

# Transportation Association of Canada

## 2007 Environmental Achievement Award Submission

Canada

**KICKING HORSE CANYON**  
• P R O J E C T •



March 2008

## Background

The Kicking Horse Canyon Project (KHCP) involves upgrading the Trans-Canada Highway from two to four lanes between Golden, B.C., and Yoho National Park. The existing highway through the Kicking Horse Canyon was constructed when the original Yoho and Park bridges were completed in 1956. The new highway design speed will be 100 km/h.

The highway runs through very difficult terrain and is of substandard design, with a low operating speed and a very poor level of safety. This includes the highest rates of animal-vehicle collisions on the mainland Trans-Canada Highway within British Columbia. Specific substandard design elements such as deficient horizontal curve radii, super-elevation, inadequate shoulder widths and clear zones, and steep gradients lead directly to low operating speeds in the 60 to 70 km/h range and a poorer than average safety record.

The reliability of the highway is compromised because of the difficult terrain, which is the primary cause of a variety of natural hazards such as avalanches and debris torrents with little mitigation at present. The difficult terrain and challenging geotechnical conditions require exceptionally high capital expenditures to implement the desired improvements. These high costs have been the primary reason in the past for not embarking on an aggressive upgrading strategy to address the much needed operational and safety deficiencies.

The 26-kilometre project is broken down into three phases. Phase 1 (Yoho Bridge replacement and approaches) and Phase 2 (Park Bridge replacement and approaches) cover the middle nine kilometers, with Phase 3 covering the two ends of the 26 kilometres. As a result of the geographical split of Phase 3, the west segment between Golden and Phase 1 is referred to as Phase 3 West and the segment between the eastern limits of Phase 2 and the Yoho National Park is referred to as Phase 3 East. Phases 1 and 2 are completed, and Phase 3 East is at the detailed design stage. Phase 3 West is at the preliminary design stage. Figure 1 shows the project area and the general limits of Phases 1, 2 and 3.

All three phases will meet the standards for a design speed of 100 km/h, with the exception of the upgrading within the limits of the town of Golden, which will have a design speed of 80 km/h. Design and construction will respect the province's own design, engineering and construction guidelines as well as those guidelines recognized by the Transportation Association of Canada (TAC). All three phases are being implemented with timely consultation with CP Rail to ensure that the improvements address issues of safety and reliability with respect to both the highway and CP Rail.

## **KHCP Environmental Elements**

### **Air Quality Protection**

Improved horizontal and vertical highway alignment design improves vehicle efficiency particularly for the high volume of transport trucks using the TCH. It is also anticipated that the new highway design will complement future federal and provincial initiatives to improve vehicle and fuel efficiency.

Implementation on the project of a no-burn policy for debris resulting from clearing reduces air pollution.

### **Revegetation and Slope Remediation**

Extensive replanting of native vegetation species was undertaken on Phases 1 and 2 of the project, thereby retaining the value of wildlife and fisheries resources. More than 10,000 square metres of revegetation planting have been undertaken on the project to date (Figure 2a). Extensive revegetation planting is also planned for the Phase 3 works. Vegetation test trials have also been conducted on the project to assist with selection of appropriate plant species and ground treatment for replanting of disturbed slopes. (Figure 2b)

An area of new construction on Phase 2 was expected to have cut slopes that extended a long way up hill. This would result in removal of vegetation and steep exposed soil that would be difficult to revegetate. An innovative technique was used to construct excavated steep slopes that were then reinforced with grouted anchors and a steel wire mesh (TECCO Mesh®) to support the soil face (Figure 3). This greatly reduced the disturbed area and allowed simpler revegetation of the slope

The project team is presently developing a revegetation and slope remediation program to promote the establishment of woody vegetation for long-term treatment of disturbed slopes in Phase 3 of the project and the entire KHCP corridor. This program includes research and planned implementation of innovative techniques for recycling wood and vegetation waste to provide composted soil suitable for replanting of native tree, shrub and grass species. The process involves an on-site wood waste management program that processes wood waste within an enclosed, controlled composting system to provide organic soil within a short period of time. This process can also potentially provide a cost saving compared to off-site supply of required topsoil. The revegetation and slope stabilization program will also employ bioengineering treatments where applicable, as well as contouring and terracing disturbed slopes, in order to facilitate effective revegetation (Figure 4).

### **Aquatic Habitat, Water Quality, and Erosion Control Protection**

Development, implementation and monitoring of sediment and drainage management plans for the project have ensured protection of aquatic habitats and minimized vegetation loss and erosion of soils during Phase 1 and 2 construction.

The innovative and cost-effective (over \$1 million in savings) engineering design of a cantilever structure along the Kicking Horse River by the Phase 1 contractor reduced environmental impact to riparian and aquatic habitats by eliminating the need for two river crossings. This reduced riparian impacts by approximately 50% (Figure 5).

The new Park Bridge structure was designed and built full-span, reducing potential instream impacts to the Kicking Horse River (Figure 6). The Mount Hunter Creek Bridge design is also a full-span structure that avoids aquatic habitat impacts. All instream impacts caused by construction of the new Phase 2 works were offset by creation of more than 1900 square metres of new aquatic habitat that was double the areas affected by the Phase 2 construction. The new aquatic habitat consists of an off channel pond connected to the Kicking Horse River that was constructed to provide a refuge and rearing area for fish and other aquatic species. The pond included woody debris and native plant species planted in the riparian zone around the pond (Figure 7).

### **Roadway Remediation**

On Phase 2 of the project portions of the old highway road grade have been used to provide an interpretive hiking trail, enhancing recreational use and access (Figure 6).

Asphalt from other portions of the old highway was and will continue to be reclaimed and used as aggregate for the new highway, providing cost savings (approximately 25%) and reducing the environmental impact of processing new aggregate. Bioremediation will also be undertaken on the old highway grade to provide habitat enhancement and erosion control (Figure 4).

### **Minimizing Impacts to Vegetation and Wildlife Habitats**

Consideration of wildlife habitat, biodiversity and rare plants and ecosystems is an important component of the Kicking Horse Canyon highway improvement project. An ecosystem and wildlife habitat and biodiversity inventory was undertaken, along with breeding bird surveys and winter wildlife track counts and aerial surveys. These studies found that the project area is very diverse. Over 200 different combinations of habitat types were identified and depicted on twenty-five different thematic 1:5000 scale maps, and highway design options were assessed for ecosystem impacts (Figure 8). A total of 72 different species of birds were detected, none of which are considered threatened or endangered. No clearing of trees was allowed during the nesting period to minimize potential impacts to bird populations.

### **Reducing Animal-Vehicle Collisions and Maintaining Highway Permeability**

The Kicking Horse Canyon project passes through important wildlife habitats with high wildlife use by species such as white-tailed deer, mule deer, bighorn sheep and elk, along with lesser numbers of bears and moose. Based on road-kill data (Wildlife Accident Reporting System), winter track counts and aerial surveys, and predicted increased animal-vehicle collisions associated with twinning this area of the Trans-Canada Highway, a wildlife-exclusion fencing system is planned for the project. Wildlife-exclusion fencing is planned for both sides of the Trans-Canada Highway at both the Phase 3 east and Phase 3 west segments of the Kicking Horse Canyon Project. The total

length that will be fenced is approximately 20 km. This fencing system will include underpass and overpass wildlife crossing structures and one-way escape structures, and is designed to greatly reduce animal-vehicle collisions, conserve wildlife resources, reduce habitat fragmentation and improve public safety.

Fencing systems designed to exclude ungulates should also include one-way escape routes to allow animals that become trapped within the highway right-of-way to escape. Recent work in Utah suggests that one-way earthen escape ramps are 8 to 11 times more effective in allowing trapped animals to escape the fenced highway right-of-way compared to the more traditional one-way gates used elsewhere in British Columbia. For this reason, and the added advantage of less maintenance being required, most of the one-way escape structures on the project will be the earthen ramp design (Figure 9). These will be installed at approximately 400-m intervals in locations with suitable topography and vegetative cover. The cost of one-way earthen escape ramps (estimated at \$3000) is similar to one-way escape gates, but because they are ten times more effective and require much less maintenance, they are considered a financial enhancement.

Unless properly designed, fencing systems can fragment populations and jeopardize their viability. When fencing is used to eliminate road-kill mortality, provisions for allowing animals to move across the highway are needed in order to prevent disruption of migration routes and movement patterns. This project includes a number of wildlife crossing structures to improve the effectiveness of the exclusion fencing and maintain the permeability of the highway to large animal movements. These include both underpass- and overpass-type structures (Figures 10 & 11, for example). At least two of these structures will be bridge-type structures 7 m wide that pass over the highway. Provisions for small animal movements across the highway are based on research in Banff National Park that recommended frequently spaced culverts (intervals of 150-300 m) of mixed size classes with abundant vegetative cover near culvert entrances. As well, special openings in concrete guardrails will be installed every 50 m to permit small animals that become trapped on the highway the opportunity to escape.

### **Summary of Environmental Elements**

The following summarizes the environmental elements of the Kicking Horse Canyon Project that address the TAC environmental achievement award evaluation criteria.

- Improved vehicle efficiency will be achieved due to highway re-alignment and design (enhancement, wide applicability).
- No burning of clearing debris to maintain air quality (protection).
- Extensive replanting of native vegetation species to retain wildlife and fisheries resources (protection).
- Innovative bioengineering (TECCO Mesh®) to stabilize and assist revegetation of steep slopes and reduce the environmental footprint (protection).

- Slope remediation program to promote the establishment of woody vegetation for long-term treatment of disturbed slopes (protection).
- On-site wood waste management program to recycle organic waste and create topsoil through composting (protection & financial)
- Sediment and drainage management plans to protect aquatic habitats and minimize soil erosion (protection).
- Full-span bridge structures to avoid aquatic habitat impacts (protection).
- Cantilevered structure adjacent to the Kicking Horse River that greatly reduced riparian habitat impacts (protection, financial, innovation, wide applicability).
- Instream impacts caused by construction on Phase 2 were offset by creation of new aquatic habitat greatly in excess of that negatively impacted (protection & enhancement).
- Portions of the old highway road grade have been used to provide an interpretive hiking trail, providing new access and recreational opportunities (enhancement).
- Ecosystem, wildlife habitat, biodiversity, breeding bird, snow-tracking and winter aerial surveys and inventory projects were undertaken (protection).
- No clearing of trees during the nesting period to maintain bird populations (protection).
- Wildlife-exclusion fencing system to greatly reduce animal-vehicle collisions (enhancement).
- Wildlife crossing structure to maintain highway permeability and prevent habitat fragmentation (protection, innovation, wide applicability).
- One-way earthen escape ramps to improve the efficiency of the wildlife exclusion fencing system (protection, financial, innovation, wide applicability).

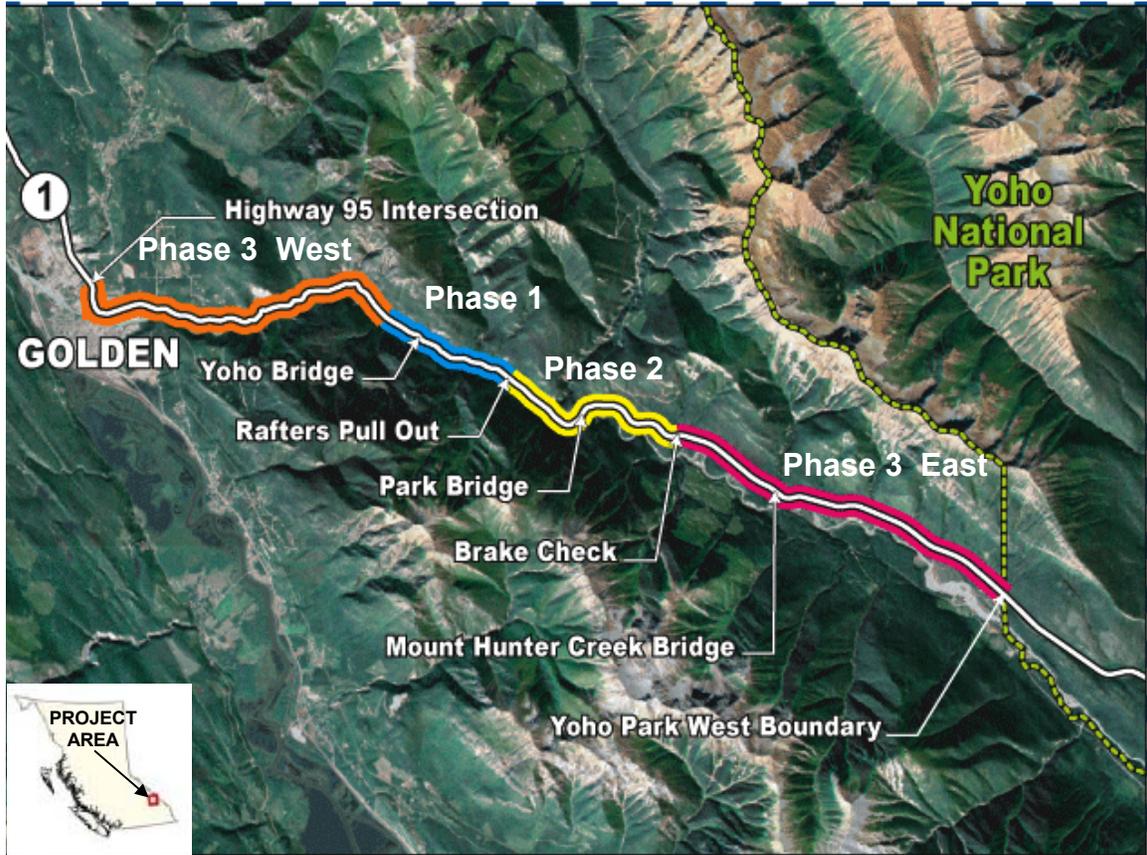
### **Background Reports**

The following is a partial list of supporting reports that document studies undertaken as part of the Kicking Horse Canyon environmental management program.

Coast River Environmental Services Ltd. 2000. Cache Creek to Rockies highway improvement program, Donald to Roth Creek fish collection reports and photographs: 1999 field program, February 2000. Prepared for Ministry of Transportation and Highways, Victoria, B.C. 66 pp

- Demarchi, M.W. and G.F. Searing. 1997. Wildlife tracking project: Golden to west boundary of Yoho National Park – final report. LGL Limited report to the Environmental Management Section, Ministry of Transportation and Highways, Victoria, BC. 79 pp.
- Ferguson, R.S. 2005. Inventory of breeding birds – Kicking Horse Canyon Project (Phase III) – Trans-Canada Highway Project, British Columbia. Kicking Horse Canyon Project Report prepared by MATRIX Resource Services, BC Ministry of Transportation, Golden BC. 20 pp.
- Golder Associates Ltd. 2007. Final habitat balance sheet (revision 3), mitigation measures and final compensation plans. Memo from D. Munday and R. Atkins to J. Guerin (DFO Kamloops) and D. Martin (MOE Cranbrook). 12 pp. + attachments.
- Hammer, M.L. 2001. Effectiveness of earthen escape ramps in reducing big game mortality in Utah. M.Sc. Thesis, Utah State University, Logan, Utah. 65 pp.
- Harper, W.L. 2008b. Preliminary design considerations for wildlife exclusion fencing and crossing structures – Phase 3: Highway 95 to West Portal. Kicking Horse Canyon Project Report, BC Ministry of Transportation, Golden BC. 30pp.
- Harper, W.L. 2008a. Preliminary design considerations for wildlife exclusion fencing and crossing structures – Phase 3 East: Brake Check to Yoho National Park. Kicking Horse Canyon Project Report, BC Ministry of Transportation, Golden BC. 31pp.
- Harper, W.L. 2007a. Winter aerial surveys and snow-tracking transects on the Kicking Horse Canyon Project: Phase 3 West – Golden to Five Mile Hill. Kicking Horse Canyon Project Report, BC Ministry of Transportation, Golden BC. 36 pp.
- Harper, W.L. 2007b. Winter aerial surveys and snow-tracking transects on the Kicking Horse Canyon Project: Phase 3 East – Brake Check to Yoho National Park. Preliminary design considerations for wildlife exclusion fencing and crossing structures – Phase 3 East. Kicking Horse Canyon Project Report, BC Ministry of Transportation, Golden, BC. 48 pp.
- Ketcheson, M.V. 2006. Vegetation and wildlife habitat mapping: Kicking Horse Canyon Project, Phase Three East and West. Report for Focus Corporation by Timberline Forest Inventory Consultants Ltd. Victoria, BC. 52 pp.
- Terasol Environment 2008. Kicking Horse Canyon Project, Revegetation Trials, Draft Report, March 2008.
- WARS 2006. Wildlife accident reporting system. Electronic file, supplied by L. Sielecki, WARS Data Manager, Ministry of Transportation and Highways, Victoria, BC.

## APPENDIX



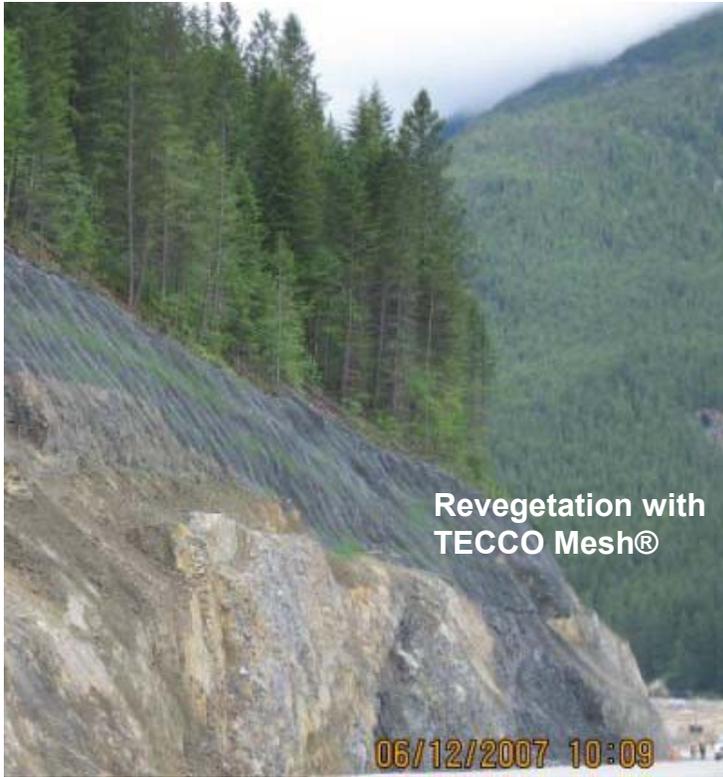
**Figure 1.** Kicking Horse Canyon Project area showing the various construction phases.



**Figure 2a.** Slope stabilization and revegetation planting on the Kicking Horse Canyon Project.

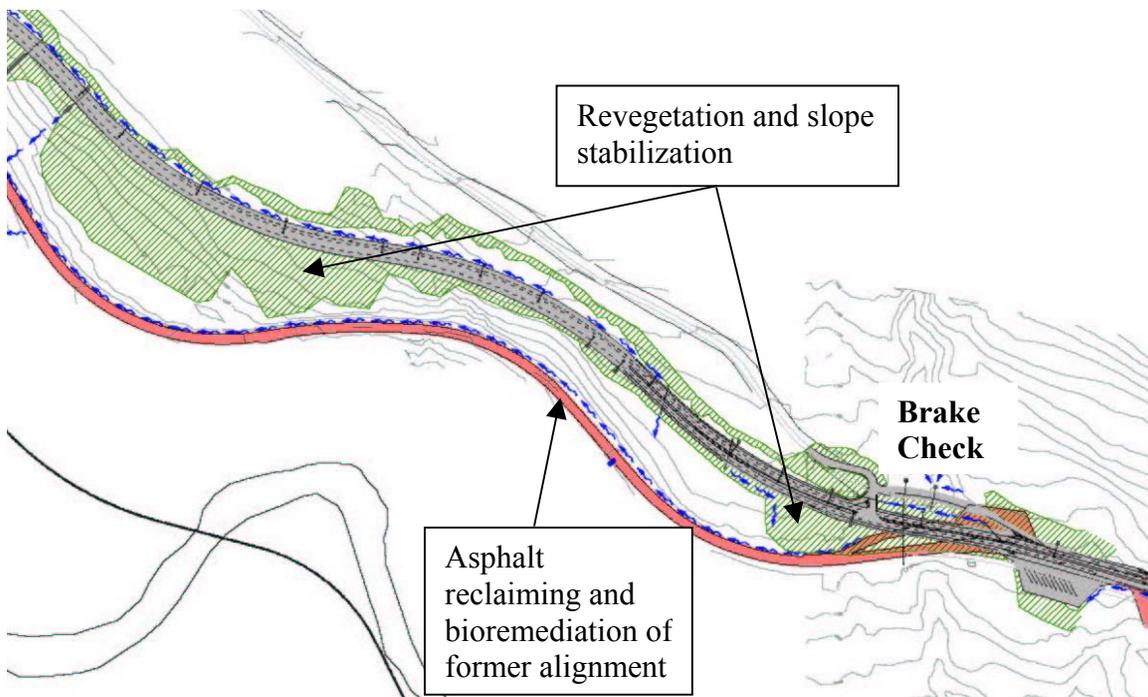


**Figure 2b.** Vegetation trials undertaken on the Kicking Horse Canyon.



Revegetation with  
TECCO Mesh®

**Figure 3.** Example of TECCO Mesh® used to stabilize and assist revegetation of steep slopes on Phase 2 of the Kicking Horse Canyon Project.



Revegetation and slope  
stabilization

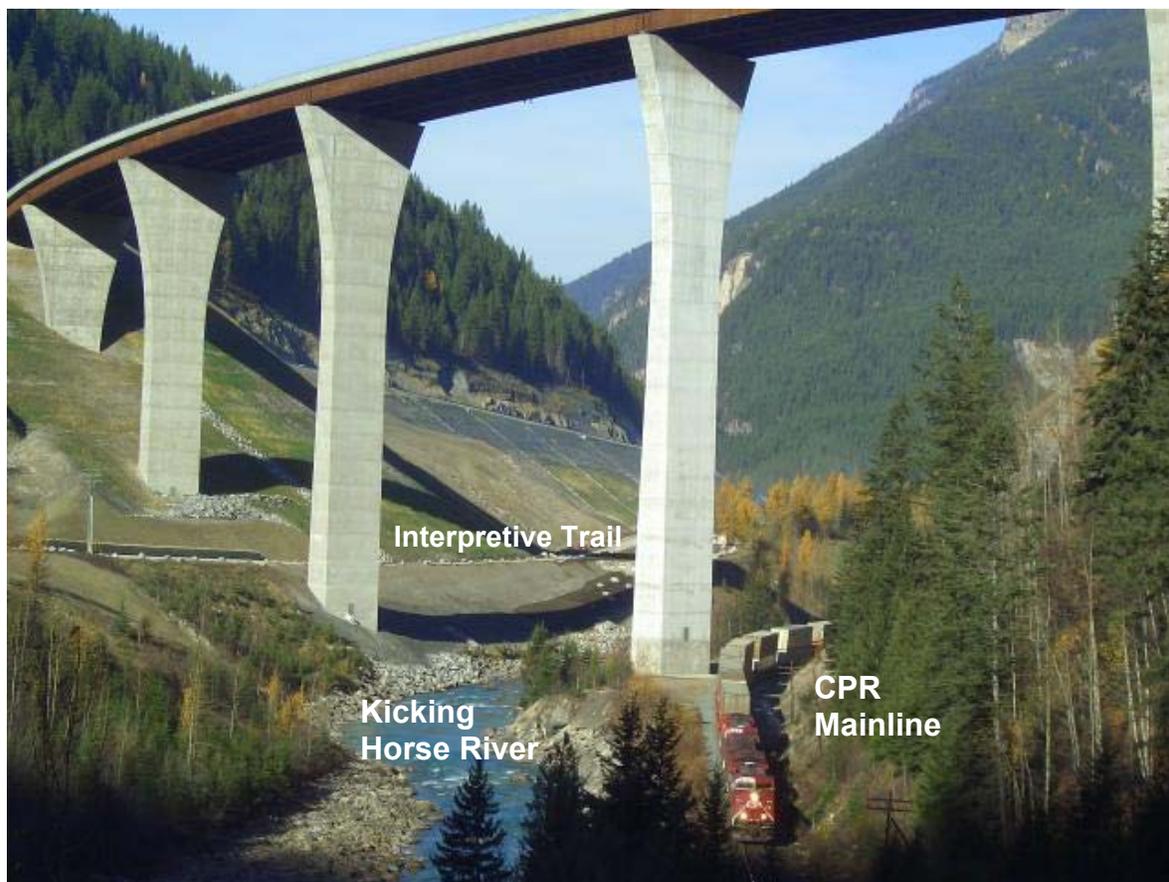
Asphalt  
reclaiming and  
bioremediation of  
former alignment

Brake  
Check

**Figure 4.** Example of planned revegetation and slope remediation proposed near Brake Check in the Kicking Horse Canyon.



**Figure 5.** Cantilevered structure along the Kicking Horse River reduced further riparian impacts.



**Figure 6.** Park Bridge is a full span structure that avoids instream impacts to the river.

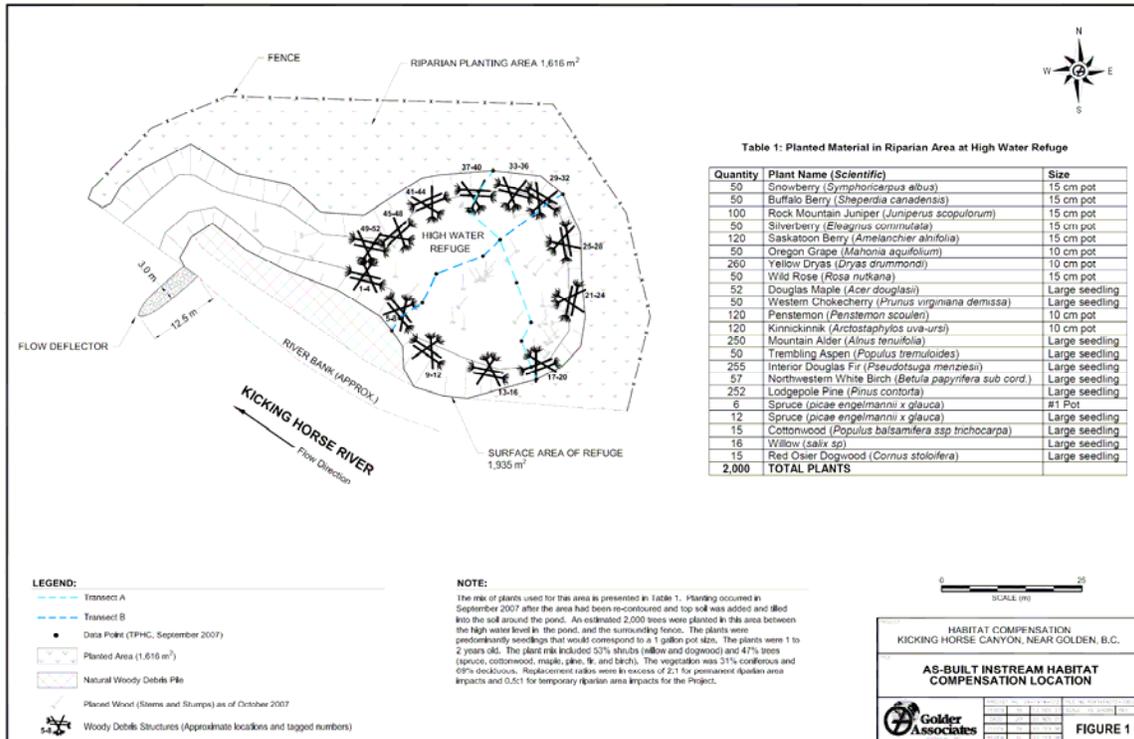


Figure 7. Newly-created aquatic habitats to offset instream impacts.

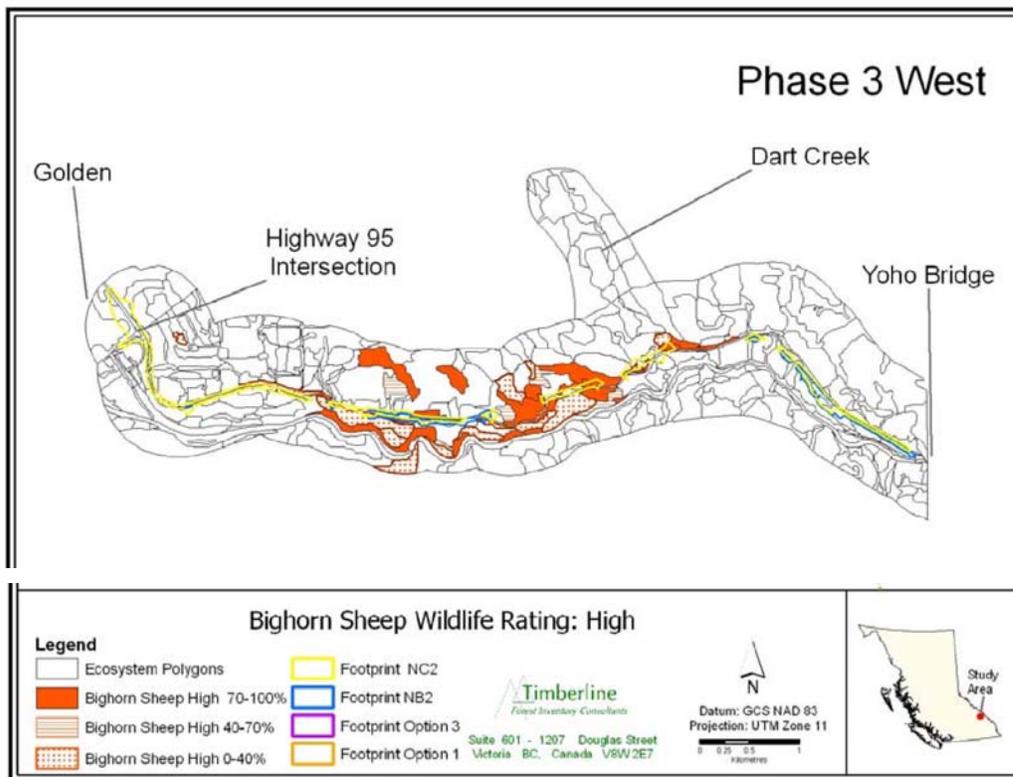
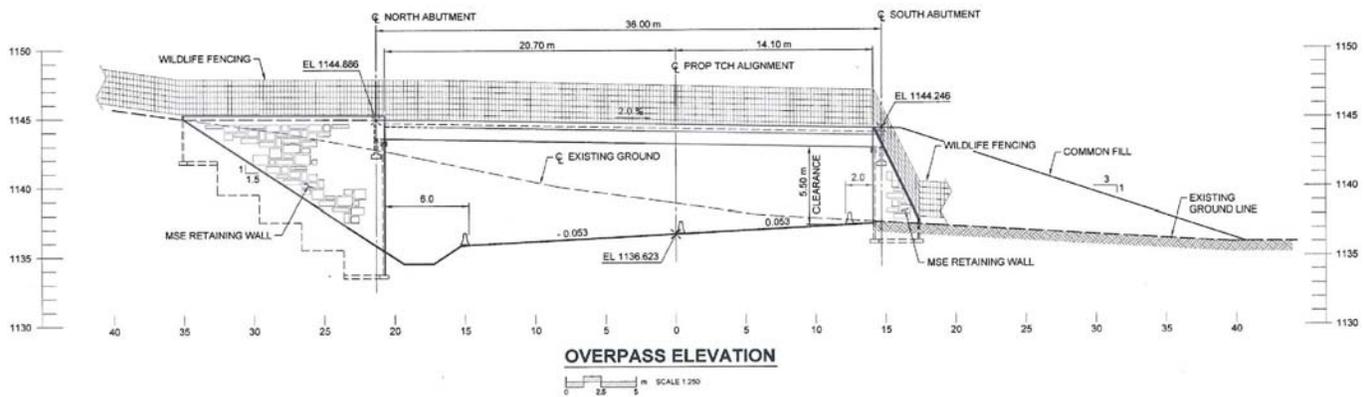


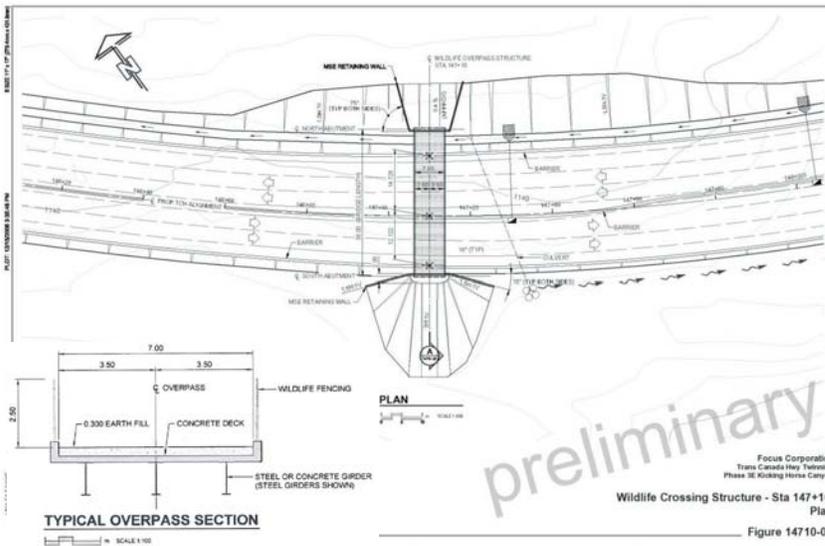
Figure 8. One example of 25 ecosystem, wildlife habitat and biodiversity inventory maps.



**Figure 9.** Example of a one-way earthen escape ramp planned for use in the wildlife exclusion fencing system – Deadman Flats, Alberta.



**Figure 10.** Preliminary design of Wildlife Crossing West over the Trans-Canada Highway within the Kicking Horse Canyon Project.



**Figure 11.** Preliminary design of Wildlife Crossing West near Brake Check.