Highway 742 – Blackshale Creek (Km 57.3)

This site is located at the highway crossing of Blackshale Creek, approximately 57 km southbound from the junction between Highway 742 and Three Sisters Parkway in Canmore, AB and roughly 9 km northbound from the junction between Highway 40 and Highway 742 near Lower Kananaskis Lake. The site location is shown on Figures A1 and A4 in Appendix A. The site coordinates are listed in Table A1 in Appendix A.

The site inspection was performed on October 18, 2008 by Mr. Andrew Bidwell, P.Eng. of AMEC.

Background

AMEC is not aware of any previously reported problems at this site. However, as described below, a check-dam structure has been installed a short distance upstream of the highway. No information on the design and construction of this structure has been reviewed.

A general description of the physical setting and conditions around this site is presented in Section 4.2 of this report.

Site Observations

- The highway crosses the Blackshale Creek channel via a fill embankment and culvert. There is a check-dam structure installed approximately 30 m upstream from the highway. Photos 742-54, 742-55 and 742-56 show general views of the check dam structure. The check dam structure consists of a row of steel H-beams driven as vertical piles and with a single H-beam approximately 10 m long welded onto the tops of the driven H-beams. There are four layers of timber lagging on the upstream side of the driven H-beams, each of the lagging measuring approximately 0.3 m by 0.17 m (12 inches by 6.5 inches) in cross section.

- The top of the check-dam structure is approximately 1.8 m above the channel elevation.

- Debris, predominantly gravel to cobble-sized pieces of shale along with soil and organic material, has accumulated upstream of the check-dam structure, as shown in Photo 742-56, and filled it to capacity. Debris that has more recently flowed over the check-dam structure is starting to accumulate in the inlet end of the culvert, as shown in Photo 742-58. An accumulation of debris was also visible along the base of the culvert near the outlet, as shown on Photo 742-59.

- The creek flow has outflanked the check-dam along the left bank of the creek. A similar flanking channel was also developing along the right bank of the creek at the time of the October 2008 inspection, as shown in Photo 742-57.

- The creek channel was traversed for a distance of approximately 250 m upstream from the check-dam. The channel gradient was approximately 10 to 12° along this segment of the channel. Photos 742-60, 742-61 and 742-62 show views from along the channel.

    - The channel is narrow and there is abundant debris along the channel. The debris consists of material that has been transported along the channel and also from local and active channel bank slumping.

    - There is a broad range of debris particle sizes, ranging from fine grained soil to cobble and boulder-sized material. There are also many logs and other pieces of organic debris that in many places have formed natural check-dams along the channel. An example of one of the natural check-dams is shown on Photo 742-62.

- The downstream face of the highway embankment is sloped at approximately 18 to 20°. A low and possibly settled area was visible on the vegetated embankment face over the culvert alignment (see Photo 742-63). This area was approximately 3 m by 1.5 m and appeared to be possibly due to erosion from surface runoff. However, due to its position above the culvert it could possibly be the result of some settlement or even sinkhole development over a breach in the culvert and internal erosion of the embankment.

Assessment

The circumstances leading to the installation of the check dam are not known, however it was presumably a mitigative measure for debris from the creek channel blocking the culvert. The area behind the check-dam structure is now completely full of debris and the check-dam does not have any capacity to retain further debris being washed down the creek channel. This creates a debris flow hazard to the highway, as follows:

1. Ongoing creek flow that either flows over or around the check-dam structure will continue to transport debris to the culvert. Debris has already started to build up along the base of the culvert. The debris in the culvert may get washed out during peak flows in the spring of 2009, however the accumulation that was noted during the October 2008 inspection illustrates that potential for debris being transported along the channel to begin to block the culvert.

2. A possible collapse of the check-dam structure, which would lead to the large volume of debris from behind the check-dam being washed towards the culvert

by the creek flow. This would not necessarily occur rapidly after a full or partial collapse of the check-dam structure, however it would increase the debris load along the creek channel in the days to months after the collapse and could cause the culvert to become partially or fully blocked, particularly if short-term peak flows along the creek transport relatively large volumes of debris from further up the channel and then entrain additional debris from the check-dam area. The check-dam structure appears to be sturdy and not at imminent risk of collapse due to the load of the debris impounded on the upstream side, however it is no longer effective and is at risk of damage and possible collapse in the future.

3. The bedrock underlying the upper portion of the Blackshale Creek watershed consists of Triassic and Jurassic shales that are noted to be erodible and prone to generating debris along drainage channels that can be lead to debris flows (Cruden and Eaton, 1985).

Short duration, high intensity rainfall events similar to the localized storm that was likely a triggering factor for the 1999 Five Mile Creek Debris Flow near Banff, AB (Cullum-Kenyon et al., 2003) could also be a factor at this site.

With respect to the surface erosion feature, and possible settlement or sinkhole area over the culvert, on the downstream face of the road embankment – this does not appear to be of any significant consequence to the stability of the embankment at this point. However, follow-up visual inspections are warranted to check if the feature changes or worsens over time.

Risk Level

The recommended Risk Level for this site, based on AT's debris flow geohazard risk matrix, is as follows:

- Probability Factor of 9 due to active debris accumulation along the channel upstream and around the check-dam area.

- Consequence Factor of 2 based on the estimation that the highway would remain passable if the culvert became partially blocked by debris. The culvert could become blocked if debris washed down along the creek channel and over top of the full check-dam and/or if the check-dam structure collapsed and released the debris that is accumulated upstream of it.

Therefore, the recommended Risk Level for this site is 18.

Recommendations

Maintenance and Short Term Measures

- The accumulated debris should be removed from behind the check-dam structure. This could be done using a tracked excavator, taking care not to damage the check-dam structure during the work. Environmental permitting along with sediment control measures would be required for this work along the creek channel.

- After the debris has been removed, inspect the timber lagging in the check-dam structure and replace pieces if necessary.

Long Term Measures

It is recommended that this site be included in the 2009 Southern Region annual inspection tour in order to:

- Visually monitor the rate of debris accumulation behind the check-dam after cleanup.

- Visually monitor the erosion feature and possible settlement/sinkhole in the downstream embankment face.

Investigation

No site investigation work is recommended at this time.

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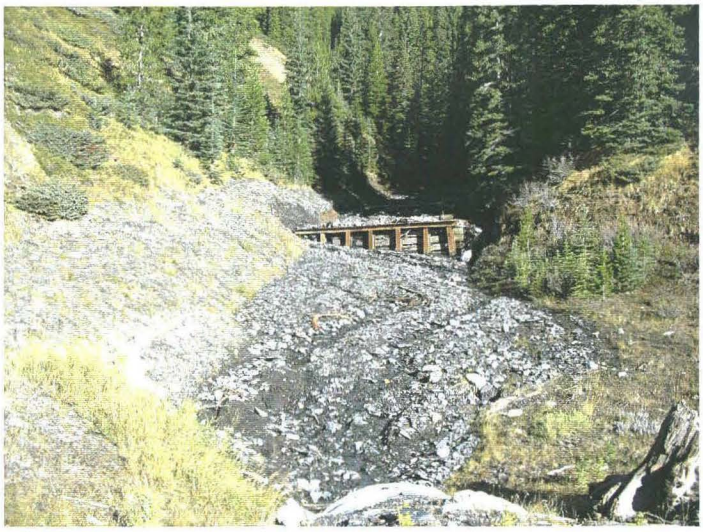

Photo 742-54 (top) – Facing upstream towards the check-dam structure, as seen from the highway.

Photo 742-55 (middle) – Closer view of the check-dam structure. Due to debris accumulating behind it, the creek flow has outflanked the structure. One of the flanking channels visible in the right foreground of this photo.

Photo 742-56 (bottom) – Another view of the check dam structure. Note the debris accumulation behind the structure.

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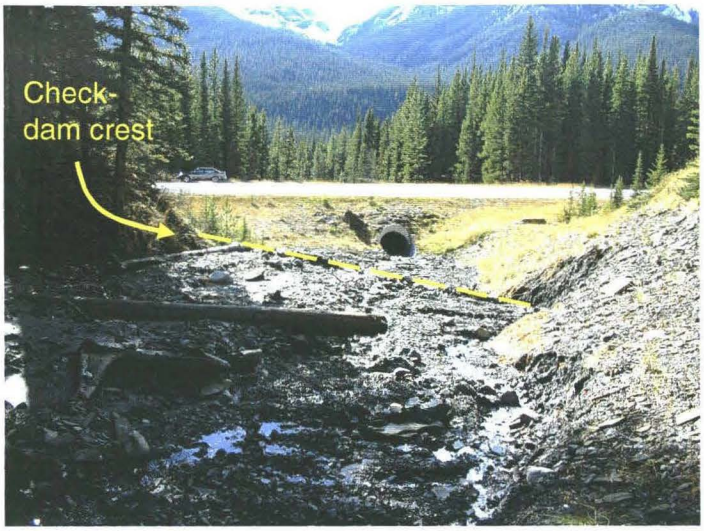

Photo 742-57 (top) – Facing downstream towards the highway from a short distance upstream of the check-dam structure. Note how the creek flow has outflanked the structure to the right. There is a similar flanking channel on the left side of the channel, but it is hidden in shadow in this photo.

Photo 742-58 (middle) – Culvert inlet. Note the debris accumulation on the base of the culvert.

Photo 742-59 (bottom) – Culvert outlet below the highway. Note the debris accumulation along the base of the culvert.

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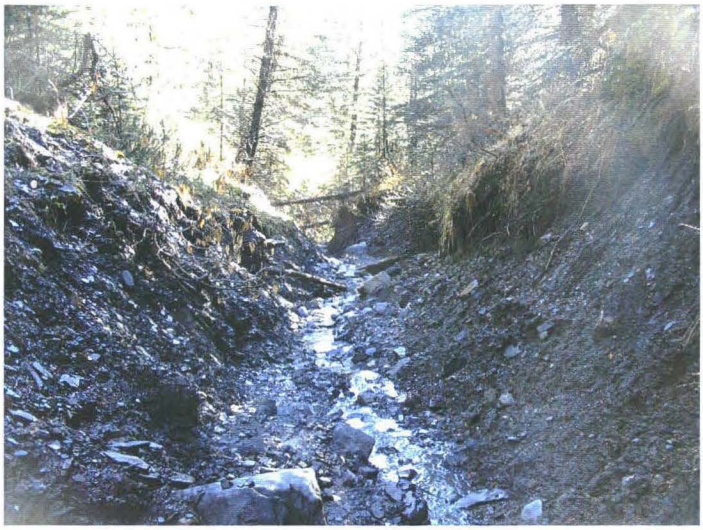

Photo 742-60 (top) – Typical view of the creek channel upstream of the check-dam structure. Note the unstable channel banks with exposed till soil.

Photo 742-61 (middle) – Another view of the creek channel upstream of the check-dam structure.

Photo 742-62 (bottom) – One of many natural check-dams along the creek channel upstream of the highway, with a large volume of soil, rock and organic debris built up behind a log that has fallen across the channel. The creek flow overtops and percolates through this debris, but when the natural dam eventually collapses the debris will be transported further downstream towards the highway.

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Photo 742-63 (top) – Settlement feature in the downslope face of the highway embankment. This feature is roughly above the culvert alignment, and may be an indicator of internal erosion of the embankment (sinkhole development) over a breach in the culvert pipe.