

2.0 CLEAR CREEK AND ASSOCIATED WATER-RELATED ISSUES

I-70 enters the Clear Creek drainage at the east portals of the Eisenhower Tunnel and resides within Clear Creek watershed to the base of Floyd Hill. I-70 was constructed along Clear Creek through this entire portion of the watershed, a distance of nearly 30 miles. The total drainage area of this watershed occupied by I-70 is 267 square miles. Clear Creek is a third order tributary to the South Platte River in Denver, with a drainage area at Golden of 400 square miles. Elevations range from 11,100 ft-mean sea level (MSL) at the Eisenhower Tunnel to 7,500 ft-MSL at the junction of I-70 and U.S. 6 (west base of Floyd Hill).

The hydrology of Clear Creek is dominated by the annual cycle of snowmelt runoff. Other factors that influence the natural hydrology of Clear Creek include transbasin diversions, storage reservoirs, and increases in impervious surfaces resulting from urban, recreational, commercial, industrial, and highway development. Clear Creek in this region bisects three major ore bearing geologic formations and was the original site for the 1859 gold rush to Colorado. The hydrology is influenced by both natural and manmade results of this geochemistry and hydrogeology.

Upper Clear Creek falls within the sub-alpine life zone. It ranges in elevation from about 11,000 ft-MSL at the east portal of the Eisenhower Tunnel to 9,100 ft-MSL at Silver Plume. National Forest and wetland valleys with interspersed low-density residential development characterize land use. Several first order headwater tributaries enter Clear Creek in this segment. The largest commercial development in upper Clear Creek is the Loveland Ski Area.

From Silver Plume to Georgetown, Clear Creek cascades down a 600-foot gorge through a large natural rock cut over a distance of about one mile. Clear Creek then flows through a small valley from Georgetown to Empire Junction, where a man-made reservoir resides downstream from the Georgetown. At Empire Junction, Clear Creek becomes confined to a canyon between the elevations of 8,500 ft-MSL and 7,500 ft-MSL from Empire Junction to Floyd Hill, including the towns of Downieville/Dumont and Idaho Springs. This area falls within the montane life zone with mixed shrubs and trees on south-facing slopes and montane forest on north-facing slopes.

The Clear Creek watershed, as with all watersheds along the Colorado Front Range, experienced very gradual landscape changes prior to the coming of the Europeans. These changes were slow, as when the glaciers retreated during the span of 4,000 years, or limited to a fairly small area, as when hunter-gatherers burned a patch of forest to improve grazing for deer (Wohl, 2001). These activities resulted in subtle effects on the rivers by altering the frequency of forest fires, and thus the movement of sediment hillslopes to the rivers and streams.

As the hunter-gatherers were indirectly and subtly increasing the sediment loads to the rivers of the Front Range, beaver populations were active in ameliorating the impacts of this sedimentation. During the early 19th century, explorers documented the abundant

beavers and associated dams and ponds. As with any reservoir, these ponds acted as settling basins and sediment traps. Eventually, the pond would fill with sediment and the beaver would abandon the pond and move upstream or downstream to establish another dam and pond. When the abandoned dam is breached, the sediment left in the former pond often supports grasses that would eventually grow back to willow, alder, or cottonwood thickets. The resulting combination of cohesive, fine-grained sediment and lush streamside vegetation would produce stream banks that were resistant to erosion (Wohl, 2001).

The discovery of gold in the mid-1800s brought an onslaught of human activity to the Colorado Front Range and Clear Creek in particular. As described in Wohl (2001), "for every miner who came hoping to dig a fortune from the Earth, there were several other people who came to build roads and railroads, plant crops, raise cattle, and found communities." Many of these activities were focused along rivers and streams.

Much of the Clear Creek watershed has been significantly altered by past mining operations (beginning in the 1800s). The mines within the Clear Creek drainage are the result of the gold rush that had its origins as rumors of gold from various Indians and Mountain Men and in discoveries of gold in streams along the Front Range in 1858 (Yeh and Associates, 2001). Placer gold and deposits of lode gold were found in the mountains in the following year. Placer mining (removal alluvial or glacial deposits and associated metals from streams) was the original type of mining that took place within the drainage. This method of mining resulted in the removal of stream substrate and the relocation of stream channels. As the source ore rock was discovered, open excavation and underground mining soon became the most prevalent mining method. Most of the former mining operations have produced mine waste. Some mines processed ore onsite while others used centrally located milling operations found at various locations along Clear Creek. Milling operations were completed in a number of ways but the end results, or mill tailings can be found in numerous places within the Clear Creek drainage and along Clear Creek.

As metals were extracted from the mountains for commercial or industrial purposes, some of the metals were conveyed to Clear Creek and its tributaries. Wastewater from mining operations was often fed directly into the stream, and unused rock was deposited in tailings piles that are now scattered across the valley walls and floor. Therefore, the loads of metals in Clear Creek increased. While there is little mining activity in the area today, rainwater is still leaching residual metals out of old tailings/waste rock piles and from bedrock exposed in the mine drainage tunnels.

In addition to alterations resulting from mining activities, Clear Creek has been altered by urbanization, railroads, and roadway construction. Most of the development is confined to the Clear Creek valley, whereas the upper portions of the watershed reside in relatively undisturbed National Forest. The construction of U.S. 6, U.S. 40, and I-70 resulted in additional channelization of Clear Creek along portions of its entire length as did development in the towns of Silver Plume, Georgetown, and Idaho Springs.

The most significant channelization of Clear Creek has taken place from the Silver Plume gorge to the Georgetown Lake dam and in the canyon from Dumont to Floyd Hill. The channel in these areas can be generally characterized as the highway fill embankment on one stream bank and steep canyon walls on the opposite stream bank. In some areas, Clear Creek is confined between fill slopes from U.S. 6, U.S. 40, and I-70. Riparian vegetation is limited in these areas. Most of the riparian vegetation remaining today occurs in the valley areas between the town of Georgetown and Dumont and between the Eisenhower Tunnel and Silver Plume.

Boring of the Eisenhower Tunnel resulted in interception of groundwater in fractured rock, which is diverted into Clear Creek at the East Portal. Discharge from the tunnel is correlated with snowmelt periods, with maximum flows in May, June, and July each year (CDOT, 2001). Tunnel discharges make up a substantial portion of upper Clear Creek flows near Loveland Ski Area.

Water from Clear Creek has been put to many uses over the past 140 years. Historically, it was used for mining, agriculture, drinking water supply, and for industries such as flour mills, breweries, and manufacturing. Clear Creek now serves as a water supply source for numerous municipalities within the mountain corridor and the Denver metropolitan area and provides drinking water for over 350,000 people and recreational opportunities for rafters, kayakers, and fishermen (EPA, 1997).

The demand for Clear Creek water makes it one of the most over-appropriated streams in Colorado. There are 46 different reservoirs that involve diversion and storage of Clear Creek water, the most notable within the I-70 corridor being Georgetown Lake (440 acre-feet). Another reservoir is being considered near Floyd Hill and U.S. 6. Trans-mountain water diversions also divert water from west slope basins into the Clear Creek watershed. About 40 percent of Clear Creek's annual flow is used outside the basin via canals to other watersheds (EPA, 1997) while 40 percent is used inside the basin. Only about 20 percent of Clear Creek flows ever reach the mouth of Clear Creek at the South Platte River due to calls or lack of storage on Clear Creek (EPA, 1997).

Public water supply intakes operated on Clear Creek adjacent to I-70 or immediately downstream include the Loveland Basin and Valley Ski Areas, the towns of Silver Plume and Georgetown, and the City of Golden.

In response to past mining impacts several investigations have been conducted within the Clear Creek watershed. EPA has conducted an investigation of the Clear Creek/Central City Superfund Site. Follow up investigations to the superfund site studies have been conducted by the Upper Clear Creek Watershed Advisory Group (UCCWAG). UCCWAG produced a report describing the prioritization of mine sites for cleanup.

Through the EPA Superfund program, a water treatment plant was constructed at the Argo Mine Site by the Colorado Department of Public Health and Environment and went into operation in 1998. Additionally, several tons of mine waste and contaminated soils