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Draft Memo

To:	Memo to File		
From:	Michael Kasch, PE	Project:	n/a
CC:	Haley Falconer, PE, Dave Clark, PE, Tom Dupuis, PE		
Date:	July 16, 2013	Job No:	n/a

RE: Fifteenmile Creek

The Idaho Department of Environmental Quality (DEQ) is writing a phosphorus total maximum daily load (TMDL) for the lower Boise River (LBR) (Lucky Peak Lake to Snake River) (**Figure 1**) to address impairment in the Middleton to Parma reach (**Figure 2**). One of the tributaries to the LBR is Fifteenmile Creek (**Figure 3**). Tributaries within the Fifteenmile Creek watershed include Fivemile, Eightmile, Ninemile, and Tenmile Creeks.

The hydrology and channels of Fifteenmile Creek and its tributaries are highly modified. As stated in DEQ's Fivemile and Tenmile Creek Subbasin Assessment (DEQ, 2001), these creeks are "…highly regulated and irrigation driven systems. An intricate system of inputs and withdrawals in combination with the local flood control policies in the lower Boise River watershed have significantly altered the flow regime and the physical and biological characteristics of Fivemile and Tenmile Creek. At present day, Fivemile Creek is intermittent from its headwaters to the Evans Drain and perennial from Evans Drain to its confluence with Tenmile Creek. Both streams remain perennial in the lower portions due to elevated groundwater levels."

Question Investigated:

- What are the flow conditions in Fifteenmile Creek at the mouth to the Boise River, potentially useful for boundary condition inputs to the AQUATOX model?

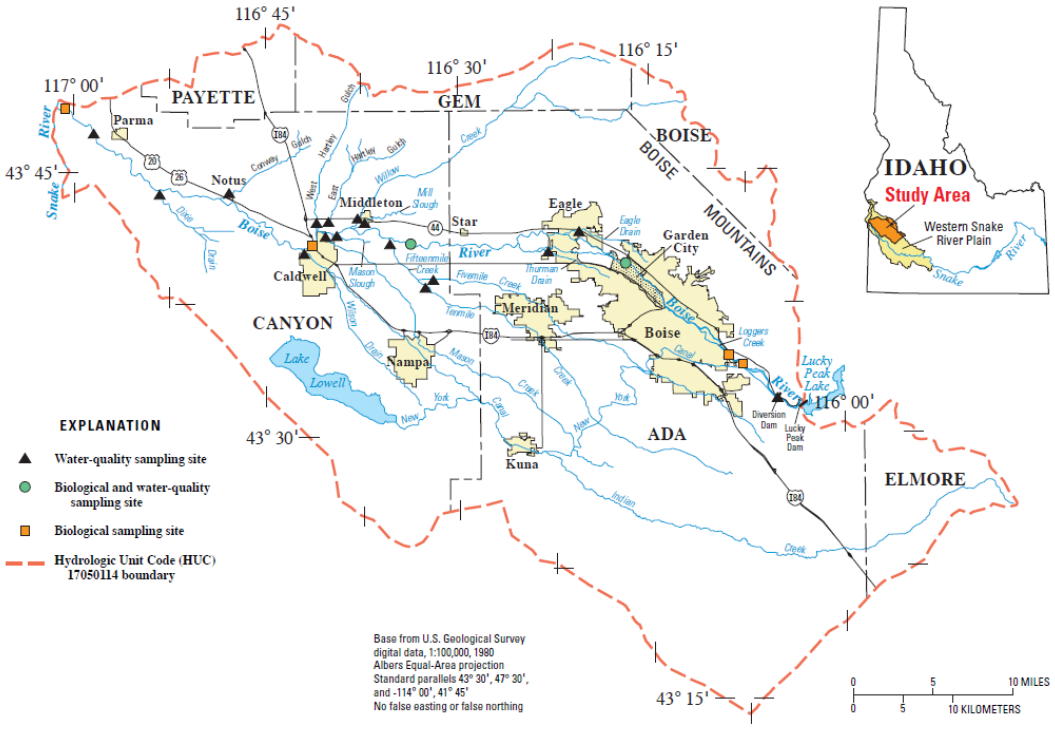


Figure 1. Lower Boise River Watershed
(source: DEQ's Lower Boise Watershed Phosphorus TMDL Addendum Strategy Paper)

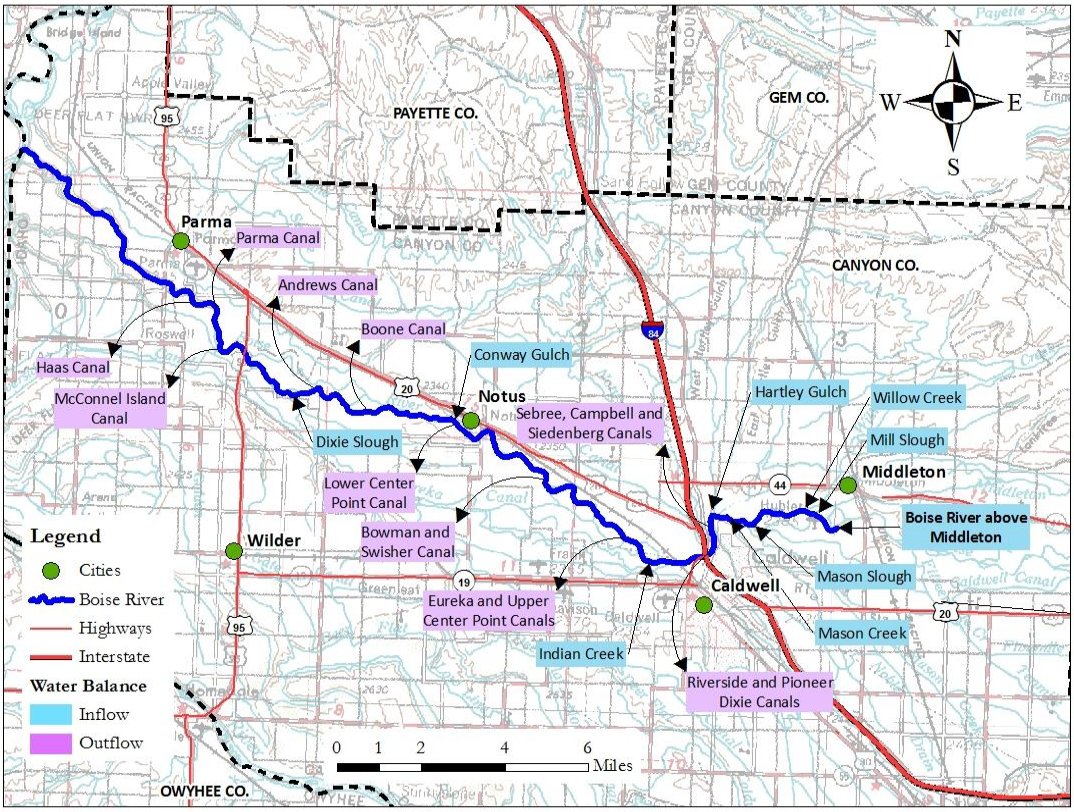


Figure 2. Map of Impaired segment of the Boise River for which a TMDL will be developed
(source: DEQ's Lower Boise Watershed Phosphorus TMDL Addendum Strategy Paper)

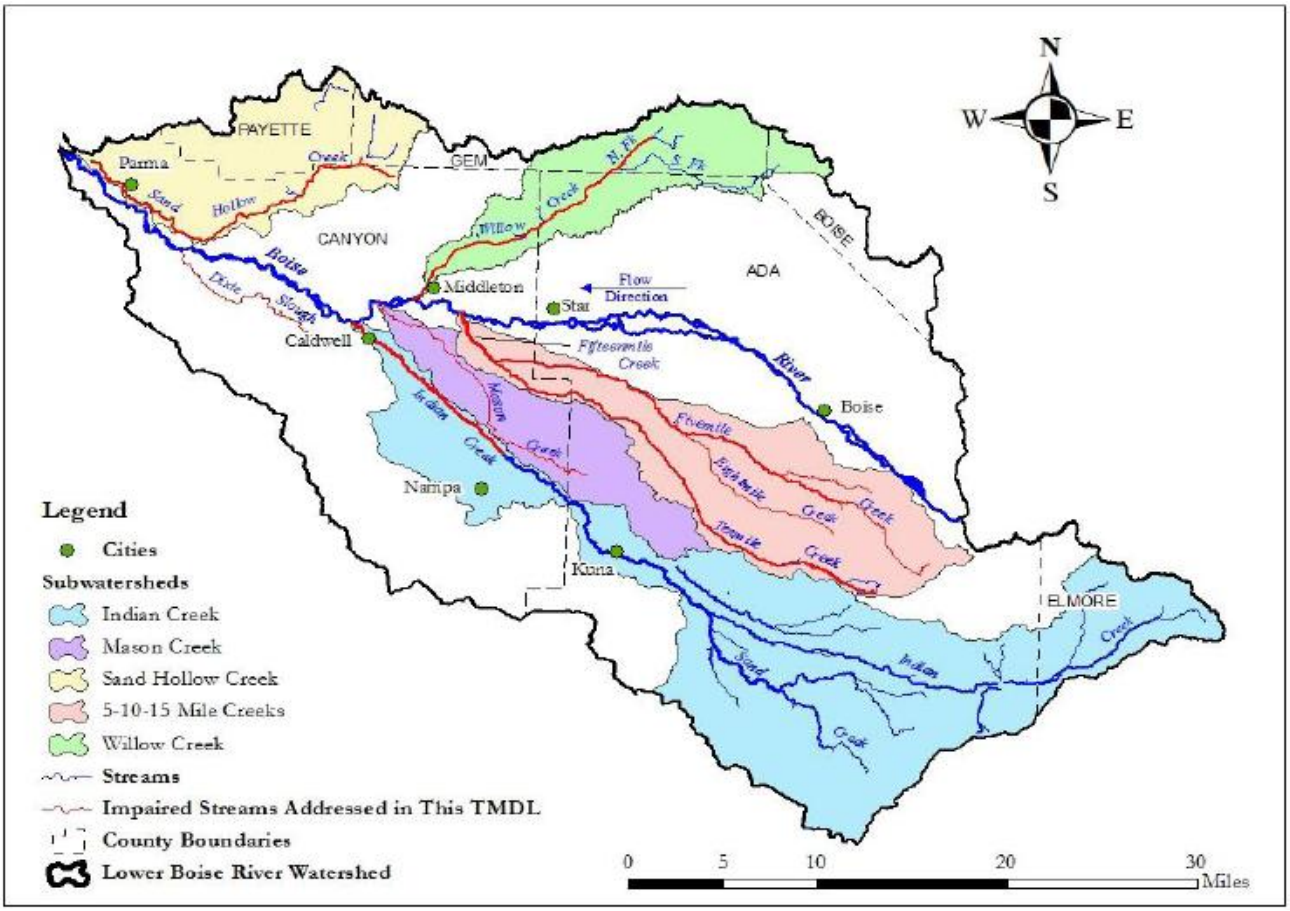


Figure 3. Fifteenmile Creek Watershed
(source: DEQ's Lower BoiseRiver Tributaries TMDL Addendum)

Flow in Fifteenmile Creek at the Mouth

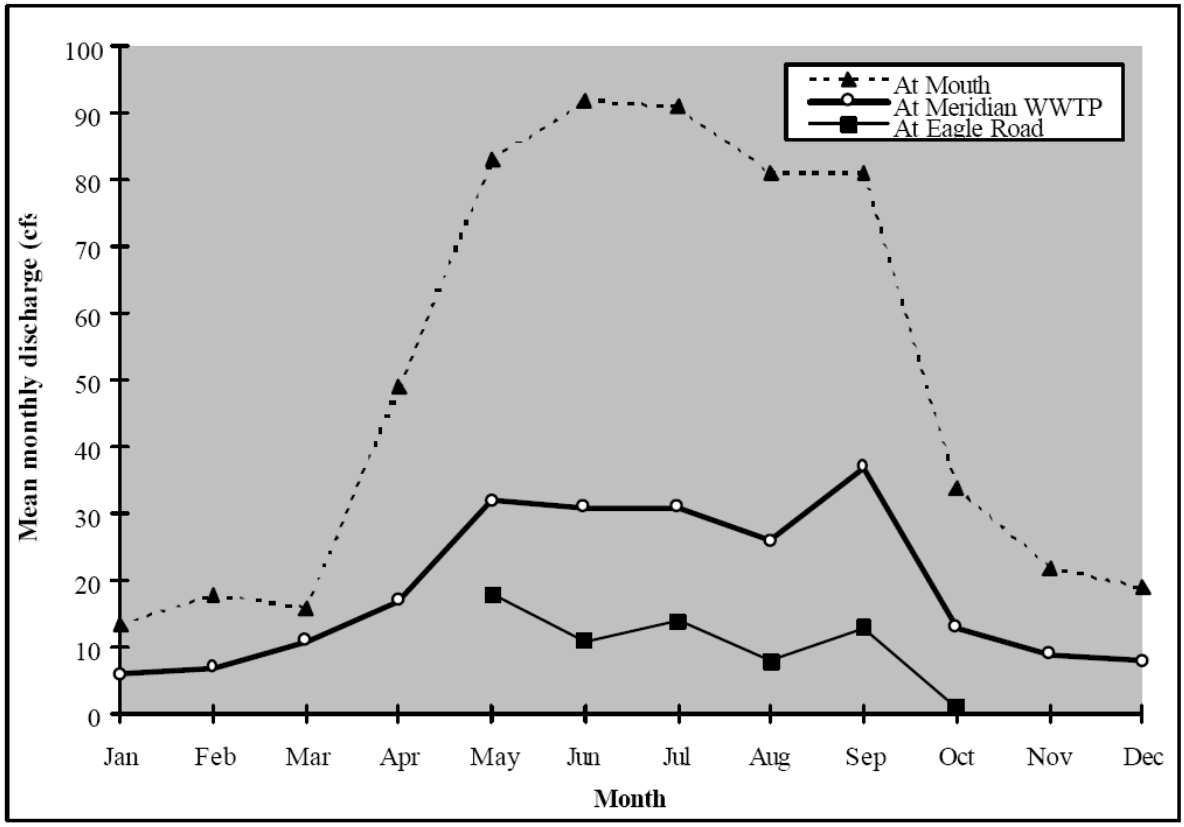
Due to the small size of the watershed and low volume of the creeks, there is not a continuous gaging record of flows. In lieu of daily data, DEQ has concluded the next best dataset is monthly averages. "In each case, ISDA collected discharge data bimonthly between 1998 and 2000. This is still the best dataset for each of the tributaries" (DEQ, 2013). These data are for Fivemile and Tenmile Creeks (**Figure 4**). Observations from the flow data include how it is interesting that the flows further up in each sub-watershed decrease precipitously during the irrigation season, but that decrease is not reflected at either of the mouth locations. This might suggest more diversion in the upper reaches and more irrigation return flow or groundwater discharge to surface water to the lower reaches that is in excess of diversions in the lower reaches.

Without a substantial record of measured data, the flow for Fifteenmile Creek at the mouth was estimated (**Figure 5** and **Table 1**). Methods used to estimate the flow included:

- Sum of the mean monthly flows at the mouth for Fivemile and Tenmile Creeks (**Figure 4**); however this would not account for reach gains or the system modifications. This method is likely an under estimate of the actual flow because it does not include flows between the mouth of Fivemile and Tenmile Creeks and the mouth of Fifteenmile Creek and although the watershed area is relatively smaller there is return irrigation flow and groundwater discharge to surface water.
- Average of available discrete measurements collected by the USGS as part of water quality sampling for the site USGS 13210815 Fifteenmile Creek at Mouth near Middleton, ID. Again this is likely an under estimate of the actual flow as it is based on approximately 50 point measurements from the years 1972 through 2013. Statistically few moderate and high flow events were likely captured within the 50 point measurements divided between 12-months so the data may be skewed low.

- Flow in Fifteenmile Creek as measured by the USGS in 1996 and shown in the Lower BoiseRiver Tributaries TMDL Addendum. Again this is likely an under estimate of the actual flow as it is based one year of data, which is statistically unlikely to be representative of typical flow conditions.
- An estimate based on the estimated reach gains in Fivemile and Tenmile Creeks, and the other three estimates of flows. This was done by calculating the gain or loss between the sum of the upstream flows compared to the measured flows for Fivemile and Tenmile Creek and then applying the percentage to data at Fifteenmile. However, the process only fits the pattern for about six months, for the remaining months the values were manually adjusted.

These estimates generally exhibit similar trends and magnitudes of flow. As stated in DEQ's Fivemile and Tenmile Creek Subbasin Assessment (DEQ, 2001), "The regulated annual hydrograph for the perennial portions of Fivemile and Tenmile Creek can be divided into two flow regimes. Low flow conditions generally beginning in mid-October after the irrigation season ends. The low flow period extends through the winter until the irrigation season begins again April. Due to the highly regulated nature of both systems, these flow regimes are relatively static from year to year." The estimates described above show results that are generally similar matching the statement that flow regimes are relatively static from year to year. The pattern of the estimates generally matches the observations stated by DEQ with distinct irrigation and non-irrigation seasons, with an additional observation that flows are reduced in the middle of the irrigation season which also is the period of greatest consumptive demand.



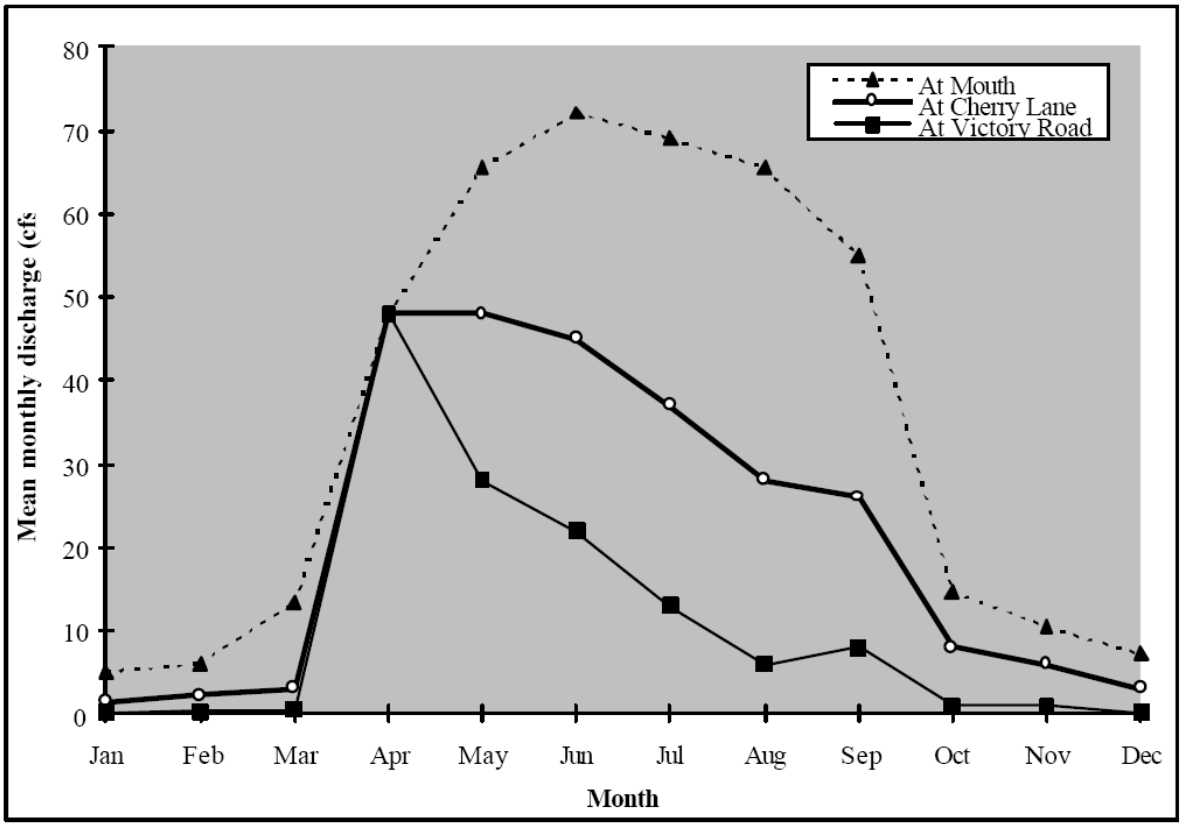


Figure 4. Mean Monthly Flow in Fivemile (upper) and Tenmile (lower) Creeks (1998-2000)
(sources: DEQ's Fivemile and Tenmile Creek Subbasin Assessment and Lower BoiseRiver Tributaries TMDL Addendum)

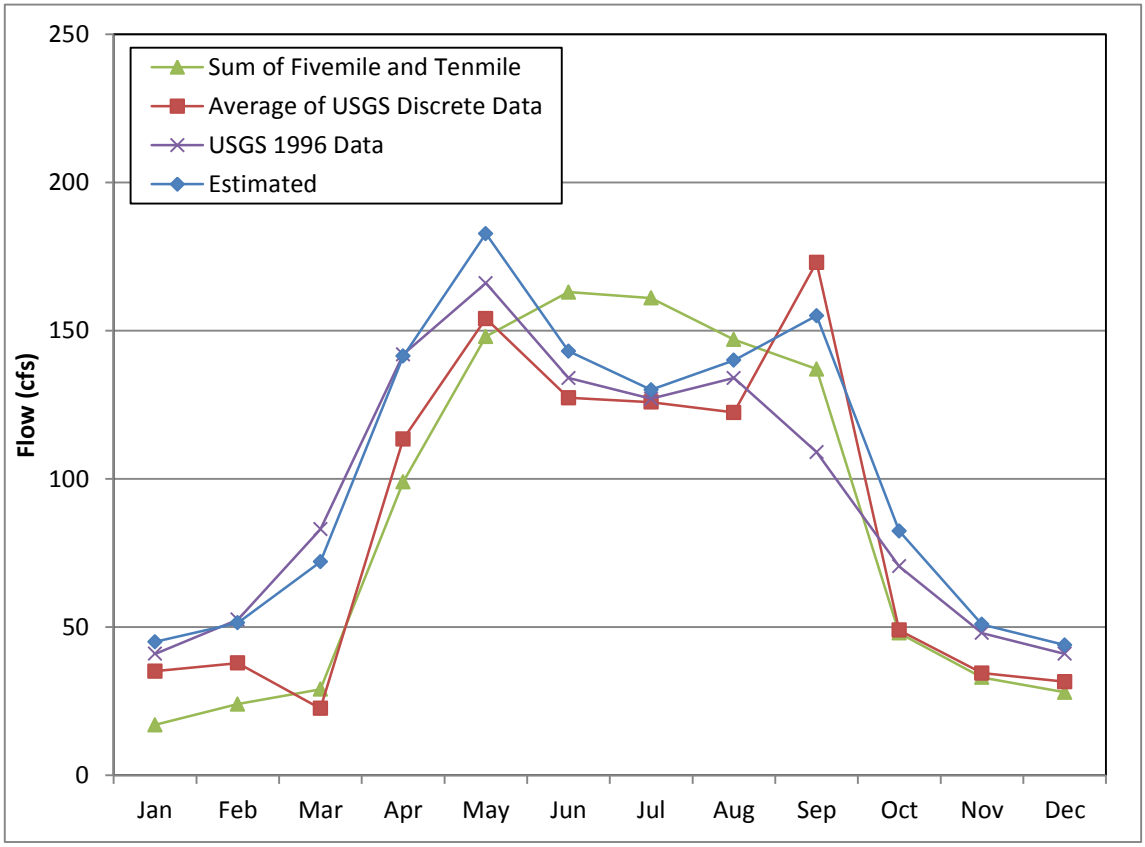


Figure 5. Estimates of Mean Monthly Flow Regime in Fifteenmile Creek at the Mouth

Observations from the flow data include the fact the sum of Fivemile and Tenmile Creeks does not show the irrigation season decrease (or saddle pattern) and bounding monthly peaks shown by the other data. This might suggest some additional flow phenomena in Fifteenmile Creek or and artifact of the differences inherent within the periods of record. For perspective the Idaho Department of Water Resources (13210810) flows are shown in **Figure 6**. For reference, flows in the LBR watershed in recent years have been characterized as (CH2MHill, et.al., 2008):

- Low water years include 2001, 2002, 2003, 2004, 2005, 2007
- Medium water years include 1995 and 2000
- High water years include 1996, 1997, 1998, 1999, and 2006

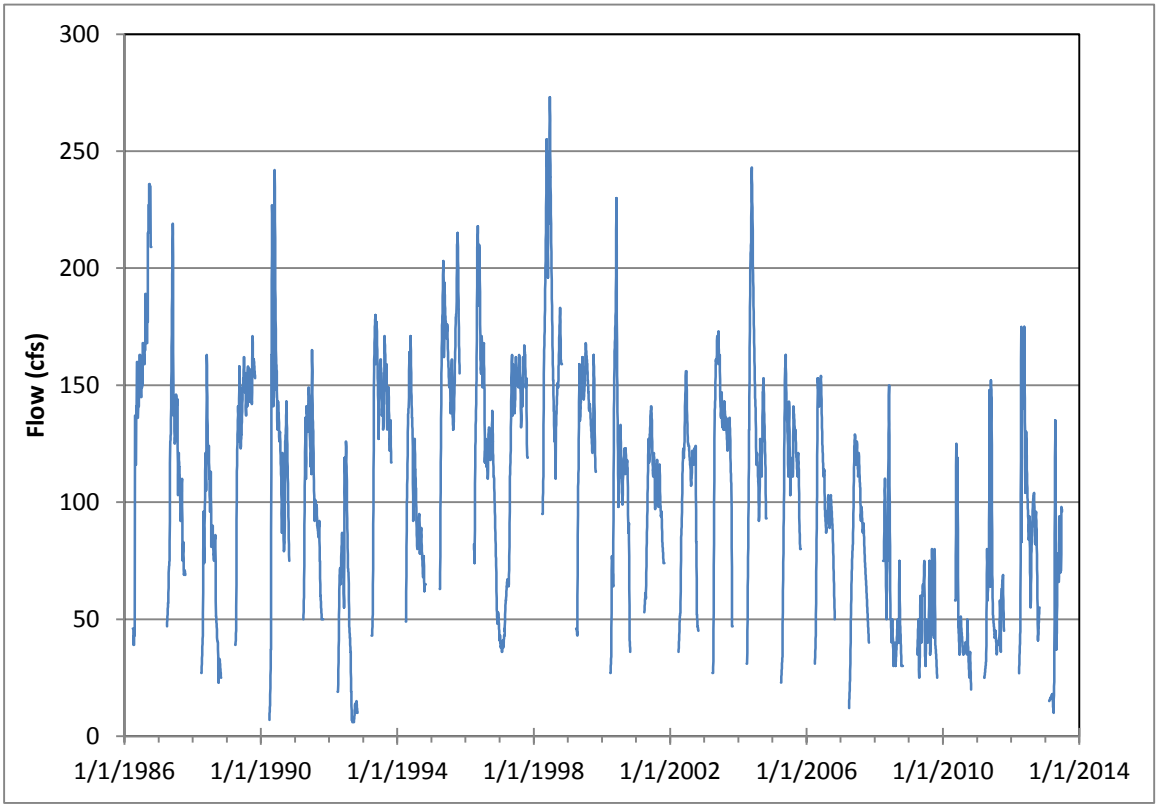


Figure 6. Daily Flows from Idaho Department of Water Resources

Table 1. Estimates of Mean Monthly Flows in Fifteenmile Creek at the Mouth

Month	Fivemile at Mouth Mean Monthly Flows[1] (cfs)	Tenmile at Mouth Mean Monthly Flows[2] (cfs)	Sum of Fivemile and Tenmile Mean Monthly Flows (cfs)	Average of USGS Discrete Data by Month[3] (cfs)	USGS 1996 Data[4] (cfs)	Estimated (Reach Gains and Other Estimates) (cfs)
January	12	5	17	35	41	45
February	18	6	24	38	53	51
March	16	13	29	23	83	72
April	50	49	99	113	142	141
May	82	66	148	154	166	183
June	91	72	163	127	134	143
July	91	70	161	126	127	130
August	81	66	147	122	134	140
September	81	56	137	173	109	155
October	33	15	48	49	71	82
November	22	11	33	34	48	51
December	20	8	28	32	41	44

[1]Figure 4 DEQ's Fivemile and Tenmile Creek Subbasin Assessment
[2]Figure 4 DEQ's Fivemile and Tenmile Creek Subbasin Assessment
[3]USGS 13210815 Fifteenmile Creek at Mouth near Middleton, ID
[4]Lower BoiseRiver Tributaries TMDL Addendum

Recommendation

Use the Estimated monthly flows for Fifteenmile Creek flows in the AQUATOX model.

References

CH2MHill, Eco Modeling, Warren Pinnacle Consulting, and Boise City Public Works, 2008. Application of the AQUATOX Model to the Lower Boise River. Final Report. December 31, 2008.

DEQ, 2001. Fivemile and Tenmile Creek Subbasin Assessment, Idaho Department of Environmental Quality, December 2001.

DEQ, 2013. Lower Boise River Tributaries, 2013 Addendum, Hydrologic Unit Code 17050114, DRAFT Friday June 14, 2013.