Appendix C - Turbidity Monitoring of Fubar Creek Restoration

In-stream restoration along Fubar Creek during the summer of 2006 resulted in increased turbidity levels for short periods of time. Turbidity increases resulted from the movement of heavy equipment in-stream, or the onset of rainfall which would increase water levels in-stream, mobilize sediments, and create turbid waters. Turbidity levels ranged between 0.3 and 4.0 nephelometric turbidity units (NTUs) upstream of the project area, and between 0.8 and 250 (maximum possible with instrumentation) downstream of the project area.


Photos 1a, and 1b. Looking upstream from the bridge at the Fubar Creek Restoration. Photo1a was taken during the diversion of water back into the channel on July 27 following 3 weeks of in-stream work. Photo 1b is taken on August 13 following the completion of the project.

Background and Methods

Fubar Creek is located along the Hydaburg Highway, south Prince of Wales Island. The road crossing is along a state of Alaska Highway and the remainder of the creek is part of the Tongass National Forest, Craig Ranger District. The creek was chosen for restoration due poorly functioning road crossings, inhibited fish passage, and decreased fish habitat. The restoration project was aimed to address these needs and improve the overall stream and watershed function. The in-stream project extended approximately 0.5 miles long and included heavy equipment in-stream, mobilization of rock and wood in the channel, and placement of rock and wood structures along and within the channel (Figure 1). Turbidity monitors were placed in-stream both above and below the project area as an effort to monitor increased turbidity levels during in-stream restoration work. The project timeline extended from July 6 to August 3, and turbidity was monitored from June 29 to August 7.

Two sites were selected for sampling turbidity; one site above the project area in a glide/pool adjacent to a large log, and a second site in a glide/pool along the stream bank located downstream of the project area. Turbidity was continually sampled at the instrumented sites using D&A Instrument Company's OBS-3A infrared turbidimeter and data collector. The infrared turbidimeter is an optical backscatter sensor used for measuring turbidity and suspended solids concentrations by detecting infrared radiation scattered from suspended particles. It measures scattered light at an angle to the beam and reports turbidity in nephelometric turbidity units (NTUs). The data collector was programmed to measure at 15-minute intervals throughout the monitoring period.

Many efforts were taken to reduce the levels of turbidity resulting from the Fubar Creek restoration work. Silt fencing and hay bails were used in various locations to minimize the downstream turbidity. All surface water flows were diverted from both the lower project area and the upper project area during in-stream work. A coffer dam was built in the location of both diversions to minimize throughflow into the lower project area. A weir was installed downstream of the project area to inhibit the passage of adult salmon into the project area, and Title 41 concurrence, including in-stream timing windows, were attained for the project.

Results and Discussion

Results from the turbidity monitoring are shown in Figure 2 and the timeline of project work is displayed in Table 1. Upstream of the project area turbidity ranged between 0.3 and 4 NTU's. Increases in turbidity were a function of increased water levels which resulted from rainfall in the watershed. The downstream turbidities ranged between 0.8 and 250 NTU's. The turbidimeters do not measure beyond 250 NTU's, hence the level of turbidity probably exceeded 250 at times. Increased in turbidity downstream were a function of heavy equipment working in-stream and water level increases resulting from rainfall within the watershed.

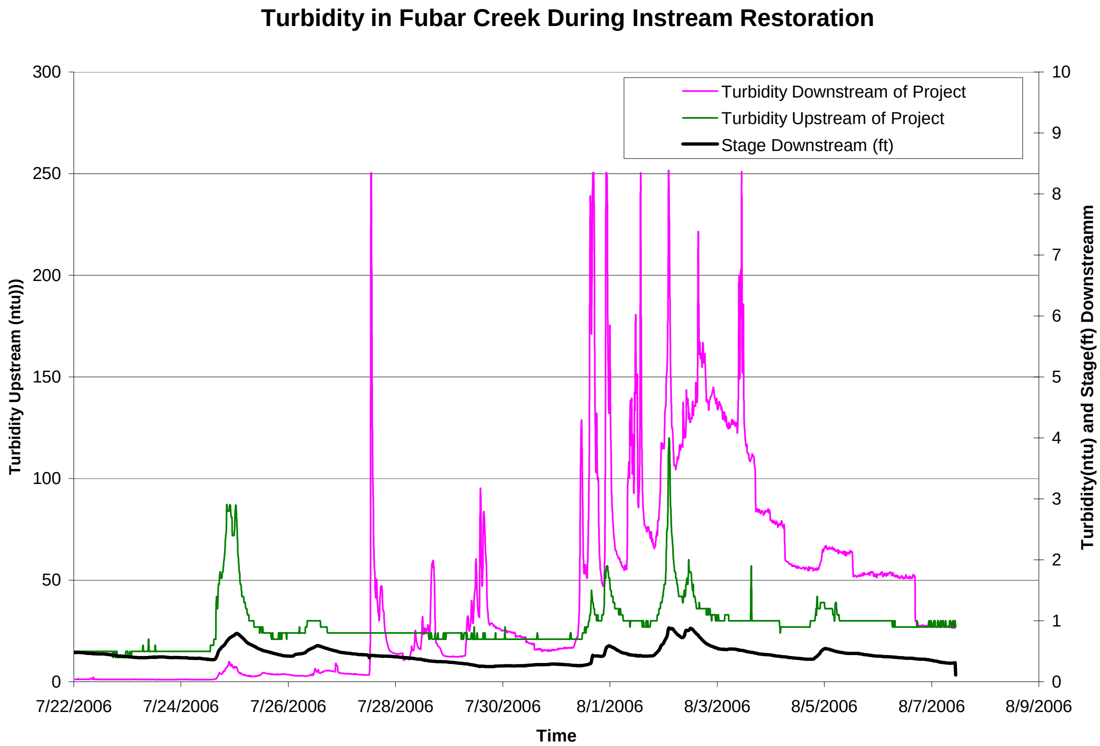
Table 1. Dates of In-stream work and turbidity monitoring

Date	Activity
July 6, 2007	in-stream work begins in dry channel
July 24, 2007	rainfall event
July 27, 2007	stream diverted into dry channel
July 28, 2007	in-stream work
July 29, 2007	in-stream work
July 30, 2007	Sunday - no work
July 31, 2007	in-stream work and 2 rainfall events
August 1, 2007	in-stream work, upper diversion released, and rainfall event
August 2, 2007	in-stream work and late night rainfall event
August 3, 2007	last day in-stream work
August 4, 2007	rainfall event
August 7, 2007	last day of turbidity monitoring

Project work began in-stream on July 6 (Table 1). The rip-rap under the bridge was the initial effort followed by log structures, grading, and side channel development, below the bridge. The in-stream work progressed upstream to the location of the diversion dam. This work included building of log structures along the cut banks, placement of grade control rock structures within the channel, and grading of the streambed to meet vertical and lateral design grade. On July 27, the water was diverted back into the lower channel in an effort to work on the upper channel portion. This diversion is seen on Figure 2 as a spike in turbidity downstream of the project area. The turbidity increased from 3 NTU's to 250 NTU's in 15 minutes. This input of water was carrying all the turbidity that had accumulated over the previous three weeks and flushing it out of the drainage system. Within 3 hours the turbidity had decreased 88% to 30 NTU's and within 15 hours it had reduced 96% to 11 NTU's. The levels did not continue to decrease because equipment was again (the following morning) in-stream working on the upstream project area. Another diversion was installed upstream to complete the upstream channel design.

This diversion utilized a side channel that merely diverted the water away from the immediate working area and returned it to the stream 100m downstream. Hence, the water was still flowing through the lower project area and past the downstream turbidimeter. The spikes in turbidity following the initial pulse were early morning times when the equipment was again working in-stream. A gap in the pulses of turbidity occurred on July 31, a Sunday when no work occurred. The following day increased turbidity resulted from both the action of heavy equipment in-stream and a rainfall event. You can see two spikes in the upstream turbidity levels resulting from these same rainfall events.

Figure 1. Results of water levels in Fubar Creek downstream of the project area and turbidity levels both upstream and downstream of the project area



The last day of in-stream heavy equipment work was on August 3. This is reflected in the decrease of turbidity data in Figure 1. Following the removal of heavy equipment from in-stream work the turbidity levels decreased through time and fluctuate only with water level increases. The final turbidity data available following the project are on August 7 at 10:45 am. Unfortunately, the turbidimeters were removed prior to attaining background levels, due to concern over a large storm event. The final turbidities measured were 0.9 NTU's upstream and 28 NTU's downstream approximately 4 days following in-stream activity. With the exception of storm events which would mobilize additional sediment and turn over the stream bed, it is expected that the turbidity levels would have reduced through time and attained background condition within the next few days.

In summary, the mobilization of heavy equipment in-stream increases turbidity levels. These increased turbidity levels are merely pulses of turbidity that occur over a short duration. The long term benefits that resulted from in-stream restoration along Fubar Creek including increased fish habitat, improved fish passage, and improved sedimentation processes, far exceed the short term, negative, impacts of turbidity in this case. Additional monitoring of turbidity will occur in upcoming projects and will continue monitoring until background turbidity levels are attained.

Photo 2. Photo of heavy equipment in-stream and mobilization of wood and rock occurring upstream of the bridge

Photo 3. Installing a log structure. Notice the turbidity resulting from the movement of heavy equipment and mobilization of stream materials.