Observed changes in hydrology downstream of large earth-fill dams in Iceland. Lessons learned

Jón Skúli Indriðason[1]* and Kristín Martha Hákonardóttir[2]

[1] EFLA consulting engineers, Lynghálsi 4, IS-110 Reykjavík, ICELAND
[2] Verkís, Ofanleiti 2, IS-103 Reykjavik,
**Corresponding author, e-mail: jons (at) efla.is*

ABSTRACT

Most avalanche defence dams in Iceland are built as earth fill dams. The defence structures are constructed from excavations of loose soil/scree material or blasted bedrock upstream of the dams. The excavation areas may extend up to 50 m horizontally upstream of dams and cut 5–15 m into the upstream slope. Their function upstream of catching dams is to create a deceleration area for avalanches and catch avalanche debris stopped by the dam. Upstream of deflecting dams they serve as a run-out area to the side of the protected area and sometimes into the sea. The dams may be up to 25 m high and a 1000 m long, with lee sides stretching down to back yards and plots of the closest residential houses. As a result, natural streams may need to be combined into fewer and larger streams and routed directly to the sea, as the existing infrastructure may not be not able to handle the increased flow. Furthermore, groundwater streams from the hillside above open into the excavation pit, rather than following the loose hillside material or bedrock to the sea. These macroscopic changes in the landscape, upstream from residential areas and towns, have turned out to affect various aspects of the downstream hydrology, such as groundwater levels, discharge in streams that are relocated or combined, discharge in existing streams and response times for runoff into back yards next to steep lee sides of dams. The excavation areas upstream of catching dams can be used for temporal damping of precipitation peaks. However, debris flows, that are a common occurrence during peaks in precipitation, may fill up the storage area upstream of dams and reduce the capacity of culverts through the dams. These issues will be discussed in some detail, examples analysed and recommendations given for future dam design.