

Washington State Department of Ecology

Stream Discharge Technical Notes

Station ID: 05B090

Station Name: North Fork Stillaguamish River at Oso

Water Year: 2014

Author: Paul D. Anderson

Watershed Description

The North Fork Stillaguamish River basin is made up of a narrow lowland valley surrounded by steep forested hillsides and a few snowcapped mountain peaks. Elevation ranges from just over 200 feet at the gage to more than 6800 feet at points along the southern boundary of the basin. The mean basin elevation is 2230 feet. The average slope in the basin is calculated as 41%. Forest canopy is estimated to cover 75% of the basin. Mean annual precipitation is about 85 inches.

- Drainage area (square miles) = 161

Gage Location

The gage is located on the right bank of the North Fork Stillaguamish River at the north end of Whitman Road bridge. The gage house is at the same elevation as the roadway; and the slant-pipe drops about 25 feet along the side of an old bridge abutment into the river. The terminal end of the pipe extends into a deep portion of the channel a few feet offshore.

- Latitude (decimal degrees) = 48.272349
- Longitude (decimal degrees) = -121.887886

Location Photograph(s)



Figure 1: Fog over the North Fork Stillaguamish River.

Discharge Summary

Discharge is the volumetric flow rate of water that passes through a given cross-sectional area of a creek or river, and is measured in cubic feet per second (cfs). The following section summarizes the streamflow conditions at the gage location during the reported water year.

Table 1: Discharge statistics

Discharge attribute	Number in cfs or number of days
Mean annual discharge	1070 cfs
Median annual discharge	780 cfs
Maximum daily mean discharge	7710 cfs
Minimum daily mean discharge	178 cfs
Maximum instantaneous discharge	11900 cfs
Minimum instantaneous discharge	178 cfs
Discharge equaled or exceeded 10% of recorded time	2120 cfs
Discharge equaled or exceeded 90% of recorded time	273 cfs
Days discharge is greater than range of ratings	16 days
Days discharge is less than range of ratings	2 days
Un-reported days	16 days
Days qualified as estimates	43 days
Modeled days	0 days

Note: Table 1 may not include values in which the predicted discharge exceeds the range of ratings.

Discussion of discharge statistics

Sixteen days were greater than the range of ratings. Two days were less than the range of ratings. These two days likely occurred during the landslide that completely blocked the river upstream of the gaging station. Flow at the gaging station nearly stopped and stage was much lower than normal. During this time the stage dropped well below the rating table's ability to predict flow. A total of 16 days were unreported during water year 2014.

Forty-three days were qualified as estimates. Forty days were qualified as estimates based on the logger drift assessment. Two days were qualified as estimates due to stages being below the useable range of the rating curve. The remaining day was qualified as an estimate due to a gap that was filled with linear interpolation.

Error Analysis Summary

The following section outlines the main component sources of potential error in the annual discharge record at this station. Logger drift is an undesired change in the continuous stage sensor that is not a function of real changes in the water surface elevation. Weighted rating error is the difference between discharges predicted by the rating curve and measured

discharges adjusted to the maximum degree of possible error, based on the field observed measurement quality rating.

Table 2: Summary of errors

Error type	Percent of discharge
Potential logger drift error	6%
Potential weighted rating error	20%
Total potential error	26%

Discussion of error analysis

Most of the error during water year 2014 came from rating error. Much of the error was driven by difficulty in measuring discharge at high flows and to a lesser extent low flows. Fast and turbulent water, standing waves, and areas of shear between fast and slow water at higher flows were the largest drivers in error.

Stage Record Summary

Stage is the height of the water surface in a creek, river, or lake above a known datum. The table below summarizes the range of stage observed at this gage during the water year.

Table 3: Summary of recorded stages

Stage record	Feet	Date
Minimum recorded stage	-0.04 feet	03/23/2014
Maximum recorded stage	9.13 feet	03/09/2014
Range of recorded stage	9.17 feet	

Discussion of stage record

Water year 2014 in the North Fork Stillaguamish River basin was a unique year. In March of 2014 a landslide blocked the flow of the river for a day. This resulted in the maximum and minimum recorded stage being recorded in the same month, within 14 days of each other.

Ratings Summary

Rating curves are developed to define the relationship between observed stage and measured discharge at a gaging station for a specific period. The table below lists which ratings were used during the water year, followed by a discussion of notable aspects of rating development and progression through the year.

Table 4: Rating summary table

Rating number	Period of ratings	Range of ratings in cfs	Number of defining measurements	Rating error (percent)
102	10/1/13 to 1/28/14	115 to 20100 cfs	68	14.6%
304	1/7/14 to 3/23/14	97 to 24800 cfs	21	19.9%
4	3/2/14 to 3/27/14	200 to 3260 cfs	1	26.4%
103	3/25/14 to 3/31/14	115 to 24800 cfs	69	15.2%
5	3/31/14 to 4/11/14	62 to 24800 cfs	22	21.3%
6	4/9/14 to 5/2/14	650 to 24800 cfs	5	28.8%
501	4/17/14 to 9/30/14	62 to 24800 cfs	22	21.3%

Discussion of rating(s)

Rating 102 is a carry-over from water year 2013. Rating 102 makes a shift for scour to rating 304. Rating 304 makes a shift for scour to rating 4. Rating 4 is a short-term rating to cover the blocking of the channel (upstream of the gaging location) due to the Oso landslide. Rating 4 makes a shift for fill to rating 103 after the river cleared the landslide plug. Rating 103 makes a shift for additional fill to rating 5. Rating 5 makes a shift for continued filling to rating 6. Filling of the gage pool likely was the result of sediment and other material moving downstream from the slide area. Rating 6 makes a shift for scour to rating 501.

High Flow Model Summary

In cases where it is not practical to measure the entire range of discharge at a gaging station, a hydrologic model is developed to estimate discharges significantly greater than the measured range.

- Model type (slope conveyance, other, none) = None.
- Range of modeled stage (feet) =
- Range of modeled discharge (cfs) =
- Valid period for model =
- Model confidence =

Discussion of modeled data

No model.

Survey Type and Date

Periodic surveys are conducted to establish or validate gage datum continuity, reference marks, and gage height indices. In addition, channel shape and slope are surveyed to develop high flow models.

Table 5: Types of surveys conducted with dates

Survey Type	Date
Not Applicable	

Discussion of surveys

Activities Completed

Routine maintenance was done at the station at six-week intervals throughout the water year. Visits included discharge measurements, data downloads, and changing batteries and desiccant as needed. There were a few additional site visits during water year 2014 due to the Oso landslide. During these visits changes were made to the logger.

Appendix