Sediment Targets in the Lower Boise River Tributaries

This document has been prepared as a vehicle for discussion about pollutant targets for the sediment-impaired tributaries to the Lower Boise River. It is a working document, is subject to change, and should not be cited.

The streams, and their corresponding assessment units, are identified below:

Assessment Unit	Stream Name	Description
ID17050114SW010_03	Five Mile Creek	3rd order section
ID17050114SW008_03	Ten Mile Creek	3rd order below Blacks Creek Reservoir
ID17050114SW007_04	Fifteen Mile Creek	Five Mile Creek to mouth
ID17050114SW006_02	Mason Creek	Entire drainage
ID17050114SW015_03	Willow Creek	3rd order section
ID17050114SW002_04	Indian Creek	Sugar Avenue to mouth
ID17050114SW016_03	Sand Hollow Creek	C-Line Canal to I-84
ID17050114SW017_03	Sand Hollow Creek	I-84 to Sharp Road
ID17050114SW017_06	Sand Hollow Creek	Sharp Road to mouth

Summary of Proposed Targets

To protect the beneficial use of Cold Water Aquatic Life:

1. Average of 20mg/L suspended sediment for a maximum of 4 months
2. Other sediment/duration combinations that protect juvenile salmonids to SEV 8

These targets provide the same level of protection as the Lower Boise River sediment TMDL, but with timeframes that are specific to the nature of the sediment pollution in the tributaries.

Rationale for Using Newcombe and Jensen (1996)

Idaho's narrative sediment criterion is expressed in IDAPA 58.01.02.200.08 and states that:

> "Sediment shall not exceed quantities … which impair designated beneficial uses."

In this case, every assessment unit has Cold Water Aquatic Life as its most stringent designated or existing beneficial use. TMDL sediment targets must be based upon attainment of this use. The Lower Boise River ("mainstem") TMDL used a 1996 paper by Charles Newcombe and Jorgen Jensen to make the link between sediment levels and beneficial uses.

Although there have been many studies that investigated how sediment affects fish, they were conducted over various timescales and species, and measured different response variables. Newcombe and Jensen performed a meta-analysis, and were able to unify and rationalize the results from 80 different studies. They found an empirical relationship between the concentration and duration of sediment, for a given effect on fish. According to DEQ and EPA scientists, this paper is still the best resource for establishing the effects of sediment on fish.

Newcombe and Jensen essentially say that the duration of a sediment concentration is as important as the concentration itself. The article provides charts that relate the concentration, duration and severity of impairment. To use the charts, we have to answer the following questions:

1. Which grouping of fish are we trying to protect?
2. What level of protection do we want to provide?
3. What is the likely duration of the elevated sediment?

The chart output will then be the concentration of sediment that satisfies the three answers above.

1. Which grouping of fish are we trying to protect?

Newcombe and Jensen's model contained five groupings of aquatic life, including adult salmonids, juvenile salmonids, and eggs and larvae.

The beneficial use of cold water aquatic life includes fish and insects, and juvenile salmonids are the most sensitive life stage. If juvenile salmonids were protected, all other cold water aquatic life would be too, and the beneficial use would be supported.

Salmonids are also a popular research target, and appear in most of the studies used in producing the sediment response charts. A large number of data points (in this case 108) ensures a more reliable analysis.

Finally, juvenile salmonids is also the grouping used in the 1998 Lower Boise River TMDL. Where possible, DEQ should use consistent targets.

We should continue to use the matrix for juvenile salmonids.

2. What level of protection do we want to provide?

Newcombe and Jensen categorized the negative effects on fish on a scale of severity between 0 and 14. They further divided the scale into 3 categories: 'behavioral effects', 'sublethal effects', and 'lethal and paralethal effects'.

We must choose a severity level (SEV) that is protective of cold water aquatic life.

SEV9 is the lowest score in the 'lethal and paralethal effects' category. In addition to high levels of physiological stress, the density of fish is reduced and their growth is retarded by as much as 84%. At SEV9, an angler is less likely to catch a fish because of its behavioral and feeding problems, and any fish he does catch will be a runt, with skin and gill damage. This clearly does not support the Clean Water Act's goal of 'fishable'.

SEV8 represents the highest level of impacts in the 'sub-lethal' category. In other words, fish experience stress, but it is not sufficient to cause death or growth defects. This stress can be severe, and includes skin and gill damage, but although the fish are clearly having difficulty, they are still alive and present in the stream. This meets the Clean Water Act's goal of a 'fishable' stream, so the beneficial use is supported.

The 1998 mainstem Boise River TMDL set a chronic sediment target at 50mg/L for 60 days. This is most closely equivalent to a SEV8 on Newcombe and Jensen's juvenile salmonid chart:

Juvenile Salmonids

Duration of exposure to SS (log_e hours)

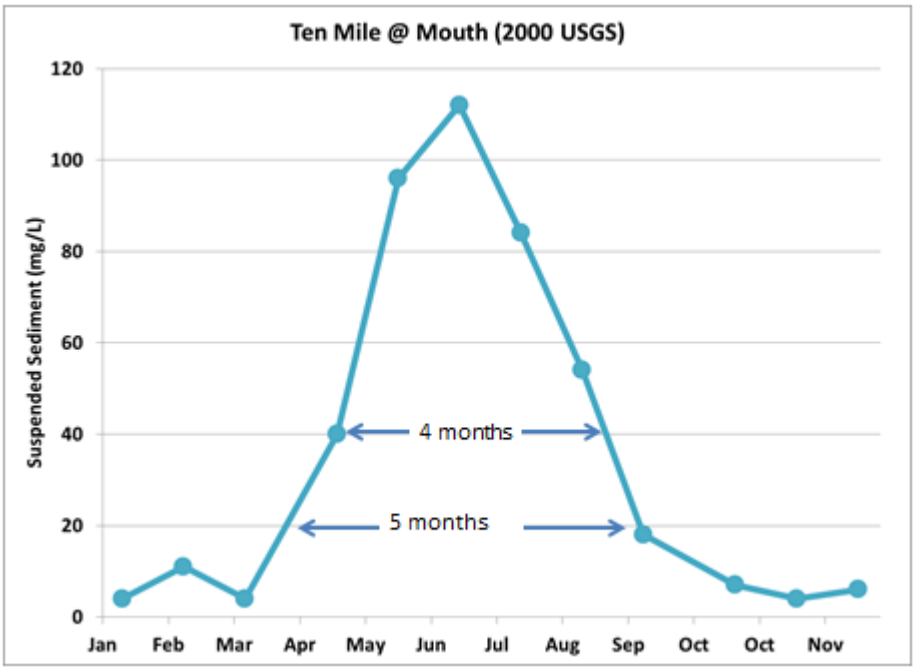
Concentration (mg SS/L)	0	1	2	3	4	5	6	7	8	9	10	(log_e mg SS/L)
(B)	Average severity-of-ill-effect scores (calculated)											
162755	9	10	11	11	12	13	14	14	-	-	-	12
59874	9	9	10	11	11	12	13	14	14	-	-	11
22026	8	9	9	10	11	11	12	13	13	14	-	10
8103	7	8	9	9	10	11	11	12	13	13	14	9
2981	6	7	8	9	9	10	11	11	12	13	13	8
1097	6	6	7	8	9	9	10	11	11	12	13	7
403	5	6	6	7	8	9	9	10	11	11	12	6
148	4	5	6	6	7	8	9	9	10	11	11	5
55	4	4	5	6	6	7	8	8	9	10	11	4
20	3	4	4	5	6	6	7	8	8	9	10	3
7	2	3	4	4	5	6	6	7	8	8	9	2
3	1	2	3	4	4	5	6	6	7	8	8	1
1	1	1	2	3	4	4	5	6	6	7	8	0
	1	3	7	1	2	6	2	7	4	11	30	
	Hours			Days			Weeks		Months			

Based upon the above descriptions, and maintaining consistency with the mainstem TMDL, DEQ believes that **SEV8 is protective of the cold water aquatic life beneficial use**.

3. What is the likely duration of the elevated sediment?

At the time the mainstem durations were chosen, there was an "absence of TSS-duration data" (1998 CH2MHill Technical Memorandum). Instead, 60 days was used because it represented half of the length of the 120-day irrigation season. The Memorandum goes on to say that if we had data, we should "select a TSS concentration that would be protective over a duration equal to the maximum length of time for which an elevated TSS concentration would be sustained."

Since that time, DEQ, USGS and ISDA have gathered at least six months of biweekly sediment data from each of the Boise River tributaries. These data enable us to see for how long the elevated concentrations persist, and therefore to pick an appropriate duration, consistent with the guidance in the Technical Memorandum. Each of the tributaries has a slightly different pattern of sediment, but the 2000 USGS Ten Mile Creek dataset provides the clearest example:



With the exception of upper Sand Hollow Creek, every assessment unit has elevated sediment levels for at least 4 months. All the creeks drop to a relatively low baseline by November.

The charts in Newcombe and Jensen offer a limited choice of timescales. The one most closely matching the actual period of elevated sediment concentrations is 4 months. **Therefore, we should use a timescale of 4 months.**

DEQ is also concerned to address the effects of shorter-term spikes in sediment, which will typically be associated with storms and runoff events. The effects of a storm may last for hours or days, and it is unclear which timescale (and therefore concentration), should be used as an appropriate target. Rather than arbitrarily picking a duration, we need a flexible target that is protective of cold water aquatic life over multiple timescales.

We can **use Newcombe and Jensen's severity level of 8 for juvenile salmonids as a surrogate target** for storm timescales (6 days or less). This could eventually provide for a set of short-term numeric targets (such as for MS4 permits) that vary depending on the period of elevated sediment.

Calculating Proposed Targets

The following figure reproduces chart 3B in Newcombe and Jensen (1996), and is the matrix for juvenile salmonids. Highlighted in green, it shows that to offer SEV 8 protection for 4 months, an average sediment concentration of 20mg/L is required.

The short term surrogate targets are highlighted in yellow.

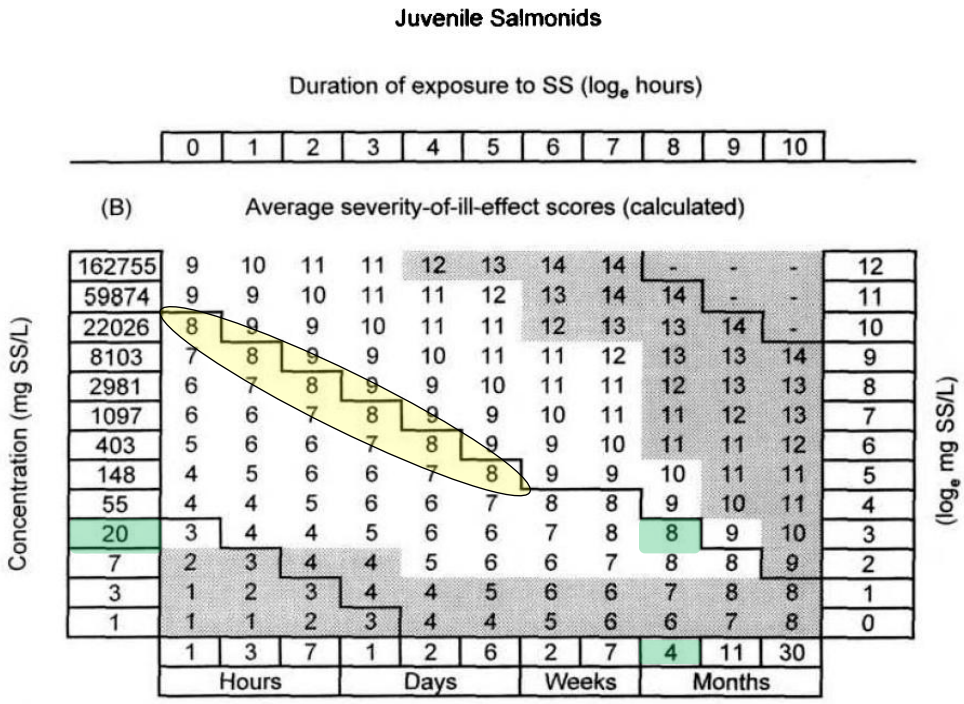


Figure 1 Matrix for Juvenile Salmonids

It is important to note that the fish can withstand the target concentration for a *maximum* of 4 months before they exhibit the effects of SEV8. In other words, after being exposed for the relevant duration, the fish 'need a break'. The target should be expressed as:

> An *average* of 20mg/l for a *maximum* of 4 months.

References

Channel Suspended Sediment and Fisheries: A Synthesis for Quantitative Assessment of Risk and Impact (Newcombe and Jensen 1996)

Guide to Selection of Sediment Targets for Use in Idaho TMDLs (Idaho DEQ, June 2003)

Selection of a Total Suspended Sediment (TSS) Target Concentration for the Lower Boise River TMDL (CH2M Hill 1998)