental Coordinators whether to proceed with AVC mitigation planning.

Example foreseeable land uses, highway or bridge projects that could affect an AVCPL evaluation, and or alter the performance of mitigation, are similar to those identified in WSSR Criteria B.

This WSSR criteria fails when the Consultant identifies a foreseeable land use development, increased human activity, or planned highway/bridge projects that could reduce/eliminate AVCs (and thus the AVCPL evaluation) and or adversely affect the function, performance, and benefits of a mitigation project.

3.4 Prepare a Wildlife Site Sensitivity Rating Record

The Consultant must use the WSSR Record template provided in the AWW website tool's ***WSSR* tab**. Using the template, the Consultant must describe the results of each of the three WSSR criteria in sufficient detail for the Department's review. Additional information/rationale may be provided as an attachment to the template, if required. Once the WSSR is complete, the Consultant will submit a WSSR Record for the Department's review and will upload each WSSR Record to the AWW website tool.

Regardless of each WSSR criteria results, a final recommendation from the Consultant whether to proceed with mitigation planning is required. The Consultant will proceed with AVC mitigation planning following this Guideline (proceed to Steps 3-6) with a passing recommendation. With a failing recommendation, the Consultant will withdraw from mitigation planning until the next review period.

The WSSR Record is sufficient to close out the mitigation planning process for failed WSSRs.

4.0 Step 3: Create Study Area Map(s)

The intent of the study area map(s) is to prepare the Consultant for field investigations required in Step 4 and to visually emphasize any linkages among the mapped features to inform the mitigation design. The Consultant's conceptual mitigation design should not exclude wildlife from accessing an existing crossing structure built on a parallel highway or from moving through a known wildlife corridor. It is for this reason that key information, such as wildlife habitat/movement corridors, AVCPLs, infrastructure, and other factors that could influence the mitigation design are added to the study area map(s).

Step 3 is completed at the scale of the Regional and Local Study Areas using a desktop investigation and validated during the field investigation in Step 4, where necessary. At a minimum, the map(s) must display any:

1. AVCPLs;

2. Known/predicted wildlife movement corridors and high-quality wildlife habitat in consultation with EPA's local Senior Wildlife Biologists (with approval from the Department) and or using available imagery (e.g., satellite imagery, aerial photography) or landcover mapping. Available habitat in the Local Study Area must be confirmed by a field investigation in Step 4;

3. Protected areas (i.e., Key Wildlife and Biodiversity Zones, Parks and Protected Areas) and local conservation efforts/objectives in consultation with EPA's local Senior Wildlife Biologists;

4. Existing/planned AVC mitigation(s) using the AWW website tool and as identified in Step 2. Effectiveness of an existing AVC mitigation to reduce AVCs and maintain/improve wildlife movement must be assessed by a field investigation in Step 4 (if not already assessed in Step 2); and

5. Existing/planned highway and bridge projects, including infrastructure that is connected to the Local Study Area by a wildlife movement corridor or protected area. Label existing highways, bridge file numbers, and the bridge file dimensions (structure type, length, width, and height). When available, approximate the location of planned projects as identified with the Department in Step 2. Permeability of the existing infrastructure to wildlife must be assessed by a field investigation in Step 4.

The Consultant must update the study area map following the Step 4 field investigation.

5.0 Step 4: Describe Site Conditions

Site conditions within the Regional and Local Study Areas will inform the conceptual AVC mitigation design and shall be described using desktop and field investigations. Relevant site conditions that the Consultant must consider are described below in Guidance Boxes 2 and 3. Additional environmental, land use, and geotechnical site conditions may be considered when appropriate to the mitigation design (e.g., water tables, recreational trails, power/telecommunication supply).

The field visit take a couple of hours and is limited to the Regional and Local Study Areas that are readily accessible from existing roads. The Local Study Area is the focus of the field investigation; however, relevant site conditions in the Regional Study Area (e.g., existing AVC mitigation along a nearby parallel highway), must also be field verified. For efficiency, the Step 4 field investigation may be completed concurrent with the field visit in Step 2 when the Local Study Area is likely to pass the WSSR based on the available desktop information and when the Step 3 desktop investigation is complete. Likewise, the Step 4 field investigations may be completed with field work associated with the Environmental Evaluation.

Guidance Box 2: Relevant Wildlife Conditions that must be Described

Animal-Vehicle Collision Prone Locations

- The location and severity of each AVCPL within the Regional and Local Study Areas.

Animal-Vehicle Collision Risk History

- A history of AVCs within the Regional and Local Study Areas may be assumed from the presence of existing AVC mitigation attempts along the highway (e.g., wildlife reflectors and warning signs) and collision analyses using the Alberta Collision Information System (ACIS) data (available in the AWW website tool).

Wildlife Species

- Wildlife species involved in AVCs and others with conservation efforts/objectives (i.e., Species at Risk) in the Regional and Local Study Areas. Although the AVCPL analyses focuses on large-bodied species (i.e., wolf size and larger) that are of most concern to motorist safety, species with local conservation efforts/objectives should also be described.

Wildlife Movement Corridors and Available Habitat

- Wildlife movement corridors identified in Step 3, as well as any natural barriers to wildlife movement.
- High-quality habitat for the target species in the Regional and Local Study Areas identified in Step 3.
- Surrounding land security (private, public lands) since land protection is important at/near AVC mitigations with long service lives (life cycles), such as underpasses.

Guidance Box 3: Relevant Highway Conditions that must be Described

Traffic

- Traffic conditions, including:
  - Number of driving lanes.
  - Roadway and clearzone width.
  - Posted speed limit(s).
  - Current and projected average annual daily traffic (AADT) volumes during the estimated life of the AVC mitigations and whether the traffic volumes could act as a barrier to wildlife movement.
  - Primary vehicle usage (e.g., percent of passenger vehicle, tractor trailer) when the effectiveness of a mitigation depends on changing the motorists' behaviour (e.g., slowing down when the Animal Detection System signage is activated).

Provincial High Load Corridors

- High Load Corridor mitigation for over-height loads when the mitigation design includes an overpass.

Motorist Sight Distances

- Motorist sight distance when motorist visibility is important to reduce AVCs, such as at fence ends. Instructions to calculate motorist sight distances are provided in the Department's Highway Geometric Design Guide Chapter B.2.3 *Stopping Sight Distance* calculation.

Existing AVC Mitigations, Bridge Files, and Other Infrastructure

- Permeability of the existing infrastructure to wildlife, including the dimensions of existing bridge files, their retrofit potential, and suitability for wildlife species movement.
- Effectiveness of the existing AVC mitigations to reduce AVCs (refer to Appendix A and or AWW website tool's mitigation monitoring results).
- The remaining service life and projected replacement dates (if known) of relevant infrastructure in consultation with the Department's Regions and Technical Standards Branch. This may identify opportunities to combine projects for a more cost-effective delivery.

6.0 Step 5: Define Mitigation Objectives & Develop a Conceptual Mitigation Design

In Step 5, the Consultant shall prepare a conceptual AVC mitigation design that is specific to the site conditions identified in earlier steps and the mitigation objectives. The primary objective of an AVC mitigation design is typically to reduce the number of large-bodied species AVCs to a level that will no longer result in an AVCPL. Additional objectives may also be to improve or maintain wildlife connectivity across a highway, reduce the number of a Species at Risk AVCs, or when approved by the Department to address road related mortality of other species within the Local Study Area. The Consultant shall explicitly define the mitigation's objective(s) and prepare a conceptual mitigation design to meet these objectives.

To meet objectives, the Consultant is encouraged to recommend mitigation that has a high expected collision reduction potential and a low risk of failure. The Consultant shall develop the conceptual design following the Department's mitigation design guidelines and a literature review.

The conceptual design should describe the following for each mitigation type (e.g., fence, crossing structure), as appropriate and in context to the target species, site conditions, and mitigation objectives.

1. Mitigation locations (e.g., extent of the fenced highway, location of underpass).
2. Dimensions (e.g., fence length, underpass length/width/height).
3. Mitigation components (e.g., exclusion fence, jump-outs, maintenance gates, wildlife guards, noise reduction walls), including the reuse/retrofit of existing infrastructure.
4. Innovations, if applicable, with a substantial likelihood of success. This may include its use and success in other jurisdictions.
5. Special accommodations or constraints to be considered during the detailed mitigation design (e.g., recreation trails, high water table, surface bedrock, construction schedule with a planned bridge replacement).
6. Effectiveness at reducing collisions (refer to Appendix A) and maintaining/improving wildlife connectivity.
7. Construction costs for each mitigation component (refer to Section 7.2.2). The construction costs are high-level (A-level) estimates and excludes engineering costs, contingency estimates, or the costs associated with an already scheduled project (e.g., a bridge upgrade). The Department's unit price averages is an appropriate resource to estimate some costs, as well as a literature review, and consultation with the Department. These cost estimates are also to be inputted later into the Benefit Cost Model in Step 6
8. Results of the Benefit Cost Ratio, if required (refer to Step 6).

6.1 Reuse and Retrofit Existing Structures

Evaluating whether existing road infrastructure can be retrofitted for AVC mitigation should be considered early in the planning steps. Retrofits are improvements to the existing infrastructure for the purpose of AVC mitigation and are tasks that are outside regular highway repair and maintenance work.

When available, existing road infrastructure may be reused/retrofitted as part of a cost-effective approach to reduce AVCs. Existing below-grade structures, such as open-span bridges and large diameter culverts that were designed for purposes other than wildlife, are potential candidates to reuse/retrofit as AVC mitigation. The option to reuse/retrofit an existing structure depends on several factors including, but not limited to, the structures dimensions and suitability for the target species and the structures remaining service life. The Consultant shall recommend whether reusing/retrofitting an existing road infrastructure would help meet the mitigation objectives.

Example retrofits are provided in Table 3.

TABLE 3: EXAMPLE RETROFITS THAT REQUIRE AN AVC MITIGATION PLAN

Retrofit	Example(s)
Bridge file wildlife passage improvement (e.g., watercourse bridge)[1]	▪ Add a wildlife pathway underneath a bridge
	▪ Preserve or restore the habitat surrounding a bridge
	▪ Add noise barriers and or visual screens to separate traffic from wildlife, with consideration to clear zone and structural impacts
	▪ Regrade slopes to improve connection between the wildlife pathway and the surrounding habitat or improve visibility to/through the crossing structure ▪ Add vegetation adjacent to the bridge or watercourse
Fence improvement and or extension[2]	▪ Extend the length of an existing exclusion fence
	▪ Regrade roadside slopes at fence ends to improve motorist visibility

1. Refer to the *Guideline for Planning Wildlife Crossing Structures*

2. Refer to the *Guideline for Planning Wildlife Exclusion Fencing*

6.2 Purpose-Built Mitigations

Purpose-built AVC mitigation may be required where retrofitting options are unavailable or unsuitable to meet the mitigation objectives. A purpose-built mitigation is specifically designed and installed to reduce AVCs. Table 4 provides general guidance for typical use scenarios of purpose-built mitigations; however, the Consultant is directed to the Department's AVC mitigation design guidelines (Section 1.2) for more detailed design considerations.

TABLE 4: TYPICAL USE SCENARIOS FOR PURPOSE-BUILT MITIGATIONS

Mitigations	Typical Use Scenarios
Exclusion Fence Prevents wild animals from entering onto the highway and funnels wildlife to a crossing structure. As fences alone would make the road corridor (nearly) impermeable to wildlife, the Department recommends that fences be combined with designated crossing opportunities.	▪ When the objective is to substantially reduce AVCs. To improve wildlife connectivity, combine fence with crossing structure(s). ▪ Combined with crossing structures to improve the effectiveness of the crossing. ▪ Along highways with high posted speed limits (≥80 km/hr) and both high and low volume roads. ▪ When at least 5 km of the roadway is fenced on both sides. ▪ More effective at excluding wildlife where there are few road intersections and access needs for pedestrians, bicyclists, off-road vehicles, and equestrians.
Animal Detection System (ADS) Designed as a standalone mitigation or in combination with exclusion fencing to detect large-bodied animals (e.g., deer, elk, and moose) and to alert drivers of an animal on or approaching the road. ADS's are currently approved on a trial basis only. The Consultant must acquire Technical Standards Branch approval prior to recommending an ADS.	▪ When the objective is to reduce AVCs with large-bodied species that are detectable by the system. ▪ When reducing the road's barrier effect on wildlife is not an objective. ▪ Along relatively low traffic volume roads (e.g., maximum 10,000 vehicles per day throughout the service life of the system). ▪ On long highway segments or at fence ends. ▪ Where access to nearby power grid and communications (e.g., land phone line or cell phone reception). ▪ Near highway maintenance shops to offer frequent maintenance.
Crossing Structure, Underpass Physically separates wildlife from traffic and allows safe passage of wildlife under highways. Must be combined with exclusion fencing. ▪ Steel and concrete culverts or bridge options suitable.	▪ When the objective is to improve or maintain wildlife connectivity across a fenced highway. ▪ Where suitable wildlife habitat will continue to exist, on either side of the road, within the service life of the structure. ▪ Relatively busy roads with high design speeds (≥80 km/hr). ▪ Where quality habitat exists, and wildlife selectively travel. ▪ More cost effective at road fills and watercourse crossings than at road cuts. ▪ Where water tables are low to avoid standing water and or saturated soils at the underpass.
Crossing Structure, Overpass Physically separates wildlife from traffic and allow safe passage of wildlife over highways. Must be combined with exclusion fencing. ▪ Bridge or culvert overpasses suitable, such as arch culverts.	▪ When the objective is to improve or maintain wildlife connectivity across a fenced highway. ▪ Where suitable wildlife habitat will continue to exist, on either side of the road, within the service life of the structure. ▪ Relatively busy roads with high design speeds (≥80 km/hr). ▪ Where quality habitat exists, and wildlife selectively travel. ▪ More cost effective at road cuts and ridgelines than at road fills. ▪ Outside existing high load corridors with special overhead conditions.

7.0 Step 6: Calculate the Benefit Cost of the Conceptual Design

Step 6 is only required for standalone AVC mitigation projects. If required, the Consultant shall calculate the benefit cost of the conceptual AVC mitigation design (and any alternatives) using the Department's AWW Benefit Cost Model to inform the financial feasibility of site-specific AVC mitigation (access the model worksheet from the AWW website tool's ***Mitigation tab***). The purpose of this model is to monetize present values for AVC mitigation construction and operation costs, the benefits from reduced collision costs, and the benefit cost ratio to compare mitigation alternatives. The AWW model was modified from an existing Department Benefit Cost Model (Alberta Transportation 2017) to determine whether a proposed project is economically desirable (i.e., when benefits exceed costs).

The AWW Benefit Cost Model helps the Consultant to design a conceptual AVC mitigation design that provides the best cost benefit to Albertans while meeting the mitigation objectives described in Step 5. The Consultant is encouraged to optimize the conceptual design from Step 5, as an iterative process depending on the results of the benefit cost analysis. The model allows a maximum of three design alternatives for any given plan to be evaluated; however, it is not a requirement to submit more than one alternative.

A benefit cost analysis is required for standalone AVC mitigation projects when planning a retrofit and or purpose-built mitigation. AVC Mitigation Plans that are being completed for a highway/bridge project's Environmental Evaluation are not required to complete Step 6. The Department can advise the Consultant when a benefit cost calculation is required.

7.1 Benefit Cost Model Introduction

7.1.1 Analysis Components

The AWW benefit cost model evaluates each AVC mitigation alternative based on the following factors:

- **Construction Costs:** for the investment including capital costs; excluding engineering costs. The Consultant estimates the construction costs in Step 5 and are used in the benefit cost model in Sept 6.
- **Annual Operating Costs:** a standard annual cost to maintain the asset at a specified condition. The Department provides standard annual operating cost estimates in Appendix B.
- **Removal and Replacement Costs:** costs to remove and replace the asset at the end of its life cycle. The Consultant shall estimate the Removal and Replacement costs.
- **Life Cycle:** of the mitigation: a standard number of years the mitigation asset is expected to perform as designed. The Department provides a standard life cycle of typical mitigations in Appendix C.
- **Collision Costs**: the Department estimates a standard collision costs $100,000 (refer to Section 7.2.2).

7.1.2 Model Features

The AWW Benefit Cost Model features allows for:

- Comparison between a maximum of three project alternatives;
- Analysis over a 20-year time frame (with residual value up to 75 years (i.e., a crossing structures expected life cycle));
- Modification to various external factors for example: capital costs, annual operating costs, associated life cycles, and collision costs; and
- Calculation of the benefit cost.

7.1.3 Limitations of the Model

As with all models, the quality of information inputted affects the quality of the analysis and results (Alberta Transportation 2017). Limitations of the model are:

- The model does not include:
  - other road user costs such as travel time and vehicle operating costs;
  - traffic growth rates;
  - environmental costs associated with vehicle emissions; and

- costs and benefits related to biological conservation parameters. The Department recognizes the importance of the conservation value of a species and will collaborate with government partners to determine how to capture this value in future benefit cost analyses.
- The model assesses individual Study Area projects; and
- The model is based on A-Level cost estimates that are appropriate for a conceptual design.

7.1.4 Valuation of Analysis Components

At the core of any benefit cost analysis is the valuation of incremental change in expenditures or revenues over time that may be associated with a project or its alternatives. The AWW benefit cost analysis uses the following expenditure and revenue definitions (Alberta Transportation 2017):

Real Dollars: All values expressed in real base year dollars which do not include inflation (i.e., their present estimated values). As a result, all base values and expenditure data used in the model need to be expressed in these terms. Where expenditures include inflation or are expressed in real values for another year, other than the base year, the Consultant shall convert these values to the base year dollars (present estimated value) using an appropriate factor.

Real Discount Rate: As this benefit cost model does not include inflation, the discount rate used to account for the time value of money and to bring all future dollar values back to the base year, must be a 'real' discount rate. The default value used in the model is 4 percent (%) per annum, as per the Department's typical practice.

7.2 Use the Benefit Cost Model Excel Worksheet

Benefit cost calculations must be completed using the Benefit Cost Model excel worksheet (the excel worksheet) available from the AWW website tool's ***Mitigation tab***. The excel worksheet allows the Consultant to compare the benefit cost of three design alternatives to develop a cost-effective mitigation design. Although the worksheet allows for three design alternatives, the Consultant must recommend only one conceptual design (with supporting rational) to the Department.

7.2.1 Cell Protection

Cells that don't require user input are 'locked' and 'protected' in the excel worksheet. This ensures that these cells are not accidentally altered. Altering cells that do not require information from the Consultant may affect the integrity of the calculations in the model.

7.2.2 Complete an Analysis

The Department recommends that the Consultant create a mitigation (refer to the ***Create Mitigation*** button) in the AWW website tool's ***Mitigation tab*** to help complete the BCR excel worksheet.

To complete the BCR, the Consultant will input data in the excel worksheet's ***Data Entry sheet***. The excel worksheet has been designed to limit the number of required inputs from the Consultant. Cells with designated formatting (coloured cells) indicates input is required.

The Consultants' input is required for the following worksheet cells:

Administrative Region: select one of five provincial administrative regions the Local Study Area is located within.

Mitigation Name: create a mitigation name based on nearest landmark, e.g., Rock Creek Underpass.

Mitigation Zone Length (km): is the overall extent of the highway that will be mitigated by the conceptual design (i.e., the total length of fenced highway, total extent of the ADS sensors) and is based on the road name, control section, and highway kilometers at each mitigation end location. This value is automatically calculated in the AWW website tool's ***Mitigation tab*** when creating a mitigation project and needs to be manually inputted into the excel worksheet.

Average Collisions Per Kilometre Per Year (Average Collisions/km/yr) in Mitigation Zone: a value for this field is automatically calculated in the AWW website tool's ***Mitigation tab*** when creating a mitigation project and needs to be manually inputted into the excel worksheet. The website tool automatically calculates the average collisions/km/year based on the road name, control section, and highway kilometres of the Consultant's mitigated zone.

The average collisions/km/year is calculated using the Alberta Collision Information System (ACIS) collision data that is available in the AWW website tool.

Mitigation Description: an applicable description that best reflects each alternative conceptual mitigation design (e.g., fence with underpass).

Expected Collision Reduction (ECR; %): a reduction in the number of AVCs is assumed when AVC mitigation is applied; however, each mitigation may differ in its effectiveness in reducing AVCs. An ECR is a percentage used to compute the expected number of collisions reduced after implementing a given mitigation. Standard ECRs for various mitigations are currently provided by the Department in Appendix A and in the excel worksheet. Standard ECRs are currently based on a literature review of ungulate-vehicle collision reduction but will be evaluated and improved over time.

Mitigation Components: a conceptual design may include several mitigation components. For example, 1) an exclusion fence with escape structures and wildlife guards, 2) an Animal Detection System (ADS), and 3) an underpass. The worksheet allows a maximum of five mitigation components.

Construction Costs ($): estimated cost to build each mitigation component, as estimated by the Consultant in Step 5. Does not include engineering costs, contingency estimates, or the costs associated with an already scheduled project (e.g., a bridge upgrade). The Consultants shall provide an initial, high-level, cost estimate to construct each mitigation design based on previous mitigation experience, the Department's unit price averages, and or a literature review.

Annual Operating Costs ($): standard annual estimated operating and maintenance costs for the AVC mitigation, in present day values. The Department has estimated the annual operation costs for the Consultant and are available in Appendix B and in the excel worksheet.

Life Cycle: The Department uses the following estimated life cycle values (or service life) for AVC mitigation (also refer to Appendix C and the excel worksheet):

- Fence = 25 years
- ADS = 10 years
- Overpass/Underpass = 75 years
- Signage = 10 years

It is assumed that a Removal plus Replacement cost (refer below) is required the year after the life cycle value. For complex project alternatives that include mitigation components with different life cycles, the specific construction, operating, and maintenance costs for each component must be entered separately (Mitigation Components 1-5 provided in the excel worksheet).

Although the benefit cost analysis worksheet calculates a residual value of mitigations with life cycles up to a maximum of 75 years, the total residual value is displayed at year 20 of mitigation measures for display purposes and to standardize with existing Department models.

Removal plus Replacement Costs ($): The estimated cost of removal and replacement of the proposed alternative in present day values as estimated by the Consultant.

Collision Cost ($): The model has pre-selected the estimated cost of an AVC to be $100,000 and is based on the probability of a rural collision on two-lane highways. This cost considers the probability of a rural collision being either a human fatality, a non-fatal injury, or a property damage-only collision and the approximate values that the Department ascribes to each.

Specifically, fatalities are valued at $9,102,367, non-fatal injuries at $66,744, and property damage-only at $5,851 (Alberta Transportation 2017). For a two-lane paved highway, the Department uses standard values which estimate that fatalities comprise 1.0%, non-fatal injuries comprise 12.8% and property damage only accidents comprise 86.2% of collisions. Thus, for a two-lane paved highway: (0.01*$9,102,367) + (0.128*$66,744) + (0.862*$5,851) = $104,611 = ~$100,000. It is acknowledged that fatality rates for AVCs are typically lower than the Department's standards used here and vary depending on the species involved in the collisions; however, these are standard rates and are used to maintain consistency with other Department cost models.

7.3 Model Output

Results of the analysis are calculated within the BCR excel worksheet's ***Results sheet***. Results of the Benefit Cost Ratio (BCR) helps Consultants to compare the mitigation design alternatives.

Benefit Cost Ratio: This calculation compares cost savings (benefits) of a conceptual design alternative over time compared to the costs (or investment). The BCR is the present value of benefits divided by the present value of costs. The benefits (in the numerator) associated with each alternative are equal to the non-investment cost savings for that alternative. Costs are reflected in the denominator and are obtained by comparing the Total Discounted Investment Costs of each alternative.

Typically, the results of a benefit cost analysis are represented as a ratio. Where the ratio is greater than 1, benefits exceed costs, and the conceptual AVC mitigation design provides overall benefits over its defined life cycle. A benefit cost ratio indicates return on investment.

8.0 Prepare the AVC Mitigation Plan Report

8.1 Prepare the Report

The Consultant shall document the results of each planning step in an AVC Mitigation Plan report. The AVC Mitigation Plan report should be organized similar to this Guideline. Specific details, such as the WSSR Record (Section 3.4) and Benefit Cost and detailed results (excel ***Data Entry and Results sheets***), should be provided as an appendix.

8.2 Upload the Mitigation Plan into the Website Tool

The Consultant must add the WSSR Records into the AWW website tool's ***WSSR tab***, the final mitigation plan report into the AWW website's ***Mitigation tab***, and all records into the Environmental Regulatory Tracking Application. The Consultant is also responsible for keeping these records up to date.

References

Alberta Transportation. 2017. Benefit Cost Model and User Guide. Applications Management Consulting Ltd. Edmonton, Alberta.

Found, R. and M. Boyce. 2011. Predicting deer-vehicle collisions in an urban area. *Journal of Environmental Management*. Vol. 92(2). pp. 2486-93. [online] https://www.ncbi.nlm.nih.gov/pubmed/21700381

Huijser, M.P., E.R. Fairbank, and F.D. Abra. 2017. The Reliability and Effectiveness of a Radar-Based Animal Detection System. Center for Environmentally Sustainable Transportation in Cold Climates and U.S Department of Transportation. INE:CESTiCC 17.14 [online] https://scholarworks.alaska.edu/handle/11122/9596?show=full

Huijser, M.P., E.R. Fairbank, W. Camel-Means, J. Graham, V. Watson, P. Basting, and D. Becker. 2016. Effectiveness of short sections of wildlife fencing and crossing structures along highways in reducing wildlife-vehicle collisions and providing safe crossing opportunities for large mammals. *Biological Conservation*. Vol. 197. pp 61-68.

Huijser, M.P., J.W. Duffield, A.P. Clevenger, R.J. Ament, and P.T. McGowen. 2009. Cost–benefit analyses of mitigation measures aimed at reducing collisions with large ungulates in the United States and Canada; a decision support tool. *Ecology and Society* 14(2): 15. [online] URL: https://www.ecologyandsociety.org/vol14/iss2/art15/

APPENDIX A

Expected Collision Reduction of Mitigations

Below is the estimated effectiveness of the various mitigations to reduce ungulate-vehicle collisions (i.e., expected collision reduction).

APPENDIX A: EXPECTED COLLISION REDUCTION OF MITIGATIONS

Mitigations	**Mitigation Components**	**Expected Collision Reduction (%)** [1]	**Source**
Animal Detection System	Doppler Radar [2]	50%	Huijser et al. 2009; Huijser et al. 2017
Exclusion Fence (≥5 km) [3]	Fence (with dig barrier)	80%	Huijser et al. 2016: 80%
	Fence & Overpass/Underpass	80%	Huijser et al. 2016: 80%
	Fence & Animal Detection System	80%	Huijser et al. 2009: 87%; Huijser et al. 2016: 80%
Exclusion Fence (<5 km) [3]	Fence (with dig barrier)	50%	Huijser et al. 2009: 86%; Huijser et al. 2016: 50%
	Fence & Overpass/Underpass	50%	Huijser et al. 2009: 86%; Huijser et al. 2016: 50%
	Fence & Animal Detection System	70%	Huijser et al. 2009: 87%; Huijser et al. 2016: 50%
Signage	Seasonal Wildlife Warning Sign [4]	25%	Huijser et al. 2009: 26%
	Urban Wildlife Signage	35%	Found and Boyce 2011
Vegetation Management *	Mowing/Brushing	40%	Huijser et al. 2009

1. Effectiveness will vary from site to site.
2. Doppler radar systems should be considered experimental, and the effectiveness is highly dependent on maintenance.
3. Measured in road length.
4. Ineffective if not specific to time/place/season.

* Vegetation Management is considered repair and maintenance works that can likely be completed under existing Alberta Transportation and Economic Corridors' contracts.

APPENDIX B

Standard Annual Operating Costs

The AWW Benefit Cost Model assumes the following annual operating and maintenance costs for AVC mitigation. These coarse estimates support a consistent evaluation of mitigation plans across the province and will be evaluated and improved over time.

APPENDIX B: STANDARD ANNUAL OPERATING COSTS		
Mitigations	**Annual Operating Cost [1] as a % of Construction Cost**	**Annual Operating Cost Assumptions**
Animal Detection System	5%	Trial system with advanced technology components (includes annual power and telecommunications-related costs)
Crossing Structure, Overpass	0%	Negligible costs when compared to the overall construction cost
Crossing Structure, Underpass	0%	Negligible costs when compared to the overall construction cost
Exclusion Fence (with jump-outs and a wildlife guard)	1%	Small repair costs when compared to the overall construction cost
Road Salt Alternatives	0%	Negligible costs (purchase included in the initial capital cost)
Signage (illuminated)	5%	Includes annual power-related costs
Signage (all)	0%	Negligible costs
Vegetation Management (i.e., mowing, brushing)	0%	Negligible costs

[1]. Coarse estimate of annual maintenance and operating costs adequate to cover inspections, repair, and operation within the service life of the mitigation.

APPENDIX C

Standard Life Cycles

The AWW Benefit Cost Model assumes the following standard life cycles for AVC mitigation. These coarse estimates support a consistent evaluation of mitigation plans across the province and will be evaluated and improved over time.

APPENDIX C: STANDARD LIFE CYCLES	
Mitigation	**Life Cycle (years)**
Animal Detection System	10
Crossing Structure, Overpass	75
Crossing Structure, Underpass	75
Exclusion Fence ≥ 5 km	25
Exclusion Fence < 5 km	25
Signage	10