ANALYSIS OF GRANITE CREEK TURBIDITY AND SEDIMENT (TSS) DATA COLLECTED IN FY08 AND EFFECTS ON SEDIMENT MODELS AND LOAD CALCULATIONS

June 30, 2008

Task 6 of the FY08 Granite Creek project workplan calls for a thorough analysis of turbidity and TSS data collected in FY08 for use in updating sediment models and in-stream sediment loads and load reduction calculations developed in FY07. This will ensure that estimates of monthly in-stream sediment loads (tons TSS/month) and load reductions use all available water quality information. The newly-calculated FY08 monthly sediment loads will allow for comparing against prior year's sediment loads and quantifying load reductions over time in compliance with the 2002 TMDL.

Over the last several years, simultaneous collection of TSS and turbidity data, along with stream staff gage height, has allowed for determining the instantaneous sediment-flow relationship for the creek and, with extrapolation, to monthly sediment loads. Sediment loads are directly proportional to flow rates (and rainfall). This recent analysis will provide quantifiable results on the effectiveness of sediment control BMPs in improving water quality of Granite Creek and a factual basis for recommending modifications to BMPs. The new simultaneous data sets will also allow for updating mathematical equations on the relationship of TSS-to-turbidity and the relationship of TSS-to-flow rate.

Monthly sampling conducted at Station GC1 since September 2007 was changed to a prescribed day of the month, independent of weather conditions, to avoid preferentially targeting high rainfall/high flow events. This more random method resulted in proportionally more low flows measured in 2007 and 2008 compared with prior years.

The Stepwise Process Used in FY08 Data Review

The FY07 comprehensive analysis of water quality data completed in June 2007 covered the period October 2002 through January 2007. Since January 2007, sixteen (16) additional monthly simultaneous TSS and turbidity data sets were collected at Station GC1 at Granite Creek. Stream gage height was also simultaneously documented, and later converted to flow rate (cfs) using the USGS stream rating table. *Table 1* includes a summary of all TSS, turbidity, gage height and flow rate data from January 2007 through May 2008.

The process used to analyze the 2007-2008 data was identical to that used in the 2007 comprehensive water quality analysis. A listing of sequential steps that needed to occur was prepared to guide the data analysis. Essential variables, parameters and relationships that needed examination were identified. As with the FY07 report, data analysis focused on the monitoring results from Station GC1, the watershed integrator

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station at the Halibut Point Road bridge site. This station is the location of a USGS staff gage and the site of monthly monitoring of TSS and turbidity concentrations.

In addition, comprehensive monitoring data collected throughout the watershed by the project consultant in FY08 were used to address time series of events over three day periods, and confirm source contributions of sediment within the watershed. These results are discussed in the section *FY08 Watershed-Wide Water Quality Data and General Observations.*

The steps in the analysis included:

- Tabulate all new turbidity and TSS data using the 16 simultaneously collected data sets from February 2007 through May 2008, adding to the previous 50 data sets.

- Complete a new linear regression analysis on all 66 simultaneously-collected TSS and turbidity data sets from October 2002 through May 2008 and generate a new "y = mx + b" equation representing that relationship.

- Use the new TSS-turbidity mathematical equation to calculate the allowable "target" TSS concentration corresponding to 6.64 NTUs (= 5 NTUs above natural conditions).

- Review new monthly flow rate data collected for February 2007 through May 2008 against the average monthly flows (AMF) calculated in June 2007 to see if any revisions to AMFs were warranted.

- Run linear regression analysis on the 16 simultaneous TSS and flow rate measurements collected from February 2007 through May 2008 and generate an equation reflected the TSS-flow rate relationship for that period. This equation then generates a TSS value for a given flow rate value. Run a similar analysis on all 66 TSS and flow rate data sets and generate an equation covering the period October 2002 through May 2008.

- Calculate average monthly TSS concentrations (for January through December) correlated to average monthly flows using the new FY07-FY08 data sets.

- Calculate annual in-stream sediment load and load capacity for the period February 2007 through May 2008 to compare with previously estimated sediment loads (in tons/year). Use two alternative methods for calculating annual in-stream sediment loads.

Table 1. Relationship of Total Suspended Solids (TSS), turbidity, and flow rate at Station GC1, Granite Creek, Alaska, from February 2007 through May 2008. [1] [2]

Date	TSS (mg/l)	Mean turbidity (NTU)	Turbidity Replicates (NTU)	Flow rate (cfs)	USGS staff gage height (ft)	Comments and notes
2/28/07	0.3	0.45	0.46, 0.44	2.2	18.82	USGS installed permanent stream staff gage on November 8, 2002
3/22/07	0.6	1.46	1.41, 1.51	4.3	18.96	
4/30/07	0.5	1.13	1.16, 1.10	3.1	18.90	
5/21/07	0.2	0.35	0.39, 0.32	2.2	18.86	
6/28/07	0.6	1.37	1.36, 1.39	1.2	18.70	
7/25/07	0.3	0.41	0.42, 0.40	1.2	18.70	
8/24/07	14.0	23.9	24.5, 23.3	1.4	18.72	
9/27/07	0.7	2.01	2.03, 1.99	5.7	19.02	
10/11/07	5.0	15.4	14.7, 16.1	4.3	18.96	
11/14/07	1.6	3.39	3.37, 3.41	4.0	18.95	
12/12/07	3.6	8.12	8.08, 8.15	8.1	19.09	
1/09/08	0.7	0.98	0.94, 1.01	1.0	18.64	
2/13/08	1.4	3.31	3.35, 3.27	4.3	18.96	
3/13/08	7.1	18.1	18.0, 18.2	2.2	18.82	
4/10/08	0.4	2.27	2.20, 2.35	2.2	18.82	
5/15/08	0.3	0.98	0.97, 0.99	12.2	19.18	

[1] Flow rates are derived from staff gage height readings converted using the USGS Stage discharge curve (SDC) and stream rating table.

1. TSS-to-turbidity relationship

Alaska water quality standards limit allowable turbidity to 5 NTUs above natural conditions to protect the drinking water use - the "default" designated use for Granite Creek. The turbidity criterion for the aquatic life use category may not exceed 25 NTUs above natural conditions.

The following assumptions were made in the TMDL and upheld in 2008.

1. Granite Creek has a natural background turbidity of *1.64 NTU*.
2. A turbidity of 1.64 NTU + 5 NTU = *6.64 NTU* as the target turbidity water quality standard

Another important conversion was necessary to allow for a quantitative calculation of sediment loading capacity for Granite Creek. The majority of water quality data collected from Granite Creek through 2002 was turbidity. Turbidity is an optical property and is a measure of the amount of light-scattering particles in the water. However, loading capacities are most often expressed as a mass per unit time. Not being a measure of the weight of particles in water, turbidity cannot be used *directly* to calculate pollutant loads (in tons of sediment) or load allocations. The TMDL required conversion of turbidity values to an equivalent TSS value to estimate sediment loads gravimetrically (by weight, in tons). Total suspended solids (TSS) was selected to represent sediment loads in Granite Creek.

In 2002, regression analysis was completed on the data sets to establish the TSS-turbidity relationship. Sixteen data sets were plotted. The following equation described the relationship between TSS and turbidity in the original 2002 TMDL:

$$\text{TSS (mg/l)} = [1.075\ (\text{turbidity in NTUs})] - 1.681$$

The correlation coefficient for the data was a highly significant 0.9676.

Validating this relationship was an important task in the comprehensive analysis completed in FY07. In June 2007, cumulative analysis was completed on 50 *simultaneously collected* TSS and turbidity data sets from October 2002 through January 2007. A new linear regression analysis was completed on the data collected from 2002 through early 2007. The following revised equation was generated:

$$\text{(2007 equation): TSS (mg/l)} = [1.2204\ (\text{turbidity in NTUs})] - 2.934$$

The correlation coefficient for the new cumulative analysis is a highly significant 0.9780.

For the FY08 water quality analysis, all 16 new data sets, along with the original 50 data sets, were run through linear regression analysis. The following equation was generated:

(2008 revised equation): TSS (mg/l) = [1.1727 (turbidity in NTUs)] – 2.8480

The correlation coefficient (r^2) for the new data analysis is a highly significant 0.9655.

The addition of 16 new TSS-turbidity data sets helps to strengthen the statistical relationship between TSS and turbidity. Importantly, the revised equation yields TSS values that deviate from the original equation by only 4% to 5% over the range of normally encountered turbidity levels. For example, using the original equation, a turbidity concentration of 10 NTUs represented a TSS equivalent of 9.27 mg/l. Using the new equation, a 10 NTU turbidity level predicts a TSS level of 8.88 mg/l, a 4% change from the original estimate. At 30 NTUs, the comparison is 30.57 mg/l and 32.33 mg/l, for old and revised equations, respectively, a roughly 5% change from the original estimate. The new allowable target TSS concentration (equivalent to 6.64 NTUs) is 4.94 mg/l, compared to the 5.17 mg/l limit derived in 2007. The new value of TSS is used in calculating the allowable monthly and annual sediment load capacity for Granite Creek, and represents a roughly 4.5% reduction in load capacity in tons TSS/year as compared with the 2007 load capacity estimates (see *Table 3*).

The bottom line is that the original regression equation was valid and acceptably accurate as confirmed from subsequent analysis of 66 data sets from 2002 through May 2008. The revised equation, however, should be used for further analysis since it is based on a larger number of data points and, hence, is expected to be more accurate.

Confirming the close relationship between turbidity and TSS provides several benefits. First, water quality sampling could potentially rely on turbidity measurements alone, or a reduced number of TSS samples, in calculating TSS with a reasonable amount of accuracy. This is both cost-effective and provides real-time information without the need to await the results of laboratory analysis. Secondly, turbidity concentrations are more easily estimated and understood by gravel operators and other lease operators in conducting visual self-monitoring of the effects of their operations on water quality.

2. Sediment (TSS)-to-flow relationship

Of key importance in estimating monthly loading capacity and in-stream sediment loads in Granite Creek is creating a statistical model of the TSS-flow relationship. In 2002, data were insufficient to support a statistically significant regression equation. This was particularly true for higher flow-higher TSS conditions.

In 2007, the cumulative analysis of TSS and flow data completed from October 2002 through January 2007 suggested that the original relationship of flow rate to average TSS concentration developed in 2002 was not entirely accurate for Granite Creek.

From October 2002 through January 2007, 50 sets of simultaneous TSS-flow measurements (flow rates converted from gage height elevations) were collected. These data allowed for developing a Granite Creek sediment-rating curve from actual stream data. Given the unique environmental characteristics of each stream, the slope and characteristics of a sediment-rating curve typically apply only to that stream. The relationship is exponential. Sediment loads tend to increase as a square of flow.

The most common statistical method of analyzing sediment – discharge data is a power function (regression analysis) that relates TSS to flow rate. Typically, a common logarithmic transformation of both TSS and discharge data is done prior to analysis. Logarithmic transformation makes it easier to evaluate the relationship between two variables by linearizing the relationship, normalizing distribution of highly skewed data, and stabilizing variance. By transforming both variables, the log-log association becomes linear when plotted. The USGS used this identical method to plot Granite Creek gage height data and discharge data on a log–log scale, generating the stage-discharge curve for Granite Creek in 2005.

For the 2007 analysis, the TSS-to-flow rate equation was:

$$\log(\text{TSS (mg/l)}) = 0.92489 * \log(\text{flow (cfs)}) - 1.1521$$

Statistical analysis of TSS-flow rate data from February 2007 through May 2008

In June 2008, an identical regression analysis was completed on all 16 TSS-flow rate data sets collected from February 2007 through May 2008. *Table 1* includes all simultaneous TSS and flow data collected over this period. Common (base 10) logarithmic transformation was completed on all the data sets for Granite Creek listed in the table. The transformed data were then run through linear regression analysis. The following equation was developed for the relationship of TSS and discharge rate in Granite Creek *for the 15-month period*:

$$\log(\text{TSS (mg/l)}) = 0.06196 * \log(\text{flow (cfs)}) - 0.03615$$

This equation represents the standard regression: $y = mx + b$

The “y” variable is TSS and the “x” variable is flow rate. The slope is “m’.
The y intercept on the graph is “b”. The mean of TSS measurements was 0.98 mg/l and the mean of all discharge rates during the 15 month period was 2.91 cfs.

Regression analysis was also completed on all 66 TSS-flow rate data sets collected from October 2002 through May 2008. This provides an alternative method for calculating annual in-stream sediment load *using all project data*. The resulting equation was:

$$\log(\text{TSS (mg/l)}) = 0.66258 * \log(\text{flow (cfs)}) - 0.67528$$

3. Average monthly flows, average monthly TSS concentrations, loading capacity and in-stream sediment loads

The sixteen monthly flow rate measurements recorded from February 2007 through May 2008 were compared against the average monthly flows (AMFs) calculated in 2007 using 208 data points. Given the relatively few number of flow observations (16), the new data did not meaningfully alter the mean monthly flow values calculated in 2007. New AMFs were therefore not calculated.

Average monthly flows listed in *Table 2* were converted to common logarithmic values and a logarithmic value for TSS was generated for that particular month using the above equation. The antilogarithm was then calculated from this value to yield the TSS concentration corresponding to the average monthly flow. This calculation was completed for all months, January through December, using the 15 monthly period of data collection. This calculation process was identical to that used in the June 2007 comprehensive analysis.

For example, January has an estimated average monthly flow of 44.5 cfs. Log transformation of 44.5 gives a value of 1.648. Using the above equation, (0.06196)(1.648) - 0.03615 = 0.066. The antilogarithm of 0.066 is 1.16 mg/l TSS. This represents the calculated average monthly TSS concentration for January for the period February 2007 through May 2008.

Using the logarithmic equation above, the *average monthly TSS concentrations* calculated for each month for the FY07-FY08 period are:

January: 1.16 mg/l	July: 1.06 mg/l
February: 1.13 mg/l	August: 1.19 mg/l
March: 1.10 mg	September: 1.21 mg/l
April: 1.06 mg/l	October: 1.19 mg/l
May: 1.08 mg/l	November: 1.25 mg/l
June: 1.09 mg/l	December: 1.21 mg/l

Existing in-stream sediment loads *(Table 2)* for each month are then calculated by the following equation:

> Average monthly flow (cfs) * 0.0027 * average TSS concentration (mg/l) correlated to that monthly flow rate * number of days in the month = tons of sediment (TSS) for that month

The analysis of all water quality data collected from February 2007 through May 2008 shows a significant reduction in the in-stream sediment load (tons/year) over that period compared to previous estimates. *The 2007-2008 annual existing in-stream sediment load calculated using the 16 data sets is estimated at 56.46 tons TSS/year as compared to the 2007 five-year average estimate of 187.06 tons TSS/year.*

A second method was also used to calculate annual in-stream sediment loads. The regression equation generated from *entering all 66 data sets from October 2002 through May 2008* was used to estimate existing monthly and annual in-stream sediment loads.

Using the regression equation found at the end of Section 2 above, the average monthly TSS concentrations calculated for each month using all 66 data set from the period October 2002 through May 2008 were as follows:

January: 2.61 mg/l	July: 0.91 mg/l
February: 1.97 mg/l	August: 3.27 mg/l
March: 1.53 mg	September: 3.84 mg/l
April: 0.96 mg/l	October: 3.41 mg/l
May: 1.18 mg/l	November: 5.53 mg/l
June: 1.30 mg/l	December: 4.12 mg/l

Using this alternative Method 2, the monthly and annual in-stream loads were then calculated (*Table 3*) using the equation on page 7. *The annual estimated in-stream sediment load for February 2007 through May 2008 was calculated at 174.25 tons TSS/year. This value shows a reduction of 12.81 tons in the annual sediment load below the five-year average of 187.06 tons TSS/year calculated in June 2007.*

A third method was also used. An alternative "worst case" method of calculating annual in-stream sediment loads is, rather than using the regression equation, the TSS concentrations measured each month. From February 2007 through May 2008 could be used to estimate average monthly TSS. Obviously, this approach cannot be supported on statistical grounds, as one sample per month is not a representative cross-section for that month. However, for purposes of comparison, the analysis was run. The annual in-stream sediment load for this period was calculated at 165.56 tons TSS/year, still below the five-year average of 187.06 tons TSS/year calculated in June 2007.

All methods used to calculate annual in-stream sediment loads demonstrate that during the period February 2007 through May 2008, Granite Creek experienced an in-stream sediment load reduction ranging from 12.81 tons TSS/year to 131.14 tons TSS/year compared to the five year average in-stream sediment loads calculated in June 2007.

Table 2. Monthly existing (in-stream) suspended sediment loads in Granite Creek, comparing February 2007-May 2008 calculations with 2007 estimates in ( ). Method 1.

Month	**Average Monthly Flow (cfs)**	**Existing In-Stream Suspended Sediment (TSS) Load (tons)[3] Revised (2007)**
January	44.5	4.32 (8.79)
February	29.0	2.48 (3.51)
March	19.8	1.82 (1.86)
April	9.9	0.85 (0.47)
May	13.4	1.21 (0.87)
June	15.5	1.37 (1.12)
July	9.1	0.81 (0.41)
August	62.4	6.22 (16.82)
September	79.5	7.79 (25.95)
October	66.7	6.64 (19.15)
November	138 [4]	13.97 (75.00)
December	88.7	8.98 (33.11)
Annual Total		**56.46 tons (187.06 tons)**

[3] Tons of TSS/month = monthly average Q (cfs) * average TSS (mg/l) concentration corresponding to the average monthly flow (see text on using the TSS-flow regression equation) * 0.0027 * # of days in the month.

[4] November average includes 2 of the 3 highest flow rates recorded at Granite Creek from October 2002 through January 2007. Throwing out one or both of these flows from the average would result in a significantly lower existing in-stream load estimate for November. They are both left in here to provide a conservative worst case scenario.

Table 3. Monthly existing (in-stream) suspended sediment loads in Granite Creek, comparing February 2007 - May 2008 calculations with 2007 estimates in ( ). Method 2.

Month	**Average Monthly Flow (cfs)**	**Existing In-Stream Suspended Sediment (TSS) Load (tons)[5] Revised (2007)**
January	44.5	9.72 (8.79)
February	29.0	4.32 (3.51)
March	19.8	2.54 (1.86)
April	9.9	0.77 (0.47)
May	13.4	1.32 (0.87)
June	15.5	1.63 (1.12)
July	9.1	0.69 (0.41)
August	62.4	17.08 (16.82)
September	79.5	24.73 (25.95)
October	66.7	19.04 (19.15)
November	138	61.82 (75.00)
December	88.7	30.59 (33.11)
Annual Total		**174.25 tons (187.06 tons)**

Monthly sediment load capacity (*Table 4*) is calculated by the following equation:

> Average monthly flow (cfs) * (4.94 mg/l TSS allowable target) * 0.0027 * number of days in the month = loading capacity in tons of sediment (TSS) for that month

The analysis of all water quality data collected from February 2007 through May 2008 suggests a slight revision (4.5% reduction) of loading capacity (tons/year) is warranted. The allowable target TSS value was reduced slightly from 5.17 mg/l to 4.94 mg/l to reflect the results of the new TSS-to-turbidity regression equation. *The revised annual sediment load capacity is estimated at 233.84 tons TSS/year as compared to the 2007 estimate of 244.86 tons TSS/year*.

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[5] Tons of TSS/month = monthly average Q (cfs) * average TSS (mg/l) concentration corresponding to the average monthly flow (see text on using the TSS-flow regression equation) * 0.0027 * # of days in the month. Method 2 was used (see text) to calculate average monthly TSS loads.

Table 4. Monthly Suspended Sediment Loading Capacity (LC) for Granite Creek, showing both FY08 revised load capacity and 2007 load estimates in ( ).

Month	Average Monthly Flow (cfs)	Natural Background Load (tons)[6]	Loading Capacity TSS (tons)[7] 2008 revised (2007)
January	44.5	1.86	18.40 (19.26)
February	29.0	0.56	10.82 (11.33)
March	19.8	0.93	8.18 (8.57)
April	9.9	1.50	3.96 (4.15)
May	13.4	2.17	5.54 (5.80)
June	15.5	1.80	6.20 (6.49)
July	9.1	1.24	3.76 (3.94)
August	62.4	0.93	25.79 (27.00)
September	79.5	3.00	31.79 (33.29)
October	66.7	4.34	27.56 (28.86)
November	138	1.20	55.19 (57.79)
December	88.7	3.10	36.65 (38.38)
Annual Total		**22.63 tons**	**233.84 tons (244.86 tons)**

[6] Natural background sediment loads used in the original 2002 TMDL remain accurate and unchanged based on seven years of water quality data collection.

[7] Monthly load capacity based on analysis of in-stream data. Includes natural background sediment load. Calculated as: (Monthly Q (cfs)) * (4.94 mg/liter TSS) * (0.0027) * (# days in month).

4. FY08 Watershed-Wide Water Quality Data and General Observations

Comprehensive water quality data collected throughout the watershed is valuable in identifying time series of events, BMP cause-and-effect relationships, and documents site-specific sources of turbidity and sediment. Eight permanent monitoring stations plus a number of opportunistic stations including drainage ditches, settling ponds, and road culvert discharges were monitored. Of immediate note is the rapidity with which runoff from unpaved roads, and associated turbidity spikes, will occur after heavy rains and truck traffic. Of equal note is the rapidity with which the system restores to normal with cessation of heavy rains. The exception is the residence time of turbidity levels in the CBS series of settling ponds receiving significant road runoff. Time series measurements over several days confirm that it typically takes 2 to 3 days for the ponds to “clear” to pre-heavy rain conditions. Ponds are working effectively the vast majority of time. Smaller ponds at the Tisher and Dormand McGraw leases experience periods where significant runoff exceeds their capacity to effectively treat turbidity, resulting in silty discharge from the ponds and into the tributaries. Retrofits are planned for both lease sites to increase volume and improve retention time.

A couple of observations have focused attention on the need for several new BMPs for FY09 and beyond. These are included in the updated Action Plan. The main culvert running under Granite Creek Road discharges ditchwater down the streambank into Granite Creek. During high flows, this discharge erodes the streambank and entrains sediment and turbidity. Higher turbidity levels were noted at the base of the streambank entering the creek compared to turbidity levels at the top of the streambank. Placing a series of small perched and baffled settling ponds to slow water down and improve treatment of stormwater will be attempted in FY09. Resuspension of turbidity/sediment in unvegetated drainage ditches during heavy rains was also observed over the last several years. Culverting, and other sediment control methods such as check dams and hydroseeding problematic ditches, are remedies to be examined.

The vegetated ditch running along Granite Creek Road below the Dormand McGraw scale area to the large culvert discharging under the road is working effectively, in combination with the installed check dams and detention pond, to immediately reduce turbidity levels. For example, turbidity levels measured on October 10, 2007 in the ditch upgradient of the check dams and pond were on the order of 1000 NTU. The turbidity level measured from the culvert discharge after grass filtration/check dam/pond treatment was 108 NTUs, for a roughly ten-fold reduction in turbidity. Winter road maintenance tends to push gravel into the ditch, covering up some of the grass fringe. This drainage ditch was reseeded in June 2008 to reestablish grasses through its length and may be reseeded in the future as a maintenance BMP.

5. Conclusions and Recommendations

Granite Creek's annual in-stream sediment load for February 2007 through May 2008 was reduced compared to the five-year average annual sediment load calculated a year ago. A disproportionate number of low flows captured with random monthly sampling initiated in September 2007 likely contributed to the reduction.

- *Using the Method 1 approach to calculating loads, the 2007-2008 annual existing in-stream sediment load is estimated at 56.46 tons TSS/year as compared to the previous five-year average estimate of 187.06 tons TSS/year.*

- *Using the Method 2 approach, the annual estimated in-stream sediment load for February 2007 through May 2008 was calculated at 174.25 tons TSS/year. This value shows a reduction of 12.81 tons in the annual sediment load below the five-year average of 187.06 tons TSS/year calculated in June 2007*

- The TSS-to-turbidity mathematical relationship has been updated and improved with the addition of 16 new simultaneous data sets to the 50 data sets available in 2007. The 66 data sets were run through linear regression analysis and a new equation generated.

- Recalculating the TSS-to-flow rate relationship proved challenging. Hence, three methods were used. The data collected from February 2007 through May 2008 included few medium to high flow rates. This period represented an anomaly in dry weather for the Sitka area. Collection of further data over several years may warrant modifying the statistical relationship developed in 2007.

- Average monthly flows were not modified, as the meager data did not substantially change the average monthly flows calculated in 2007.

- An estimated 4.5% reduction in the annual load capacity was calculated in comparison to load capacity calculated in 2007. This is due to the recalculated allowable target TSS limit of 4.94 mg/liter compared to the 5.17 mg/l limit used in the 2007 calculations.

It is recommended that any future water quality analyses for purposes of modifying the TMDL annual load capacity and annual in-stream sediment load calculations be scheduled not more frequently than every two to three years. Given that Granite Creek's existing sediment load is considerably below the allowable load capacity on an annual basis, the recommended focus should be on ensuring that in-stream loads during problematic months (September through December) are reduced below the allowable monthly load capacity for those months.