BRITISH COLUMBIA

Ministry of Transportation

# Grand Forks to Christina Lake

# Wildlife Mitigation Measures Business Case

## FINAL REPORT






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## EXECUTIVE SUMMARY

In 2004, the Ministry of Transportation contracted Urban Systems Ltd. to conduct a business case to determine the most appropriate means of addressing wildlife collisions on a segment of Highway 3 between Grand Forks and Christina Lake. The objective of this report is to confirm the project desirability and viability, generating a business case to advance the project to construction. This report seeks to identify appropriate mitigation measures and presents options for implementation as well corresponding cost estimates.

Highway 3 is an 840 km Provincial highway corridor traversing the Southern Interior of BC, essentially connecting the Town of Hope to the Alberta border and all the communities in between. While it largely plays a secondary role when compared to other primary links in the Southern Interior, such as Highway 1 (Trans-Canada Highway (TCH)) and Highway 97, it provides connection to the US and is a highly valuable asset providing a 'lifeline' to many small communities. The highway provides access to services, goods and recreational areas within the Province, as well as providing east-west support for the TCH.

The section of Highway 3 being analyzed as part of this business case assignment is located between the communities of Grand Forks and Christina Lake. This part of the Kootenay Boundary region is home to high value deer habitat and indeed there have been a significant number of collisions with deer. These collisions have led to the death of wildlife, and resulted in damages to vehicles and injuries to people.

The implementation of wildlife mitigation measures has been recommended in the Highway 3 Corridor Investment Strategy. This recommendation is supported by reports prepared by the Ministry of Transportation that have noted that this area has a high number of wildlife collisions. According to the Highway Accident System (HAS) data from January 1993 to December 2003, there were a total of 232 collisions on this section of Highway 3. Eighty-eight of these collisions involved wildlife as the first contributing factor. This comprised 38% of the total number of collisions on the corridor, easily the highest proportion of collisions.

Wildlife collisions have economic costs, both in terms of damage to property, injuries to people and potentially fatalities as well as costs due to the loss of the actual wildlife. Table 1 provides a summary of the economic costs associated with wildlife collisions on a yearly basis on this corridor.

**Table 1: Economic Costs of Wildlife Collisions**

| Type | Cost Per Incident | Number Per Year | Total |
|---|---|---|---|
| Injury Collisions | $99,999 | 0.9 | $90,000 |
| PDO Collisions | $7,342 | 13 | $95,446 |
| Cost of Deer Clean-up | $100 | 60 | $6,000.00 |
| Lost Opportunity for Resident Hunting Licence Fee | $15 | 9.7 | $145.50 |
| Lost Opportunity for Non-Resident Hunting Licence Fee | $125 | 0.3 | $37.50 |
| Net Value to British Columbia – Resident Hunter | $1,270 | 9.7 | $12,319.00 |
| Net Value to British Columbia – Non Resident Hunter | $7,450 | 0.3 | $2,235.00 |
| | | | $206,183 |

In combination with other factors, the total economic cost of accidents per year is approximately $206,000.

A number of mitigation measures have been proposed. These include wildlife fencing, wildlife reflectors, wildlife repellent, signage and wildlife passage structures and are summarized in Table 2.

**Table 2: Countermeasures Summary**

| Countermeasure | Cost | Effectiveness |
|---|---|---|
| Wildlife Exclusion Fencing | High ($40,000 - $80,000 per km plus maintenance) | High (85% - 100% reduction in wildlife kills) |
| Wildlife Reflectors | Moderate ($10,000 per km, maintenance $500 - $1000 per year per km) | Varying (little impact in some areas, moderate impact in other areas). Effectiveness not proven |
| Wildlife Repellents | Moderate | Impractical (must be reapplied constantly and effectiveness over large area questionable). Effectiveness not proven |
| Signage – non-dynamic | Low | Low (often ignored by motorists) |
| Signage – dynamic | High | Effectiveness not proven |
| Wildlife Grade Separation | High ($1 M +) | High in combination with other methods, particularly fencing |

As is indicated in Table 2, wildlife exclusion fencing provides the most proven effectiveness. For this reason, it was determined that wildlife fencing would be the most suitable option for further exploration.

Three fencing options have been proposed for further examination. Option 1 builds on the existing fencing and extends eastward to km 143.7 with fencing on either side of the highway. Option 2 extends Option 1 to 144.1 and encompasses a small cluster of homes on the south side of the highway, while connecting to Stewart Creek Road on the north side. Option 3 extends from the previous two options to km 144.4 and ties into the Kettle Valley Railway trail bridge. The Multiple Account Evaluation summary is included in Table 3 below.

**Table 3: Multiple Account Evaluation Summary**

| | Option 1 | Option 2 | Option 3 |
|---|---|---|---|
| **Financial** | | | |
| Project Cost | $1,790,640 | $1,818,590 | $2,104,153 |
| **Discounted Costs** | | | |
| Project Cost | $1,689,280 | $1,715,646 | $1,853,000 |
| Salvage Value | $0 | $0 | $0 |
| Increased Maintenance Cost | $228,900 | $232,500 | $251,000 |
| Reduced Rehabilitation Cost | | | |
| **Life Cycle Cost** | **$1,918,183** | **$1,948,146** | **$2,104,153** |
| **Customer Service** | | | |
| Reduced Travel Time Cost | $0 | $0 | $0 |
| Other Benefits | $238,280 | $238,280 | $252,296 |
| Reduced Accident Costs | $2,130,873 | $2,130,873 | $2,256,218 |
| **Total User Benefits** | **$2,369,154** | **$2,369,154** | **$2,508,516** |
| **Community Social** | Moderate | Moderate | Moderate |
| Full Property Takings | None | None | None |
| Partial Property Takings | None | None | None |
| Property Impacts/Community Separation | Moderate | High | High |
| **Economic** | | | |
| Net Present Value | $450,971 | $421,007 | $404,362 |
| Benefit Cost Ratio | 1.24 | 1.22 | 1.19 |
| NPV Project Cost Ratio | 0.2 | 0.2 | 0.2 |
| **Environmental** | Significant | Significant | Significant |
| | | | |

Based on the Multiple Account Evaluation, it was determined that Option 1 was the preferred option as it demonstrated the highest benefit-cost ration. The advantage of this option is that it allows a phased approach to installing the fence. While it is believed Option 1 will be quite effective, there is also the ability in the future to pursue the other two options proposed in this report as each option builds on the other.

A number of technical risks have been identified. These are mainly due to the lack of more detailed information and the potential that existing fencing is not of a sufficient standard to deter wildlife from entering the highway corridor, thus circumventing to a certain extent the benefits incurred. However, these risks are well accounted for in project cost contingencies.

Since this project will have strong benefits to groups with non-transportation mandates, there is a strong possibility for project partnership. A number of funding programs have been identified and these should be explored further to determine opportunities for sharing project costs.

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**APPENDICES**

## GLOSSARY OF TERMS

| | |
|---|---|
| MoT | Ministry of Transportation |
| HAS | Highway Accident System |
| WARS | Wildlife Accident Reporting System |
| LKI | Landmark Kilometre Inventory |
| PDO | Property Damage Only collision |
| ICBC | Insurance Corporation of British Columbia |
| Collision Modification Factor | The reduction in the number of collisions that can be expected with a proposed mitigation measure |
| MAE | Multiple Account Evaluation |
| MicroBENCOST | Computer software program used to calculate benefit-cost ratios |
| Salvage Value | The amount of cost saved through the reuse or recycle of existing infrastructure |
| Travel Time Cost | Costs of travel time based on hours of travel |
| Other Benefits | Benefits derived from reduced economic loss for wildlife values |
| Net Present Value | The value of the construction project in current (2004) dollars |
| Benefit Cost Ratio | Is the comparison of project benefits to project costs. A value of greater than 1 indicates that the project has greater benefits than costs |
| Life Cycle Cost | Is the discounted project cost less the salvage value plus the increased maintenance cost |
| User Benefits | Total benefits to the public of the highway project including reduced accident costs, travel time savings and other economic benefits |

## 1.0 INTRODUCTION

Highway 3 is an 840 km Provincial highway corridor traversing the Southern Interior of BC, essentially connecting the Town of Hope to the Alberta border and all the communities in between. While it largely plays a secondary role when compared to other primary links in the Southern Interior, such as Highway 1 (Trans-Canada Highway (TCH)) and Highway 97, it provides connection to the US and is a highly valuable asset providing a 'lifeline' to many small communities. The highway provides access to services, goods and recreational areas within the Province, as well as providing east-west support for the TCH.

The section of Highway 3 being analyzed as part of this business case assignment is located between the communities of Grand Forks and Christina Lake. Grand Forks is a community of approximately 4000 people with an area population of 10,000 people. Christina Lake, located approximately 20 km east of Grand Forks is a small tourist based centre home to many summer homes. The highway is primarily a two lane facility though there are two long passing lanes supporting mobility in both the east and westbound directions. Annual daily traffic through this area is approximately 4500-5000 vehicles with heavy trucks comprising 10 – 15% of this traffic.

This part of the Kootenay Boundary region is home to high value deer habitat and indeed there have been a significant number of collisions with deer. These collisions have led to the death of wildlife, and resulted in damages to vehicles and injuries to people. The Ministry of Transportation (MoT) contracted Urban Systems Ltd. to undertake a business case to examine the various wildlife deterrents available to prevent wildlife from entering the Highway 3 corridor between Grand Forks and Christina Lake.

The implementation of wildlife mitigation measures has been recommended in the Highway 3 Corridor Investment Strategy. This recommendation is supported by reports prepared by the Ministry of Transportation that have noted that this area has a high number of wildlife collisions. Locally, it has been a significant issue with the public and one landowner in the area has already started constructing wildlife fencing in the area. Support for mitigation measures is high. Questions remain

however to the most appropriate mitigation measure, the cost of the mitigation measures, the funding strategies and the location of features to prevent wildlife from entering the roadway.

## 1.1 Report Objectives

The objective of this report is to confirm the project desirability and viability, generating a business case to advance the project to construction. This report seeks to identify appropriate mitigation measures and presents options for implementation as well corresponding cost estimates.

The business case will address the following, in accordance with the Ministry of Transportation's requirements for capital program development and the terms of reference stated in the Request for Proposals:

- the rationale for the project in terms of identified and defined highway deficiencies;
- the cost-effectiveness of the proposed project;
- the impacts of the project on external stakeholders; and
- the identification of potential funding agencies.

The business case report will be generated based upon a simplified multiple account evaluation process, consistent with the level of detail for which information regarding the project is available and within the limitations of the scope. The business case will include a quantitative assessment comparing the relative benefits to the cost estimate generated and will be performed based upon the application of the MicroBENCOST model with Ministry of Transportation default values. In addition, a qualitative assessment of the remaining accounts will also be performed, rounding out the process to the extent possible.

## 1.2 Project Study Area

The project study area is illustrated in Figures 1.1 and 1.2. The project study area is Highway 3 corridor between the communities of Grand Forks and Christina Lake. This section of Highway 3 is referenced on the MoT's landmark kilometre inventory (LKI) system as segment 1325 between km 128 and km 145.

**Figure 1.1 – Regional Context**

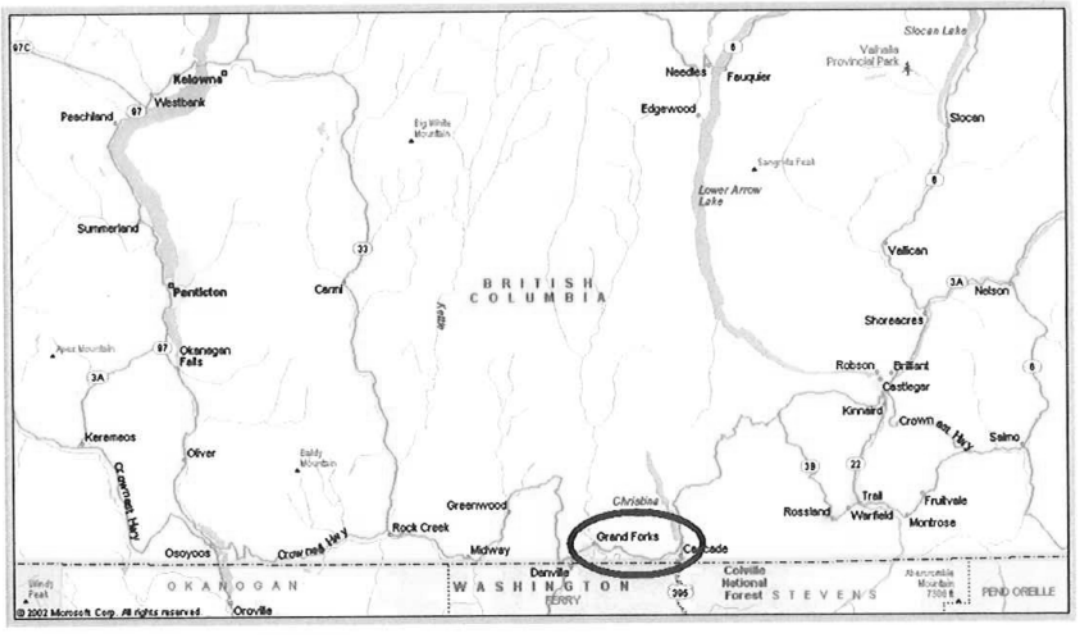



**Figure 1.2 – Highway 3: Grand Forks to Christina Lake**

## 2.0 PROBLEM DEFINITION

This business case seeks to identify the problem based on safety measures and discussions with Ministry of Transportation and Ministry of Water, Lands, and Air Protection staff, who have provided background information pertaining to wildlife in the Grand Forks area.

Since this business case focuses on the safety aspects of wildlife collisions and the impacts to wildlife, no analysis of mobility is being undertaken as the corridor already has a posted speed of 100 km/h and this is unlikely to be increased in the future. Further, the installation of wildlife mitigation measures will have no impact on highway capacity.

### 2.1 Wildlife Patterns

Brian Harris, a wildlife biologist with the Ministry of Water, Lands and Air Protection (MWLAP), indicated that most of the wildlife that would enter the highway corridor between Grand Forks and Christina Lake would be white-tailed deer. These would comprise 80-90% of the wildlife found on the corridor. Other species of wildlife found in the area include mule deer, bighorn sheep and elk.

The mule deer suffered badly in the winter of 1996/97 when the population was reduced by 50%. The population has rebounded significantly everywhere except for the Grand Forks area where it is still down 30-40%. MWLAP would like to protect these animals to ensure that the population grows in the future.

In addition to the deer population, there are approximately 200 elk located east of Christina Lake of which, 30-40 have migrated to the west of Christina Lake. As well, there are 200 bighorn sheep in the area.

The migratory routes of deer take them back and forth across Highway 3 and the Canada-US border. Many of the deer winter in Canada and migrate to the United States during the spring and summer. The area is a in a low elevation valley bottom and provides winter range for the animals mentioned (Gyug, 22). The highway runs at the base of the steep south-facing grasslands that are very productive ungulate winter and spring range (Gyug, 22).

The installation of a physical barrier would impact the migratory routes of deer. If a physical barrier were constructed in the winter months, it would keep more of the animals in Canada. The one potential issue with a physical barrier is that it would limit the ability of animals to access the Kettle River which may be a source of drinking water for wildlife. However, Mr. Harris

indicated that this is not a significant concern at this time as deer are resourceful and can find other sources of water.

## 2.2 Wildlife Collisions

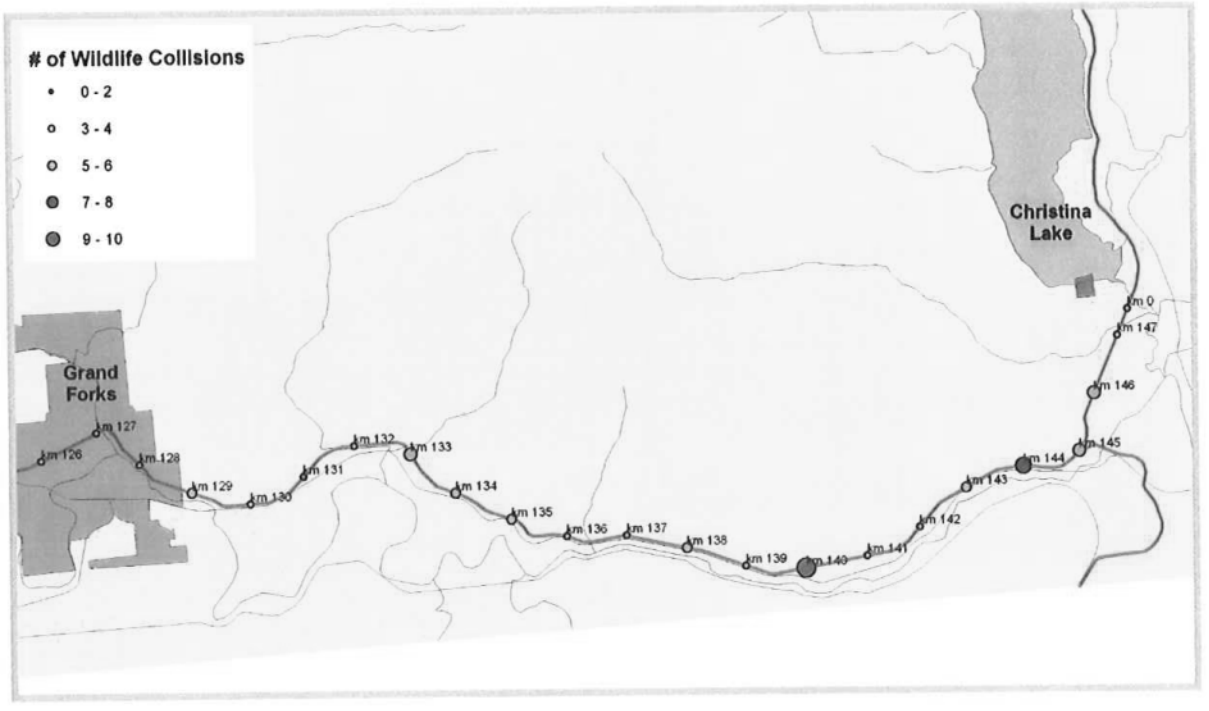
As has been noted, there have been a significant number of collisions with wildlife on this corridor, principally with deer. These collisions have an impact on people in terms of damage to property, injuries and fatalities, as well as additional costs to society in terms of lost wildlife for other purposes such as hunting and recreational pursuits, and cost of clean-up of road kill. The Ministry of Transportation and other agencies have calculated the economic costs of various components of wildlife collisions and these will be used to determine the potential benefit of wildlife mitigation measures.

Tracking wildlife collisions has been challenging but there are two main sources of information pertaining to these events. The first is the MoT's Highway Accident System (HAS) database which details the location, first contributing cause and severity of all reported collisions. The second source is the MoT's Wildlife Accident Reporting System (WARS) database, which is information collected from contractors and road crews and gives a general location of where road-killed wildlife is found. Data from these two sources are summarized in the following sections.

### *2.2.1 Highway Accident System*

The HAS database allows users to query and analyze data of traffic accidents on Provincial jurisdiction highways. The data comes from the ICBC Traffic Accident System database. As mentioned earlier, this data includes the location by LKI, the first contributing cause and severity of all reported collisions. Severity is measured by whether the collision caused Property Damage Only (PDO), Injury, or Fatality. One of the first contributing factors that is tracked specifically in the database is whether the collision was the result of wildlife. HAS data from January 1993 to December 2003 indicated that there were a total of 232 collisions on this section of Highway 3. Eighty-eight of these collisions involved wildlife as the first contributing factor. This comprised 38% of the total number of collisions on the corridor, easily the highest proportion of collisions. Seven of the collisions resulted in injuries to motorists. Figure 2.1 indicates the location of wildlife collisions on the corridor.

**Figure 2.1 – Wildlife Collisions – 1994 – 2004**




The MoT uses a default value depending on the severity of a collision to determine the total cost of a collision. The MoT uses a value of $99,999 for collisions causing injury and $7,342 for a collision causing property damage only. Collisions from January 1993 to December 2003 would have cost approximately $1.3 million.

For the purposes of further analysis, HAS data from 1993 to 1995 was used to derive wildlife collision frequencies. In this period, there were 65 collisions with wildlife. Four of these collisions resulted in injuries while 61 resulted in property damage only. The rationale for this is that there was a period of underreporting of collisions in 1996 and 1997. Since that time, data reporting has stabilized but with a tendency towards lower reporting. While this in itself is not a significant issue, the data from 1993-1995 more closely resembles the information obtained from other data sources, such as Wildlife Accident Reporting System, indicating the total number of deer killed on the corridor. Therefore, it is assumed that data from 1993-1995 provides a more accurate picture of collision history on the corridor. In order to take into account the benefits of the existing fencing, which has been constructed in this time, the number of collisions was reduced by 35% to reflect the fact that approximately 35% of the corridor has been fenced by private interests.

### 2.2.2 Wildlife Accident Reporting Summary

According to the report *WARS 1983-2002 Wildlife Reporting and Mitigation in British Columbia*, "WARS was designed to systematically record the location, number and type of wildlife accidents reported by BCMoT Maintenance Contractors on numbered highways in British Columbia" (Ministry of Transportation 2004). Data from WARS for the Grand Forks to Christina Lake area was synthesized from a report entitled *Crowsnest Highway No.3 Corridor Study: Wildlife Accident Overview*. This information indicated that there are approximately 60 animals killed per year on the corridor between Grand Forks and Christina Lake.

The WARS report provided values for the cost of each wildlife accident. These are based on research conducted by the Ministry and other generalized assumptions made. These are summarized in Table 2.1.

**Table 2.1 – Cost to the Province of Wildlife Collisions**

| Factor | Value |
|---|---|
| Cost of Wildlife Clean-up | $100 |
| Lost Opportunity for Resident Hunting Licence Fee | $15 |
| Lost Opportunity for Non-Resident Hunting Licence Fee | $125 |
| Net Value to British Columbia – Resident Hunter | $1270 |
| Net Value to British Columbia – Non Resident Hunter | $7450 |

A report prepared by Keystone Wildlife Research estimated that approximately 17% of deer were killed by hunters. This represents lost opportunity for hunting in the province as well as lost revenue to the province in terms of licence fees and economic value. Non-resident hunters account for approximately 3% of hunting days in the province. These factors were applied to determine the potential per year cost of lost wildlife for hunting.

### 2.2.3 Summary of Economic Value of Wildlife Collisions

This section summarizes the economic value of wildlife collisions based on the sources outlined above. This is summarized on an estimated cost of wildlife collisions per year. Table 2.2 summarizes these costs.

**Table 2.2 – Summary of Wildlife Collisions Costs Per Year**

| Type | Cost Per Incident | Number Per Year | Total |
|---|---|---|---|
| Injury Collisions | $99,999 | 0.9 | $90,000 |
| PDO Collisions | $7,342 | 13 | $95,446 |
| Cost of Deer Clean-up | $100 | 60 | $6,000.00 |
| Lost Opportunity for Resident Hunting Licence Fee | $15 | 9.7 | $145.50 |
| Lost Opportunity for Non-Resident Hunting Licence Fee | $125 | 0.3 | $37.50 |
| Net Value to British Columbia – Resident Hunter | $1,270 | 9.7 | $12,319.00 |
| Net Value to British Columbia – Non Resident Hunter | $7,450 | 0.3 | $2,235.00 |
| | | | $206,183 |

As can be seen from the table above, the greatest economic cost of wildlife collisions occurred due to the cost of injuries and property damage sustained in the collision. These two factors alone had economic costs of greater than $185,000 per year. In combination with other factors, the total economic cost of accidents per year is approximately $206,000.

As can be seen in Table 2.2, the number of deer killed in one year does not equal the number of injury and property damage collisions. Reasons for this discrepancy include:

- Not all damage to vehicles due to wildlife collisions is reported due to the low cost of repair;
- Damage claims are not reported to ICBC if the motorist is out of province or if the motorist has private insurance; and
- Not all collisions with deer cause damage to vehicles.

However, it must also be concluded that one of the indices has been underreported. Given the anecdotal evidence of the number of deer struck and killed on this section of Highway 3, it is likely that HAS data does not have an adequate record of all collisions or that the first contributing factor of collisions was misrepresented.

## 3.0 POTENTIAL MITIGATION MEASURES

Transportation authorities throughout the world have experimented with a number of mitigation measures designed to deter wildlife from entering highway corridors with varying degrees of success. One issue in determining the appropriate mitigation measure is the cost that will be incurred as the cost of many of these measures varies significantly. In assessing the type of mitigation method to use there must be a balance between the capital cost and the expected benefit to arise and the degree of success that is needed. For instance, if wildlife is present along the corridor, but has not caused significant conflict, it may be appropriate to select a lower cost solution. However, if there has been significant conflict, a higher impact solution may be required which in many instances incurs a higher cost.

The most common methods used to mitigate wildlife collisions include wildlife fencing, wildlife reflectors, wildlife repellent, signage and wildlife passage structures. These are summarized in the sections below.

### 3.1 Wildlife Exclusion Fencing

Wildlife fencing acts a physical barrier to wildlife accessing highway corridors. The size and extent of fencing depends on the type of wildlife that is prone to accessing the highway corridor. If, for example, the desire is to prevent deer from entering the corridor, fencing must be 2.4 m high and have specific tie points. It is one of the most expensive options but achieves the most success as there is an actual physical barrier that is erected. Further success is achieved if fencing is constructed on both sides of the corridor where there is not a natural barrier on one side to prevent deer from entering the corridor. In order to be truly successful, proper ungulate guards or gates must be installed at highway access points. In addition, measures that allow wildlife to pass through wildlife fencing are recommended approximately every two kilometres for the length of the fencing. Two common measures include the installation of one way gates that allow wildlife to pass through and raised platforms that allow deer to pass over the fence. It can cost between $40,000 and $80,000 per kilometre to install wildlife fencing on both sides of the highway depending on the terrain. "Exclusion fencing is the most effective means of keeping wildlife off highway right-of-ways" with reductions of between 93% and 99% in the number of wildlife-vehicle collisions (Ministry of Transportation, 2004). In previous reports, maintenance costs were estimated to be 1% of construction costs per annum.

### 3.2 Wildlife Reflectors

Reflectors have been installed along many of BC's highways. "The reflectors are prisms mounted on posts and installed on along the sides of the highway as a means of deterring animals from entering the highway when vehicles are present" (Ministry of Transportation, 2004). Lights from vehicles reflect off the prisms, which in turn reflect beams of light at 90 degree angles to the roadway. It is believed that wildlife will stop their movements when the light is reflected into their eyes. Reflectors cost approximately $10,000/km to install and have ongoing maintenance costs of $500 - $1000 annually. While there has been some measure of success with the use of wildlife reflectors, they have some distinct shortcomings including the fact that they require cleaning, have been targeted by vandals and are frequently installed incorrectly. There have been few long term studies that have been completed that the effectiveness of wildlife reflectors. Therefore, it is difficult to determine what kind of impact reflectors could have.

### 3.3 Wildlife Repellent

In some examples, authorities have sprayed a wildlife repellent near the highway to keep wildlife away from the right-of-way. These repellents have had varying degrees of success. One issue is the fact that the repellent must be re-applied frequently and thus are not as practical as other wildlife exclusion methods. Further, while there has been some success with regards to repellents, widespread application has been found to be impractical and therefore application of repellent may need to be focused on specific, high-collision areas.

### 3.4 Signage

Wildlife warning signs are placed along highways where a need for them has been identified. While data can be used to determine placement of signs, often times it is anecdotal evidence that leads to the installation of wildlife signs. Signs are by far the cheapest option for addressing wildlife issues with an individual sign ranging in price from $150 to $550. However, in a study done in Sweden, it was noted that drivers only noticed approximately 37% of conventional signs along the roadway which may challenge the effectiveness of wildlife signs.

More advanced signage includes those that warn motorists that there is indeed an animal on the road up ahead. These signs utilize a low power microwave beam that covers the highway and detects movement in the highway corridor. In one case study, this led to a 100% reduction in the number of wildlife collisions (Keystone Wildlife Research, 1997). The one drawback is that this type of signage is expensive and therefore widespread installation on a corridor is not

feasible. Further, since there has not been widespread implementation of this type of signage throughout the province, there is little documented evidence of effectiveness.

### 3.5 Wildlife Passage Structures

Grade-separated wildlife passage structures have been installed to minimize habitat fragmentation, both independently and in conjunction with other wildlife exclusion means. They are the safest option for wildlife to cross the highway corridor. A natural environment must be present on the overpass to keep habitat similar and to encourage wildlife to use it. It has been noted that locating wildlife overpasses can be difficult due to terrain and geologic conditions. Emphasis is now being given to designing underpasses that meet both the wildlife and highway infrastructure needs and underpasses are being designed larger with special flooring to attract targeted species. This mitigation measure is installed in conjunction with wildlife fencing.

## 4.0 EVALUATION OF MITIGATION MEASURES

The mitigation methods detailed in Section 3 have a variety of costs and success rates. In determining the most appropriate mitigation method, the Ministry must balance the cost with the potential benefit. Table 4.1 offers a comparison based on cost.

**Table 4.1 – Wildlife Collision Countermeasures**

| Countermeasure | Cost | Effectiveness |
|---|---|---|
| Wildlife Exclusion Fencing | High ($40,000 - $80,000 per km plus maintenance) | High (85% - 100% reduction in wildlife kills) |
| Wildlife Reflectors | Moderate ($10,000 per km, maintenance $500 - $1000 per year per km) | Varying (little impact in some areas, moderate impact in other areas). Effectiveness not proven |
| Wildlife Repellents | Moderate | Impractical (must be reapplied constantly and effectiveness over large area questionable). Effectiveness not proven |
| Signage – non-dynamic | Low | Low (often ignored by motorists) |
| Signage – dynamic | High | Effectiveness not proven |
| Wildlife Grade Separation | High ($1 M +) | High in combination with other methods, particularly fencing |

The countermeasure that is most likely to achieve success would be the wildlife exclusion fencing. While the cost is high, strong results are almost guaranteed as long as fence maintenance is done regularly. Results from other methods are questionable at best and while the cost is not as significant as wildlife fencing, there is a strong likelihood that the problem will not be addressed properly and that property damage will continue to occur. Therefore, wildlife fencing is recommended as the preferred method.

## 5.0 OPTION GENERATION

In Section 4, wildlife exclusion fencing was identified as the preferred countermeasure for mitigating wildlife collisions. This would connect well with existing wildlife fencing in the area and would offer the most potential success. Fencing is to be included on both the north and south side of the highway. Three options have been considered for the installation of fencing on either side of the corridor. However, these three options have similar alignments for much of the corridor and include the following common components:

1) Use of existing fencing on the north side between km 128.9 and km 138.2, with the replacement of fencing between km 133.4 and km 134.1;
2) South side tie in point at km 128.9 at the west end;
3) North side tie in point at km 138.2 to connect with the existing fence;
4) Similar fence elements on both side of the highway to km 143.7;
5) Use of existing fencing on the south side between km 132.7 and km 132.7 and between km 133.1 and km 133.1; and
6) The need to address access points, private driveways and intersecting roads through either gates or ungulate guards.

Appendix A includes a conceptual drawing of the proposed common elements of the fence alignment. It also includes two potential locations for grade separated crossings of the highway. It must be noted that these are not explored further as an option at this time but may be considered in the future as part of road upgrades in the area. In addition, while not included on the drawings, it has been assumed that one-way gates would be required every two kilometres on either side of the highway.

The following sections provide a description of each of the proposed options. The proposed options differ in terms of their tie-in points at the east end of the corridor. A visual representation of the options is provided in Figure 5.1.

### 5.1 Option 1 – Tie-in at km 143.7

Option 1 would involve tying the fencing in at km 143.7 on either side of the corridor. This would leave approximately 1 km of the corridor (measured to the junction of Highway 3/395) exposed to wildlife and there is the potential that wildlife could eventually exploit the gap in fencing to continue their migration patterns and thus there would be a concentration of wildlife at this point. Thus, part of the rationale in selecting this tie-in point is based on the fact that the corridor, at this location, has favourable sightlines that would allow motorists to better see wildlife entering the highway right-of-way. This is important as having the fencing end in this location would concentrate deer crossings. Therefore, if this option is pursued, it is recommended that highly visibly and location specific signage be installed in conjunction to warn of the potential of deer crossing in this location and advising motorists to proceed with caution.

Another rationale for selecting this option is that it would avoid a cluster of private dwellings located in close proximity to the highway. This would limit some of the community/social impacts that the fencing would have, particularly segregation from the Kettle River.

### 5.2 Option 2 – Tie-in at km 144.1

Option 2 includes all of Option 1, but the fencing would be extended to end near Stewart Creek Road on the north side of the highway, while on the south side of the highway, the fencing would extend behind properties and tie in just east of the properties near the intersection of Stewart Creek Road.

There are two disadvantages of this option. The first is that the installation of fencing would impact private property and potentially the KVR recreational trail. The second disadvantage is that wildlife could be attracted to a field on the south side of the highway that is outside of the fenced area and become trapped in the corridor.

### 5.3 Option 3 – Tie-in at km 144.4

Option 3 includes Options 1 and 2, but would extend further eastward. On the north side of the highway, an ungulate guard would be installed on Stewart Creek Road and fencing would continue east and tie-in near the Highway 3/Highway 395 junction. On the south side of the highway the fence would be directed back towards the highway and then extend south to tie in with the northwest corner of the KVR trail bridge. Fencing would be extended from the east side of the bridge to the highway along the ridge that is present here.

This option most effectively excludes wildlife from the corridor. However, the terrain becomes more challenging for construction as there are some rock bluffs that would need to be constructed on. Another issue is the potential that deer would follow the fencing searching for an opening and end up on the highway. This may be mitigated by the addition of more one-way gates in this area.

## 6.0 OPTION EVALUATION

This section presents a summary of the project evaluation process for the fencing improvements currently being considered. A cost estimate has been generated using standard pricing for fencing, guards and gates provided by the Ministry of Transportation. Safety benefits associated with the proposed improvements are quantified using appropriate accident modification factors derived from previous reports outlining the effectiveness of wildlife exclusionary fencing in reducing wildlife collisions. Other financial account elements (i.e. changes in maintenance costs) are quantified using the MicroBENCOST model and the Ministry of Transportation 2003 default values.

The project, as it currently exists, includes installing fencing from Grand Forks to Christina Lake on both the north side and south side of Highway 3.

### 6.1 Multiple Account Evaluation

Multiple account evaluation (MAE) is the most common method of comparing and assessing projects used by the Ministry of Transportation. MAE is a form of multi-criteria decision support and uses a combination of quantitative and qualitative assessments organized by 'accounts'.

There are five accounts that are usually considered by the Ministry of Transportation, including:

- Financial;
- Customer Service;
- Social / Community;
- Economic Development;
- Environmental.

The criteria used in applying these accounts are described in the following sections.

#### *6.1.1 Financial Account*

The financial account represents the discounted life-cycle cost of the project. It includes all project costs (construction, engineering, project management), rehabilitation cost over the life of the analysis period, annual maintenance and salvage value, discounted over 25 years at 6% (the Ministry of Transportation's standard rate). The financial account does not include consideration

of cost-sharing or other differentiation between funding responsibility. Cost sharing opportunities should be considered exclusive of the MAE process. Costs are based on documented resources and information provided by the Ministry of Transportation. These include the following:

- $30 per lineal metre of fence
- $30,000 per 7.24 m ungulate guard
- $40,000 per 9.66 m ungulate guard
- $3000 per 3 m wide swing gate
- $6000 per 6 m wide swing gate
- $2500 per one-way gate assembly
- 35% Engineering and Contingency

Cost estimates are based on average costs for wildlife exclusion fencing and various complementary infrastructure from other MoT projects. Since terrain in this area is favourable for construction, it is anticipated that cost estimates are sufficient to cover the cost of inputs and project management. The contingency includes engineering costs and costs incurred due to potential alterations of the plan that may arise after public consultation with affected landowners.

A summary of the cost estimate generated on the prices provided by the Ministry is included in Table 6.1.

**Table 6.1 – Preliminary Cost Estimate Summary**

| | Option 1 | Option 2 | Option 3 |
|---|---|---|---|
| Construction Cost | $1,326,400 | $ 1,347,100 | $1,454,990 |
| Engineering and Contingency (35%) | $ 464,240 | $ 471,485 | $ 509,247 |
| Total | $1,790,640 | $ 1,818,585 | $1,964,237 |

### *6.1.2 Customer Service Account*

The customer service account is the cost to highway users expressed as dollar values for travel time, vehicle operating costs and collisions. Since there will be no benefits to mobility or change to vehicle operating costs as a result of this project, this has not been included.

Values for accident costs that have been established by the Ministry of Transportation have been used. Statistically, fatal collisions have a value to society of approximately $5.7 M, injury

collisions are $100,000 each and property damage collisions carry a value of approximately $7,300. All user costs are discounted over the 25-year analysis period at 6%. The sensitivity to the discount rate and other factors is provided in later sections.

Accident modification rates have been derived from previous reports which indicated collision reduction factors generally in the range of approximately 85% to 95%. Collision modification factors of 85% were applied to Options 1 and 2 and 90% to Option 3. These would be considered conservative estimates based on past studies.

This account will also include information pertaining to the cost of clean-up of road-killed deer and the potential loss of benefit from the death of a deer due to a highway collision.

### *6.1.3 Social / Community Account*

The social / community account assesses the potential effect of the highway project on communities and social values. Factors generally considered include:

- Noise, Visual and Pollution Impacts – exposure and magnitude of the impacts related to the highway project:
- Community Displacement – property takings, partial and full;
- Community Severance – the "barrier effect" of the highway on local vehicle and pedestrian traffic;
- Consistency With Community Plans – degree of support the project provides to local community plans; and
- Equity – changes that benefit one group at the expense of another.

These factors will be summarized in a simple qualitative assessment of the impacts given the localized context and impact of the improvements under review.

### *6.1.4 Economic Account*

This account provides an indication of **Provincial** economic benefits. Regional and local benefits are generally captured within the community / social account. Also, income and jobs generated during highway construction represent an economic benefit to the local area, but are a loss to other regions and thus there is no net provincial gain. The Provincial economic benefits are derived from reductions in out-of-pocket costs for transportation and health care due to reduced travel times, lower vehicle operating costs and reduced highway accident costs.

### *6.1.5 Environmental*

While this account should identify significant environmental issues, it is not a replacement for an environmental assessment. Where reliable information is available, the account should identify consumption of lands with specific environmental or other value, such as parks/protected areas, wetlands, agricultural lands and high habitat values. The account also includes fuel consumption and carbon monoxide emissions as calculated within MicroBENCOST.

The primary environmental issue related to this option is the blocking of deer movements across the highway. As mentioned previously, deer have been found to winter on the north side of the highway and then travel to the south for the spring and summer. An exclusion fence would impact these movements, even with the installation of one-way gates or similar fence bypass options.

## 6.2 Multiple Account Evaluation Summary

A summary of the MAE for the proposed fencing options is presented in Table 6.2. For the purposes of this analysis, construction is assumed to occur in 2005 (note the discounted project cost).

**Table 6.2 – MAE Summary – Grand Forks Wildlife Fencing**

| | Option 1 | Option 2 | Option 3 |
|---|---|---|---|
| **Financial** | | | |
| Project Cost | $1,790,640 | $1,818,590 | $2,104,153 |
| **Discounted Costs** | | | |
| Project Cost | $1,689,280 | $1,715,646 | $1,853,000 |
| Salvage Value | $0 | $0 | $0 |
| Increased Maintenance Cost | $228,900 | $232,500 | $251,000 |
| Reduced Rehabilitation Cost | | | |
| **Life Cycle Cost** | **$1,918,183** | **$1,948,146** | **$2,104,153** |
| **Customer Service** | | | |
| Reduced Travel Time Cost | $0 | $0 | $0 |
| Other Benefits | $238,280 | $238,280 | $252,296 |
| Reduced Accident Costs | $2,130,873 | $2,130,873 | $2,256,218 |
| **Total User Benefits** | **$2,369,154** | **$2,369,154** | **$2,508,516** |
| | Moderate | Moderate | Moderate |

| | | | |
|---|---|---|---|
| **Community Social** | | | |
| Full Property Takings | None | None | None |
| Partial Property Takings | None | None | None |
| Property Impacts/Community Separation | Moderate | High | High |
| **Economic** | | | |
| Net Present Value | $450,971 | $421,007 | $404,362 |
| Benefit Cost Ratio | 1.24 | 1.22 | 1.19 |
| NPV Project Cost Ratio | 0.2 | 0.2 | 0.2 |
| **Environmental** | Significant | Significant | Significant |
| | | | |

All three options demonstrate positive performance indicators entailing that this project would be a desirable investment for the MoT. This is despite the significant contingency applied to the project costs, the conservative estimate for collision modification rates and the potential that HAS data has underreported the number of wildlife collisions resulting in injury or property damage only. This is also in the absence of any fatal collisions, which is a real possibility given the high wildlife collision rates.

The primary benefits associated with this project are the reduction in deer collisions causing property damage, injuries and potentially fatalities, as well as a reduction in deer fatalities that require highway clean-up and loss of economic value for hunting. A significant safety problem related to wildlife has been identified on this section of Highway 3. Over 30% of collisions on this corridor during the past ten years have had a first contributing factor listed as wildlife. It was assumed for this analysis that wildlife collisions would be reduced by 85% for Options 1 and 2 and 90% for Option 3 as this option provides more extensive fencing.

The community and social impacts are deemed to be moderate for Option 1 and potentially higher for Options 2 and 3. For Option 1, there will be some impact on properties located on the highway. However, this is offset by the fact that many of the properties, while directly accessing the highway, have many of their main facilities a significant distance from the highway. One possibility is that in consultation with property-owners, they may request that fencing be installed at the back of their properties as opposed to along the highway. This potential property impact is common to Options 2 and 3 as well. The community and social impacts are considered more significant for Options 2 and 3 as there is a cluster of homes that no matter where the fencing is located, there may be some issues of aesthetic appeal. This is due to the smaller parcel sizes and the shorter distance between the highway and the river. In addition, while the Kettle River runs parallel to Highway 3 throughout the study area, the fencing in this area could potentially act as a more significant barrier to the river then in those areas covered by Option 1. Further, there may be some impact on KVR Recreational Trail, which is part of the Trans Canada Trail and is used by cyclists. Community consultation will be required.

Environmental impacts are deemed to be significant. This project will alter deer migratory patterns as it will impose a physical barrier. However, there should be a significant reduction in the number of deer that are killed as a result of highway collisions.

## 6.3 Sensitivity

A sensitivity analysis was conducted to test the sensitivity of the following for each of the options:

- Discount rate (4%, 8% and 10%)
- Cost estimate (50%, 150%)
- Traffic growth rates (1.5%, 5.0%)

The results are presented in Tables 6.3 to 6.5 below.

**Table 6.3 - Sensitivity Analysis – Option 1**

| **Discount Rate** | **6%** | **4%** | **8%** | **10%** |
|---|---|---|---|---|
| Discounted Project Cost | $1,689,283 | $1,721,769 | $1,658,000 | $1,627,855 |
| Salvage Value | | | | |
| Incr. Maintenance | $228,900 | $279,000 | $191,100 | $162,500 |
| Reduced Rehab | | | | |
| Life Cycle Cost | $1,918,183 | $2,001,469 | $1,849,100 | $1,790,355 |
| User Benefits | $2,369,154 | $3,047,144 | $1,882,894 | $1,526,480 |
| Net Present Value | $450,971 | $1,045,674 | $33,794 | -$263,874 |
| Benefit Cost Ratio | 1.24 | 1.52 | 1.02 | -0.1 |
| **Cost Estimate** | | **50%** | **150%** | |
| Project Cost | $1,790,640 | $895,320 | $2,685,960 | |
| Discounted Project Cost | $1,689,283 | $844,642 | $2,533,925 | |
| Salvage Value | | | | |
| Life Cycle Cost | $1,918,183 | $1,073,542 | $2,762,825 | |
| User Benefits | $2,369,154 | $2,369,154 | $2,369,154 | |
| Net Present Value | $450,971 | $1,295,612 | -$393,671 | |
| Benefit Cost Ratio | 1.24 | 2.21 | 0.86 | |
| **Traffic Growth Rate** | **1.40%** | **0.00%** | **3.50%** | |
| Life Cycle Cost | $1,918,183 | $1,918,183 | $1,918,183 | |
| User Benefits | $2,369,154 | $1,993,898 | $3,108,426 | |
| Net Present Value | $450,971 | $75,715 | $1,190,243 | |
| Benefit Cost Ratio | 1.24 | 1.04 | 1.62 | |

**Table 6.4 - Sensitivity Analysis – Option 2**

| **Discount Rate** | **6%** | **4%** | **8%** | **10%** |
|---|---|---|---|---|
| Discounted Project Cost | $1,715,646 | $1,748,639 | $1,683,875 | $1,653,259 |
| Salvage Value | $0 | $0 | $0 | $0 |
| Incr. Maintenance | $232,500 | $284,100 | $194,100 | $165,100 |
| Reduced Rehab | $0 | $0 | $0 | $0 |
| Life Cycle Cost | $1,948,146 | $2,032,739 | $1,877,975 | $1,818,359 |
| User Benefits | $2,369,154 | $3,047,144 | $1,882,894 | $1,526,480 |
| Net Present Value | $421,007 | $1,014,404 | $4919 | -$291,879 |
| Benefit Cost Ratio | 1.22 | 1.5 | 1.0 | 0.84 |
| **Cost Estimate** | **Proposed** | **50%** | **150%** | |
| Project Cost | $1,583,520 | $909,293 | $2,727,878 | |
| Discounted Project Cost | $1,715,646 | $857,823 | $2,573,469 | |
| Salvage Value | $0 | $0 | $0 | |
| Life Cycle Cost | $1,948,146 | $974,023 | $2,922,169 | |
| User Benefits | $1,476,074 | $1,476,074 | $1,476,074 | |
| Net Present Value | -$472,072 | $502,051 | -$1,446,095 | |
| Benefit Cost Ratio | 0.76 | 1.52 | 0.51 | |

**Table 6.4 - Sensitivity Analysis – Option 2** ***(continued. . .)***

| **Traffic Growth Rate** | **1.40%** | **0.00%** | **3.50%** | |
|---|---|---|---|---|
| Life Cycle Cost | $1,948,146 | $1,948,146 | $1,948,161 | |
| User Benefits | $2,369,154 | $1,993,898 | $3,108,426 | |
| Net Present Value | $421,007 | $45,752 | $1,160,280 | |
| Benefit Cost Ratio | 1.22 | 1.02 | 1.60 | |

**Table 6.5 - Sensitivity Analysis – Option 3**

| **Discount Rate** | **6%** | **4%** | **8%** | **10%** |
|---|---|---|---|---|
| Discounted Project Cost | $1,853,053 | $1,888,689 | $1,818,738 | $1,785,670 |
| Salvage Value | $0 | $0 | $0 | $0 |
| Incr. Maintenance | $251,100 | $306,900 | $209,700 | $178,300 |
| Reduced Rehab | $0 | $0 | $0 | $0 |
| Life Cycle Cost | $2,104,153 | $2,195,589 | $2,028,438 | $1,963,970 |
| User Benefits | $2,508,516 | $3,226,387 | $1,993,653 | $1,616,273 |
| Net Present Value | $404,362 | $1,030,798 | -$34,785 | -$347,696 |
| Benefit Cost Ratio | 1.19 | 1.47 | 0.98 | 0.82 |
| **Cost Estimate** | **Proposed** | **50%** | **150%** | |
| Project Cost | $ 1,964,237 | $982,118 | $2,946,355 | |
| Discounted Project Cost | $1,853,053 | $926,527 | $2,779,580 | |
| Salvage Value | $0 | $0 | $0 | |
| Life Cycle Cost | $2,104,153 | $1,052,027 | $3,156,180 | |

| | | | | |
|---|---|---|---|---|
| User Benefits | $2,508,516 | $2,508,516 | $2,508,516 | |
| Net Present Value | $404,362 | $510,875 | -$647,664 | |
| Benefit Cost Ratio | 1.19 | 2.38 | 0.79 | |
| **Traffic Growth Rate** | **1.40%** | **0.00%** | **3.50%** | |
| Life Cycle Cost | $2,104,153 | $2,104,153 | $2,104,153 | |
| User Benefits | $2,508,516 | $2,111,187 | $3,291.274 | |
| Net Present Value | $404,362 | -$7033 | $1,187,121 | |
| Benefit Cost Ratio | 1.19 | 1.0 | 1.56 | |

The sensitivity analysis indicates that the conclusions reached are somewhat sensitive to a range of changes in discount rates, changes in traffic growth and cost estimate. Break-even points are as follows:

- Discount Rate: approximately 8%
- Cost Estimate: 120% to 125% of estimated costs
- Traffic Growth: 0%

## 6.4 Project Phasing and Construction

If fencing were to be installed in phases, it would be most appropriate to start the installation on the north side of the highway. It would also be best to start at the west end and tie into existing fencing and continue eastward from there. The rationale for this is that deer populations are in their highest numbers closest to Grand Forks and therefore it is expected the most benefit from fencing would be in this area. The south side of the highway is already protected somewhat by the presence of the Kettle River, however, it must be noted that this does not present a complete barrier as deer cross the river during their migration. Also, as previously indicated in Figure 2.1, the highest number of wildlife collisions occur in the area just beyond the existing wildlife exclusion fencing on the north side of the highway.

Once fencing is installed on the north side of the highway, it should also be installed on the south side of the highway in order to provide better protection for wildlife. This is the only way that collision reductions that have been utilized for analysis could be achieved.

In further outlining a phased approach, it is recommended that project funding be secured for Option 1 and to proceed with construction. This option avoids impacting private property and is the least costly option. If fencing to this point is effective at reducing wildlife collisions, then no further work will be required. However, if it is determined that more complete exclusion fencing is required, the extensions of Option 2 or 3 could be constructed.

Construction should be timed to coincide with the time of year the deer are in their winter ranges on the Gilpin hillside, typically between January and April in order to alter the migration route of the deer. The issue is that if fencing were to be installed outside of this timeframe, there is the potential that deer would not return to the area.

## 7.0 TECHNICAL RISKS AND UNCERTAINTIES

There are some technical risks and uncertainties that the MoT should be aware of. These include the following:

1) The cost estimate for this report was based on average prices for fencing and guards. Localized information for construction costs and materials has not been included. Average costs are however deemed appropriate given current pricing and the relative ease of construction throughout the study area.
2) Mapping has been based on TRIM data for the area which comes at a scale of 1:20,000. Contour data is included at 20 m intervals and therefore topographical considerations are only referred to anecdotally, based on a site visit.
3) This report has not included any consultation with property owners in the area. Property owners may request that the fencing alignment that has been proposed may be moved to a different location. This could have a significant impact on cost. It is however assumed that the contingency cost will be sufficient to cover any increased costs.
4) Analysis has assumed that fencing will be installed on both sides of the highway and costs and benefits are based on this. If fencing is not installed on both sides of the highway, potential benefits will decrease.
5) This report has assumed that existing fencing on the north side of the highway, except for a short section, is adequate and will result in similar collision reductions as new fencing. If this fencing needs substantial replacement, the costs will increase significantly and performance indicators may become negative. One issue pertaining to the existing fencing is the question of ownership. This fencing has been installed by private interests on several different properties with a variety of land owners and in MoT rights-of-way. This issue of ownership, maintenance and replacement of fencing to MoT specifications should be addressed at some point. If maintenance of the existing fence is not continued in the future, benefits of the new fencing could be compromised.

## 8.0 FUNDING OPPORTUNITIES

There are a number of potential project partners that could contribute funding to the construction of the wildlife fencing. The groups mentioned in this section have mandates that would be supported by the installation of wildlife fencing, whether it be through increasing road safety for motorists are by enhancing habitat for wildlife. These funding opportunities are summarized below. There are a few potential funding sources to pay for the installation of fencing. These are summarized in this section.

### 8.1 Insurance Corporation of British Columbia

Consideration should be given to assessing the Partnership possibilities with ICBC's Road Safety Improvement Program as this project will result in a detectable and quantifying safety performance benefit. The ICBC methodology to establish funding interest is different from what is presented in this report and is based upon net claims reduction. Currently, ICBC uses a 3:1 return ratio over three years to justify project funding.

### 8.2 Habitat Conservation Fund

The Habitat Conservation Trust Fund was created in 1996 by an amendment to the *Wildlife Act*. It succeeded The Habitat Conservation Fund which operated from 1981-82 to 1995-96. Hunters, anglers, trappers and guide-outfitters contribute to the Trust Funds' enhancement and education projects through licence surcharges. The province contributes to the acquisition of land through an annual allocation from the Crown Land Account. Voluntary contributions, proceeds from the sale of education materials, and court awards provide additional revenue.

### 8.3 Columbia Basin Fish and Wildlife Compensation Program

The Columbia Basin Fish and Wildlife Compensation Program (CBFWCP) is a joint initiative between BC Hydro, the Ministry of Water, Land & Air Protection and Fisheries & Oceans Canada to conserve and enhance fish and wildlife populations affected by the construction of BC Hydro dams in Canada¹s portion of the Columbia Basin. The deadline for funding is October 1st every year.

### 8.4 British Columbia Conservation Foundation

The Wildlife-Vehicle Accident Prevention Program (WVAPP) was formed in 2001, as a partnership between the British Columbia Conservation Foundation (BCCF) and the Insurance Corporation of British Columbia (ICBC), in response to the increasing number and severity of wildlife-vehicle accidents in BC. BCCF was founded in 1969 under the guidance of the BC Wildlife Federation,

and is a non-profit registered charity dedicated to the conservation and stewardship of BC's ecosystems and species.

### 8.5 Rocky Mountain Elk Foundation

The mission of the Rocky Mountain Elk Foundation is to ensure the future of elk, other wildlife and their habitat. To that end, they fund a variety of conservation projects and programs. These include programs to enhance habitat, manage the elk species, conduct research and education and improving hunting heritage. Further, they will assist with the acquisition of habitat and the creation of conservation easements.

### 8.6 Foundation for North American Wild Sheep

The mission of the Foundation for North American Wild Sheep is to promote and enhance increasing populations of indigenous wild sheep to safeguard against their decline or extinction, and to fund programs for professional management of these populations. They have funded land acquisition, wild sheep transplants, biological studies and research projects, prudent wild sheep management, wildlife habitat improvement, and education programs.

### 8.7 Okanagan Region Wildlife Heritage Fund Society

The Okanagan Region Wildlife Heritage Fund Society has funded numerous wildlife projects throughout the area and helped to fund the Highway 97 fencing project.

## 9.0 BIBLIOGRAPHY

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# APPENDIX A

## Common Elements