5. Preliminary Effects of Beaver Dams on Sediment Transport and Trapping in Fanno Creek at Greenway Park

By Cassandra Smith¹, Micelis C. Doyle¹, James White¹, Erin Poor, ⋅ Alex Costello², Krista Jones¹, Stewart Rounds¹

¹ U.S. Geological Survey, Oregon Water Science Center, Portland, OR  ⋅ ² Portland State University  ⋅ Correspondence: cassandrasmith@usgs.gov, jameswhite@usgs.gov: mcdoyles@usgs.gov

Goals and Objectives

Beaver dams and associated ponding affect sediment transport and trapping by pushing water onto the floodplain and decreasing stream velocity, allowing for increased sediment deposition.

For this part of the Tualatin beaver study, USGS assessed changes in sediment dynamics along beaver-affected reaches of Fanno Creek at Greenway Park and Bronson Creek. Here, we highlight results from the Fanno Creek reach. Fanno Creek is a high-energy urban stream with sufficient velocity and turbulence to erode and transport huge loads of sediment during storms (fig. 1).

Findings will be helpful for quantifying the effects of beaver dams and ponds on sediment dynamics in flashy urban streams that have the erosive power and capacity to carry large amounts of sediment during storm events.

Data Collection Methods

Three methods were used to measure sediment transport and deposition along a beaver-affected reach of Fanno Creek:

1. Comparison field surveys of bathymetry and sediment depth to quantify the volume of sediment stored in the south pond upstream of the long dam at Greenway Park (fig. 2).

2. Turbidity, discharge, and suspended-sediment samples were collected during a range of storm events and at base flow to calculate suspended-sediment loads upstream and downstream of beaver dams at the Fanno Creek site (fig. 2).

3. Sensors to continuously measure turbidity were installed at the upstream boundary, in the ponded area, and at the downstream boundary of the study reach (fig. 2).

The continuous datasets are available online at: https://or.water.usgs.gov/cgi-bin/graph/graph_setup.php?basin_id=tualheav

Sediment Deposition Results

1. Comparison of the surveys of water depth and depth-to-refusal (a commonly used indicator of sediment depth) suggests that the south pond has accumulated about 1,200 cubic meters of fine sediment (fig. 3). This is a volume that is approximately equivalent to 120 dump-truck loads.

2. Field observations indicate that fine sediment is depositing in the original (pre-ponded) incised channel upstream of the long dam. Beaver activity also has resulted in the excavation of new channels throughout the south pond. Beaver tend to dig these channels to allow them to swim away from danger and to transport food and building materials.

Sediment Depth Results

- High 0.74
- Low 0

Next Steps for this Study

- Correlate SSC concentrations and turbidity measurements, and develop a regression model to compute instantaneous values of SSC.
- Estimate continuous discharge over study period using measured water-level data and discrete discharge measurements.
- Develop a regression model to compute instantaneous values of SSC.
- Investigate turbidity and SSC on the rising and falling limb of the storm hydrograph to understand when the highest periods of sediment deposition occur at different study reaches.
- Repeat the SSC and turbidity analyses for other study reaches.

Continuous Turbidity Results

1. Statistical comparison of peak turbidity values using an ANalysis Of Variance (ANOVA) and post-hoc pairwise comparison (Tukey's Test) for 25 storm events revealed that peak turbidity values for the middle and downstream sites were significantly different (p<0.05), indicating that peak turbidity decreases as the water travels through the large south pond during storm events.

2. All peak turbidities were lower at the downstream site compared to the middle site for the 25 events (fig. 7).

3. Conversely, during periods of low flow, the downstream site tended to have higher turbidity values than the middle site (fig. 8). A diurnal trend was observed in the downstream site’s turbidity, suggesting that turbidity in the area may be locally affected by animal activity (such as bioturbation by nutria and beavers). Higher turbidity values occurred between midnight and noon.

Considerations for Future Studies

- Refine models of predicting suspended-sediment concentrations and loads.
- Investigate or confirm the cause of elevated turbidity during low-flow conditions.
- Create a general approach for studying sediment transport and trapping in beaver-affected stream reaches.
- Construct a model to predict sediment deposition and resuspension for beaver-affected stream reaches.

All data and findings are provisional and subject to change.