Review of Proposed Bighorn Sheep Mitigation Measures Along Montana Hwy 200, East of Thompson Falls, Montana

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A section of Montana Highway 200 (MT Hwy 200) east of Thompson Falls, Montana is scheduled for road reconstruction (Figure 1). Bighorn sheep (*Ovis canadensis*) cross and spend time on and adjacent to this section of MT Hwy 200 (Foresman et al., 2007). The bighorn sheep appear to be primarily interested in licking salt off the road surface and are frequently hit by vehicles. This direct mortality is believed to be among the primary causes for the substantial decline of the local population of bighorn sheep that has been observed in recent years (Pat Basting, Personal communication, Montana Department of Transportation).

The section of MT Hwy 200 between mile reference posts 55.9 and 59.1 (project names TR-E bridge and approach; E-TR-E) is scheduled for reconstruction and wildlife mitigation measures including wildlife fencing and wildlife crossing structures have been suggested (Basting, 2005; Pat Basting, Personal communication, Montana Department of Transportation). These measures are aimed at reducing collisions with large wild mammals, especially with bighorn sheep, and providing safe crossing opportunities for wildlife.

This report aims to:

1. Summarize the existing site conditions, wildlife-vehicle collisions, and wildlife movements in the area - with an emphasis on bighorn sheep - based on existing information.
2. Review the mitigation measures proposed by the Montana Department of Transportation and suggest potential modifications to these mitigation measures based on the available information.

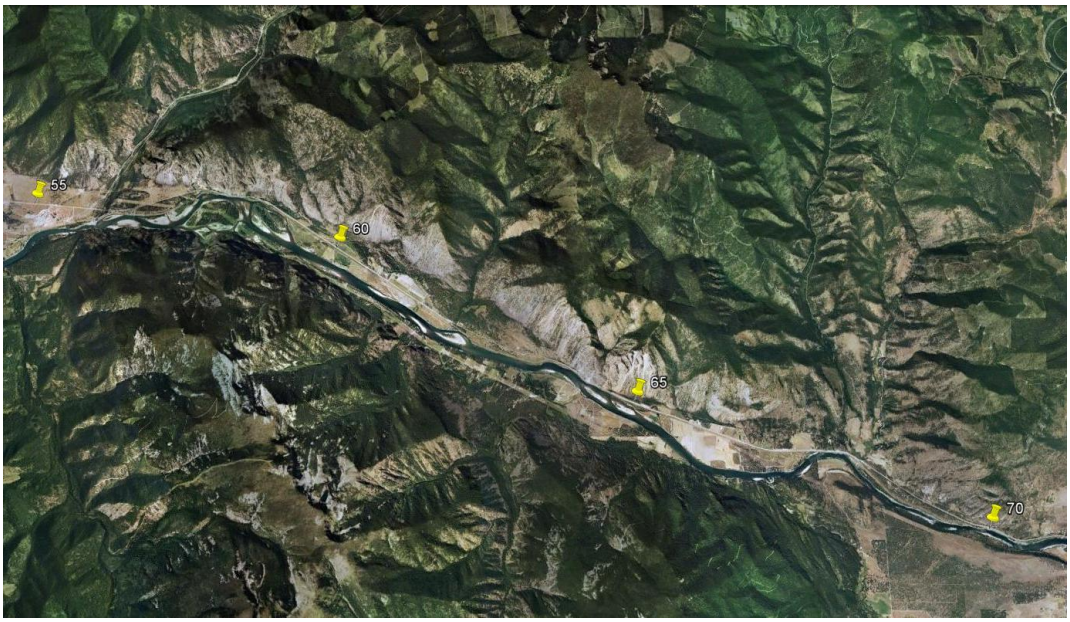

Figure 1: Montana Highway 200 between mile reference posts 55.0 and 70.0, east of Thompson Falls, MT, USA.

2. EXISTING SITE CONDITIONS

2.1. Montana Highway 200

Currently much of the road section between mile reference post 55 and 70 is relatively narrow, windy, has short sight distances and is located at the bottom of steep rocky slopes (Figure 1). The railroad and the Clark Fork River parallel MT Hwy 200 on the south side. In several sections there is a rock fence between MT Hwy 200 and the railroad to stop rocks that may be falling from the slopes on the north side of the road. Some wildlife, including bighorn sheep are killed on the railroad.

2.2. Bighorn Sheep

Bighorn sheep (*Ovis canadensis*) cross and spend time on and adjacent to a section of Montana Highway 200 (MT Hwy 200) east of Thompson Falls, Montana. The bighorn sheep appear to be primarily interested in licking salt off the road surface which increases the probability of collisions with vehicles. The bighorn sheep population has mostly been estimated at about 200 individuals, but in the last few years their population size has dropped considerably with only about 50 individuals in 2012 (Figure 2). The number of bighorn sheep killed on this section of MT Hwy 200 has mostly varied between 10 and 25 per year (Figure 2).

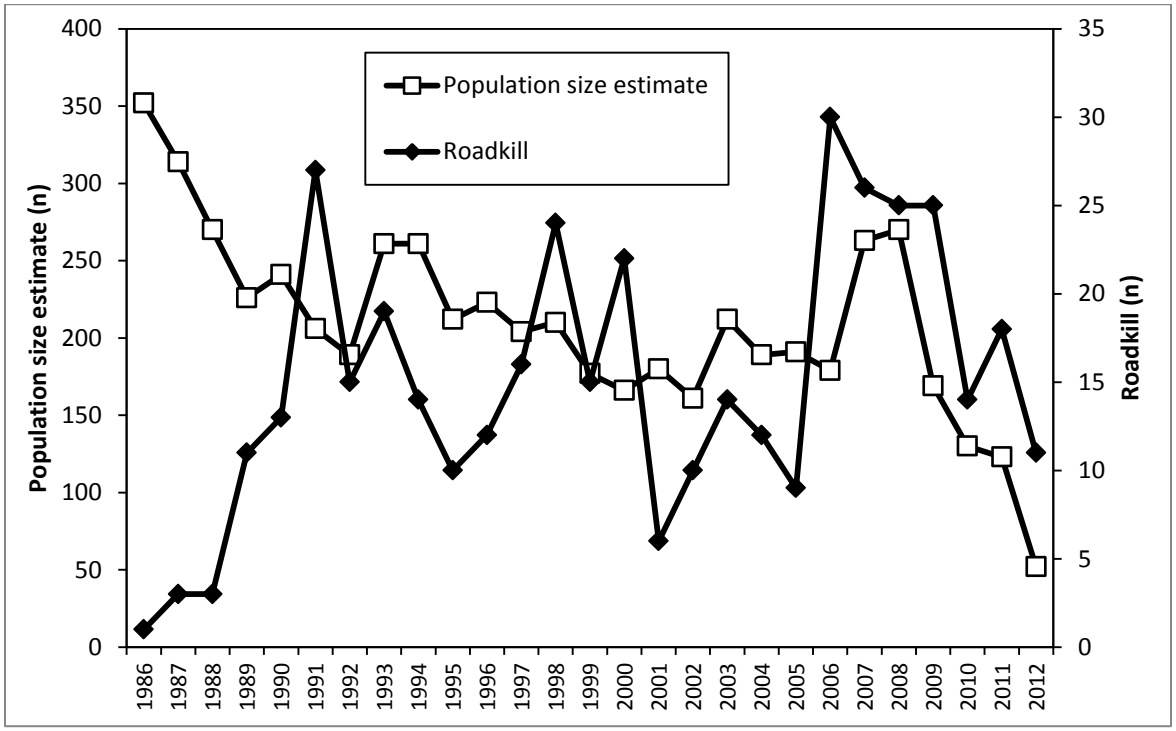

Figure 2: The yearly population size estimate for bighorn sheep in the area and the number of bighorn sheep killed along MT Hwy 200 between mi marker 55.0 – 70.5 between 4 December 1985 and 12 January 2011 (n=363, excluding unclear or unknown location). Raw data were obtained from Montana Fish Wildlife and Parks through the Montana Department of Transportation.

The decrease in the bighorn sheep population is thought to be related to road mortality in combination with predation, potentially by mountain lion (*Puma concolor*), and, to a lesser extent mortality along the railroad that parallels MT Hwy 200. This report does not address the potential predation pressure on the bighorn sheep or the direct bighorn sheep mortality on the railroad. This report only reviews proposed mitigation measures aimed at reducing wildlife-vehicle collisions and providing safe crossing opportunities for wildlife along a segment MT Hwy 200 that is scheduled for reconstruction. While the mitigation measures are aimed at all medium and large wild mammal species in the area, bighorn sheep is the main target species.

Between 4 December 1985 and 12 January 2011 there were 378 bighorn sheep killed by vehicles on MT Hwy 200 between mile marker 55.0 and 70.5 (Figure 2). There were two areas with higher collisions: 1. Between mile marker 58.0-59.5 and 2. Between mile marker 64.0-65.0 with higher numbers of roadkill continuing until mile marker 67.0 (Figure 3).

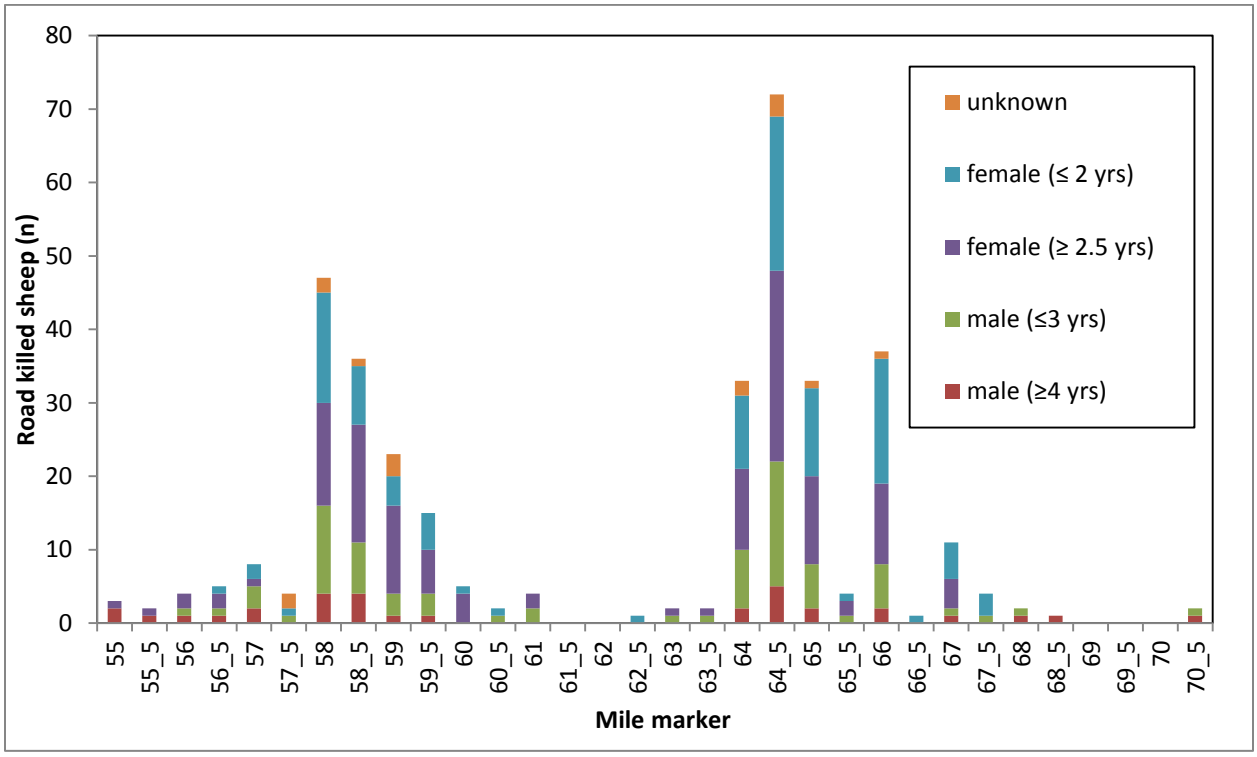

Figure 3: The number of bighorn sheep killed along MT Hwy 200 between mi marker 55.0 – 70.5 between 4 December 1985 and 12 January 2011 (n=363, excluding unclear or unknown location). Raw data were obtained from Montana Fish Wildlife and Parks through the Montana Department of Transportation.

Most of the bighorn sheep are killed in winter (November through April) (Figure 4). This is likely related to road salt licking behavior as the bighorn sheep are also in the area in summer (Foresman et al., 2007).

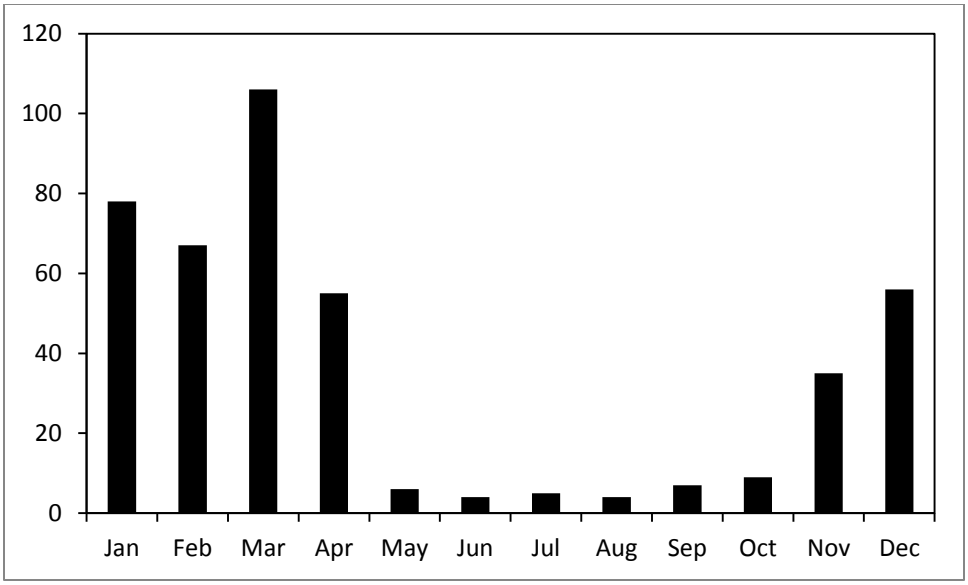

Figure 4: The number of bighorn sheep killed along MT Hwy 200 between 4 December 1985 and 31 December 2010 (n=432). Raw data were obtained from Montana Fish Wildlife and Parks through the Montana Department of Transportation.

2.3. Other Wildlife Species

Bighorn sheep are not the only large mammal species that have been recorded as roadkill along this section of MT Hwy 200. White-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), elk (*Cervus canadensis*), and black bear (*Ursus americanus*) have also been hit by vehicles (Pat Basting, Personal communication, Montana Department of Transportation). This area, especially the area north of MT Hwy 200, is known to be important habitat, including critical winter range, for bighorn sheep (Foresman et al., 2007), and grizzly bear (*Ursus arctos*) (Dodd et al., 2006).

3. PROPOSED MITIGATION MEASURES

The proposed highway reconstruction project includes measures aimed at reducing collisions with the bighorn sheep while also providing safe crossing opportunities for bighorn sheep and other wildlife species in the area. In particular, the current plans for the section between mile reference posts 55.9 and 59.1 include wildlife fencing, wildlife barriers (gates or wildlife guards) at access roads, and safe crossing opportunities for large mammals (i.e. bridge across Thompson River, and a 30 ft (9.15 m) wide, 11 ft (3.35 m) high bridge with reinforced soil abutments approximately 1.3 miles (~2.1 km) to the east) (Pat Basting, Personal communication, Montana Department of Transportation) (Figure 5).

Figure 5: The two proposed safe crossing opportunities for wildlife along MT Hwy 200, east of Thompson Falls, MT.

4. REVIEW PROPOSED MITIGATION MEASURES

The researchers reviewed and commented on the mitigation measures based on a series of principles that are discussed below.

4.1. Length of the road section to be mitigated

The mitigation measures are primarily aimed at reducing collisions with bighorn sheep. Reducing collisions with other large mammal species and providing for safe crossing opportunities for bighorn sheep and other large mammals are of secondary importance, at least along the sections that have the railroad rock fence that is likely to be a barrier to ungulates. Based on Foresman et al. (2007) there are two distinct populations:

- West of the Thompson River and north of MT Hwy 200.
- East of the Thompson River and north of MT Hwy 200.

The bighorn sheep are present frequently along almost the entire road section between mile reference point 55 and 70 (Foresman et al., 2007). It is believed that the sheep come onto MT Hwy 200 mainly to lick road salt off the pavement, especially in winter from November through April (Figure 4). Given this situation, the researchers suggest that mitigation measures to reduce bighorn sheep road mortalities should be implemented along the entire road section (mile reference points 55-70), and also along additional buffer zones on each end. The buffer zones should be long enough so that the bighorn sheep are discouraged from simply walking to the fence end and licking road salt off the highway surface there (e.g. buffer zone should at least be similar to the radius of the home range of bighorn sheep; perhaps about 1 mile). However, the researchers realize that the road reconstruction is currently only proposed between mile reference posts 55.9-59.1 and that mitigation measures may only be implemented in association with road reconstruction rather than as a standalone effort. This not only means that road sections further to the west and further to the east are likely to continue to have bighorn sheep-vehicle collisions, but that there may also be relocation of bighorn sheep-vehicle collisions from mile posts 55.9-59.0 to the west and east near the fence ends. The researchers advise to also plan for the implementation of mitigation measures along the remaining road sections so that when an opportunity arises the mitigation measures can be extended for the entire road section where the bighorn sheep roam and are hit by vehicles including buffer zones (e.g. between mile reference posts 54-71). The researchers suggest emphasizing the need to eventually mitigate the entire road section (mi reference posts 54-71) and use this as a framework when proposing mitigation measures for a more limited road section between mile reference posts 55.9-59.0.

Note that there is an ongoing experiment along this road section. The experiment includes tests with alternatives and/or additives to road salt to discourage bighorn sheep to lick salt off the road surface.

4.2. Fence and MSE wall as barrier for bighorn sheep

The main mitigation measure to keep bighorn sheep from accessing the highway is fencing alongside both sides of the highway. Fencing for bighorn sheep should at least be 8 ft (2.4 m) high, though 8 ft (2.4 m) is unlikely to be an absolute barrier to bighorn sheep (Arizona Game

and Fish Department; Clevenger & Huijser, 2011). In some sections due to road alignment and design needs a mechanically stabilized earth wall (MSE) is proposed instead of a wildlife fence. The researchers suggest that this wall is relatively smooth to prevent bighorn sheep climbing the MSE wall and that the wall is at least 8 ft (2.4 m) high (similar to the wildlife fence). If the road section between mile reference posts 55.9-59.0 is mitigated in two phases, one could consider delaying the construction of the wildlife fence until the Thompson River bridge and the wildlife underpass (about 1.3 mi (2.1 km) to the east) have been completed. In most cases wildlife fencing is combined with right-of-way or livestock fencing to mark the property boundaries and to keep livestock from accessing the road. In this particular case the 8 ft (2.4 m) tall poles for the wildlife fencing could be installed and have the short (about 4 ft (1.2 m) high) right-of-way fencing attached. Once the crossing structures have been completed, then the 8 ft (2.4 m) tall wildlife fence could be attached to these posts in between the two crossing opportunities. The proposed height of the fences and MSE walls are consistent with the recommendations.

4.3. Access roads in fenced sections.

There are access roads between mile reference posts 55.9 and 59.0. The researchers propose to reduce the likelihood that bighorn sheep access MT Hwy 200 at these access roads through;

a. Locked gates: This measure may only be suitable for an access road with very low traffic volume and one landowner/road user.
b. Wildlife guards or double wide cattle guards: This measure is more suitable for access roads with higher traffic volumes and multiple landowners and road users. It is not entirely certain though if these guards are indeed a substantial barrier to bighorn sheep; they should at least be double the width that is standard for cattle (e.g. Gagnon et al., 2012).
c. Electrified wildlife guards or cattle guards or electric mats (e.g. Electrobraid, 2007; Gagnon et al., 2010): These measures are likely more effective than wildlife guards or cattle guards alone in keeping bighorn sheep from accessing the highway as long as the mats or guards are wide enough.

Currently only gates and wildlife guards or cattle guards are considered. Electrified wildlife or cattle guards or electric mats may be a more substantial barrier to bighorn sheep.

4.4. Escape opportunities from the fenced road corridor.

Jump-outs or escape ramps allow animals that end up in the fenced road corridor to walk up to the height of the fence and jump down to the safe side of the fence. The jump-outs should be low enough so that animals will readily jump down but high enough so that they are discouraged from jumping up into the fenced road corridor. A design for jump-outs considered successful for bighorn sheep is 6-7 ft (1.8-2.1 m) high with an added bar about 16 inches (40 cm) above the jump-out (Gagnon et al., 2012). The researchers advise to position jump-outs opposite of the gaps for the access roads, regardless whether these gaps have been mitigated through wildlife guards or electric mats. If there is more than 300 m (about 1000 ft) between gaps for access roads consider putting in additional jump-outs. Jump-outs should preferably be located in relatively quiet areas, a bit further from the road and preferably out of sight from the road (e.g. trees or shrubs between the road and the jump-out). Jump-outs can also be considered along an MSE wall through bulb-outs (Figure 6). The guard rail may follow the bulb-out and can

potentially serve as the 'bar" on top of the jump-out (similar to Gagnon et al., 2012). In this context the MSE wall and wildlife fence can be treated similarly when providing jump-outs. The proposed mitigation measures already included jump-outs for fenced road sections. The researchers recommend also considering the construction of jump-outs alongside MSE walls

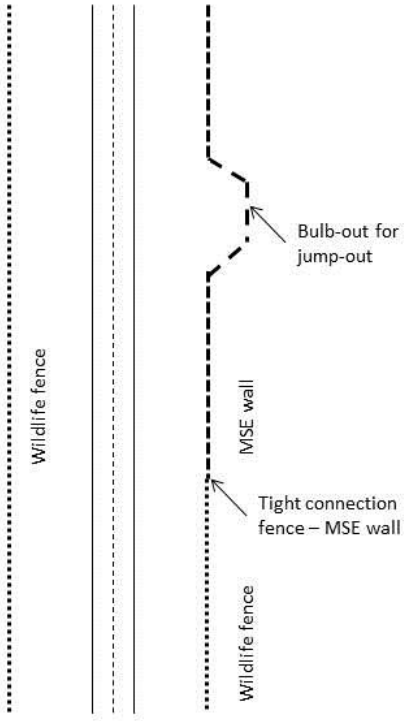

Figure 6: Fenced road corridor with jump-outs integrated into MSE wall through a bulb-out.

4.5. Fence end treatments

Fence ends are potential weak spots in the fenced road corridor. The researchers suggest considering modified bridge grade as a wildlife guard or electric mats at fence ends or MSE wall ends. The researchers suggest that there are only two ends: one on the west side at the bridge across Thompson River and one on the east side towards mile reference post 59.0. If the road section further to the east is reconstructed and mitigated at a later time, the wildlife guard or electric mat may be relocated to the fence end that will then be located further to the east. The wildlife guard or electric mat on the west end should preferably be located at the west end of the Thompson River bridge (Figure 7). This would prevent the animals from walking onto the bridge

and perhaps being forced into the fenced road corridor or jumping off the bridge when traffic approaches.

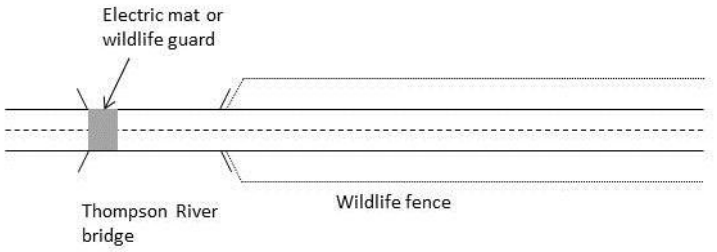

Figure 7: Fence end mitigated by wildlife guard or electric mat on west side Thompson River bridge.

4.6. Safe crossing opportunities for bighorn sheep and other large mammals.

The researchers consider landscape bridges, wildlife overpasses or viaducts (long bridges) to be most suitable for bighorn sheep while a large mammal underpass may be suitable under some circumstances (Clevenger & Huijser 2011). Dimensions for a large mammal underpass for bighorn sheep are at least 40 ft (12 m) wide and 15 ft (4.5 m) high. The bridge across the Thompson River may be considered similar to a viaduct, but care should be taken to allow sufficient space on both sides of the bridge to allow for passage of large mammals (e.g. pathway width >10 ft (3 m); pathway height >13 ft (4.0 m) (Clevenger & Huijser, 2011). The proposed large mammal underpass (a 30 ft (9.15 m) wide, 11 ft (3.35 m) high bridge) is smaller than what the researchers would recommend if bighorn sheep are the target species. However, it is quite possible that the bridge would be used by at least some of the bighorn sheep. Care must be taken though to position the bridge in such a way that the line of sight through the structure is optimized from both directions. This may require pushing away some of the slopes of the drainage as the culvert is currently proposed to be perpendicular to the road while the drainage runs from the north-west to the south-east.

For the other large mammal species that have been recorded as road mortality or that are known to be present in the areas in the area (white-tailed deer, mule deer, elk, black bear, and grizzly bear), 8 ft (2.4 m) high wildlife fencing is considered suitable, though black bear may well be able to climb mesh wire fencing that is only 8 ft (2.4 m) high. Smaller mesh sizes, metal posts (instead of wooden posts), taller fences and an overhang at the top of the fence can increase the barrier effect for black bear. Large mammal underpasses (e.g. >21 ft (7 m) wide, >13 ft (4 m) high) are used by all the species listed above, especially if their home ranges are close to the road or on either side of the road and they can quickly learn about the location of the structures and that it is safe to use them. However, the researchers suggest viaducts, wildlife overpasses or landscape bridges if the safe crossing opportunities are to be tailored to grizzly bears that may

not have their home range in the immediate vicinity of the road and that may be dispersing to areas on the other side of the road.

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