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Department of Environmental Quality
State Water Quality Programs

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
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Seattle, WA 98101-3140

OFFICE OF
WATER AND WATERSHEDS

OCT 13 2009

Mr. Barry N. Burnell, Administrator
Water Quality Program
Department of Environmental Quality
1410 N. Hilton
Boise, Idaho 83706

Dear Mr. Burnell:

EPA is hereby transmitting to you the final list of waters and pollutants that EPA is adding to the State's final 2008 Clean Water Act Section 303(d) List (see Enclosure 1). Detailed decision documents for each water and a responsiveness summary explaining public comments received and EPA's responses is also enclosed (see Enclosures 2-7).

On February 4, 2009, EPA took action on Idaho's 2008 Clean Water Act Section 303(d) list to disapprove the State's decision not to list the Lower Boise River (ID17050114SWOOl_06) and Hem Creek (ID17060307CL007_02b). EPA provided public notice and solicited public comment on its identification of additional waters and pollutants for inclusion. EPA reviewed the five sets of written comments for the Lower Boise River and one set of comments for Hem Creek that were received from the State and other parties. We have concluded that both of these waters are water quality-limited and as required by 40 CFR 130.7, will be added to the State's 303(d) list.

During our review process for the Lower Boise River, EPA identified a listing error that likely occurred as a result of Idaho's revision of its waterbody identification system, converting from water quality limited segments (WQLSs) to assessment units (AUs). As a result of the transition to AUs, it appears that approximately 13 miles of a section of the Lower Boise (formerly WQLS 2727) was removed from the 303(d) list for nutrients without being identified as a delisting in 2002. The AU which now comprises the Lower Boise (ID17050114SW00l_06) does not include the approximately 13 mile segment (WQLS 2727 originally began at the City of Star). EPA assumes this error was inadvertent as a result of the complexities of the transition in waterbody identification from WQLSs to AUs. Based on this discovery, EPA encourages Idaho to reexamine all the data and information concerning the waters originally included in WQLS 2727 (now included in AU ID17050114SW005_06), and consider whether this segment should be listed during the 2010 303(d) listing cycle.

We look forward to working with the State during the 2010 listing process. If you have any questions on any aspect of this final listing decision, please call me at (206) 553-4198 or David Croxton at (206) 553-6694.

Sincerely,

Michael A. Bussell, Director
Office of Water and Watersheds

Enclosures

cc: Mr. Michael McIntyre, Idaho Department of Environmental Quality

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Enclosure 1: Water body pollutant combinations added by EPA to Idaho's 2008 §303(d) List

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Description of Table Columns:
"AU" column identifies the Assessment Unit Idaho uses to identify the water body
"Water body name" column identifies the water body on the 303(d) list
"Pollutant" column identifies the pollutant causing impairment

Table 1: EPA's additions to Idaho's 2008 §303(d) List.

Assessment Unit	Water body name	Pollutant
ID17050114SWOOl_06	Lower Boise River	nutrients
ID17060307CL007_02b	Hem Creek	temperature

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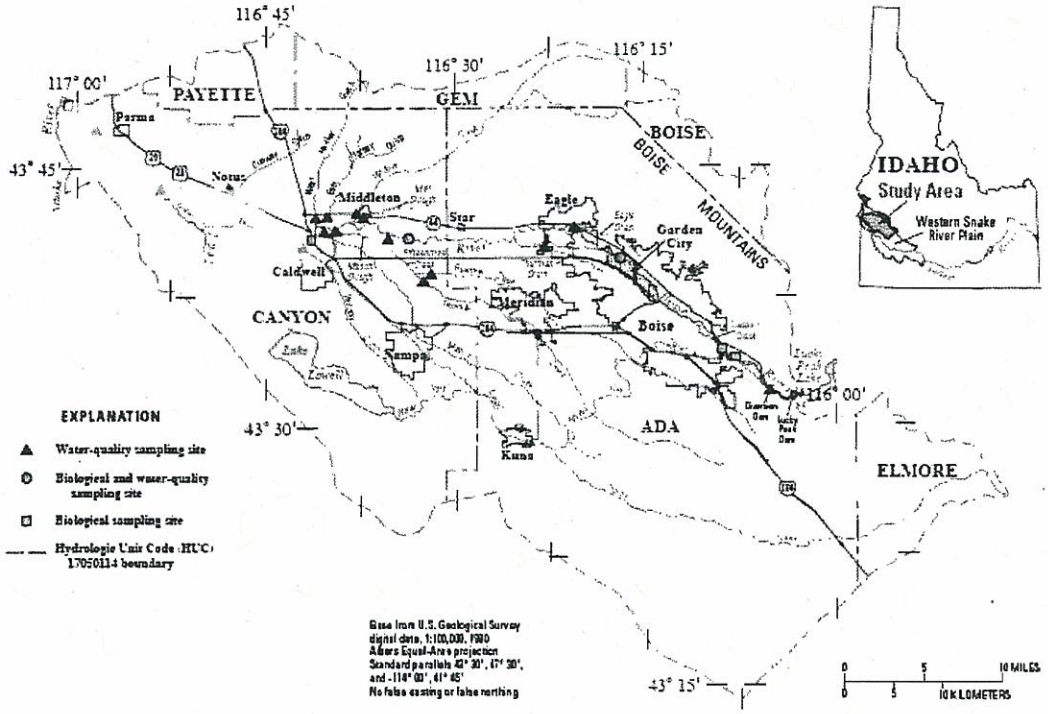
ENCLOSURE 2: Rationale for Adding Lower Boise River onto Idaho's 2008 303(d) List

On February 4, 2009, EPA sent a letter to Idaho Department of Environmental Quality (IDEQ) announcing the decision to disapprove the delisting of the Lower Boise River segment - Boise River from Indian Creek to the mouth- AU:ID17050114SW001_06 (Lower Boise River) for nutrients from Idaho's 2008 303(d) List (Bussell, 2009). On March 25, 2009, EPA issued a Federal Register notice seeking comments on EPA's proposed decision to add the Lower Boise River segment onto Idaho's 303(d) List for nutrients. This document describes the basis for EPA's final decision to add the Lower Boise River to Category 5 of Idaho's 303(d) List for nutrients and includes the following sections:

Federal Requirements to add an impaired water onto the 303(d) List
Applicable Water Quality Standards for Nutrients in Idaho
Data Reviewed by EPA
Interpretation of Narrative Nutrient Criteria in the Lower Boise River
Analysis of Total Phosphorus Data
Analysis of Total Nitrogen Data
Analysis of Periphyton Chlorophyll-a Data
Analysis of Other Water Quality and Biological Data
Conclusion

The impaired segment of the Lower Boise River is highlighted in Figure 1 and extends from river mile 19.7 to mouth. Figure 2 describes flow inputs and outputs into the Lower Boise River mainstem from Lucky Peak Reservoir to Snake River.



ENCLOSURE 2: Rationale for Adding Lower Boise River onto Idaho's 2008 303(d) List

Figure 1. Modified Map of the Lower Boise Watershed (MacCoy, 2004)

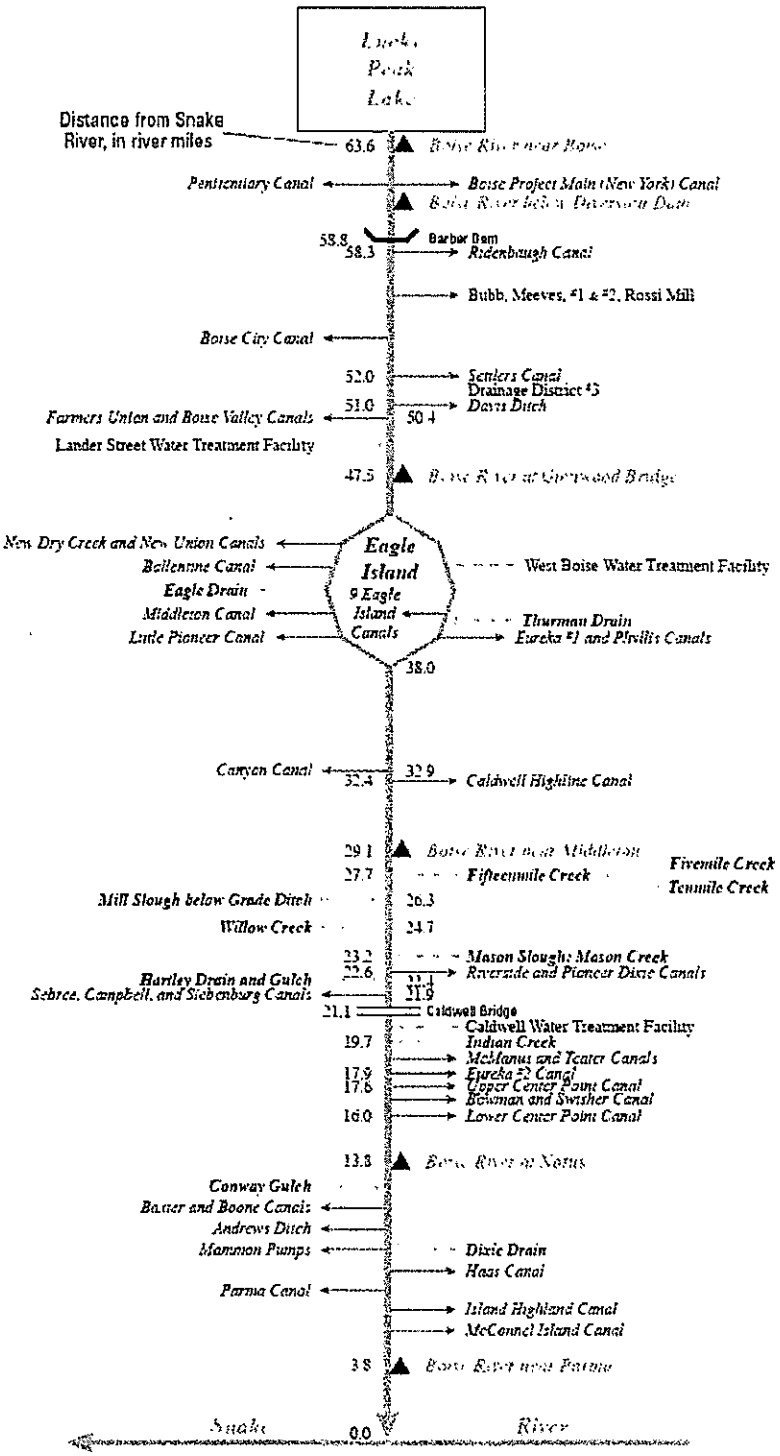


Figure 2. Flow inputs and outputs into the Lower Boise River from Lucky Peak Reservoir to the Snake River (MacCoy, 2004)

ENCLOSURE 2: Rationale for Adding Lower Boise River onto Idaho's 2008 303(d) List

A. Federal Requirements to add an impaired water onto the 303(d) List

According to Section 303(d)(1)(A) of the Clean Water Act, states are required to identify waters that do not meet applicable water quality standards. States are required to submit a list biennially (CFR 130.7(d)) to EPA for their approval. If EPA disapproves the listings, EPA must "identify such waters in such State...(CFR 130.7(d)(2))."

B. Applicable Water Quality Standards for Nutrients in Idaho

The Idaho water quality standards that address nutrients are as follows:

Idaho Administrative Code (IDAPA 58.01.02-200.05,06)

05. Floating, Suspended or Submerged Matter. Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities.

06. Excess Nutrients. Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses.

The beneficial uses of the Lower Boise River segment from Indian Creek to the mouth (AU:ID17050114SW001_06) include cold water biota and primary and secondary contact recreation.

C. Data Reviewed by EPA

EPA reviewed the following data to evaluate impairment of the Lower Boise River from nutrients. These data were readily available to the state of Idaho prior to IDEQ's decision to delist the Lower Boise River in their 2008 303(d) List submitted in July 2008. They include the following:

- 13 years of total phosphorus data collected monthly or bimonthly by the USGS from October 1989 to 2002 at four stations (Diversion, Glenwood, Middleton, Parma).
- 8 years of nitrogen data collected monthly or bimonthly by the USGS from 1994 to 2002 at four stations (Diversion, Glenwood, Middleton, Parma).
- 7 years of periphyton chlorophyll-a data collected annually by the USGS from 1995 to 2002 at five stations (Diversion, Glenwood, Middleton, Caldwell, Parma).
- 5 years of planktonic chlorophyll-a data collected annually by the USGS from 1995 to 2000 at four stations (Diversion, Glenwood, Middleton, and Parma).
- 8 years of dissolved oxygen and pH data collected monthly or bimonthly by the USGS from 1994 to 2002 at four stations (Diversion, Glenwood, Middleton, Parma).

- 1 day of dissolved oxygen and pH data collected continuously by the USGS in August 1997 at four stations (Diversion, Glenwood, Middleton, Parma).
- 3 years of dissolved oxygen and pH data collected continuously by the City of Boise from 2004 to 2007 at two stations (Glenwood and Linder Bridge).
- 7 years of macroinvertebrate data collected annually by the USGS from 1995 to 2002 at five stations (Diversion, Glenwood, Middleton, Caldwell, Parma).

EPA also considered the above data in its decision to disapprove Idaho's proposal to delist the Lower Boise River from their 2008 303(d) List for nutrients (Bussell, 2009).

D. Interpretation of Narrative Nutrient Criteria in the Lower Boise River

In interpreting Idaho's narrative criteria for nutrients, EPA has relied on the use of indicator parameters and numeric criteria recommended in EPA's 304(a) guidance documents, peer-reviewed scientific literature, and site-specific information. These methods have also been used by Idaho DEQ in interpreting their nutrient narrative criteria in recent State listing and TMDL actions. EPA's interpretation of the state's narrative criterion is consistent with the guidance in the preamble to the final rule for Water Quality Standards which promulgated the definition of "applicable water quality standards" at 40 CFR 130.7(b)(3). The preamble to the final rule that promulgated 130.7(b)(3) outlines a number of factors states should consider when interpreting a narrative criterion for 303(d) listing purposes and further explained the definition (57. Fed. Reg. 33040, 33046 (7/24/92)):

> *In the case of a pollutant for which a numeric criterion has not been developed, a State should interpret its narrative criteria by applying a proposed state numeric criterion, an explicit State policy or regulation (such as applying a translator procedure developed pursuant to section 303(c)(2)(B) to derive numeric criteria for priority toxic pollutants), EPA national water quality criteria guidance developed under section 304(a) of the Act and supplemented with other relevant information, or by otherwise calculating on a case-by-case basis the ambient concentration of the pollutant that corresponds to attainment of the narrative criterion. Today's definition is consistent with EPA's Water Quality Standards regulation at 40 CFR part 131. EPA may disapprove a list that is based on a State interpretation of a narrative criterion that EPA finds unacceptable.*

Furthermore, EPA's interpretation is also consistent with the decision in a recent administrative NPDES appeal regarding the interpretation of narrative criteria under 40 C.F.R. 122.44(d)(1)(vi), which sets out similar factors to be used to interpret narrative criteria for permitting purposes. In *re: City of Attleboro Department of Wastewater,* NPDES Appeal No. 08-08, 14 E.A.D. (EAB, September 15, 2009), the EAB approved EPA's approach to interpreting a state's narrative criterion when developing numeric effluent limits in an NPDES permit.

ENCLOSURE 2: Rationale for Adding Lower Boise River onto Idaho's 2008 303(d) List

1. Appropriate indicators for interpreting narrative standards for nutrients.

Several EPA guidance documents address considerations for determining nutrient impairment. In light of these guidances and other relevant information, EPA concluded that appropriate indicators for interpreting Idaho's narrative criteria for nutrients include nitrogen, phosphorus, and periphyton chlorophyll-a. EPA's most recent guidance published under Section 304(a) of the Clean Water Act entitled *Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion III* considers total phosphorus, total nitrogen, chlorophyll-a, and some measure of turbidity as the best indicators of nutrient impairment. The guidance also considers additional indicators such as dissolved oxygen and macrophyte growth or speciation, and other fauna and flora useful indicators. This guidance establishes recommendations drawn from reference sites and peer-reviewed scientific literature in geographic areas in the Xeric West where the Lower Boise River is located. EPA's Ecoregion III 304(a)criteria recommends total phosphorus levels no greater than 0.043 mg/L and total nitrogen levels no greater than 0.38 mg/L (EPA, 2000a).

The 1986 Quality Criteria for Water ("Gold Book") established under Section 304(a) of the Clean Water Act sets maximum threshold concentrations for nutrients to prevent or control harmful impacts from nutrients. The literature values set forth in EPA's Gold Book recommends in-stream phosphorus concentrations of no greater than 0.1 mg/L for any stream not discharging directly to lakes or impoundments and in-stream nitrate + nitrite-nitrogen no greater than 0.3 mg/L (EPA, 1986)

ENCLOSURE 2: Rationale for Adding Lower Boise River onto Idaho's 2008 303(d) List

Table 1. Nutrient (µg/L) and algal biomass criteria limits recommended to prevent nuisance algae conditions and water quality degradation in streams based either on nutrient-chlorophyll *a* relationships or preventing risks to stream impairment as indicated.

PERIPHYTON Maximum in mg/m^2						
TN	**TP**	**DIN**	**SRP**	**Chlorophyll *a***	**Impairment Risk**	**Source**
				100-200	nuisance growth	Welch et al. 1988, 1989
275-650	38-90			100-200	nuisance growth	Dodds et al. 1997
1500	75			200	eutrophy	Dodds et al. 1998
300	20			150	nuisance growth	Clark Fork River Tri-State Council, MT
	20				*Cladophora* nuisance growth	Chetelat et al. 1999
	10-20				*Cladophora* nuisance growth	Stevenson unpubl. data
		430	60		eutrophy	UK Environ. Agency 1988
		100[2]	10[3]	200	nuisance growth	Biggs 2000
		25	3	100	reduced invertebrate diversity	Nordin 1985
			15	100	nuisance growth	Quinn 1991
		1000	10[2]	~100	eutrophy	Sosiak pers. comm.
PLANKTON Mean in µg/L						
TN	**TP**	**DIN**	**SRP**	**Chlorophyll *a***	**Impairment Risk**	**Source**
300[3]	42			8	eutrophy	Van Nieuwenhuyse and Jones 1996
	70			15	chlorophyll action level	OAR 2000
250[3]	35			8	eutrophy	OECD 1992 (for lakes)

[1]30-day biomass accrual time
[2]Total Dissolved P
[3]Based on Redfield ratio of 7.2N:1P (Smith et al. 1997)

Source: *Nutrient Criteria Technical Guidance Manual – Rivers and Streams,* EPA-822-B-00-002. U.S. EPA. July, 2000.

ENCLOSURE 2: Rationale for Adding Lower Boise River onto Idaho's 2008 303(d) List

Additional support for the use of nitrogen, phosphorus, and periphyton chlorophyll-a as appropriate indicators of nutrient impairment in the Lower Boise River were discussed in a USGS study. In USGS's report published in 2004, MacCoy assessed the relationship between nitrogen and phosphorus to algal biomass in the Lower Boise River. Nutrient availability affects how algae respond to nutrients. According to MacCoy's 2004 USGS report, the limiting nutrient concept of Liebig states that the amount of algal growth is limited by the nutrient most scarce in the environment that the organism needs most for growth. To determine the limiting nutrient, scientists developed a nitrogen:phosphorus ratio (N:P), where ratios less than 7.2 indicate nitrogen limitation and ratios above indicate phosphorus limitation. MacCoy evaluated N:P ratios for the Lower Boise River and concluded that the River may be limited by nitrogen or phosphorus depending on location and seasonality (MacCoy, 2004). That is, either nitrogen or phosphorus may cause excessive algae growth. For instance in Parma during the irrigation season, the Lower Boise River is limited by both nitrogen and phosphorus. However, during the nonirrigation season, the system was limited by nitrogen. In either case, total nitrogen and total phosphorus are both linked to algal growth. IDEQ's Nutrient Subbasin Assessment in the Lower Boise River Watershed published in 2001 also concludes that nitrogen and phosphorus are linked to algal growth.

In addition to phosphorus and nitrogen as indicators for nutrients, several peer-reviewed scientific articles describe periphyton chlorophyll-a levels that constitute nuisance algae levels. These are based on a collection of field and lab studies. A summary of EPA-recommended nutrient and algal biomass criteria are described in EPA's technical guidance document entitled *Nutrient Criteria Technical Guidance Manual – Rivers and Streams* (EPA, 2000b) shown in Table 1.

MacCoy's 2004 USGS Report concludes that in the Lower Boise River, "the growth of aquatic plants is largely associated with periphyton (MacCoy, 2004)." In IDEQ's Nutrient Subbasin Assessment for the Lower Boise River and in several subbasin assessments from 2004-2008, chlorophyll-a is used as an indicator for nuisance algae levels which directly relates to the primary and secondary contact recreation uses. As described in EPA's review of Idaho's delisting rationale for the Lower Boise River (Bussell, 2009), chlorophyll-a is the primary pigment in all algae and is used to measure algae growth. Planktonic chlorophyll-a measures the amount of pigment in phytoplankton or suspended algae. Phytoplankton consist of small plants that drift in the water column and have limited or no ability to move. Periphyton, also called attached algae or benthic algae, refers to microfloral growth on substrata or river bottoms (Wetzel, 2001). The Nutrient Subbasin Assessment for the Lower Boise River states that "several authors have suggested that periphyton chlorophyll-a values from 100 to 200 mg/m^2 constitute a nuisance threshold, above which aesthetics are impaired." EPA's *Nutrient Criteria Technical Guidance Manual – Rivers and* Streams (EPA, 2000b) also summarizes various peer-reviewed studies which show that nuisance algae levels for periphyton chlorophyll-a occur in the 100-200 mg/m^2 range.

2. EPA's numeric interpretation of Idaho's narrative nutrient criteria.

In the Lower Boise River, EPA uses both Gold Book criteria for phosphorus of 0.1 mg/L and instream nitrate + nitrite-nitrogen no greater than 0.3 mg/L (EPA, 1986) and ecoregional 304(a) criteria of total phosphorus levels no greater than 0.043 mg/L and total nitrogen levels no greater than 0.38 mg/L (EPA, 2000a) to interpret Idaho's "excess nutrients" criterion (IDAPA 58.01.02-

200.06) for assessing nutrient impairment. As discussed above, EPA uses the range of 100-200 mg/m^2 for periphyton chlorophyll-a to interpret Idaho's "excess nutrients" criterion (IDAPA 58.01.02-200.06) to determine if periphyton growth from excess nutrients in the Lower Boise River constitutes a level of nuisance algae growth that impairs the recreational use. Further, in the Lower Boise River, EPA interprets the "floating, suspended, and submerged matter" criterion (IDAPA 58.01.02-200.05) as periphyton chlorophyll-a above the nuisance algae range of 100-200 mg/m2 as an exceedance of this criterion. In addition, the narrative criterion states that surface shall be free from floating, suspended, or submerged matter that *may* impair designated beneficial uses.

3. Idaho DEQ's interpretation of its narrative standard for nutrients

As an additional analysis, EPA also evaluated how IDEQ interpreted their narrative nutrient standards in past watershed assessments and TMDLs completed between 2004 to 2008 for nutrient-impaired waters. IDEQ considered total phosphorus in all nutrient-impaired watersheds and used EPA's 304(a) Gold Book criteria (EPA, 1986) to determine whether to recommend delisting nutrients in the subsequent 303(d) List or whether to complete a TMDL for nutrients (IDEQ, 2008b, 2007a, 2007b, 2007c, 2006, 2005a, 2005b, 2005c, 2004). In some cases, TP were coupled with other water quality parameters such as planktonic chlorophyll-a and dissolved oxygen. Table 2 outlines the listing and delisting analyses described in watershed subbasin assessments from 2004 to 2008.

Table 2. Listing and Delisting Analyses in Nutrient-Impaired Waters in Idaho (2004-2008)

Waterbody Name	Approval Date	Listing/Delisting Analysis
Bear River/ Malad River Basin	June 2006 (pages 112-125)	Listing rationale: * BURP data not supporting beneficial uses; * Water quality samples above 0.05 mg/L TP (EPA Gold Book, 1986), 0.075 mg/L TP (Ecosystems Research Institute, 1995); * DO below standards * Dense macrophyte stands
Lindsay Creek	June 2007	Listing rationale: * Taxa richness low; SMI = 0 * TP greater than 0.1 mg/L (EPA, 1986), TP greater than 0.030 mg/L (EPA, 2000). * High nitrite+nitrate-N concentrations in groundwater above 2 mg/L (IDWR, 1995).
Upper Hangman	September 2007	Delisting rationale: * TP less than 0.1 mg/L (EPA, 1986)
North Fork Payette River	August 2005	Delisting rationale for NF Payette River: * TP less than 0.1 mg/L TP (EPA, 1986) * DO meeting standards
Weiser	January 2007	Delisting Rationale: * Diel DO data below standards * TP less than 0.1 mg/L TP (EPA, 1986)
Salmon Falls Creek	February 2008	Listing rationale for free-flowing rivers:

Waterbody Name	Approval Date	Listing/Delisting Analysis
		* TP greater than 0.1 mg/L monthly average, 0.16 mg/L TP daily maximum * Planktonic chlorophyll-a greater than 15 µg/L.
Snake River-Hells Canyon	September 2004	Listing rationale for free-flowing rivers: * TP greater than 0.070 mg/L monthly average * Planktonic chlorophyll-a greater than 15 µg/L * DO below standards
Beaver-Camas Creek	August 2005	Delisting rationale: * TP less than 0.05 mg/L and nitrite + nitrate-N less than 0.3 mg/L (EPA Gold Book, 1986).
Camas Creek	September 2005	Delisting rationale for Soldier Creek: * Planktonic chlorophyll-a below 15 µg/L * TP below 0.1 mg/L average TP; below 0.16 mg/L instantaneous TP * DO, pH and turbidity show that beneficial uses are fully supported

In IDEQ's most recent nutrient TMDL for Salmon Falls Creek approved by EPA in February 2008, IDEQ interpreted its narrative excess nutrients standard by applying EPA's 304(a) Gold Book criteria of 0.1 mg/L total phosphorus to establish the loading capacity (IDEQ, 2008b).

IDEQ has interpreted the narrative nutrient criteria using nitrogen as an indicator based on EPA-recommended criteria and scientific literature. The numeric interpretation based on nitrogen values use different metrics: either total nitrogen or nitrate + nitrite-nitrogen. Total nitrogen values are listed in Table 1. In the Beaver-Camas Creek TMDL (IDEQ, 2005), IDEQ used EPA's Gold Book 304(a) criterion of 0.3 mg/L nitrate + nitrite-nitrogen to delist the water for nutrients. The state's Lower Boise River Nutrient Subbasin Assessment prepared for development of a TMDL uses a total nitrogen level of 1.5 mg/L derived from scientific literature to indicate enrichment in streams and rivers (IDEQ, 2001). In the Lindsay Creek TMDL, IDEQ interprets the narrative nutrient criterion by using a background level of nitrate + nitrite-nitrogen found in groundwater of 2 mg/L to develop the loading capacity (IDEQ, 2007a). Thus, IDEQ has used different metrics and values when interpreting their narrative nutrient standards for nutrients using nitrogen as an indicator.

The following sections provide an analysis of total phosphorus, nitrogen, periphyton chlorophyll-a. dissolved oxygen, pH, and macroinvertebrate data and compares it to EPA-recommended values and other peer-reviewed scientific literature to evaluate nutrient impairment in the Lower Boise River. EPA's analyses consider all the water quality data in sum and looks at the weight of evidence to determine whether the Lower Boise River exceeds Idaho's narrative nutrient criteria.

E. Analysis of Total Phosphorus Data

Phosphorus levels in the Lower Boise River consistently exceed EPA's 304(a) Gold Book criteria of 0.1 mg/L total phosphorus (EPA, 1986) as well as EPA's 304(a) ecoregional criteria of 0.043 mg/L, thus indicating impairment. In EPA's review of Idaho's Delisting Rationale for the Lower Boise

River (Bussell, 2009), the document summarizes a series of studies completed in the Lower Boise River watershed. IDEQ's Nutrient Subbasin Assessment for the Lower Boise River describes total phosphorus data collected from 1989 to 2000 by USGS (IDEQ, 2001). MacCoy's 2004 USGS Report describes water quality and biological data collected at four stations in the Lower Boise River watershed from 1994 to 2002 (MacCoy, 2004). Both reports show exceedances of total phosphorus well over EPA's 304(a) Gold Book value of 0.1 mg/L total phosphorus and EPA's 304(a) ecoregional criteria of 0.043 mg/L (EPA, 2000).

According to IDEQ's 2001 Nutrient Subbasin Assessment,

> *"High concentrations of phosphorus have been documented in the Boise River at Glenwood Bridge from 1989 through 1999 (Figure 12) [sic-Figure 3 below]. The river is also significantly phosphorus-enriched at Middleton and Parma (Figure 13) [sic-Figure 3 below]. If phosphorus concentrations are considered exclusively, algae blooms may be possible under the right conditions. Total phosphorus concentrations in samples collected by the USGS since 1994 range from well below the EPA guideline value for flowing waters of 0.1 mg/l at Diversion Dam to as high as 1.3 mg/l at Middleton and 0.6 mg/l at Parma. The highest concentrations occur during low flow conditions, which are generally in the winter when aquatic plant growth is less of a concern. Exceptionally high concentrations were measured at Glenwood Bridge and Middleton in 1992 when the lowest flow on record occurred in the Boise River. Ortho-phosphate concentrations follow a similar pattern to total phosphorus with respect to flow conditions and location. Highest concentrations are during low flow periods, concentrations increase downstream, and ortho-phosphate is more than adequate to support nuisance aquatic growth under the right conditions. Bothwell (1988, 1989) and Horner et al. (1983) have shown that phosphorus concentrations as low as 25 to 50 ug/l are sufficient to support growth of periphyton communities. The data indicate that ortho-phosphate comprises 75% to 80% of total phosphorus concentrations in the Boise River."*

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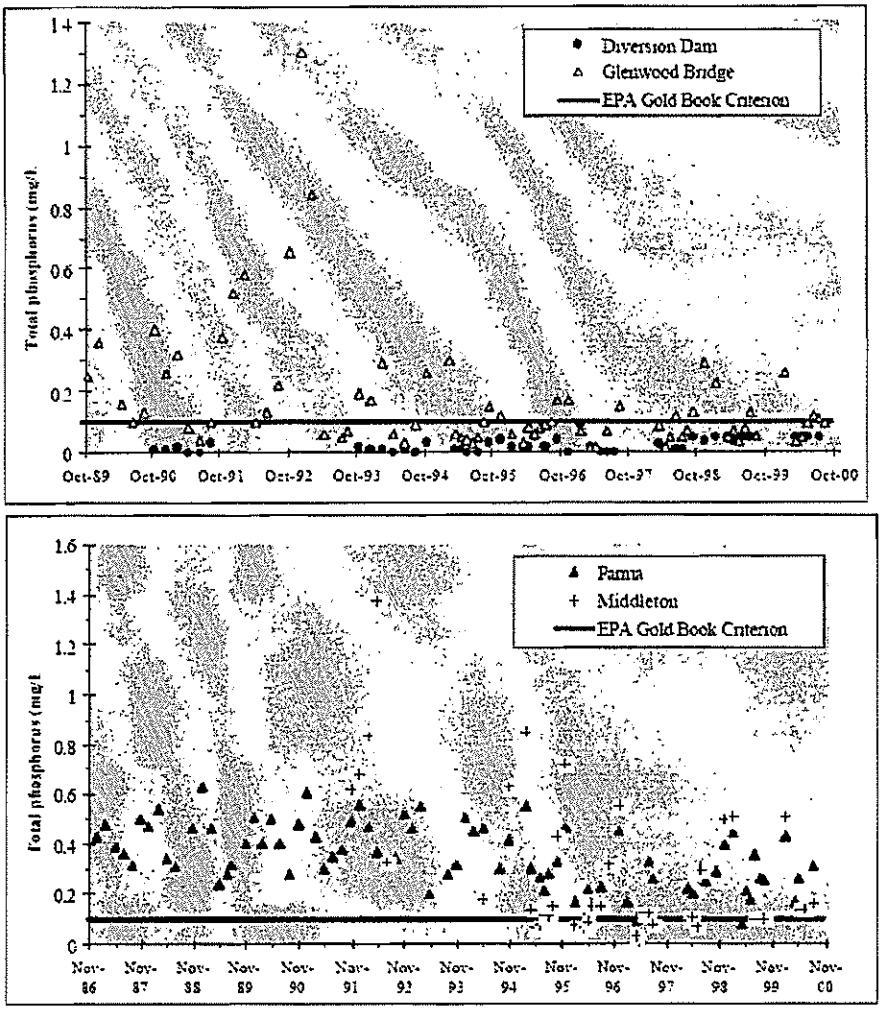

Figure 3. Total phosphorus levels reported in the Lower Boise River Nutrient Sub-basin Assessment, IDEQ, 2001, page 30.

Figure 3 shows total phosphorus data collected at the following stations: Diversion Dam, Glenwood Bridge, Middleton, and Parma. Diversion Dam is the most upstream station and has relatively low total phosphorus values. Glenwood Bridge has higher values in some cases as high as 1.3 mg/L. Figure 2 shows the location and river miles of these stations as well as phosphorus inputs from wastewater treatment plants, tributaries, and agricultural drains. As more phosphorus loads enter into the lower Boise River, total phosphorus increases downstream. IDEQ's Nutrient Subbasin Assessment for the Lower Boise River watershed indicates that total phosphorus levels in the Lower Boise River are high enough to cause nuisance algae levels under critical conditions (IDEQ, 2001).

Total phosphorus levels collected at the same four stations in the Lower Boise River through 2002 and reported in MacCoy's 2004 USGS report show similar trends of exceedances of EPA's 304(a) Gold Book criteria and EPA's 304(a) ecoregional criteria. Table 3 summarizes the mean total phosphorus concentrations in the Lower Boise River, compared to EPA Gold Book, ecoregional

criteria and other literature values. These results show the same trends of relatively low total phosphorus values at upstream locations with few anthropogenic phosphorus loads compared to relatively high average concentrations downstream in Middleton and Parma after phosphorus inputs from wastewater treatment plants, agricultural drains and tributaries. These total phosphorus levels exceed EPA's ecoregional criteria as well as EPA's Gold Book and therefore constitute a violation of the excess nutrients narrative criterion (IDAPA 58.01.02-200.06).

Table 3. Comparison of Mean Total Phosphorus (TP) Levels to Reference Targets

Location	Mean TP Conc. (mg/L)	Range of TP (mg/L)	Example TP Targets	Mean % dissolved orthophosphate
Diversion Dam	0.03	0.01 – 0.09	0.043 mg/L TP[1]	54
Glenwood	0.11	0.02 – 0.38	0.10 mg/L TP[2]	75
Middleton	0.25	0.03 – 0.85	0.02 mg/L TP[3]	81
Parma	0.29	0.08 – 0.55		75

MacCoy, D.E., 2004

[1] EPA, 2000. Ambient Water Quality Criteria Recommendations, Nutrient Ecoregion III

[2] EPA, 1986. [Note: EPA's Gold Book reference values have been updated with nutrient ecoregion numbers.]

[3] Watson and Gestring, 1996

Furthermore, total phosphorus includes all forms of phosphorus, particulate and non-particulate phosphorus, inorganic and organic. Orthophosphate is the bioavailable portion of total phosphorus which can be readily absorbed by algae. Therefore, higher levels of orthophosphate in total phosphorus indicate a greater potential for algal growth within the system.

According to IDEQ's Salmon Falls Creek Subbasin Assessment and TMDL,

> *"In freshwater systems, typically greater than 90% of the TP present occurs in organic forms as cellular constituents in the biota or adsorbed to particulate materials (Wetzel, 1983). The remainder of phosphorus is mainly soluble orthophosphate, a more biologically available form of phosphorus than TP that consequently leads to a more rapid growth of algae. In impaired systems, a larger percentage of the TP fraction is comprised of orthophosphate. The relative amount of each form measured can provide information on the potential for algal growth within the system (IDEQ, 2007)."*

In the Lower Boise River, orthophosphate levels in the 2001 Lower Boise River Nutrient Subbasin Assessment comprised from 75-80% of the total phosphorus. MacCoy's 2004 USGS Report, shows the same range of percentage orthophosphate. The percent orthophosphate in the Lower Boise River is much higher in downstream stations of Glenwood, Middleton, and Parma in comparison to Diversion Dam.

As described earlier, MacCoy's 2004 USGS report and IDEQ's Nutrient Subbasin Assessment for the Lower Boise River watershed also conclude that both phosphorus and nitrogen cause periphyton

growth (USGS, 2004; IDEQ, 2001). Public comments submitted to EPA support EPA's conclusion. The City of Boise completed a study of the Lower Boise River using an AQUATOX model which identifies phosphorus as the responsible nutrient variable and the periphytic algae as the responsive variable. Though this study was finalized after the submittal of Idaho's Final 303(d) Integrated Report and therefore not available to IDEQ, nor a basis for EPA's determination, it nonetheless does support EPA's conclusions. Furthermore, the Lower Boise Watershed Council's (LBWC) comment letter (Lower Boise Watershed Council, 2009) also states that phosphorus and periphytic chlorophyll-a have the strongest correlation compared with planktonic chlorophyll-a in the Lower Boise River. The comment letter from the Cities states, "It is evident that phosphorus is threatening water quality and causing nuisance algae aesthetic concerns at sensitive locations." The letter further states, "We do agree that phosphorus is modestly impairing the Lower Boise River and causing nuisance periphyton concentrations at some locations (Cities, 2009)."

F. Analysis of Total Nitrogen Data

Total nitrogen levels and mean nitrate + nitrite levels in the Lower Boise River exceed EPA 304(a) criteria and values for nitrogen indicating impairment. Table 4 compares measured nitrogen values at four stations in the Lower Boise River with EPA reference values and values used by IDEQ to interpret their narrative nutrient standards.

Table 4. Comparison of Mean Nitrogen Levels to Reference Targets (1994-2002)

Location	[1]Mean and range of TN Conc. (mg/L)	Reference Values for TN	[1]Mean nitrate + nitrite – nitrogen levels (mg/L)	Reference Values for nitrate + nitrite – nitrogen levels [4]
Diversion Dam	0.27 (0.15-0.51)	[3]0.38 mg/L	0.11 (0.05-0.31)	[5]0.3 mg/L
Glenwood	0.56 (0.18-1.90)	[2]1.5 mg/L	0.34 (0.05-1.5)	[4]2 mg/L
Middleton	1.37 (0.38-3.51)		1.09 (0.18-3.0)	
Parma	2.57 (0.62-5.33)		2.08 (0.42-4.56)	

[1] MacCoy, 2004.
[2] IDEQ, 2001.
[3] EPA, 2000.
[4] IDEQ, 2005; IDEQ, 2007a.
[5] EPA, 1986;

As shown in the data above and in MacCoy's 2004 USGS study, nitrogen levels increase downstream following the same trend as phosphorus levels. Mean total nitrogen concentrations in the mainstem increase from 0.27 to 2.57 mg/L as inputs from wastewater treatment plants, agricultural drains and tributaries enter into the Lower Boise River mainstem as shown in Figure 2. The levels of nitrogen in the Lower Boise River, particularly at Parma, exceed EPA's 304(a) Gold Book criteria, 304(a) ecoregional criteria, and values used by IDEQ to interpret their narrative standards for nutrients. As previously discussed, nitrogen levels contribute to algal growth which exceeds nuisance levels and therefore, the excess nutrients standard is violated.

G. Analysis of Periphyton Chlorophyll-a Data

Periphytic chlorophyll-a is a direct measurement of nuisance algae that can result from excess nutrients. Chlorophyll-a is the primary pigment of all algae and is used as a measure for algae growth. Planktonic chlorophyll-a is the amount of pigment in phytoplankton, or suspended algae. Phytoplankton consist of small plants that draft in the water column and have limited or no ability to move. Periphyton, also attached or benthic algae, refers to microfloral growth on substrata on river bottoms (Wetzel, 2001).

In IDEQ's delisting and listing analysis of nutrient impairment in watershed subbasin assessments from 2004 to 2008, IDEQ uses planktonic chlorophyll-a values in some watersheds to assess the relationship between excess nutrients and algae growth to determine violation of the narrative nutrient standards for excess nutrients and floating, suspended or submerged matter (IDAPA 58.01.02-200.05, 06). In the Lower Boise River, however, the most direct surrogate for assessing violations of the both narrative nutrient criteria is periphytic chlorophyll-a since *"in the lower Boise, the growth of aquatic plants is largely associated with periphyton (MacCoy, 2004)."*

Supporting these assessments are periphyton chlorophyll-a data from the Lower Boise River Sediment and Bacteria TMDL (IDEQ, 1999), Idaho's 2001 Nutrient Subbasin Assessment and data from MacCoy's 2004 report, which exceed the nuisance algae level range of 100-200 mg/m^2 as discussed in Section D, thus indicating impairment. Figure 4 shows data collected by USGS from 1995 to 1997 compared to a nuisance algae level of 200 mg/m^2 reported in IDEQ's Boise River TMDL for sediment and bacteria. Figure 4 shows 33 chlorophyll-a data points for five locations on the Lower Boise River. Fifteen of the measurements from Caldwell, Middleton and Glenwood Bridge are above 200 mg/m^2 with a maximum measurement above 900 mg/m^2 (IDEQ, 1999). The Lower Boise River Nutrient Subbasin Assessment cites data collected by the USGS from 1995 to 1999 and states that "chlorophyll-a in periphyton ranges from a low of 0.025 mg/m^2 at Eckert Road to a high of 933 mg/m^2 at Caldwell."

ENCLOSURE 2: Rationale for Adding Lower Boise River onto Idaho's 2008 303(d) List

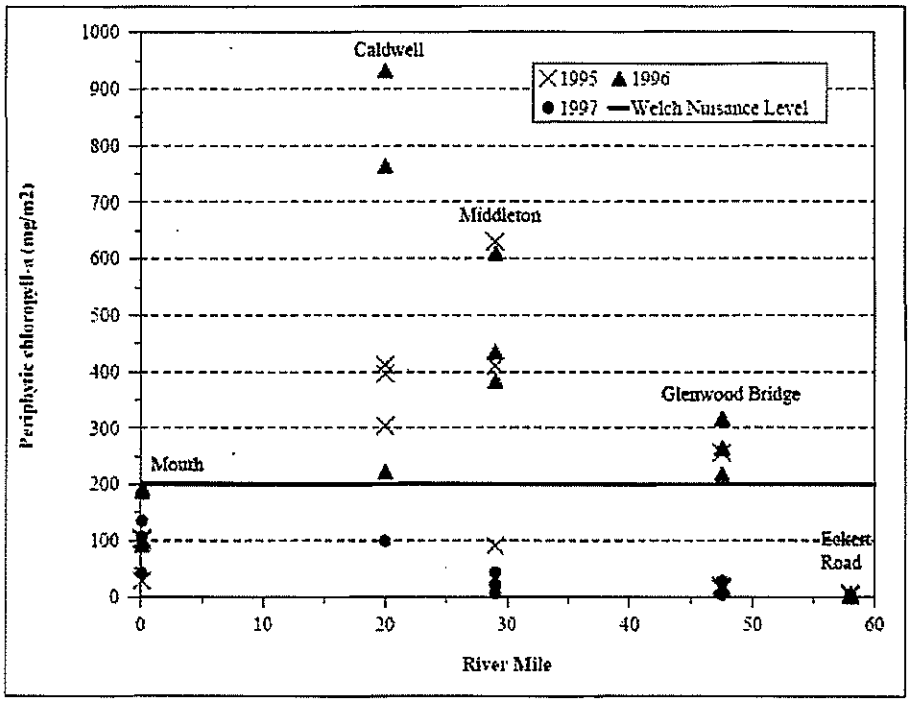

Figure 4. Periphytic chlorophyll-a concentrations, 1995-1997 (IDEQ, 1999)

Figure 5 illustrates the periphytic chlorophyll-a values collected from September to early November by USGS from 1995-2002 which use a threshold of 100 mg/m^2 to determine nuisance algae thresholds. These data show low periphytic chlorophyll-a levels in the upper reach of the lower Boise River at Diversion Dam, which gradually increase with the highest levels occurring at Middleton and Caldwell. They increase gradually with the highest concentrations recorded continuing to exceed concentrations used to determine the threshold for nuisance algae impairment. Figures 4 and 5 show periphyton chlorophyll-a levels in the Lower Boise River collected over the past seven years demonstrating consistent exceedances of the nuisance algae threshold range of 100-200 mg/m^2.

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Enclosure 3: Lower Boise River Response to Comments, October 13, 2009

General Response to Comments

EPA appreciates the comments received in response to the Federal Register Notice published on March 25, 2009 on EPA's proposed decision to add the Lower Boise River segment – Indian Creek to mouth - AU:ID17050114SW001_06 (Lower Boise River) to Idaho's 2008 303(d) List. The basis for EPA's decision to list the Lower Boise River segment for nutrients is outlined in detail in EPA's *Rationale for Adding Lower Boise River onto Idaho's 2008 303(d) List* ("Decision Document") dated October 13, 2009. Considerations raised by commenters such as a lack of complaints and dissolved oxygen and pH data, do not outweigh the evidence of exceedances of Idaho's narrative nutrient criteria (IDAPA 58.01.02-200.05, 06) based on other water quality data including total phosphorus, nitrogen, periphyton chlorophyll-a, macroinvertebrate, dissolved oxygen and pH data. The responses to specific comments are outlined below.

Specific Response to Comments

#	Name	Comment	Response
1	Idaho Conservation League (Letter)	"After careful review of the EPA's decision to reject DEQ's delisting of the Lower Boise River we have concluded that EPA's action is appropriate and supported by the preponderance of the best available data. Further, we concur with EPA's rational[e] for adding the lower Boise River to Idaho's 303(d) list of impaired waters and we agree that this section should be listed as impaired for nutrients."	Thank you for your comment.
2	Idaho Power Company (Letter)	"On March 21, 2008, IPC submitted comments to the IDEQ stating that the decision to delist was not supported by the documentation record. Further, IPC has concern as to the implications delisting could have on downstream water quality targets in the Snake River... IPC has documented large phytoplankton blooms (147 µg/L), depressed surface water DO, and anoxic hyporheic conditions in the Snake River downstream of Lower Boise... Delisting of one source of nutrient pollution such as the Boise River will affect attainment of the goals in the SR-HC TMDL... Failure to clearly identify all sources of nutrient pollution such as the Boise River will affect attainment of water quality goals in Snake and may result in inequitable allocation of loads that does not fairly and consistently partition the responsibility to the appropriate sources."	Thank you for your comment.
3	Idaho Department of Environmental Quality (IDEQ), pages 1-2.	"IDEQ disagrees with EPA's Use of EPA's Recommended Ecoregion Criteria... DEQ agrees that appropriate guidance and other literature identifying levels of nutrients	In this comment, DEQ disagrees with EPA's use of recommended ecoregional nutrient criteria to evaluate nutrient impairment, in part because they are not specific

		protective of beneficial uses should be used to help interpret and apply a narrative standard. DEQ disagrees with EPA, however, that the recommended criteria in EPA's Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion III should be used to determine impairment in the Lower Boise River... These findings demonstrate problems of scale and method (percentile) in using EPA's national nutrient criteria. This suggests these ecoregional criteria are a poor gauge of LBR nutrient concentrations relative to Idaho's narrative criterion."	enough to each watershed. EPA used a range of values set forth in EPA-recommended criteria, peer-reviewed, scientific literature and site-specific information to determine impairment. EPA's 304(a) ecoregional criteria for phosphorus and nitrogen is one set of values EPA used to determine impairment in the Lower Boise River. EPA also based its determination of impairment on EPA's 304(a) Gold Book criteria, which IDEQ also routinely uses in their listing and TMDL decisions for interpreting Idaho's narrative nutrient criteria, and periphyton chlorophyll-a nuisance algae levels published in peer-reviewed scientific literature. For a further description of EPA's basis for determining impairment, see the decision document section D entitled *Interpretation of Narrative Nutrient Criteria in the Lower Boise* River.
4	IDEQ, page 2	"DEQ disagrees with EPA's use of a photo log to show impairment... Mere presence of algae does not indicate excessive nutrients nor does it prove impairment of beneficial use... EPA provides no quantitative evidence for their claim of "high levels of algae growth", nor is it known from their photo log how limited or extensive are the conditions in the photos... DEQ would suggest algae in the lower reaches of a river system should be expected, that's a basic ecological/river theory as put forth by Vannote et al. (1980) in the River Continuum Concept (RCC)... Coming at the end of the watershed. Flat with little vegetative cover, one should expect algae, the question is how much and EPA did not define in their photo logs."	DEQ states that EPA uses a photo log showing algae to demonstrate that the Lower Boise River is impaired for nutrients. EPA did not base its determination of impairment in the Lower Boise on a photo log, since it was not available to the State at the time of their delisting decision. The basis for EPA's determination is articulated in its Decision Document (October 13, 2009) and was based on data available to DEQ at the time it made its listing decision Because the photo log and accompanying discussion is not necessary to EPA's decision, EPA agrees that the final decision document need not include it.
5	IDEQ, page 2 -3	"[DEQ] disagrees with EPA's dismissal of information showing a lack of complaints from recreational users... EPA contends that the lack of complaints is invalid because DEQ supposedly did not do a thorough enough job soliciting public comment on water quality conditions on the LBR... DEQ does, however, encourage public comment and participation in water quality decisions... The Integrated Report, of which the entire 303(d) list is a part of goes out for a lengthy public comment period affording ample opportunity for public engagement in the process... Watershed Advisory Groups (WAGs) are publics and	DEQ states that EPA dismisses the information on a lack of complaints from the public because DEQ did not do a thorough job of soliciting comments. This is an incorrect statement regarding EPA's position. EPA states that IDEQ does not specifically solicit public feedback on recreational conditions in the Lower Boise River. Furthermore, EPA notes that in its 303(d) submission DEQ includes information only from 1997 to 2000, so there is no information from 2001 to 2008 on whether recreational users complained about the

		stakeholders who work with DEQ in making critical water quality management decisions, namely TMDLs... In short, DEQ did a thorough job of soliciting public input regarding water quality conditions."	recreational conditions on the Lower Boise River. Most importantly, a lack of complaints as to recreational use does not demonstrate that the waterbody is not impaired. Although it is informative to know that there have been no complaints, this along with other lines of evidence, do not outweigh the water quality data for total phosphorus, nitrogen, periphyton chlorophyll-a, macroinvertebrates, dissolved oxygen, and pH which collectively show exceedances of the narrative nutrient criteria (IDAPA 58.01.02-200.05,06). EPA recognizes that IDEQ's public participation process is adequate.
6	IDEQ, page 3	"DEQ's narrative criteria for excess nutrients must be applied on a water body specific basis... DEQ's narrative criterion requires a site specific analysis to determine the level of nutrients that in the particular water body "will cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses... IDEQ agrees with EPA that values in relevant guidance documents and other literature should be used in evaluating nutrient levels... But DEQ disagrees with EPA that levels that exceed guidance targets, such as the chlorophyll-a target from Oregon's Water Quality Standards, always equate to a violation of the Idaho narrative criteria... Instead DEQ believes that all lines of evidence must be reviewed to determine whether the narrative standard is violated."	DEQ states that multiple lines of evidence are needed to interpret the narrative nutrient standards in Idaho and that these should be applied on a site-specific basis. EPA agrees with DEQ that multiple lines of evidence should be reviewed to determine whether the narrative nutrient standard is exceeded, and that relevant guidance documents and other literature values should be used to evaluate nutrient levels. EPA has followed just such a course in making its determination to list the Lower Boise River AU:ID17050114SW001_06 by considering total phosphorus, nitrogen, periphyton chlorophyll-a, macroinvertebrates, dissolved oxygen, and pH data. In EPA's review of Idaho's delisting (EPA, 2009), EPA noted that available total phosphorus and periphytic chlorophyll-a data were not considered by DEQ, despite these being key indicators for nutrient and beneficial use impairment, as recommended in EPA's Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion III (EPA, 2000b). Total phosphorus, nitrogen, and periphytic chlorophyll-a data in the Lower Boise regularly exceed EPA-recommended guidance values and literature thresholds used nationally and by IDEQ in interpreting its narrative criteria in 303(d) listing decisions and nutrient TMDLs from 2004 to 2008 (EPA, 2009).
7	IDEQ, page 4	"In September 2008, after the proposed delisting, DEQ collected additional water quality data that further shows the lack of correlation between elevated phosphorus and	DEQ's comment describes continuous DO data collected at Caldwell, Notus, Highway 95 and Parma in September 2008, after the submittal of the IDEQ's Final 303(d)

		excess algal growth as measured by chlorophyll-a levels. On September 16 Hydrolab minisondes were installed by DEQ staff at Caldwell, Notus, Highway 95 and Parma... At the middle two DO dropped moderately but remained above the criterion of 6.0 mg/L, while the uppermost and lowermost sites DO dropped more dramatically and fell below the criterion, especially at Parma... At least two other plausible explanations would fit better with the observed DO pattern. First is localized input of low DO/high BOD runoff triggered by the rainstorm, in other words a more direct but external source. Second is fouling of the sensors... So while there may be a DO problem, it needs to be confirmed and in DEQ's opinion, the data does not yet exist to link it to elevated nutrients."	Integrated Report. In deciding whether to list a waterbody as impaired, EPA only relies on data that were available to the state when it made its final 303(d) listing decision. However, even though EPA's conclusions were not based on this data, EPA's review of these data show that they would only serve to support EPA's conclusions and in addition could support a listing of the Lower Boise for DO violations in a future 303(d) list. Though the Lower Boise River is not listed for DO, DO can be an indicator of adverse nutrient-caused effects on aquatic life. Therefore, low DO can be an indicator of potential impairment of aquatic life uses (EPA, 2000b). IDEQ's "floating, suspended, and submerged matter" criteria (IDAPA 58.01.02-200.05) states that waters shall be free from floating material ... that may impair beneficial uses. This indicates that if nutrients have the potential to impair beneficial uses, they may be at levels that exceed the nutrient criteria. In IDEQ's continuous monitoring study conducted in September 2008, DO violations occurred at Caldwell and most notably at Parma, where DO data were below the water quality standard of 6.0 mg/L five out of ten days sampled. At Parma, the DO levels were as low as 1 mg/L and regularly below 5.0 mg/L on the five days the violations occurred. DEQ attributes these DO violations as being caused by high BOD runoff from a rainstorm. However, at Parma, DO levels fell below the DO water quality criteria of 6.0 mg/L starting on September 18, 2008, two days before the storm event.
8	IDEQ, page 3	"The data is consistent with impairment of the Boise River by Excess Sediment and flow alteration... In support of its decision to delist the LBR for nutrients, DEQ relied upon a number of factors: (1) no violations of the dissolved oxygen criteria; (2) no violation of the pH criteria; (3) chlorophyll-a measurements; and (4) no complaints from recreational users. DEQ also took into account macroinvertebrate data, but felt this data was consistent with impairment from sediment. EPA agrees that the	DEQ's comments state that the Lower Boise River is impaired from sediment and E-coli, but not nutrients. We agree with DEQ that the Lower Boise River is also impaired by sediment and E-coli bacteria. That is why there is an approved TMDL for those parameters. We also believe that there is a nutrient impairment, the effects of which may or may not be masked by the sediment impairment. The sediment load in the Lower Boise River is likely reducing light transmissivity and

		factors relied upon by DEQ are relevant indicators of nutrient impairment. Nevertheless, EPA discounts the data relied upon by DEQ and instead relies upon total phosphorus data and periphytic chlorophyll-a levels to supports its conclusion that the LBR is impaired as a result of excess nutrients. DEQ continues to believe that the factors as a whole are consistent with impairment due to excess sediment and flow alteration rather than excess nutrients... DEQ believes the suggested relationship between phosphorus and water quality is a spurious relationship due to co-variation with sediment, altered flow conditions and to some degree the natural river continuum... In September 2008, after the proposed delisting, DEQ collected additional water quality data that further shows the lack of correlation between elevated phosphorus and excess algal growth as measured by chlorophyll-a... The above data indicates the lack of correlation between phosphorus levels and other water quality parameters. For example, while the phosphorus levels were relatively high, the chlorophyll-a levels remained low. DEQ believes the cause of impairment is driven by flow alteration, channel alteration, irrigation withdrawals, e-coli, and sediment, not total phosphorus... We agree the LBR is impaired; we disagree with EPA that a cause is nutrients/phosphorus."	affecting plant growth in the river. High phosphorus concentrations present in the river would likely manifest as heavy plant growth if the sediment pollution were removed from the river and light was not as restricted (EPA, 2008a). As stated in the response to comment 6, DO, pH, and the other lines of evidence are important factors to consider for nutrient impairment. However, total phosphorus, nitrogen, and periphytic chlorophyll-a are direct indicators of nutrient impairment. As noted in response to comment 6, TP, nitrogen, and periphytic chlorophyll-a data regularly exceed recommended values in EPA 304(a) criteria documents and in peer-reviewed scientific literature used by EPA and IDEQ in interpreting IDEQ's narrative nutrient criteria. As well, EPA's analysis found exceedances of the DO and pH criteria as well.
9	City of Boise, City of Meridian, City of Nampa, City of Caldwell – Cover Letter, p. 2	"Protecting the water quality of the Lower Boise River to support beneficial uses identified by the state of Idaho under authority of the federal Clean Water Act is not in dispute. We concur with EPA that is appropriate to include an analysis of *all* available data to evaluate properly nutrient impairment for listing purposes. This includes not only data that DEQ's listing did not address, but also should include ongoing data collection by the city of Boise which began in 2004. This information was made available to EPA during the comment period and should be part of the analysis. From EPA's written comments on the decision to deny delisting, it appears we agree that the essential element to be considered for listing is whether or not water quality data indicate Idaho's narrative standard for nuisance algae has been exceeded for the Lower Boise	Thank you for your comments. The Cities' comment indicate that all data should be considered to evaluate nutrient impairment, including continuous DO, pH, and temperature monitoring data collected at Glenwood and Linder Bridges from 2004 to present. The response to comment 3 describes information that EPA used when considering whether to add the Lower Boise River segment to Idaho's 303(d) List. The Decision Document dated October 13, 2009 describes the data reviewed, which includes the continuous monitoring data collected by the City of Boise at Glenwood and Linder Bridges from 2004 to present.

		River. We believe that this standard is clearly understandable to our citizens and provides clear expectations for management of both point and non-point source discharges into the river. Therefore, the narrative standard must be the ultimate bottom line for listing and associated pollutant control efforts."	
10	City of Boise, City of Meridian, City of Nampa, City of Caldwell – Cover Letter, p. 3	"The cities agree that nutrient reduction actions are necessary on the Lower Boise River in order to meet the Snake River-Hells Canyon TMDL of which the Lower Boise River is a tributary...Disagreement can exist as to whether the Lower Boise River water quality monitoring data indicate impairment for nutrients using the state's narrative water quality standard. To move beyond this debate, however, we encourage EPA to consider an alternative listing under the Clean Water Act. If collective consideration is given to the new data, the AQUATOX modeling, and the adopted Lower Boise Implementation Plan, we believe this information will lead to a conclusion that listing under 4b is more appropriate than listing under category 5... The benefits of a category 4blisting to EPA, Idaho DEQ and the cities are significant. A 4b listing would expedite the issuance of innovative NPDES discharge permits that allow compliance flexibility in improving water quality. A 4b listing results in swifter action toward improving in support of the Snake River-Hells Canyon TMDL. Lastly, a 4b listing avoids an unnecessary TMDL regulatory process that diverts resources away from achieving what is already a common water quality goal."	The Cities state that nutrient reduction activities are necessary to ensure that the Lower Boise River meets water quality standards for nutrients. They describe how the Total Phosphorus Implementation Plan would satisfy listing the Lower Boise River under Category 4b, rather than Category 5. EPA has disapproved DEQ removal of the Lower Boise from Category 5, i.e. the 303(d) list. EPA's proposed action is to list the Lower Boise for nutrient impairment on the 303(d) list (i.e. category 5). Consistent with 40 CFR 230.7(b)(6) (requiring states to provide documentation to EPA to support the state's determination to not list a water), USEPA only reviews Category 4b proposals that are first considered by states and formally submitted to USEPA as part of their Section 303(d) list or Integrated Report. If you are interested in further pursuing a Category 4b assignment for the Lower Boise River, we encourage you to coordinate with IDEQ and EPA as part of the state's next Section 303(d) reporting cycle. However, for your information for use in the next 303(d) listing cycle, we include below a discussion of some elements of a successful 4(b) proposal and identify at least one potential weakness in the Implementation Plan. USEPA's Clean Water Act Section 303(d) program regulations recognize that alternative pollution control requirements may obviate the need for a TMDL. Specifically, impaired waters are not required to be included on a State's Section 303(d) list if technology-based effluent limitations required by the CWA, more stringent effluent limitations required by State, local, or federal authority, or "[o]ther pollution control

			requirements (e.g., best management practices) required by local, [s]tate or [f]ederal authority" are stringent enough to implement applicable water quality standards (see 40 CFR 130.7(b)(1)). These alternatives to TMDLs are commonly referred to as "Category 4b" waters, as described in USEPA's Integrated Reporting Guidance (IRG) for the 2006 and 2008 (i.e., Attachment 2) reporting cycles. While EPA is not formally reviewing the Category 4b proposal submitted for the Lower Boise River for the state's 2008 Section 303(d) reporting cycle, we are providing cursory feedback that may assist with coordination for the next reporting cycle. One of the essential elements of a successful 4(b) proposal is a demonstration of reasonable assurance that the alternative actions will result in meeting water quality standards. In general, USEPA has concerns regarding the lack of assurances that proposed nonpoint source reductions will occur. The Lower Boise River Implementation Plan (which is the key basis for the Category 4b proposal) highlights reasons for USEPA's concerns. For example, page 104 of the implementation plan seems to indicate the lack of reasonable assurance: it states, "Though it is committed to improving phosphorus loading, the agricultural community cannot guarantee any specific numeric load improvements given the voluntary nature of BMP implementation and the uncertainties associated with BMP funding. This is particularly true if anticipated land use conversion rate slows as recent evidence suggests it likely will. The agricultural community is not in a position to make up any projected phosphorus loading improvement shortfall attributable to declining land use conversion rates."
11	City of Boise, City of Meridian, City of Nampa, City of Caldwell – Attachment A, p. 2	"As described in our cover letter, the AQUATOX model was applied to the Lower Boise River to further investigate the relationship of nutrient "stressor variables" and "response variables" (EPA 2008). Phosphorus was identified as the responsible nutrient variable (stressor) and periphytic	The Cities describe the AQUATOX model and how it supports that phosphorus is threatening water quality and nuisance algae aesthetic concerns at sensitive locations. EPA agrees with this conclusion and notes that total phosphorus and periphytic chlorophyll-a data also

		algae the responsive variable. It is evident that phosphorus is threatening water quality and causing nuisance algae aesthetic concerns at sensitive locations.	support this conclusion.
12	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, page 1	"As previously indicated (cover letter) and described in Attachment A although we believe that the Lower Boise River is currently in compliance with the State's narrative WQS for nutrients, we concur that failure to take action to reduce nutrients may cause impairment in the future."	The Cities note that though the Lower Boise River is in compliance with the state's narrative water quality standards for nutrients, the failure to take action to reduce nutrients may cause impairments in the future. While we do not agree that the Lower Boise River is in compliance with the state's nutrient standard, we agree that taking action to reduce nutrients is important.
13	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, page 2	"We concur that dissolved oxygen measurements alone are not a sufficient basis for listing or delisting nutrients."	We agree.
14	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, page 2	"EPA has acknowledged that the document incorrectly states: 'On at least three occasions, EPA requested from the City of Boise the 15-minute interval DO data cited in DEQ's Final Response to Comments to EPA. The information has not been provided, so EPA is only able to consider the data collected by USGS, and grab samples collected by the City of Boise.' The Agency suggested that it requested the City's data from IDEQ on several occasions but did not receive it (personal communication, Bill Stewart, April 6, 2009). The City of Boise provided all continuous data from Glenwood and Linder Bridge locations (2005-2007), as well as all periphyton and phytoplankton data available."	The Cities' comments state that EPA has acknowledged EPA's evaluation of Idaho's rationale to delist the Lower Boise (Bussell, 2009) incorrectly states that EPA requested continuous DO, pH and temperature data and did not receive it. During the review of Idaho's delisting rationale for the Lower Boise River, EPA received data from the City of Boise that contained data of grab samples of DO and pH and continuous temperature data from the Glenwood and Linder Bridge sites (August, 2008). However, we did not receive continuous DO and pH monitoring data collected at these sites, until the public comment period on EPA's proposed listing action (April 2009). In making its determination, EPA has considered data available to the state prior to the submission of the Final 303(d) Integrated Report in July 2008.
15	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, pages 2-3	"Single measurement DO data are summarized from USGS NWIS data 1994-2009. Dissolved oxygen values (mg/L) were above the 6.0 mg/L water quality standard (grey line) at all sites for all measurements... The City of Boise has continuous water quality monitoring stations at Glenwood and Linder Bridges. Data have been collected in 15 minute intervals (diurnal data) since July 2004. In addition, diurnal dissolved oxygen data are currently being collected at Parma on the Lower Boise River (within the listed segment) as well as two Snake River sites."	The Cities state that grab and continuous DO samples at different locations are above water quality standards, and therefore, the beneficial uses for aquatic life are satisfied. In EPA's review, (EPA, 2009), we note that the Lower Boise River is not listed for DO impairment. However, DO is an important indicator for nutrient-related impacts and is important for aquatic life. However, even if DO were meeting standards during critical times and under critical conditions in the Lower Boise River, it would still be

			crucial to consider phosphorus, nitrogen, and periphytic chlorophyll-a during critical conditions when considering nutrient impairment. It is unclear whether DO is impaired in the Lower Boise River. Grab samples collected by USGS have shown that with a few exceptions, DO is within standards. Continuous DO monitoring collected by the City of Boise are upstream of the impaired area, but show occasional violations of the percent saturation dissolved oxygen standard (City of Boise, 2009). Continuous DO monitoring collected by DEQ in the impaired section was taken in September 2008, just past the critical season. These data showed violations of the DO standard at Caldwell and most notably at Parma, where DO were below the water quality standard of 6.0 mg/L five out of ten days sampled. At Parma, the DO levels were as low as 1 mg/L and regularly below 5.0 mg/L on the five days the violations occurred (IDEQ, 2009). DO data indicate that nutrients may be impacting DO, possibly to levels constituting a 303(d) impaired waters listing. They do not support the conclusion that nutrients are not affecting the Lower Boise River. As indicated in previous responses, EPA considers DO data as well as other water quality data to determine nutrient impairment in the Lower Boise River segment as described in EPA's Decision Document dated October 13., 2009.
16	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, pages 5-8	"EPA's disapproval decision applies to the river segment from Indian Creek to mouth which is designated primary contact recreation and cold water biota; the applicable DO criterion is 6 mg/L with no % saturation requirement as salmonid spawning is not a designated use. Dissolved oxygen percent saturation data are irrelevant for the segment involved in this disapproval action. Within the RM 50 to Indian Creek segment, 2.25 and 0.18% of the continuous dissolved oxygen percent saturation values were less than 75% saturation at Linder Bridge in 2007 and 2008, respectively. 0.003 and 1.5% of the values at	The Cities' comment notes that in the impaired area, the DO percent saturation water quality criteria does not apply and that supersaturated DO levels do not indicate impairment of beneficial uses. In MacCoy's 2004 USGS report, the supersaturated levels of DO are attributed to aquatic plant growth that indicate "photosynthetic production of DO by aquatic plants [sic] was in excess of oxygen demands from respiration and decomposition at all the mainstem sites at some time during the study (MacCoy, 2004)." EPA describes

		Glenwood Bridge (continuous data) were below 75% saturation in 2007 and 2008... Median instantaneous dissolved oxygen percent saturation values exceeded 100% at the four mainstem river sites. These data in and of themselves do not indicate impairment as supersaturation is a condition unrelated to nutrient gradient in the Boise River or algae level observed in the Lower Boise River... Supersaturation is not uncommon in natural waters with no nutrient impairment and supersaturation in high eutrophic systems can be as high as 300-400%. Diurnal dissolved oxygen patterns and sufficient oxygen concentrations during the evening (respiration dominated) hours suggest that dissolved oxygen concentrations are not significantly impaired by elevated nutrient concentrations."	supersaturated DO levels likely caused from nutrient impairment that may negatively impact aquatic life and macroinvertebrates (Hayslip, 2008). As described in response to comment 7, the "floating, suspended and submerged" criteria (IDAPA 58.01.02-200.05) describes the potential for nuisance algae to cause impairment of beneficial uses. DO levels are indicators of aquatic life uses. Therefore, when DO is threatened, for instance by regular supersaturated levels of DO, there is a potential for impairments to aquatic life use. DO water quality data in combination with other water quality data in the Lower Boise River segment show exceedances of both narrative nutrient standards.
17	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, pages 9-11.	"Median pH values did increase between Diversion Dam and the three downstream sites; however, Glenwood, Middleton, and Parma had consistent median values of 8.0, 8.0 and 8.1 SU (Figure 10). Two instantaneous measurements (one at Diversion Dam and one at Glenwood) fell below the state water quality standard of 6.5 SU... As mentioned in the dissolved oxygen section, the City of Boise has been collecting continuous data at two Boise River locations (Glenwood and Linder Bridges) since 2004. 4.1% of the pH values at Glenwood Bridge exceeded the WQS of 9.0 in 2007 and 2.51% in 2008. In addition, 0.38% of the values in 2008 were below the lower end of the pH WQS, 6.5 SU. pH values at Linder Bridge also exceeded the 9.0 WQS; 0.96% in 2007 and 1.82% in 2008. Neither year at Linder Bridge had values below 6.5 SU. These infrequent exceedances do not necessarily indicate impairment. IDEQ has identified policies and procedures for assessment of data for the 2008 listing cycle... The available continuous pH data from Parma (October 2008 to February 2009) are within the WQS range of 6.5 to 9.0 SU."	The Cities' comment presents information that pH data does not warrant listing, thereby showing that nutrients do not impair aquatic life uses. The Cities include information showing that in fact, there are exceedances of the pH standard at Glenwood and Linder Bridges, upstream of the impaired area. There are no continuous pH data in the impaired area, except for one month at Parma, where data are not collected during the critical season. The continuous pH data exhibit a diurnal pattern indicative of algae photosynthesis and respiration. Since pH is an indicator for aquatic life uses, pH data support that nutrients have a potential to impair aquatic beneficial uses in the Lower Boise River.
18	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B,	"We agree that 40 µg/L is not the most appropriate target; 15 µg /L may be used as a threshold for further consideration. Suspended chlorophyll a samples were	The Cities' comment states that phytoplanktonic chlorophyll-a data are below literature thresholds.

	pages 12-14.	collected in the Boise River (Diversion, Glenwood, Middleton and Parma) from 1994-2009. Only 4 of the measured values exceeded 40 µg/L and only 18 samples in a 14 year period exceeded 25 µg/L. Data presented were collected throughout the year, not just during the May-September period in which the Snake River-Hells Canyon target applies... Continuous chlorophyll-a data from Parma (October 2008-February 2009) indicate that chlorophyll a seasonal averages were less than 14 µg/L values infrequently exceeded 25 µg/L (0.1% of the measurements), and never exceeded 40 µg /L.	We have three concerns. First, we disagree with the use of planktonic chlorophyll-a instead of periphytic chlorophyll-a. According to MacCoy, "the growth of aquatic plants is largely associated with periphytic chlorophyll-a." In the Lower Boise River, As stated in the delisting evaluation, periphytic chlorophyll-a data is the most predominant form of algal growth in the Lower Boise and related of the narrative standards, which reference "submerged matter", "visible slime growths" and "other nuisance growths (MacCoy, 2004)". Second, it appears that phytoplankton data presented exceed 15 µg/L. We concur that if one were to compare planktonic chlorophyll-a to literature values, the appropriate target is 15 µg/L. We are unclear about the conclusions from this comment. Initially, it is stated that 15 µg/L is an appropriate threshold. Then values are compared to the 40 µg/L to conclude compliance. Third, data were not taken during critical times when algal growth would be expected to be highest and at critical locations, where algal growth would most likely occur.
19	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, pages 15-20.	"The data presented in the figure referenced on page 9 are the maximum values for each year and represent the worst case scenario. This highest chlorophyll values are typically observed at Middleton and Caldwell reaches, however 933 mg/m^2 appears to be an isolated occurrence. The USGS has indicated that samples collected above Middleton are probably more representative of true benthic chlorophyll conditions. USGS pebble counts in 1997 indicated that only 57% of the substrate at Middleton was larger than 2 mm, compared to 79-81% at upstream locations... The first figure is mean (rather than maximum) periphytic chlorophyll a concentrations in the Lower Boise River 1995-2007. The second figure is based on the same periphyton data, but results have been normalized for percent substrate > 2mm... After normalization, fewer chlorophyll a values are above 200 mg/m^2. We agree that these concentrations exceed	The Cities' comment refers to periphytic chlorophyll-a values that exceed a nuisance threshold of 150 mg/m^2. We agree that periphyton chlorophyll-a levels exceed the nuisance level of 150 mg/m^2. On Table 5, page 14 of EPA's review of Idaho's Delisting Rationale for the Lower Boise (EPA, 2009), periphytic chlorophyll-a levels in the Lower Boise River are regularly above 150 mg/m^2 in the impaired area. In the Lower Boise River TMDL for bacteria and sediment IDEQ, 1999), fifteen of 33 measurements have values higher than 200 mg/m^2 and a maximum measurement greater than 900 mg/m^2. We do not agree that nutrients do not negatively impact DO and pH. See responses to comments 15 to 17. As such, periphyton chlorophyll-a levels appear to violate both the "excess nutrients" and "floating, suspended, and

		nuisance levels... Diel dissolved oxygen (DO) measurements in the LBR have shown that the DO standard of 6.0 mg/L is met, even during nighttime algal respiration. The pH standard is exceeded, but infrequently. Thus, it would appear that nuisance aesthetic concerns would govern for any nutrient or algae criteria for the LBR."	submerged" narrative criteria, since levels are above nuisance algae thresholds.
20	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, pages 15-20.	"Relationships between phytoplankton chlorophyll a and TP were weak (low R2 values) on the Lower Boise River. Periphyton chlorophyll a and TP relationships were stronger, but were not significant. AQUATOX modeling was utilized to further investigate this relationship."	See response to comment 11.
21	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, pages 21.	"Use of the Boise River is supported by a large variety of stakeholders that are well informed citizens and likely aware of their ability to provide public comment on the condition of the Boise River. It is an unreasonable conclusion that the lack of public complaints of nuisance growth of algae is due to public's lack of awareness of the ability make comments."	See response to comment 5.
22	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, pages 21.	"We concur that IDEQ complaints from 2001-2008 would be useful information if they are available and summarized."	We agree.
23	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, pages 21.	"It appears that this comment is an opinion and is not based on scientific data."	We agree that the comment is an opinion. This is an example of a citizen complaint.
24	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, pages 21-24.	"Based on the geographic photos were at locations not on the Boise River and only 11 photos (three locations) were from the reach of the Boise River in question. All of these sites should be deleted from the photo log and not used as they are not photos of the Boise River segment in question and therefore not representative of Lower Boise River conditions. Photos of one rock covered with periphyton do not indicate nuisance conditions. Recent photos of the South Fork Boise River during non-growing season exhibit high periphyton concentrations. The South Fork of the Boise River is often used as a reference stream to compare Lower Boise River conditions... 26 of 70 photos are not	The Cities' comment refers to the photo log as not being representative of Lower Boise River conditions. See response to comment 4. The photo log included the entire reach of the Lower Boise River from Lucky Peak dam to the confluence of the Boise with the Snake. There are pictures of a side channel to the Lower Boise and of the Snake River near the mouth. All of these were identified and geographic coordinates were provided to identify the location of the picture. The photo log is a qualitative (not quantitative) look at the river from the dam to the mouth.

		from the Boise River but a tributary to the Boise River or the Snake River itself, and are therefore not representative sites for assessing Lower Boise River channel conditions and not appropriate justification to assert that scour is not occurring within the Lower Boise River channel. The photos from non-Boise River locations can not be used as evidence of impairment of the lower Boise River."	
25	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, pages 24-25.	"We agree that all available data from 1994-2009 should be considered in the delisting process and that consistent rationale should be applied when determining what parameters are used to list and delist waterbodies."	The Cities' comment states that all available data from 1994 to 2009 should be considered. In deciding whether to list a waterbody as impaired, EPA only relies on data that were available to the State when it made its final 303(d) listing decision. The data that EPA considered in its decision to add the Lower Boise River segment onto the list is described in EPA's October 13, 2009 Decision Document in Section C entitled *Data Reviewed by EPA.*
26	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, page 25.	"We agree that Lower Boise River phosphorus values exceed targets recommended in EPA's 304(a) guidance and example narrative standards developed by neighboring states. However, nutrient concentration in and of itself is not indicative of "impairment" unless there is a causal relationship between nutrients and nutrient related chemical, physical, or biological effects of sufficient scale to violate state water quality standards. We do agree that phosphorus is modestly impairing the Lower Boise River and causing nuisance periphyton at some locations (aesthetic narrative standard related to nutrients). This impairment is characterized as modest due to the meeting of DO water quality standards, infrequent exceedances of pH water quality standards, and meeting two of the narrative standards that apply to nutrients detailed below.	The Cities' comment states that nutrient levels themselves do not demonstrate impairment unless there is a demonstrated link between nutrients and other effects that violate state water quality standards. The Cities' comment also acknowledges that phosphorus impairs the Lower Boise River at some locations. We concur that there are nutrient impairments in the Lower Boise River as demonstrated by high TP levels, high nitrogen levels, periphytic chlorophyll-a levels and occasional violations of DO and pH. MacCoy's 2004 USGS Report describes the relationship in the Lower Boise River between total phosphorus, nitrogen and algal growth indicating that both phosphorus and nitrogen contribute to algal growth (USGS, 2004). IDEQ's Nutrient Subbasin Assessment also discusses the algal growth as a result of phosphorus and nitrogen levels in the Lower Boise River (IDEQ, 2001).
27	City of Boise, City of Meridian, City of Nampa, City	"We agree that all algae data should be considered when determining impairment from nuisance algae. We also	The Cities' comment states periphytic chlorophyll-a exceeds target thresholds from other states and that

	of Caldwell - Attachment B, page 25.	agree that periphyton chlorophyll a values have exceeded target thresholds developing in neighboring states (i.e. Montana). Nutrient reductions from the SR-HC Boise River Implementation Plan will improve nutrient conditions and reduce nuisance algae conditions."	nutrient reduction actions are needed. We agree, although it is unclear if the Implementation Plan will reduce algae and phosphorus to levels needed to meet water quality standards in the Snake River and the lower Boise River.
28	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, page 25-29	"We agree that MI assemblages in the Lower Boise River are impaired. However, there is no conclusive relationship between high nutrient levels and invertebrate community data. As concluded in the September 25, 2008 EPA memorandum (Hayslip), there is evidence that sediment (and we would add habitat/flow alteration) and nutrients are both likely sources of impairment. However, there is not sufficient information to show that one stressor is causing this impairment exclusively of the other."	The Cities state that macroinvertebrate impairments are from sediment, habitat, and flow alteration, not nutrients. The benthic data in the 2004 USGS study (MacCoy, 2004) show that there is impairment. However there is not sufficient evidence to conclude that sediment (or any single parameter such as habitat, flow alteration or nutrients) is the sole cause of impairment. The dominant macroinvertebrate taxa change from intolerant to tolerant species moving downstream, indicating a decline in water quality. The tolerance values used are not parameter specific tolerance values, so this data cannot be used to exclude nutrients as a potential cause. Also, the assemblage shifts from more collectors, gatherers and predators to more scrapers, which could indicate an increase in periphyton due to nutrient enrichment. It is likely that there are multiple parameters that are influencing impairment of the benthic macroinvertebrate community (Hayslip, 2008).
29	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, page 29	"The Lower Boise has high phosphorus concentrations that exceed targets recommended in EPA's 304(a) guidance, however the TP vs. chlorophyll a relationships are not significant in the Lower Boise River."	The Cities' comment implies that high phosphorus concentrations do not correspond to high chlorophyll-a levels. It is unclear what type of chlorophyll-a is discussed here. If it is planktonic chlorophyll-a, we agree that there is not a good relationship between total phosphorus and planktonic chlorophyll-a. However, there is a correlation between total phosphorous and periphyton chlorophyll-a. As noted in MacCoy's 2004 report, the growth of aquatic plants is largely associated with periphyton. The Cities' own comments note that the most direct relationship is between total phosphorus and periphytic chlorophyll-a levels.
30	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B,	"Recent diurnal data from upstream locations (Glenwood and Linder bridges) and at Parma were evaluated to assess dissolved oxygen and pH sags in relation to water quality	The comment refers to pH and DO data. See responses to comments 15, 16 and 17.

	page 29	standards. Data review support previous evaluations that found no impairment, however infrequent exceedances of WQS may indicate that water quality is threatened."	
31	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, page 29	"Many of the photographs cited as demonstrating the presence of nuisance levels of algae in the Lower Boise River should be disregarded as they were not taken within the mainstem Boise River and are not representative of Boise River conditions."	This comment refers to the photo log. See response to comment 4.
32	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, page 29	"We agree that all data should be considered when assessing use attainment, however, it is an unreasonable and improvable conclusion that lack of public complaints of nuisance growth of algae is due to the public's lack of awareness of the ability to make comments."	The Cities' comment discusses the lack of complaints of nuisance growth algae. See response to comment 5.
33	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, page 29	"There is no conclusive relationships between nutrient levels and invertebrate communities on the Lower Boise River. Multiple stressors exist (sediment, temperature, habitat/flow alteration, and nutrients) that make it difficult to separate out cause and effect within a complex river system like the Lower Boise River."	See response to comment 28.
34	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, page 29	"Continuous water quality data are being collected at Parma that can be reviewed by the State to make a more informed decision regarding beneficial use status for the 2010 Integrated Report."	The Cities note that continuous water quality data will be collected at Parma and used in the 2010 Integrated Report. This data will be helpful if data are collected during the critical times of the year. Nevertheless, total phosphorus and periphytic chlorophyll-a data are well above EPA 304(a) Gold Book criteria, EPA 304(a) ecoregional criteria, and peer-reviewed scientific literature values, which indicate nutrient impairment. Though DO and pH are important, total phosphorus, nitrogen and periphytic chlorophyll-a data must also be considered.
35	City of Boise, City of Meridian, City of Nampa, City of Caldwell - Attachment B, page 30.	"We believe that the Lower Boise River is currently in compliance with the State's narrative WQS for nutrients, however, also believe that failure to take action to reduce nutrients may cause impairment in the future. The LBR Implementation Plan sets the framework for a 4b listing.	The Cities' comment states that the Lower Boise River is in compliance with standards, but actions should be taken to ensure that the river is not impaired in the future. This statement conflicts with comment 26 from the Cities indicating there is not a definitive causal relationship between nutrients and impairment. We concur that actions are needed to reduce nutrients. See response to comment 10 regarding the proposal to list the Lower Boise River in the 303(d) 4b category.

36	Lower Boise Watershed Council (LBWC) – Letter, page 2	"The extensive data and analysis contained in the enclosed report demonstrate: (1) that there is insufficient evidence to establish nutrient-caused impairment of beneficial uses in the Lower Boise River; (2) that there is good cause for not including the Lower Boise River on Idaho's 2008 Section 303(d) list, and (3) a nutrient TMDL for the Lower Boise River is not necessary to ensure continued protection of beneficial uses in the Lower Boise River. The LBWC seeks EPA's concurrence with these conclusions. If EPA does not concur, the LBWC requests the EPA specifically identify the data, and explain the analysis that establishes that there is nutrient-caused impairment of beneficial uses in the Lower Boise River, and that a Lower Boise River TMDL is necessary to address such impairment.	Thank you for your comments. The LBWC's comment states that insufficient evidence exists to demonstrate impairment in the Lower Boise River and that a TMDL is not necessary. We disagree with these conclusions. Total phosphorus, nitrogen and periphytic chlorophyll-a levels are clearly above EPA 304(a) Gold Book and ecoregional values as well as reference values from peer-reviewed scientific literature used by EPA and DEQ in interpreting its narrative nutrient criteria, as noted in EPA's delisting evaluation (Bussell, 2009a) and EPA's Decision Document (Bussell, 2009b). In the comment letter from the Cities to EPA, they observe "that phosphorus is modestly impairing the Lower Boise River and causing nuisance periphyton at some locations (aesthetic narrative standard related to nutrients) (City of Boise, City of Caldwell, City of Meridian, City of Nampa, 2009)." Additionally, macroinvertebrates are impaired, likely by several causes, including nutrients (EPA, 2009; see response to comment 28). Continuous pH data at Glenwood and Linder bridges show violations, and recent continuous DO monitoring at Parma and Caldwell show violations of DO water quality criteria as low as 1 mg/L. See responses to comments 15 to 17. EPA's Decision Document dated October 13, 2009 provides more information on EPA's conclusion to add the Lower Boise River segment onto Idaho's 2008 303(d) List for nutrients.
37	Lower Boise Watershed Council (LBWC) – Letter, page 2	"In 2001, IDEQ prepared the Subbasin Assessment (SBA) for nutrient impairment in the river. This document concluded that 'nutrients are not impairing aquatic life or recreational beneficial uses in the Lower Boise River. Thus nutrients will be proposed for 303(d) delisting."	The LBWC comment discusses the 2001 Nutrient Subbasin Assessment's conclusions that nutrients are not impairing aquatic life or recreational beneficial uses. The Decision Document describes EPA's interpretation of Idaho's narrative nutrient criteria, which includes the evaluation of total phosphorus, nitrogen, periphytic chlorophyll-a, DO, pH, and macroinvertebrate data and compares it to EPA 304(a) criteria and literature values. EPA believes the weight of evidence from water quality data shows nutrient impairment in the Lower Boise River.

			As stated in EPA's comments on the 2001 Subbasin Assessment, EPA did not support delisting the Lower Boise River for nutrients (Filippini, 2002). In subsequent documents, EPA provided comments disagreeing with conclusions from the Subbasin Assessment (Croxton, 2008). EPA's review of Idaho's delisting rationale for the Lower Boise (EPA, 2009) also summarizes the reasons why EPA does not agree with the conclusions from the 2001 Nutrient Subbasin Assessment.
38	Lower Boise Watershed Council (LBWC) – Letter, page 3	"The core issue that the SBA addressed and that forms the basis of the EPA decision to include the Lower Boise River on Idaho's Section 303(d) list for nutrient impairment is: 'What levels of phosphorus are acceptable to minimize nuisance algae (phytoplankton and periphyton) conditions and maintain other water quality parameters such as dissolved oxygen (DO) and pH in the Lower Boise River itself?' To answer this question, we have compiled data collected over the last 15 years."	The LBWC's comments state the central question is to determine the acceptable level of phosphorus to minimize nuisance algae conditions and maintain water quality parameters. The central question for EPA is whether there are violations of the nutrient water quality standard. As stated in response to comment 36 and EPA's review of Idaho's delisting rationale (EPA, 2009), water quality data from total phosphorus, nitrogen, periphytic chlorophyll-a, macroinvertebrates, and DO and pH show that nutrients impair beneficial uses in the Lower Boise River. See also EPA's Decision Document.
39	Lower Boise Watershed Council (LBWC) – Letter, page 3	"Listing for nutrient-caused impairment necessarily requires findings that: 1. There is documented impairment of beneficial use; 2. There is sufficient evidence to establish that the impairment is caused by nutrients; and 3. A TMDL is necessary to control the documented impairment."	LBWC's comment states that a waterbody segment can be listed for nutrients if data indicate nutrient-induced impairment of beneficial use and a TMDL is needed. The criteria for adding a waterbody segment for nutrient impairment on the 303(d) list is when water quality standards are not met. Idaho's nutrient standards are narrative. Therefore, EPA has interpreted these narrative standards and reviewed Idaho's interpretation of its narrative nutrient criteria in past actions. See EPA's Decision Document which outlines the basis for determining nutrient impairment in the Lower Boise River.
40	Lower Boise Watershed Council (LBWC) – Letter, pages 3-4	"The evidence does not establish nutrient-caused impairment of any beneficial use. The data and analysis show a poor correlation between nutrient concentrations and phytoplankton or invertebrates. While there is stronger correlation between nutrients and periphyton,	LBWC's comment states that there is no evidence of nutrient-caused impairment of any beneficial use. We agree that the analysis presented by the commenter based on the AQUATOX work do not indicate a strong correlation between total phosphorus data and

		the only indication of potentially marginal impairment related to periphyton occurs at Middleton, whether other factors support periphyton growth that sometimes exceeds certain numeric thresholds used by other jurisdictions to indicate impairment. Here, where the standard is narrative, there have been no reports and no data showing impairment of beneficial uses at Middleton."	planktonic chlorophyll-a data. However, EPA does not agree that there is no evidence of impairment of a water quality standard. TP and nitrogen exceed EPA 304(a) Gold Book and ecoregional criteria. Periphyton chlorophyll-a exceed nuisance algae levels compared with peer-reviewed scientific literature used by EPA and IDEQ. DO and pH data indicate a potential impairment, and macroinvertebrates are impaired where nutrients and sediments may be co-factors. See Decision Document (EPA, 2009b).
41	Lower Boise Watershed Council (LBWC) – Letter, page 4	"A TMDL is not necessary to control any potential impairment because allocations contained in the Snake River-Hells Canyon TMDL and in the IDEQ 2008 Implementation Plan reduce phosphorus in, and discharging from, the Lower Boise River to address nutrient-caused impairment in the Snake River. If EPA concludes and demonstrates that periphyton levels at Middleton require a regulatory classification for the Lower Boise River in IDEQ's 2008 Integrated Report, Category 4 provides the only valid classification."	The LBWC's comment states that allocations from the Snake River-Hells Canyon TMDL and nutrient reductions from the Total Phosphorus Implementation Plan are sufficient to address nutrient-caused impairment. This comment addresses the need for a TMDL and not whether the Lower Boise should be listed as impaired on Idaho's 303(d) list. For an impaired water, a TMDL or a more stringent pollution control plan requirement is required. The Snake River-Hells Canyon TMDL sets limits for the phosphorus concentration at the mouth of the Lower Boise River. A TMDL for the Lower Boise River must meet the downstream targets. However, within the Lower Boise River basin itself, water quality standards must be met in all waters. This action pertains to whether the Lower Boise River is impaired. See response to comment 10 regarding changing the Lower Boise River to Category 4 of the 303(d) list.
42	Lower Boise Watershed Council (LBWC) – Report, page 9	"The phosphorus data from the longer period of record confirm that, in general, phosphorus concentrations increase in the downstream direction. The gray line in Exhibit 3E represents the Snake River-Hells Canyon TMDL target of 0.070 mg/L (as measured at Parma), and only the Diversion Dam site is consistently below this level... The total phosphorus data do not indicate, in and of themselves, what the river-specific relationship is between nutrient levels and algae growth. This relationship depends on a number of location-specific factors including hydraulics, light availability, and available physical habitat."	The LBWC's comment states that though TP increase downstream, the relationship between TP and algae growth is unclear. We agree that total phosphorus increases downstream and that there are many factors affecting algal growth. However, phosphorus values regularly exceed EPA's 1986 Gold Book 304(a) criteria of 0.1 mg/L total phosphorus and EPA's ecoregional 304(a) criteria of 0.043 mg/L total phosphorus(EPA, 2000). Periphyton levels also regularly exceed the nuisance algae levels in the range of 100-200 mg/m^2. These two parameters are important indicators of nutrient impairment. See responses to comments 6 and 19 and

			EPA's Decision Document.
43	Lower Boise Watershed Council (LBWC) – Report, pages 9-14	"The instantaneous DO data do not show any samples where DO fell below the minimum 6.0 mg/L Idaho standard at any of the stations... Available continuous DO data (collected at Glenwood Bridge during 2007 and 2008 and at Parma beginning in Fall 2008) also do not show any samples where DO fell below the minimum 6.0 mg/L Idaho standard. This information confirms earlier limited diurnal sampling conducted by the USGS in August 1997 (MacCoy, 2004). Hourly DO measurements were collected over 24-hour periods at Diversion Dam, Glenwood, Middleton, Caldwell, and Parma to assess the possibility that DO might fall below criteria during a DO sag in the late evenings or early morning. The expected night time sag DO concentrations were observed, but the concentrations never dropped below the criteria. The lowest 24-hour average DO concentration (7.5 mg/L) occurred at Middleton."	This comment refers to continuous and grab samples of DO that do not exceed the water quality criteria. See response to comment 15.
44	Lower Boise Watershed Council (LBWC) – Report, pages 9-14	"Supersaturation conditions can also result from increased water temperatures, turbulence and aeration downstream from impoundments. Unless diurnal swings are also large, supersaturated conditions are not necessarily indicative of excessive algal productivity. Given that supersaturated conditions are common throughout the mainstem river, there does not appear to be a relationship between high nutrient levels and DO supersaturated conditions."	See response to comment 16.
45	Lower Boise Watershed Council (LBWC) – Report, pages 15-18	"The instantaneous pH data show that pH values almost entirely fall within the Idaho standard of 6.5 – 9.0, with one exception each at Diversion Dam and Glenwood. It is very important to note that one excursion from the standard does not mean impairment exists... This policy allows deference to biological health in judging whether a water supports cold water aquatic life use when exceedance in numeric temperature criteria is infrequent... So this one exceedance of the pH range at these stations, which is far below a 10% level cannot be used to justify any listing recommendations. Although the Idaho standard does not include diurnal	LBWC's comment refers to instantaneous and continuous pH samples falling within Idaho's pH standards. The raw data show far more than one exceedance at Glenwood and Linder Bridges. In the Cities' comments, they provide an analysis of the number of violations (City of Boise, City of Caldwell, City of Meridian, City of Nampa, 2009). See response to comment 17.

		evaluation of pH levels, it can be an indicator of ecosystem (algal) productivity levels. Available continuous pH data (collected at Glenwood Bridge during 2007 and 2008 and at Parma beginning in Fall 2008) also do not show any observations where pH levels were outside the acceptable Idaho standards.	
46	Lower Boise Watershed Council (LBWC) – Report, pages 19-23	"The gray line in Exhibit 13F is drawn at 15 µg/L. In the 2001 SBA, a target of 40 µg/L was used as a measure of potential impairment due to phytoplankton growth. Since that time, Oregon has applied a chlorophyll *a* target (15 µg/L) as a trigger for only further analysis and potential development of a nutrient management plan...Notwithstanding that no specific chlorophyll *a* target has been established for phytoplankton in the mainstem Lower Boise River itself, none of the four mainstem stations exceed the Snake River-Hells Canyon TMDL target of 14 µg/L between May-September period (Exhibit 14)."	LBWC's comment refers to phytoplanktonic chlorophyll-a data. See response to comment 18.
47	Lower Boise Watershed Council (LBWC) – Report, pages 24-28	"The data presented in these figures have all been pebble count normalized using the U.S. Geological Survey pebble count 1997 data reported for each station. Specifically results have been normalized for % substrate > 2mm... Periphyton data are not shown by month because the periphyton data are only collected and analyzed once per year, typically in October or November... A potential periphyton target of 150 mg/m^2 is shown in Exhibit 15E because this value falls within the commonly accepted range of nuisance aquatic growth thresholds established in the literature... Notwithstanding that no specific chlorophyll *a* target has been established for periphyton in the mainstem Lower Boise River median periphyton values at all of the four mainstem stations are below a 150 mg/m^2 threshold (see Exhibit 15E).	LBWC's comment refers to periphytic chlorophyll-a data. See response to comment 19.
48	Lower Boise Watershed Council (LBWC) – Report, pages 30-39	"To that end, chemical data and biological data for each station have been compared to assess any relationship specific to this system. As a reminder, the core question is: 'What levels of phosphorus are acceptable to minimize nuisance algae (phytoplankton and periphyton) conditions and maintain other water quality parameters such as DO and pH in the Lower Boise River itself?' Because other	See response to comments 6 and 38.

		water quality parameters such as DO and pH are within the applicable numeric water quality standards, the link between total phosphorus and associated biological responses is critical."	
49	Lower Boise Watershed Council (LBWC) – Report, pages 30-39	"Collectively, the data indicate that elevated phosphorus concentrations are poor predictors of observed phytoplankton levels (R^2 value of 0.26). The data plotted show that total phosphorus concentrations are reasonably good predictors of observed periphyton levels in this system (R^2 value of 0.60). For the nearly 50 paired values shown in Exhibit 20, mean total phosphorus concentrations that correspond to periphyton levels below 150 mg/m^2 are 0.18 µg/L and mean total phosphorus concentrations that correspond to periphyton levels greater than 150 mg/m^2 are 0.390 µg/L. If this relationship is true, a total phosphorus concentration of 0.070 mg/L might be expected to result in a periphyton level of less than 20 mg/m^2, which is well below the 150 mg/m^2 threshold used elsewhere to establish impairment from nuisance algae."	This comment discusses the regression equation from Exhibit 22, rather than Exhibit 20. The regression equation is used to derive a relationship between total phosphorus and periphyton. See response to comment 40. The modeled regression line in Exhibit 22 has a large amount of variability that makes it difficult to draw a final conclusion that 0.070 mg/L TP would result in a periphyton chlorophyll-a level of 20 mg/m^2.
50	Lower Boise Watershed Council (LBWC) – Report, page 39	"Collectively, the data indicate that total phosphorus concentrations are poor predictors of invertebrate (EPT) taxa abundance (R^2 value of 0.06)."	LBWC's comment states that total phosphorus is a poor indicator of taxa abundance. EPT taxa abundance is just one of many indicators of benthic community condition. Though the AQUATOX model runs by the City of Boise showed that the annual average phosphorus was a poor predictor of EPT taxa abundance, it is not sufficient reason to show that phosphorus is not, at least in part, associated with impairing the benthic community. There are many possible reasons for the AQUATOX results. For instance, EPT taxa abundance is not an especially sensitive metric. Also, annual average phosphorous concentrations and AQUATOX may not be the best method to analyze this relationship (Carleton, 2009). See EPA's Decision Document for a detailed discussion of EPA's use of phosphorous data to determine nutrient impairment in the Lower Boise.
51	Lower Boise Watershed Council (LBWC) – Report, page 40	"Since the 2001 SBA (IDEQ, 2001) reported that no public comments had been received regarding nuisance algae conditions, there has been one negative comment received... While we agree that management of nutrients	This comment refers to a negative comment received during the public comment period of the 2008 303(d) Integrated Report. See response to comment 5.

		on all streams is essential to meeting the Snake River-Hells Canyon TMDL, this one comment (out of hundreds received by IDEQ) is an opinion, and is not based on a review of the available scientific data such as observed DO levels as compared to numeric criteria. In addition, macrophytes only violate the narrative standard if they are present at levels that create nuisance conditions... Public feedback was contained in the 2001 SBA originally as one more data point in IDEQ's weight-of-evidence approach... It would be impossible to prove whether IDEQ would have received more public input on this issue had more public outreach occurred prior to 2001 SBA."	We agree that public feedback is important. The comment in IDEQ's 2008 303(d) Integrated Report regarding conditions in the Lower Boise River constitutes a complaint. However, the public process set forth by the 303(d) Integrated Report is not designed to solicit comments from the public on nuisance algae conditions in the Lower Boise River. Additionally, in the rationale to delist nutrients from the 303(d) impaired waters list, the only information on lack of complaints is from 1997-2000.
52	Lower Boise Watershed Council (LBWC) – Report, page 41-42	"What is unclear from these photographs is whether they are representative of specific reaches. These photos were not collected in the mainstem Boise River, but rather a side tributary of the mainstem river. The separate, stagnant, shallow channel is not representative of Lower Boise River hydrology and/or channel conditions where swimming and fishing would be occurring. We also note again that the presence of algae does not mean that standards are impaired."	This comment refers to the photo log. See response to comment 4.
53	Lower Boise Watershed Council (LBWC) – Report, page 44-48	"The AQUATOX model predicts that the Snake River-Hells Canyon TMDL total phosphorus target of 0.070 mg/L is expected to be met so long as the wastewater treatment plants reduce their effluent concentrations. Even though wastewater facilities have committed to reducing their effluent concentrations of total phosphorus to 0.200 mg/L in the 2009 Implementation Plan, discharges at levels higher than that are also predicted to attain the Snake River-Hells Canyon TMDL target."	LBWC's comment discusses AQUATOX modeling results to conclude that a 0.200 mg/L discharge limit will meet the Snake River-Hells Canyon TMDL target. This comment is not relevant to the decision that EPA is making to determine whether the Lower Boise River is impaired. The comment seems to address what the appropriate phosphorus discharges should be in a TMDL in order to meet the targets at the mouth of the Lower Boise River established in the Snake River-Hells Canyon TMDL. Although this action addresses whether the Lower Boise is impaired for nutrients and does not specifically address the development of phosphorus discharge limits in a TMDL, EPA has identified several uncertainties with the way in which conclusions were drawn from the Aquatox modeling completed by CH2M Hill. These concerns include extrapolation of a periphyton response beyond the calibration range, and the limited amount of

			periphyton chlorophyll-a data used to calibrate the model (Carleton, 2009).
54	Lower Boise Watershed Council (LBWC) – Report, page 48-50	"The AQUATOX model was also used to provide a relationship between total phosphorus and periphyton at Middleton, the most sensitive station... The model output suggests that total phosphorus concentrations that will result in periphyton levels less than 150 mg/m^2 are in the 120-130 µg/L range during the summer at Middleton... The exhibit shows that the most sensitive period (that is, when phosphorus levels need to be lowest at 0.124 mg/L) to achieve periphyton levels of 150 mg/m^2 is between June and August at Middleton. Currently, median total phosphorus concentrations at Middleton of 0.150 mg/L would need to be reduced by about 20% to achieve the necessary total phosphorus concentration of 0.124 mg/L. This level of total phosphorus is less stringent than the 80% target needed to meet the Snake River-Hells Canyon TMDL target. It is highly likely that a 20% reduction can be achieved at Middleton given that the upstream loads are dominated by wastewater discharge."	LBWC's comment discusses conclusions from the AQUATOX model. See response to comment 53.
55	Lower Boise Watershed Council (LBWC) – Report, page 51	"Data collected since the 2001 SBA assessment do not show any changes in water column trends, nor biological trends."	LBWC's comment states that there have been no changes in water quality or biological trends. EPA does not agree with the interpretation of data from the 2001 SBA Assessment concluding that nutrients are not impaired in the Lower Boise River. Additional total phosphorus, periphyton, DO, and pH data collected since 2001 provide more information about the Lower Boise River. These include data collected by the USGS, City of Boise and IDEQ (MacCoy, 2004; City of Boise, 2009; IDEQ, 2009).
56	Lower Boise Watershed Council (LBWC) – Report, page 51	"Nutrient levels in the mainstem are higher than reference conditions (these phosphorus levels are expected to be reduced by 80% at Parma to meet the Snake River-Hells Canyon TMDL)."	LBWC's comment states that nutrient levels are higher than reference conditions. We agree with this comment.
57	Lower Boise Watershed Council (LBWC) – Report, page 51	"Instantaneous DO and pH do not exceed numeric criteria. Data gaps include more complete diurnal measurements of both parameters at more mainstem locations.	This comment refers to DO and pH data See responses to comments 6, 7, and 15.
58	Lower Boise Watershed Council (LBWC) – Report, page 51	"There is no conclusive relationship between total phosphorus concentrations and phytoplankton or invertebrate taxa."	See responses to comments 49 and 50.
59	Lower Boise Watershed	"There does appear to be a stronger relationship between	This comment refers to the relationship between total

	Council (LBWC) – Report, page 51	total phosphorus concentrations and periphyton, particularly in the middle reaches of the mainstem systems."	phosphorus and periphyton. We concur with this conclusion.
60	Lower Boise Watershed Council (LBWC) – Report, page 51	"The AQUATOX model confirms that periphyton appear to be the best measure of whether excess nutrients are impairing beneficial uses."	We agree.
61	Lower Boise Watershed Council (LBWC) – Report, page 51	"The AQUATOX model predicts that the Snake River-Hells Canyon TMDL total phosphorus target of 0.070 mg/L is expected to be met so long as the wastewater treatment plants reduce their effluent concentrations as outlined in the IDEQ 2008 Implementation Plan (IDEQ 2008). At these phosphorus levels, phytoplankton levels should also improve slightly and periphyton concentrations should also improve to levels below a 150 mg/m^2 threshold."	See response to comment 53.
62	Lower Boise Watershed Council (LBWC) – Report, page 51	"The AQUATOX model indicates that the most sensitive period to achieve periphyton level(s) of 150 mg/m^2 is between June and August at Middleton. The model predicts that median total phosphorus concentrations would need to be reduced by about 20% to achieve the necessary total phosphorus concentration."	See response to comment 53. We concur that phosphorus reductions are needed in order to meet a periphyton level below 150 mg/m^2.
63	Lower Boise Watershed Council (LBWC) – Report, page 52	"This level of total phosphorus reduction is less stringent than the 80% target needed to meet the Snake River-Hells Canyon TMDL target and outlined in the IDEQ 2008 Implementation Plan. It is highly likely that a 20% reduction can be achieved at Middleton given that the upstream loads are dominated by wastewater discharge."	See response to comment 53.
64	Lower Boise Watershed Council (LBWC) – Report, page 53	"In the case of the Lower Boise River, nutrient levels above regional or national recommendations do not, in and of themselves, mean that this specific waterbody is impaired for nutrients. Instead it is necessary to determine the level of nutrients causing excessive plant growth (above nuisance conditions for recreational uses) and to relate the consequences of excessive plant growth (for example, low DO) to its [e]ffect on invertebrates or fisheries."	See responses to comments 6 and 8.
65	Lower Boise Watershed Council (LBWC) – Report, page 53	"This report presents all of the available periphyton (and phytoplankton) data to evaluate impairments by nutrients. The highest levels are at Glenwood and Middleton, even though median periphyton levels are below 150 mg/m^2. Extreme observed values should be used to determine impairment, particularly for conventional pollutants that	The LBWC comment states that median periphytic chlorophyll-a values are below 150 mg/m^2 and using extreme values are inappropriate. Relying on these median values is inappropriate, because they do not take into account the algae levels during the

		are not toxic... EPA's listing guidance (EPA, 2006) indicates that the statistical assessment methodology should be reflective of the applicable water quality criterion. Because our nutrient impairment targets are based on represent longer-term, seasonal effects, the statistical methodology should also represent a long-term averaged approach. Thus, using the extreme maximum observation for one day from one sub-sample is not appropriate to assess impairment spatially or temporally."	critical growing seasons at the critical locations. Even when values are averaged, periphytic chlorophyll a remains above 150 mg/m^2. Periphytic chlorophyll-a levels are significantly higher than 150 mg/m^2 during the critical conditions at critical locations. On Table 5, page 14 of EPA's review of Idaho's Delisting Rationale for the Lower Boise, periphytic chlorophyll-a levels in the Lower Boise River are regularly above 150 mg/m^2 in the impaired area. See also EPA's Decision Document (Bussell, 2009b). In the Lower Boise River TMDL for bacteria and sediment, fifteen of 33 measurements have values higher than 200 mg/m^2 and a maximum measurement greater than 900 mg/m^2 (IDEQ, 1999).
66	Lower Boise Watershed Council (LBWC) – Report, page 53	"The macroinvertebrate data summarized in this report do not show impairment decreasing downstream in parallel with increasing sediment or nutrient concentrations. In addition, there does not appear to be any correlation between total phosphorus concentrations and invertebrate (EPT) taxa abundance. The levels of total phosphorus do not appear to result in excessive plant growth (acceptable levels of phytoplankton and slightly higher levels of periphyton) nor do they result in consequences of excessive plant growth (available diurnal DO and pH levels do not fall outside the acceptable water quality criteria)."	The comment refers to macroinvertebrate data. See responses to comments 28 and 50.
67	Lower Boise Watershed Council (LBWC) – Report, page 53	"As explained in the background section, the information and rationale contained in the 2001 SBA was finally formally submitted to EPA to support delisting the river during the 2008 cycle because the information could not be incorporated into the 2002 listing cycle and the 2004 and 2006 listing cycles did not occur. The information contained in this report was presented to be consistent with more recent delisting/listing methodologies to the extent that those methodologies and rationale are supported by river-specific information."	See responses to comments 6, 8, and 37.
68	Lower Boise Watershed Council (LBWC) – Report, page 54	"One of the reasons this report was prepared was to provide a more complete picture of not only DO and pH, but the other water quality parameters that could potentially affect impairment of the river. The available data indicate that as DO levels are lowest at Parma, but	LBWC's comment describes the relationship between DO and periphytic algae. Total phosphorus and periphyton data show nutrient impairment in the river. DO and pH data show that nutrients may be harmfully impacting DO and pH, based on the violations that have been observed.

		periphytic algae levels are highest in the middle of the river near Glenwood and Middleton. Certainly, as more diurnal DO and pH information is collected, that data can be used to confirm the existing summary or influence future listing decisions as needed."	As such, there is sufficient data that supports the Lower Boise River nutrient impairment in Category 5 of the 303(d) Integrated Report under which a TMDL is required.
69	Lower Boise Watershed Council (LBWC) – Report, page 54	"Although maximum phytoplankton levels exceed a 15 µg/L threshold, long-term and seasonal phytoplankton levels do not. In addition, total phosphorus concentrations are not particularly strong indicators of phytoplankton levels."	The comment refers to phytoplankton data. We agree. As noted in MacCoy's 2004 USGS study, periphyton is the main algae of concern in the Lower Boise River.
70	Lower Boise Watershed Council (LBWC) – Report, page 54	"This report contains this updated information, which supports the earlier record of no river user complaints with the exception of one opinion received by IDEQ in 2008. The photo logs taken by EPA in July and August 2008 confirm that even if periphyton levels appear to be high, IDEQ does not receive complaints from river users that algae levels are at nuisance conditions."	See response to comment 4.
71	Lower Boise Watershed Council (LBWC) – Report, page 54	"This report contains this updated information, which supports the earlier record of no river user complaints with the exception of one opinion received by IDEQ in 2008. The photo logs taken by EPA in July and August 2008 confirm that even if periphyton levels appear to be high, IDEQ does not receive complaints from river users that algae levels are at nuisance conditions."	See response to comment 5.
72	Lower Boise Watershed Council (LBWC) – Report, page 54	"Velocities were discussed and evaluated in the 2001 SBA to help assess why algae levels were not higher given the observed phosphorus levels. In contract to other systems where phosphorus levels have been shown to have a direct and measurable response on algae communities, we expected algae levels to be higher. The velocity analysis was one element of a larger weight-of-evidence approach.	This comment refers to the scour velocities in the Lower Boise River. We note that velocity is an element of the weight-of-evidence approach.

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Decision Document

Rationale for Adding Hem Creek to Idaho's 2008 303(d) Integrated Report

October 13, 2009

Background

On February 4, 2009, EPA sent a letter to IDEQ announcing the decision to disapprove the delisting of Hem Creek – AU: ID17060307CL007_02b - for temperature from Idaho's 2008 303(d) Integrated Report (Bussell, 2009). In March 2009, EPA then issued a federal register notice seeking comments on EPA's proposed decision to add Hem Creek to Category 5 of Idaho's 303(d) Integrated Report for temperature. This document describes the basis for EPA's decision to add Hem Creek to Category 5 of Idaho's 303(d) Integrated Report for temperature.

Legal basis for EPA's action

According to Section 303(d)(1)(A) of the Clean Water Act, states are required to identify waters that do not meet applicable water quality standards. States are required to submit a list biennially (CFR 130.7(d)) to EPA for their approval. If EPA disapproves the listings, EPA must "identify such waters in such State and establish such loads for such waters as determined necessary to implement applicable [water quality standards] WQS, (CFR 130.7(d)(2))."

Applicable Water Quality Standards for Temperature in Idaho

The Idaho water quality standards which address temperature are as follows:

Idaho Administrative Code (IDAPA 58.01.02.250.02)

250.02. Cold water. Waters designated for cold water aquatic life are not to vary from the following characteristics due to human activities:

b. Water temperatures of twenty-two (22) degrees C or less with a maximum daily average of no greater than nineteen (19) degrees C,

f. Salmonid spawning: waters designated for salmonid spawning are to exhibit the following characteristics during the spawning period and incubation for the particular species inhabiting those waters:

ii. Water temperatures of thirteen (13) degrees C or less with a maximum daily average no greater than nine (9) degrees C.

Idaho water quality standards which address natural conditions, and are relevant to issues in Hem Creek are as follows:

Idaho Administrative Code (IDAPA 58.01.02.03.68; 200.09)

03.68. Natural Background Conditions. No measurable change in the physical, chemical, biological, or radiological conditions existing in a water body without human sources of pollution within a watershed.

200.09 Natural Background Conditions. When natural background conditions exceed any applicable water quality criteria set forth in Sections 210, 250, 251, 252 or 253, the applicable water quality criteria shall not apply; instead pollutant levels shall not exceed the natural background conditions, except that temperature levels may be increased above natural background conditions when allowed under section 401.

[Section 401 has to do with allowances for temperature increases from point sources and is not relevant to temperature issues on Hem Creek.]

Temperature Impairment in Hem Creek.

Temperature Data

In 2003, IDEQ completed the Upper North Fork Clearwater River Subbasin Assessment (SBA) and TMDLs (IDEQ, 2003). The SBA concluded that data collected from 1996-1999 by the U.S. Forest Service (USFS) demonstrated exceedances of the salmonid spawning temperature criteria applicable to cutthroat trout from April through July in this waterbody (IDEQ, 2003; p. 63).

EPA contacted the USFS to determine whether any additional temperature data for Hem Creek would have been readily available to Idaho at the time the 2008 303(d) list was finalized in July 2008. The USFS was able to provide additional data for the years 1994, and 2000 - 2007 (USFS, 2008a; see data summary in Attachment A). EPA evaluated this additional data to determine if applicable temperature criteria were exceeded, particularly the salmonid spawning criteria applicable to cutthroat from April through July, noted by IDEQ in the 2003 SBA. In completing this evaluation to establish whether exceedances of criteria were sufficient to warrant 303(d) listing, EPA used a threshold of 10% of measurements exceeding the temperature criteria, on a yearly basis. This approach is consistent with recommendations in EPA's Consolidated Assessment and Listing Methodology (EPA, 2002). EPA's review of these data found that temperature criteria were exceeded in >10% of measurements in all13 years for which data were available, from 1994 – 2007, as documented in Attachment A.

The record is clear that Idaho's numeric temperature criteria have been exceeded based on data cited by IDEQ in their 2003 Upper North Fork Clearwater Subbasin Assessment, and additional data readily available to Idaho at the time the 2008 303(d) list was submitted to EPA on July 24, 2008.

The next step in determining whether this information warrants 303(d) listing is to evaluate whether these criteria exceedances were due to natural conditions.

Enclosure 4: Rationale for Adding Hem Creek onto Idaho's 2008 303(d) List

Evaluation of natural conditions provisions in Idaho water quality standards.

IDEQ's basis for delisting Hem Creek was based on a conclusion that temperature exceedances were due to natural conditions. EPA analysis of data has shown that the temperature exceedances were, at least in part, due to anthropogenic sources.

The natural background conditions provision in Idaho water quality standards indicates that if there is no measurable change in physical, chemical, biological or radiological conditions due to human source of pollution, then the applicable water quality criteria do not apply, and instead, pollutant levels shall not exceed the natural condition (IDAPA 58.01.02.200.09).

A number of human sources of pollution including point and non-point source human activities, can impact stream temperature, and result in temperatures which are not natural. Disturbance of riparian areas in forested conditions can lead to various water quality changes, including (but not limited too) sediment delivery changes, sediment transport changes (through changing hydrography), and temperature load changes (through reduction of shade conditions).

Timber harvest, road construction, grazing, and related activities are some of the most common sources of riparian shade reduction in a forested setting. Previous research (Brown, 1969) has shown that reduced riparian shade conditions do result in increases in river/stream temperature conditions.

To assess the impacts of human activity in the Hem Creek watershed, EPA compiled readily available management history information and air photo documentation of management activities in the Hem Creek watershed. The USFS provided information on timber harvest and road construction history (USFS, 2008b). These data indicate that 7.3% of the watershed has been logged, approximately 10 miles of roads exist in the watershed, and approximately 2 miles of road are within 300' of Hem Creek. In addition, air photos indicate that the timber harvest and road construction has occurred primarily in lower Hem Creek. As can be seen in Figures 1 and 2, timber harvest was evident in the 1998 and 2004 photos in the lower watershed, and is near the stream channel in some locations. This information was evaluated and additional modeling was conducted, as described in Attachment B and summarized below.

Figure 1. 2004 Photograph of the Lower Hem Creek Watershed.
[Red line represents a 300 foot buffer from the Hem Creek mainstem.]

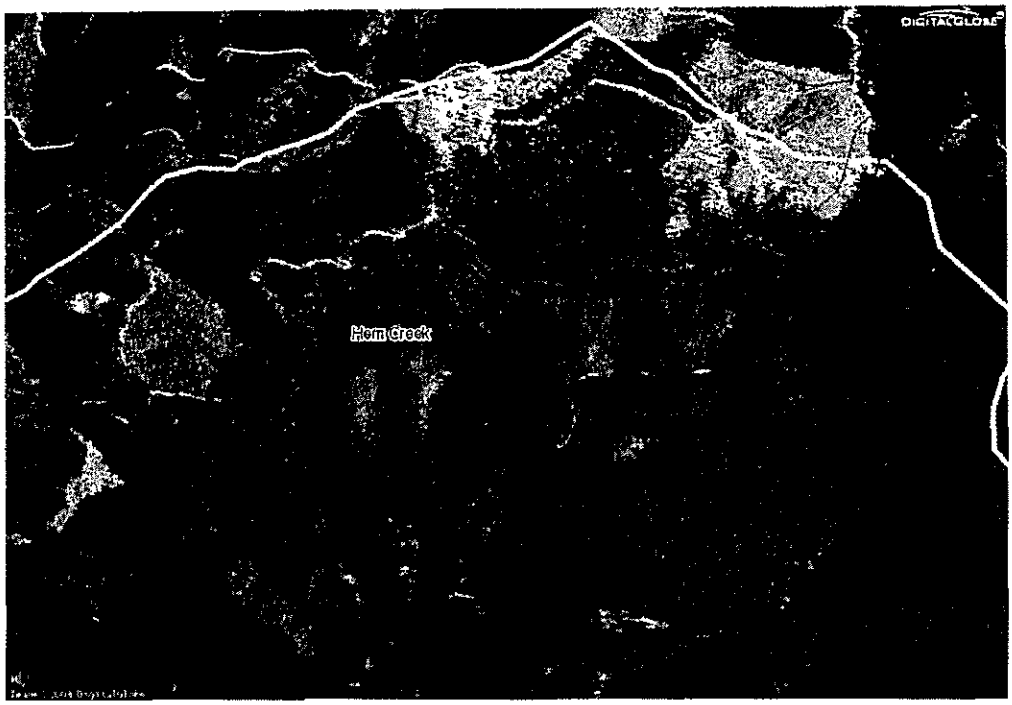
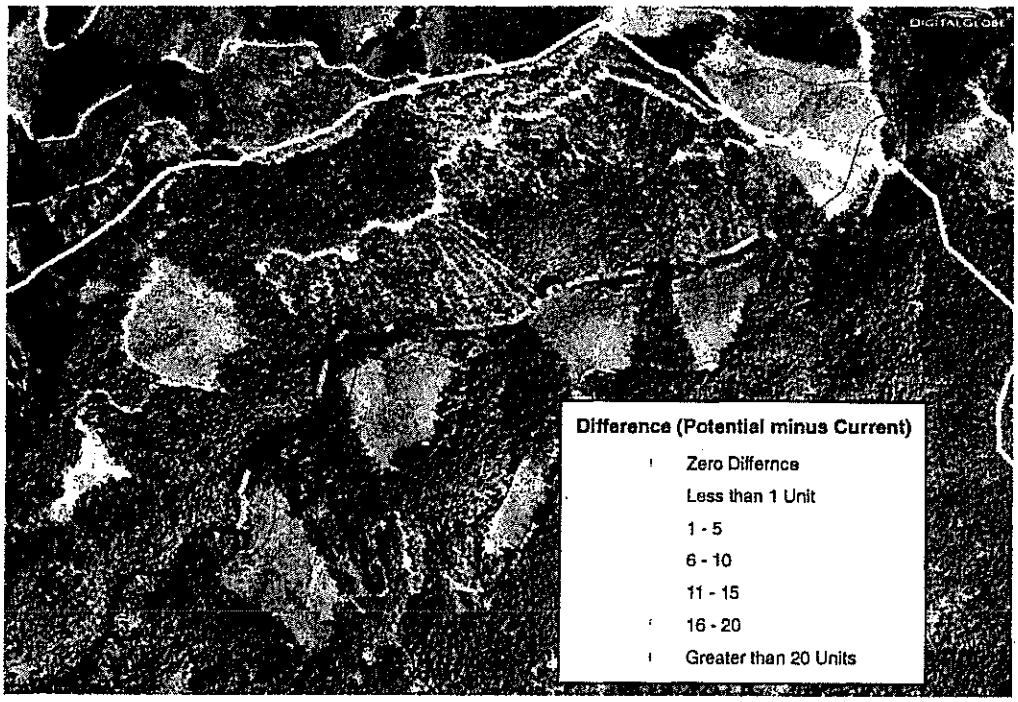


Figure 2. 1998 Photograph of the Lower Hem Creek Watershed.
[Red line represents a 300 foot buffer from the Hem Creek mainstem.]

Potential impacts resulting from these harvest activities were evaluated using a shade model developed by the Washington Department of Ecology and Oregon Department of Environmental

Quality. Assumptions used in the analysis are presented in Table 2 in Attachment B. The results of this analysis, shown in Figure 3 below, illustrate that several areas within the lower reach of Hem Creek have reduced shading resulting from harvest activities, and several areas have shade reductions up to or greater than 20%, as indicated in the figure below. Measurable impacts to stream temperature due to the loss of shade from harvest are probable based the on stream heating relationship described in the paragraph above, and therefore Hem Creek temperature conditions cannot be considered to be "natural".

Figure 3. Estimated Shade Reduction along Lower Hem Creek.
[Red line represents a 300 foot buffer from the Hem Creek mainstem.]



Conclusion

Information cited by IDEQ in the 2003 NF Clearwater Subbasin Assessment and other temperature data readily available at the time the 2008 303(d) list was finalized establish that Idaho salmonid spawning temperature criteria are exceeded in > 10% of measurements in all 13 years for which data were available. Subsequent analysis and modeling of conditions in the Hem Creek watershed establish that timber harvest and road construction has occurred in lower Hem Creek and has likely resulted in reduced stream shade in lower Hem Creek. Consequently, stream shade and stream temperature could not be considered to be in a natural condition, and temperature criteria violations noted above could not be considered to reflect a natural condition. Therefore the temperature exceedances in Hem Creek are a basis for 303(d) listing, and EPA is adding Hem Creek (AU: ID17060307CL007_02b) to Idaho's 303(d) list as impaired for temperature.

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Enclosure 5: Hem Creek Response to Comments

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Hem Creek Response to Comments
10/13/09 version

Comments and Responses summary

#	Name	Comment	Response
1	Idaho Department of Environmental Quality (IDEQ), page 1.	DEQ agrees that at this time, pending field verification of shade levels and their effect on stream temperatures, Hem Creek should not be removed from Idaho's 303(d) list.	EPA agrees
2	Idaho Department of Environmental Quality (IDEQ), page 1,2	EPA incorrectly suggests that the existence of forest harvest activities within the riparian area, as that is generally defined in footnote 3 on page 20 of the NBC Concepts Paper, requires the conclusion that the water body does not reflect NBC. Some forest harvest within the riparian area does not preclude NBC, but only indicates further investigation must be done in order to determine whether NBC exist. Second, DEQ makes it clear in the NBC Concepts Paper that the broad width of the riparian areas used to presume NBC does not preclude the determination that a narrower width may be sufficient for NBC: "Because in this context, intact riparian widths are recommended as one factor in a rebuttable presumption of natural stream conditions, these riparian width recommendations are broad. While narrower riparian widths may in some cases be sufficient for natural stream conditions, that should not be presumed and would need to be demonstrated on a case specific basis." (NBC Concepts Paper, footnote 3, pages 20-21). Again, EPA incorrectly suggests that impacts within 300 feet of a water body do not affect temperatures, and therefore, do not affect NBC.	IDEQ guidance identifies a default riparian no harvest setback distance of 300'. We agree that narrower setback distances could be justified on a case-by-case basis, as indicated in the NBC guidance, but no such justification was presented in the final 2008 303(d) delisting rationale for Hem Creek, nor in IDEQs response to EPA's proposed disapproval of the delisting.
3	Idaho Department of Environmental Quality (IDEQ), pages 2	Idaho's Potential Natural vegetation process, Rather than the Model Chosen by EPA should be used as an aid in determining whether NBC exist.... The Idaho PNV process, compared to the process used by EPA, more accurately estimates existing shade conditions ... EPA presumably used a model to estimate the existing shade condition in the Hem Creek watershed....the PNV process uses the highest quality aerial photographs at high magnification ... looks at the location of the actual water body as shown on .. photographs. The PNV process also recommends that the aerial interpretation be checked by field verification. The use of aerial photographs and field verification under the Idaho PNV process provides a much more accurate assessment of existing shade conditions than the model used by EPA.	Idaho's PNV process is a useful tool, but a PNV analysis was not completed when IDEQ delisted Hem Creek. The PNV analysis relies upon manual examination of two dimensional aerial imagery. To account for errors in air photo interpretation, ground truthing with direct shade measurements in streams is important. Previous analysis in completed TMDLs has shown that precision can be very good, e.g. within a

Enclosure 5: Hem Creek Response to Comments

#	Name	Comment	Response
			few percentage points of a PNV estimated shade levels, to deviations ranging from 10 – 20%. We note that the PNV analysis which IDEQ recently completed concludes that an anthropogenic loss of shade has occurred in the lowest reaches of Hem Creek, similar to EPA modeling. We agree with IDEQ that the most reliable way to verify current shade conditions is via field verification. Until such data are collected, available information suggests anthropogenic shade reduction has resulted in non-natural stream temperature in the lower reaches of Hem Creek.
4	Idaho Department of Environmental Quality (IDEQ), pages 3, 4	EPA's evaluation of shade conditions, using the model, has a number of errors that affect the results EPA is relying upon to make its decision to retain Hem Creek on the 303(d) list for temperature. ▫ GIS information used by EPA misrepresents the location of Hem Creek - "For this reason, EPA's conclusion that many of the harvest areas "appear to be near the stream channel" is suspect." ▫ EPA used a channel width estimate of 30 feet – DEQ's analysis determined that Hem Creek bankfull width varies from 1 M (3.3 feet) in headwaters to 7 M (23 feet) at its mouth.	Hem Creek location data used in the analysis was obtained from the IDEQ GIS coverage which is named "Streams of Idaho (2002 305(b) & 303(d) Integrated Report – Water Quality) and was downloaded from the Inside Idaho website. We agree that stream location is very important, but it appeared that this coverage was sufficiently accurate and did not produce more bias than other available stream layers – i.e., derived from 10 m DEM. We also agree that stream channel width is another important factor affecting stream shade production from riparian vegetation. The 30 feet estimate was derived from inspection of aerial images

Enclosure 5: Hem Creek Response to Comments

#	Name	Comment	Response
			within the lower section of Hem Creek. The area of interest is the lower section of the river and it appears that 30 foot was only a slight increase over estimated by IDEQ PNV modeled values for these lower "impacted" reaches. In addition, the model used by EPA included a tree overhang component of 4 feet, which resulted in an open area of 22 feet (i.e., 30' minus 8' (i.e., 4'*2 banks)). Accordingly, channel width used in USEPA model is very similar to the PNV modeled channel width.
		▫ Harvest has not occurred on 39% of class 1 fish bearing stream miles .. should actually be 15%	We appreciate the clarification/correction. It is still important to point out that 15% remains a high number, and this summary statistic does not take into consideration spatial variability (i.e., riparian harvest and road activity is located primarily in the lower watershed).
		▫ Harvest activity ended in 1994, so the watershed has had 14 years to recover. EPA uses 5 foot trees in model, but in 14 – 22 years trees would grow taller than 5 feet.	The aerial images show that clearcut harvest has occurred within the Hem Creek basin since 1994 (i.e., between 1998 and 2004). The earliest image (1998) shows several relatively newly created harvest areas within the 300 foot buffer of Hem Creek. It was assumed that these harvests occurred in 1998, resulting in an approximately 10 year stand (assuming that replanting occurred immediately following the harvest). Accordingly, it was assumed that these trees were in the initial growth stage, where canopy cover is high, and height increases are relatively dramatic but

Enclosure 5: Hem Creek Response to Comments

#	Name	Comment	Response
			trees are still relatively short compared to mature heights. The IDEQ comment is correct in pointing out that tree height is important to shade production, but it is also important to point out that tree shade production of shorter trees behind taller trees along a stream has a lower impact than if these trees were at the stream edge. The IDEQ comment brings up a valid concept, but implementing a slightly taller initial tree height following clear cut harvest would not result in a dramatically different model estimates for this simulation.
		▫ The 300 foot Class 1 RHCA buffer width is based on two tree heights for coastal forest types. EPA's modeling uses tree height of 80 feet. This would suggest a more appropriate buffer width for Hem Creek is 160 feet.	The 80 foot tree height used in the model were current condition estimates, not site potential tree height. In addition PACFISH/INFISH established riparian buffer width for the entire Columbia Basin recognizing ecosystem differences in tree height. RHCA width can be changed, but it must be supported by a watershed analysis. EPA is unaware of any watershed analysis as contemplated by PACFISH/INFISH which justifies narrower RHCAs in Hem Creek.
		▫ DEQ questions EPA's use of 60% and 40% canopy cover appears low, and DEQ would like to verify them with on site data	Canopy cover estimates for 1) initial re-growth following clearcut harvest (i.e., 80%), 2) unthinned mature forest (i.e., 60%) and 3) thinned forest (i.e., 40%) can be refined/improved using several methods, including site data. However the general trends shown by the model would not be dramatically affected by modifications of these canopy cover estimates.

Enclosure 5: Hem Creek Response to Comments

#	Name	Comment	Response
5	Idaho Department of Environmental Quality (IDEQ), pages 4	Overall DEQ's PNV analysis shows that lowest 990 meters of Hem Creek is not meeting potential shade for apparently unnatural reasons of historic timber harvest and riparian road construction. While the effect of this shade reduction on stream temperatures is not known, DEQ agrees that Hem Creek should remain on the 303(d) list, at least until DEQ conducts a field investigation, and evaluates the field data.	EPA agrees
6	Idaho Department of Environmental Quality (IDEQ), pages 5	The biological data shows aquatic life uses in Hem Creek are not impaired.	As pointed out in EPA's proposal to disapprove the delisting of Hem Creek for temperature, it is encouraging that aquatic life appears to be fully supported based on available data. However, this information does not affect the interpretation of the Idaho natural background provisions for temperature, which simply specifies that there shall be no anthropogenic influence on temperature, and there is no discussion of the condition of aquatic life uses.
7	Idaho Department of Environmental Quality (IDEQ), pages 6	DEQ's principles and policies for the 303(d)/305(b) report is incorrect and needs to be modified. The guidance states that "For an AU to be considered for this exclusion process, it must have biological monitoring data that indicates beneficial uses are fully supported and there must be a continuous temperature record indication <10% exceedance of DEQ's temperature criteria." The natural condition standard does not mention frequency of exceedance. As such DEQ has modified the sentence above and it now ends at fully supported, making it consistent with the natural conditions standard.	Comment noted.

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State Water Quality Programs

Enclosure 6: Hem Creek Temperature Data

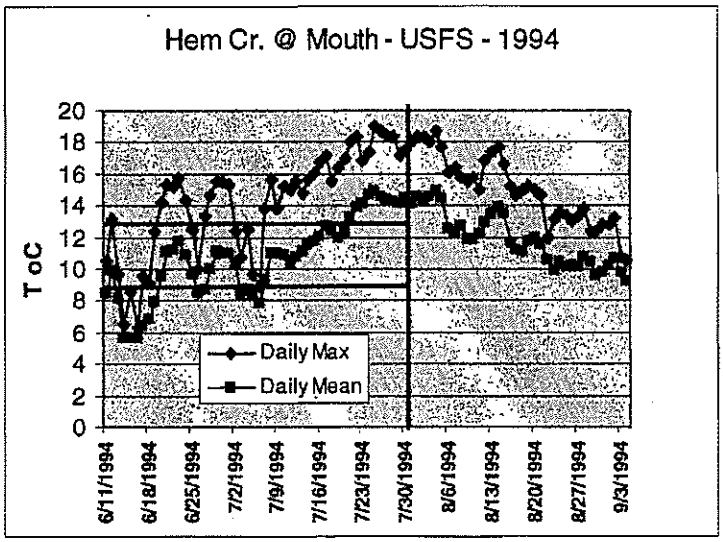
Hem Creek - USFS Temperature Data

1994 to 2007

	# days T recorded during cutthroat spawning window (April 1 - July 31)	% measurements exceeding daily average of 9° C	% measurements exceeding daily max. of 13°C
1994	51	71	67
1996	14	79	57
1997	37	19	0
1998	31	100	84
1999	12	75	25
2000	41	63	46
2001	41	80	54
2002	54	41	35
2003	63	49	41
2004	73	49	32
2005	75	48	39
2006	73	51	44
2007	61	64	77

Data provided electronically by Patrick Murphy, USFS Fisheries Biologist, Clearwater National Forest. November 24, 2008.

Footnote:
Daily average and daily maximum measurements were compared to Idaho criteria of 9°C and 13°C respectively to determine if >10% of measurements exceed criteria.


Hem Cr. @ Mouth - USFS - 1994
T oC
Daily Max
Daily Mean
6/11/1994
6/18/1994
6/25/1994
7/2/1994
7/9/1994
7/16/1994
7/23/1994
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8/6/1994
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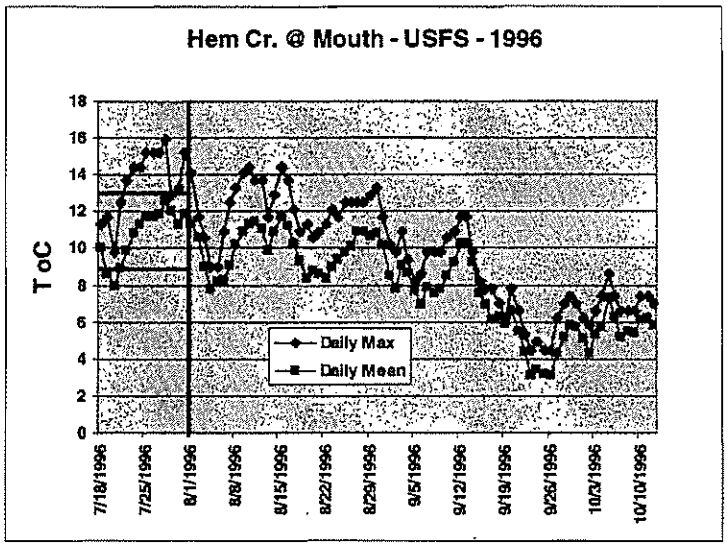
8/20/1994
8/27/1994
9/3/1994


Hem Cr. @ Mouth - USFS - 1996
T oC
Daily Max
Daily Mean
7/18/1996
7/25/1996
8/1/1996
8/8/1996
8/15/1996
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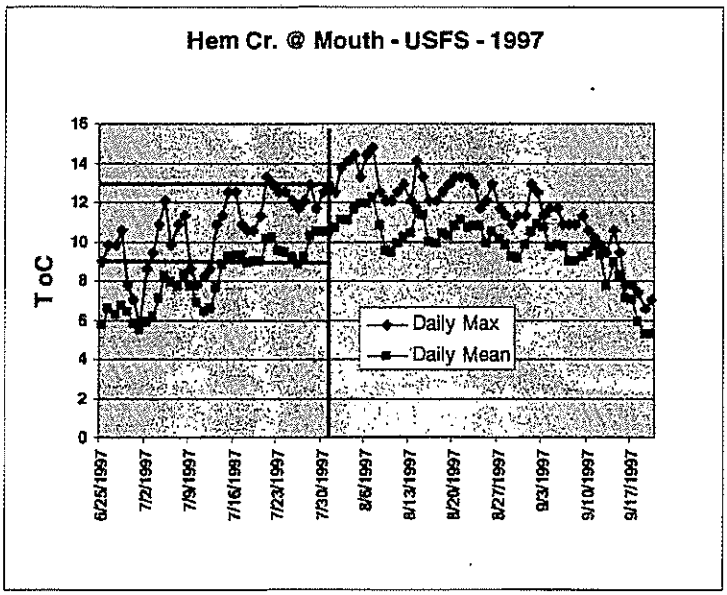
9/26/1996
10/3/1996
10/10/1996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T oC
Daily Max
Daily Mean
6/25/1997
7/2/1997
7/9/1997
7/16/1997
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8/6/1997
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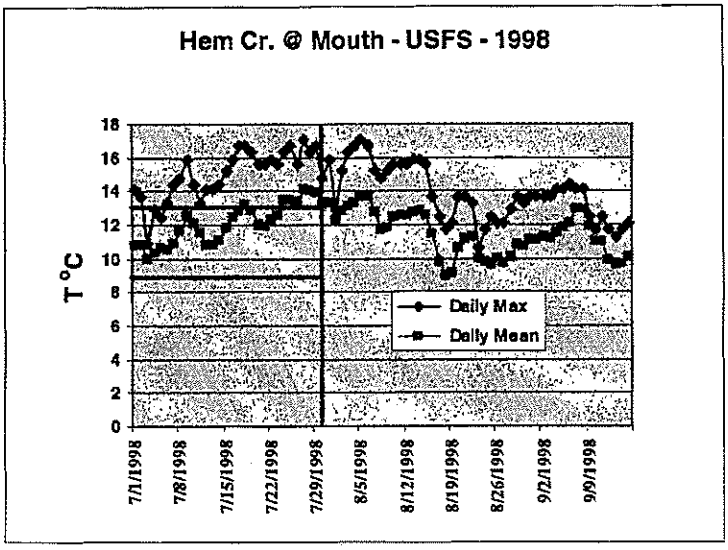
9/3/1997
9/10/1997
9/17/1997


Hem Cr. @ Mouth - USFS - 1998
T °C
Daily Max
Daily Mean
7/1/1998
7/8/1998
7/15/1998
7/22/1998
7/29/1998
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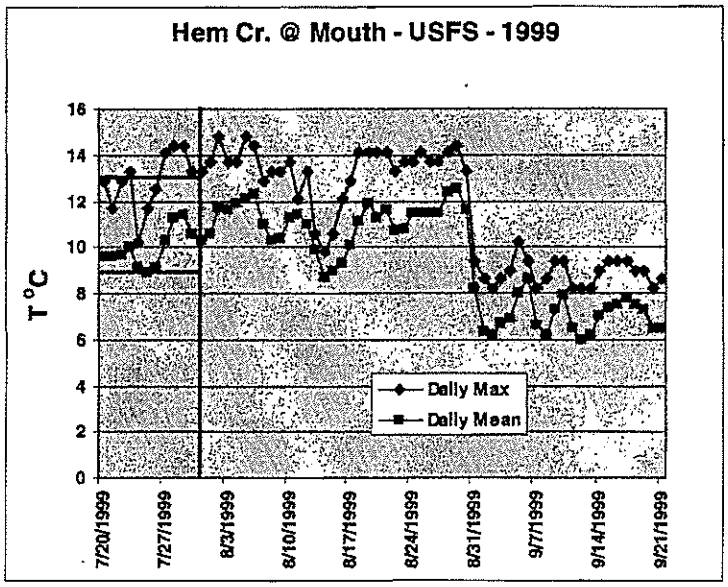
8/26/1998
9/2/1998
9/9/1998


Hem Cr. @ Mouth - USFS - 1999
T °C
Daily Max
Daily Mean
7/20/1999
7/27/1999
8/3/1999
8/10/1999
8/17/1999
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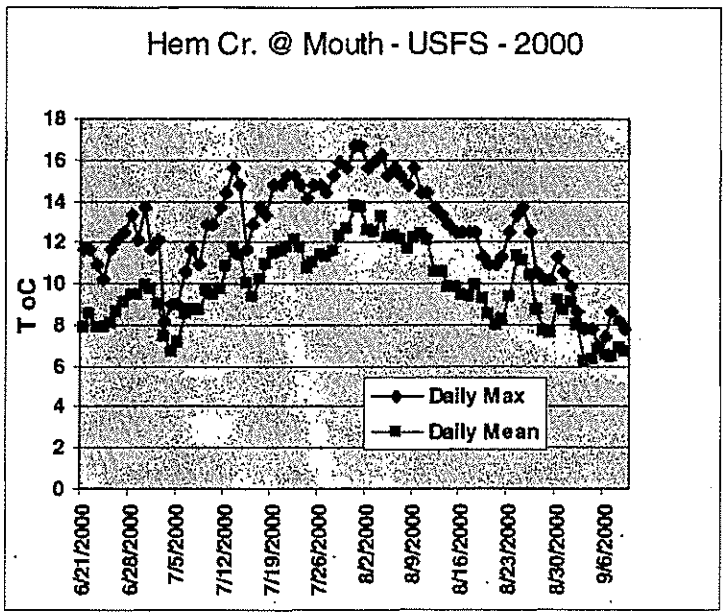
9/7/1999
9/14/1999
9/21/1999


Hem Cr. @ Mouth - USFS - 2000
T oC
Daily Max
Daily Mean
6/21/2000
6/28/2000
7/5/2000
7/12/2000
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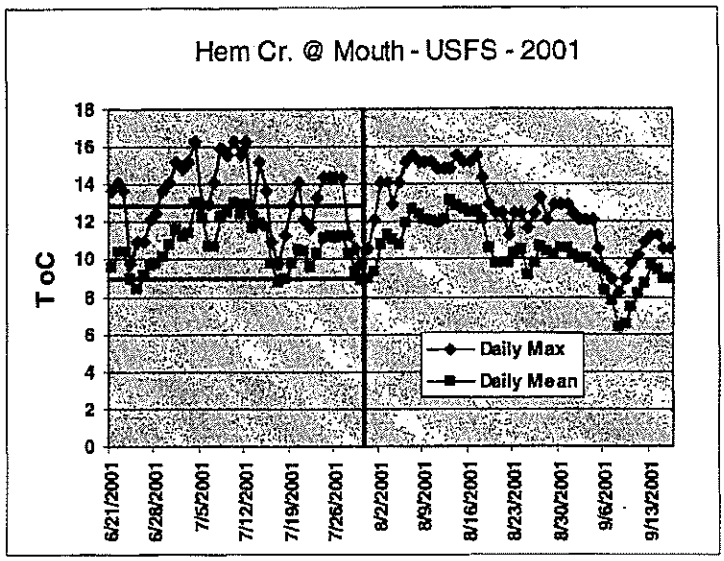
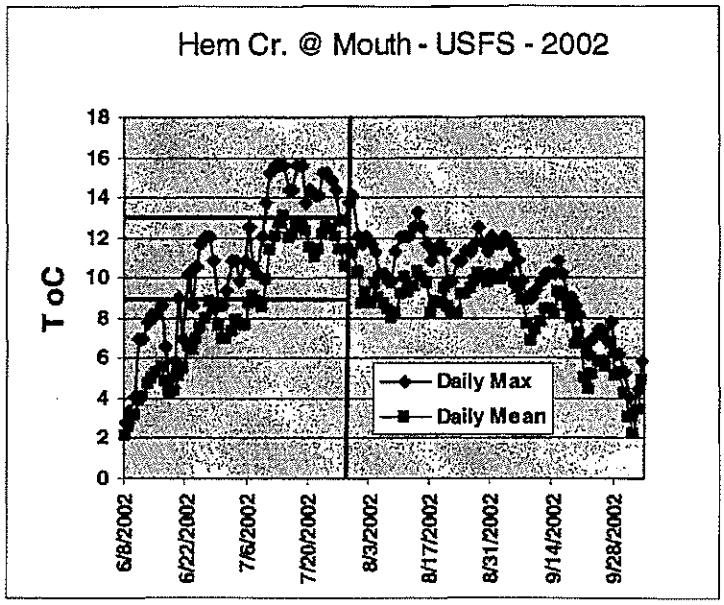
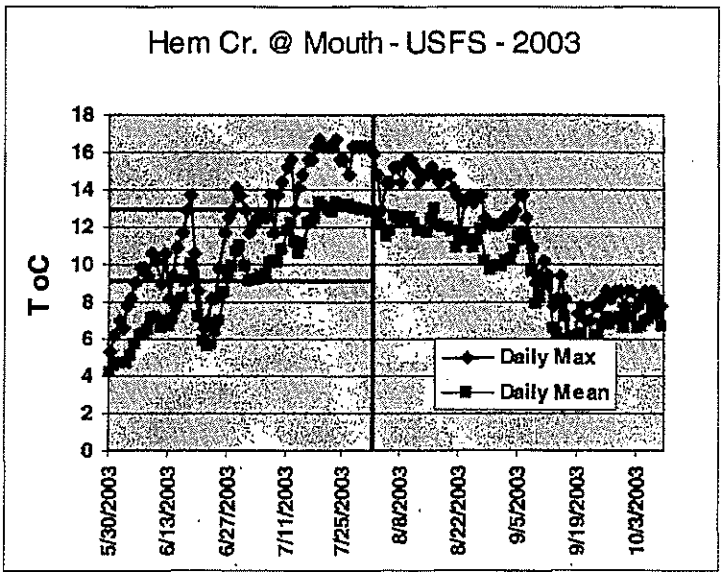
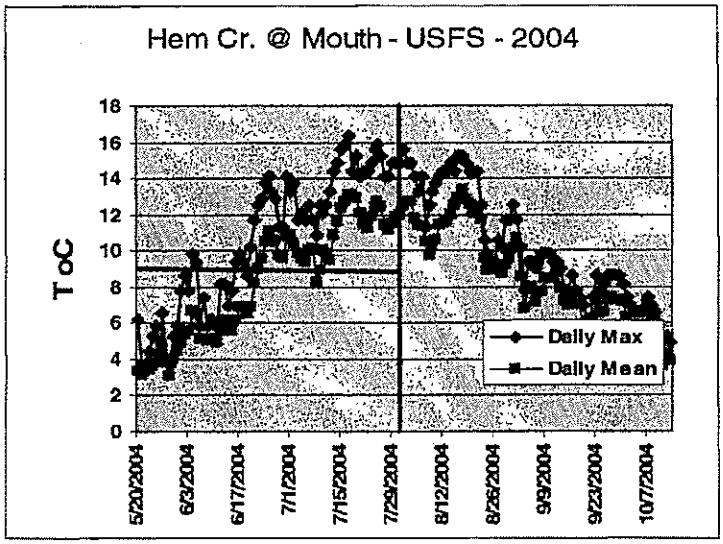
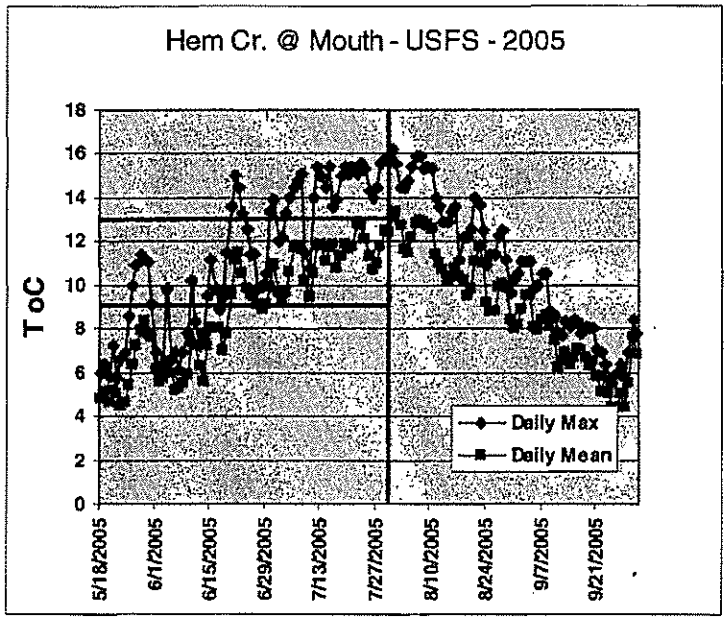
8/30/2000
9/6/2000


Hem Cr. @ Mouth - USFS - 2001
T oC
18
16
14
12
10
8
6
4
2
0
6/21/2001
6/28/2001
7/5/2001
7/12/2001
7/19/2001
7/26/2001
8/2/2001
8/9/2001
8/16/2001
8/23/2001
8/30/2001
9/6/2001
9/13/2001
Daily Max
Daily Mean


Hem Cr. @ Mouth - USFS - 2002
T oC
18
16
14
12
10
8
6
4
2
0
6/8/2002
6/22/2002
7/6/2002
7/20/2002
8/3/2002
8/17/2002
8/31/2002
9/14/2002
9/28/2002
Daily Max
Daily Mean


Hem Cr. @ Mouth - USFS - 2003
T oC
18
16
14
12
10
8
6
4
2
0
5/30/2003
6/13/2003
6/27/2003
7/11/2003
7/25/2003
8/8/2003
8/22/2003
9/5/2003
9/19/2003
10/3/2003
Daily Max
Daily Mean


Hem Cr. @ Mouth - USFS - 2004
T oC
0
2
4
6
8
10
12
14
16
18
5/20/2004
6/3/2004
6/17/2004
7/1/2004
7/15/2004
7/29/2004
8/12/2004
8/26/2004
9/9/2004
9/23/2004
10/7/2004
Daily Max
Daily Mean


Hem Cr. @ Mouth - USFS - 2005
T oC
0
2
4
6
8
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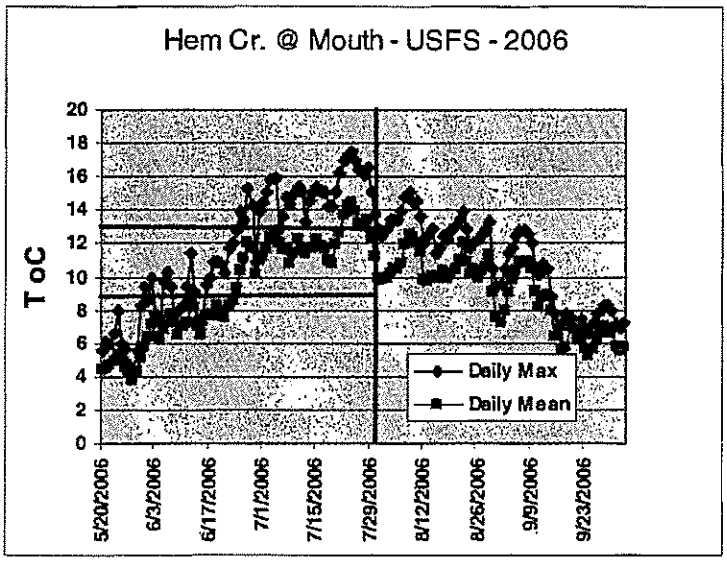
12
14
16
18
5/18/2005
6/1/2005
6/15/2005
6/29/2005
7/13/2005
7/27/2005
8/10/2005
8/24/2005
9/7/2005
9/21/2005
Daily Max
Daily Mean


Hem Cr. @ Mouth - USFS - 2006
T oC
0
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5/20/2006
6/3/2006
6/17/2006
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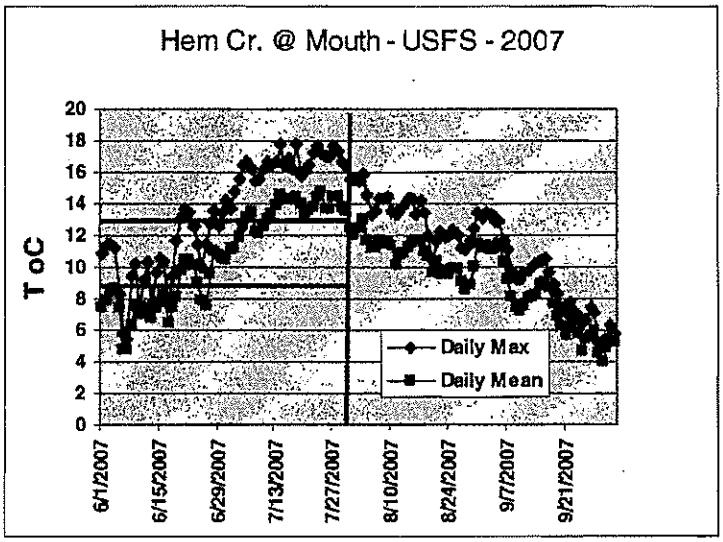
7/29/2006
8/12/2006
8/26/2006
9/9/2006
9/23/2006
Daily Max
Daily Mean


Hem Cr. @ Mouth - USFS - 2007
T oC
20
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16
14
12
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8
6
4
2
0
6/1/2007
6/15/2007
6/29/2007
7/13/2007
7/27/2007
8/10/2007
8/24/2007
9/7/2007
9/21/2007
Daily Max
Daily Mean

Enclosure 7: Description of Current Conditions for Hem Creek

Memorandum

December 12, 2008

To: File

From: Peter Leinenbach, USEPA Region 10

Subject: Description of current conditions for Hem Creek Idaho.

The watershed area for Hem Creek is illustrated in **Figure 1.** In addition, the topographic (i.e., "hill shade") relief for this watershed is illustrated in this image. Several clearcut harvest and thinning harvest areas have occurred in the lower portions of this watershed (**Figure 2**). Road building in support of these harvest activities has also occurred in this lower portion of the watershed.

Table 1 presents a summary statistics for the Hem Creek watershed developed by the Clearwater National Forest (CWNF) staff. This table shows that road development occurred in 1982, and forest harvest soon followed. Locations of these harvest activities are illustrated in **Figures 3, 4, 5,** and **6.** These images show that harvest activities continue in this basin[1]. In addition, these figures show that harvest has occurred within a 300 foot buffer of the stream. Similarly, the CWNF reported that 52.1 acres in this basin have been harvested within the stream buffer (300 foot) (See **Table 1**). In addition, the CWNF indicated that 39%[2] of "Class 1" stream miles in this basin have buffer conditions which are "impacted" by harvest activities.

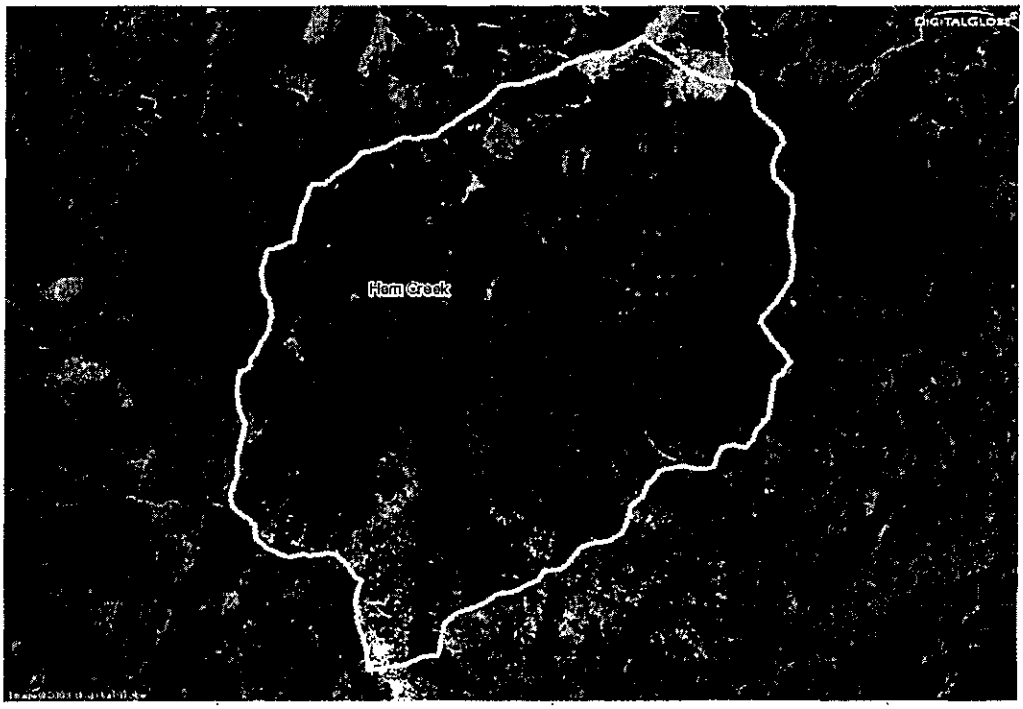
Riparian disturbance in forested conditions can lead to water quality changes, including (but not limited too) sediment delivery changes, sediment transport changes (through changing hydrography), and temperature load changes (through reduction of shade conditions). Previous research has shown that reduce riparian shade conditions often result in increases river/stream temperature conditions. It is important to note that data collected on this river has shown that temperature conditions are above the water quality criteria (described in another document). Accordingly, a quick analysis was developed in order to determine if harvest activities along Hem Creek mainstem could have a "potential" to reduce stream shade conditions (**Table 2**). Results from this analysis indicated that areas along the mainstem Hem Creek may have lower shade conditions as a result of the historic riparian harvest (**Figure 7**).

[1] The CWNF analysis appears to represent approximately 1994 conditions. Harvest has occurred in the basin since this time (see Figure 3 and 4).

[2] Calculated as product of (1) 1.4 miles of "Impacted" stream miles (amount of miles within the impacted buffer zones) (2) divided by 3.63 miles of Class 1 streams in the basin.

Figure 1. Watershed boundary and topographic relief for the Hem Creek Watershed.
[Yellow line represents the watershed boundary and thick blue line is the Hem Creek mainstem.]

Figure 2. 2004 Photograph of the Hem Creek Watershed.



Enclosure 7: Description of Current Conditions for Hem Creek

Table 1. Summary statistics calculated by the CWNF for the Hem Creek watershed.

Hem Creek Watershed - 17060307070203
Harvesting and road impact statistics

- **Watershed Size:** 4723 acres
- **Stream Habitat:** 20.2 miles of streams (GIS layer mileage)
  - **Class 1:** 3.63 miles
  - **Class 2:** 16.58 miles
- **Harvested Acreage:** 347.7 acres (7.3%)
  - **Clearcut:** 200 ac.
  - **Partial Cut:** 147.7 ac. (no more then 24% standing volume harvested)
- **Impacted Buffers (amount of acres of harvest within the buffers)**[1]
  - **Within Clearcuts:** 18.4 acres class 1
    9.1 acres class 2
  - **Within Partial Cuts:** 16.8 acres class 1
    7.8 acres class 2
- **Impacted stream miles (amount of miles within the impacted buffer zones)**
  - **Class 1:** 1.40 miles
  - **Class 2:** 0.53 miles
- **Miles of Roads: 9.67 miles**
  - **Class 1 crossings:** 1 (Hem Creek)
  - **Class 2 crossings:** 2
- **Harvest Years:** 1985-86, 1994
- **Road Construction:** 1982 (1930 for the 547 road)

1 – No harvest occurred directly along the class 1 stream channels. Only within the 300 foot buffer

Figure 3. 2004 Photograph of the Lower Hem Creek Watershed.
[Red line represents a 300 foot buffer from the Hem Creek mainstem.]

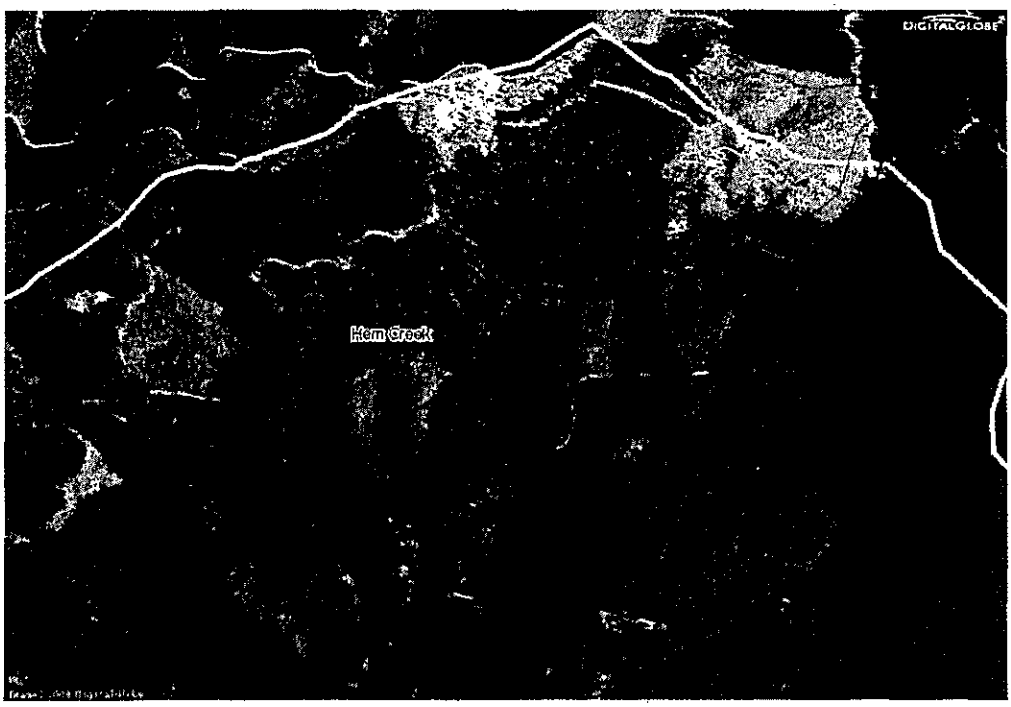


Figure 4. 1998 Photograph of the Lower Hem Creek Watershed.
[Red line represents a 300 foot buffer from the Hem Creek mainstem.]

Figure 5. Harvest areas the Lower Hem Creek Watershed – 2004 Image.
[Purple polygons are thinning harvest areas and yellow polygons are clearcut harvest areas.]

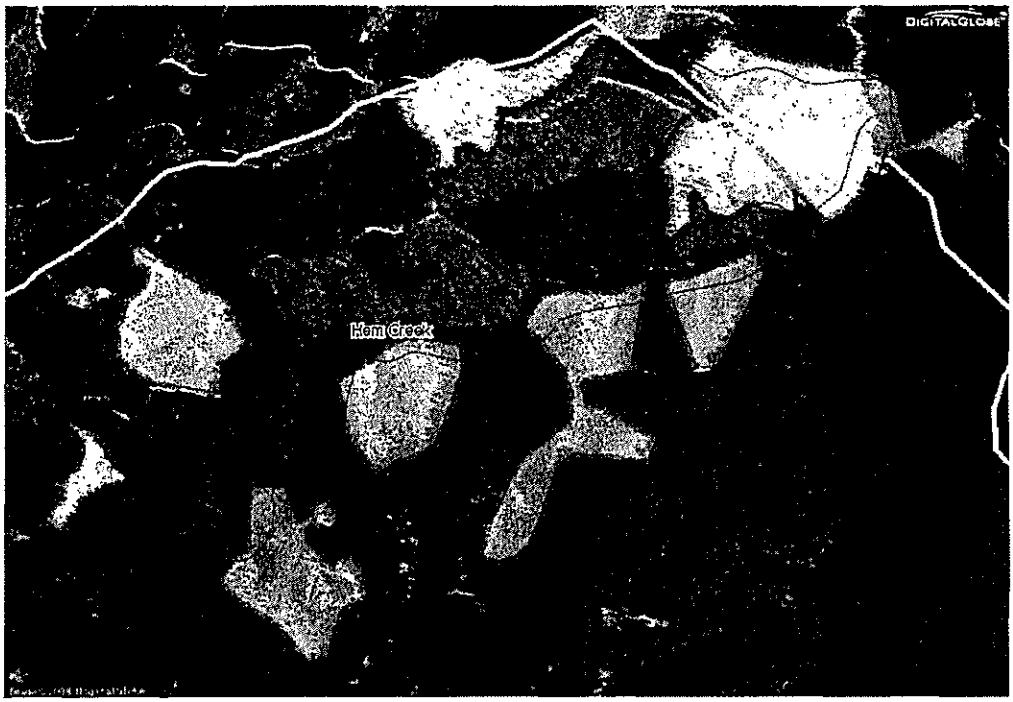


Figure 6. Harvest areas the Lower Hem Creek Watershed – 1998 Image
[Purple polygons are thinning harvest areas and yellow polygons are clearcut harvest areas.]

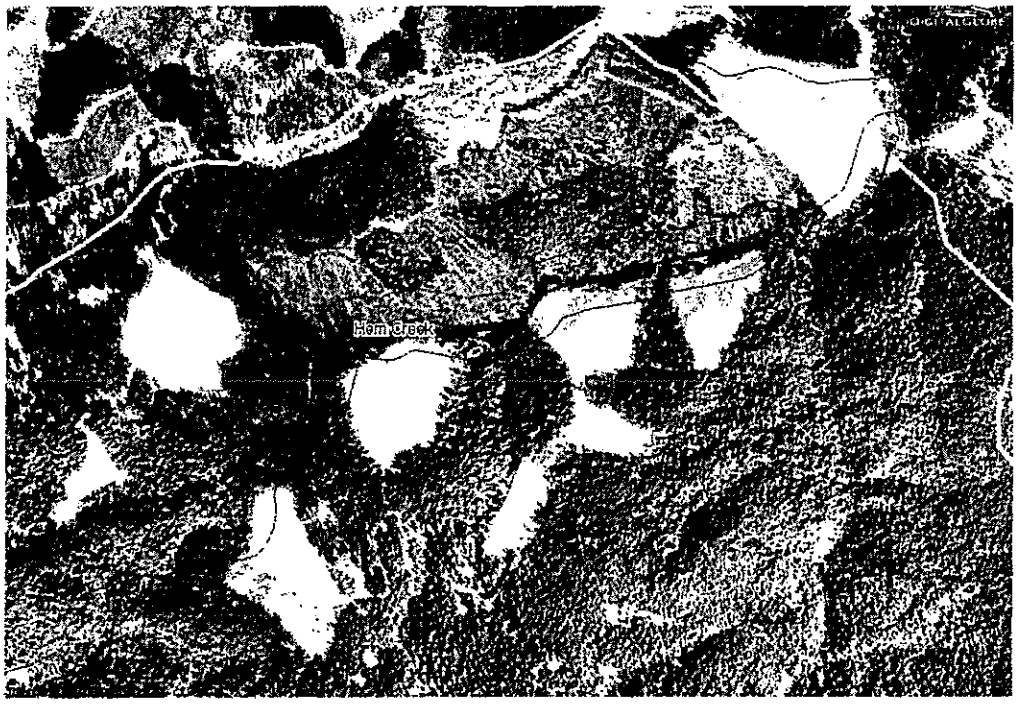


Table 2. Model Description

- Models/Sampling Tools – Obtained "shade" model from Washington Department of Ecology webpage - www.ecy.wa.gov/programs/eap/models.html. Obtained GIS sampling tool from Oregon Department of Environmental Quality webpage - www.deq.state.or.us/wq/TMDLs/tools.htm.

- Input Data – High resolution stream layer (NHD), 10 m Digital Elevation Model, Harvest Area dataset (see Figures 5 and 6).

- Sampling and Analysis Methods – Assumptions (1) forest vegetation was 80 feet tall and 60% canopy cover, (2) thinning forest vegetation condition was 80 feet tall and 40% canopy cover, (3) clearcut areas were 5 feet tall and 80% canopy cover, and (4) stream channel was 30 feet wide. Ran the model for current conditions, and then ran the model for a "potential" vegetation conditions (i.e., change all vegetation to the "forest" condition which is presented above). **Figure 7** illustrates the product of potential model run results minus the current model run results. These results should not be viewed as absolute values, but rather as a relative risk of potential change in shade conditions along the mainstem Hem Creek. In other words, although there is uncertainty, these results indicate that several areas may have reduced shade levels.

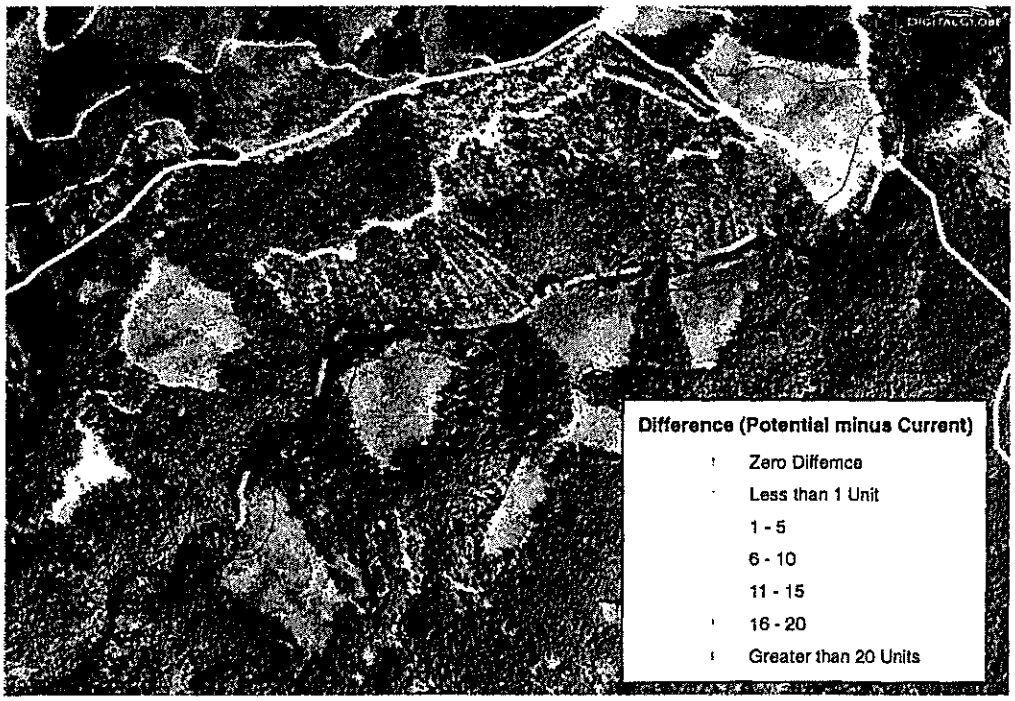



Figure 7. Estimated Shade Reduction along Lower Hem Creek.
[Red line represents a 300 foot buffer from the Hem Creek mainstem.]