

Memo

To: Jaime Short, Shoreline Planner, SEA ERO Jaime Short, Shoreline Planner, SEA, ERO
From: Patricia L Olson, Senior Hydrogeologist, SEA, HQ
CC: Sara Hunt, ERO SEA Section Manager
Brian Lynn, Coastal Zone and Shorelines Unit Manager, SEA, HQ
Date: July 1, 2014
Re: SMP Jurisdiction determination request for Whetstone Hollow, Walla Walla County

SMP JURISDICTION EVALUATION: WHETSTONE HOLLOW, WALLA WALLA COUNTY

Jaime Short requested assistance in determining if Whetstone Hollow is in SMP jurisdiction. The most recent USGS study that estimates the upper SMP jurisdiction points (Higgins 2003) identifies the Whetstone Hollow's SMP jurisdiction point approximately 3.1 miles from the confluence with the Touchet River (Figure 1).

There is very little data available to determine the mean annual flow for Whetstone Hollow. The USGS has some miscellaneous discharge at water quality sampling gages. Some streams also have peak annual flow measurements which are not representative of mean annual flow. The nearby USGS gage on the Touchet (USGS 14017000 Touchet River at Bolles, WA) has continuous discharge data from 1925-29; 1952-1989. WA Department of Ecology reestablished the gage and has continuous data from 2007-present. The Tucannon gage at Starbucks (USGS 13344500 Tucannon River near Starbuck, WA) has continuous discharge data from 1915-17; 1929-31; 1959-present. The discharge data from these 2 gages provides some information for identifying miscellaneous discharge measurements that are within a range of mean annual flow and control for comparing regression results (Table 1). The continuous discharge data from these two gages can't be used to extrapolate runoff to Whetstone Hollow because:

- Whetstone Hollow headwaters are partially within the Blue Mountains but are not as influenced by storm runoff and snow melt from the Blue Mountains as the Tucannon and Touchet Rivers. Likely they have different discharge regimes.
- Whetstone Hollow watershed (97 mi² at the suggested SMP point, 102 mi² at confluence) is much smaller than the Touchet River (316 mi² at the gage) and Tucannon River (431 mi² at the gage)

Because there is little discharge data I am mostly relying on three USGS regression equations developed to estimate mean annual flow (MAF) to evaluate MAF for Whetstone Hollow (Table 1).

- Determination of upstream boundary points on southeastern Washington streams and rivers under the Requirements of the Shoreline Management Act of 1971 (Higgins 2003)
- NHDPlus v2, Enhanced Unit Runoff Method (EROM) http://www.horizon-systems.com/nhdplus/NHDPlusV2_documentation.php
- NHDPlus v2, Vogel http://www.horizon-systems.com/nhdplus/NHDPlusV2_documentation.php

I also evaluated precipitation records using the US Historic Climate Network stations at Pomeroy (WA456610_5283) and Dayton (WA452030_4177) and discharge on the Tucannon and Touchet Rivers to see if there were any trends (Figure 1 and 2). There appears to be a very slightly decreasing trend in mean annual precipitation at Pomeroy and Dayton climate stations but it is not significant (Figure 2). At the Tucannon gage there is also a very slightly decreasing trend but at Touchet there is a slightly increasing trend in discharge. Again these are not significant at all.

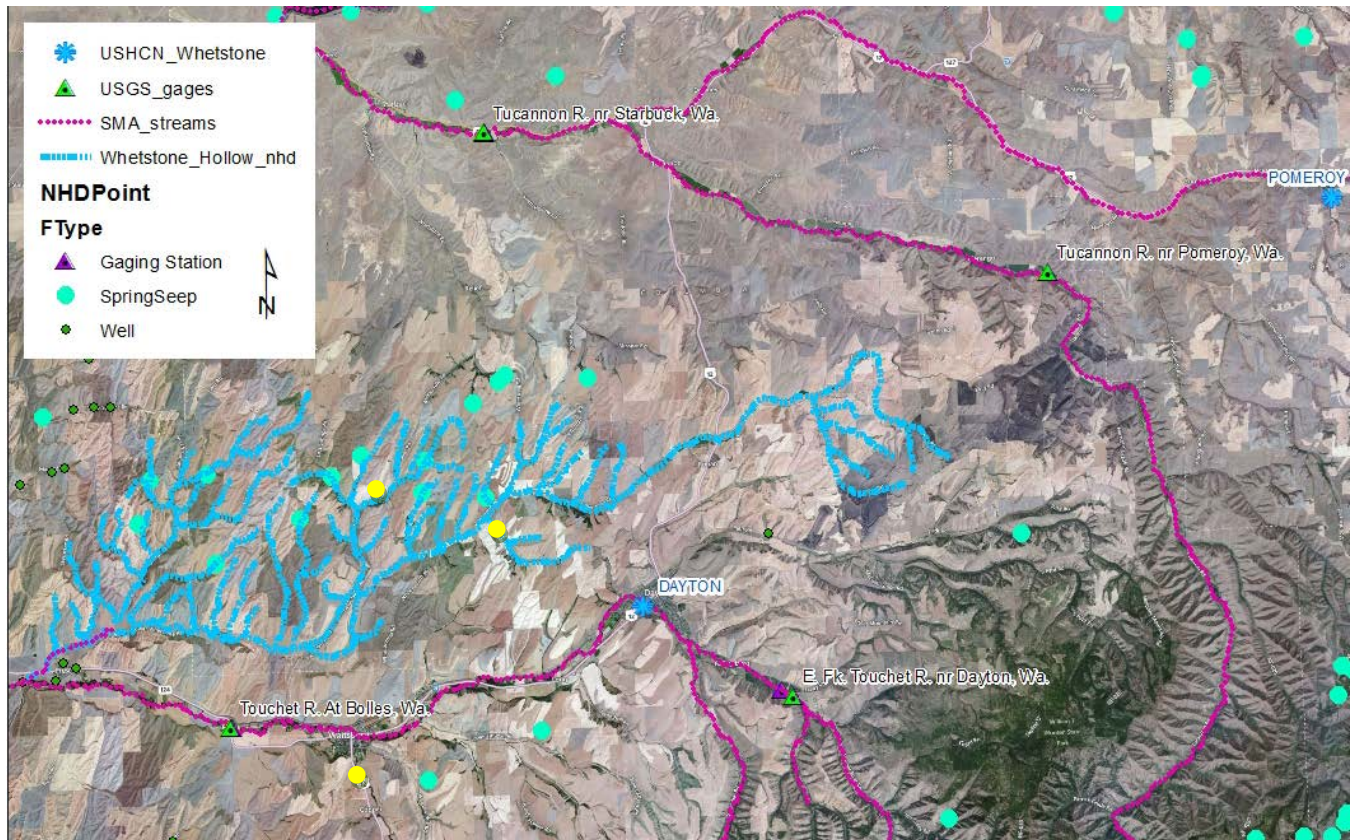


Figure 1: The map shows the USGS gages and NOAA US Historical Climate Network (USHCN) precipitation gages used in the analysis. SMA_streams are the layer that has suggested jurisdiction points. The blue stream lines are Whetstone Hollow and tributaries extracted from the NHD (National Hydrography Dataset) Plus flow lines. The green circles show seep/spring locations from the NHD Point data. The yellow circles are USGS water quality stations with miscellaneous discharge measurements. These gages (USGS 14017070 EAST FORK MCKAY CREEK NEAR HUNTSVILLE, WA, USGS 14017040 THORN HOLLOW NEAR DAYTON, WA both tributary to Whetstone, and USGS 14016950 COPPEI CREEK NEAR WAITSBURG, WA) were used to estimate runoff in cubic feet per square mile.

There were three USGS gages with miscellaneous discharge measurements which included wet and dry periods. Two, USGS 14017070 EAST FORK MCKAY CREEK NEAR HUNTSVILLE, WA and USGS 14017040 THORN HOLLOW NEAR DAYTON, WA were located on tributaries to Whetstone Hollow (Figure 1, yellow circles). One, USGS 14016950 COPPEI CREEK NEAR WAITSBURG, WA, was located south of Waitsburg (Figure 1). The miscellaneous discharge measurements were collected from 1966-2001. These discharge measurements were converted into cubic foot per square mile (cfsm) which provides areal runoff per square mile. This data can then be used to estimate discharge at the SMP point and confluence (Table 1).

The regression equations in Higgins (2003) were developed using precipitation data from 1930 to 1957. Using the equations with different mean annual precipitation than used to develop them is not recommended. Nevertheless, I used two other precipitation scenarios to estimate the discharge at the suggested SMP and confluence based on Higgins (2003) for comparison. The scenarios are:

- Mean annual precipitation (20 inches) used in the Higgins (2003).
- Mean annual precipitation (16.4 inches) based on more up to date PRISM precipitation grids (years 1970-2000) obtained from the NHD Plus (Version 2.1) flow lines.
- Mean annual precipitation (18.6 inches) at Touchet River near Bolles from the PRISM precipitation grids.

Table 1 Three USGS developed regression estimates for MAF were used to calculate MAF at the suggested SMP jurisdiction point on Whetstone Hollow and at the confluence of Whetstone Hollow with the Touchet River. Higgins (2003) equation was also used to estimate MAF (cfs) at USGS gages 14017000 TOUCHET RIVER AT BOLLES, WA and 13344500 TUCANNON RIVER NEAR STARBUCK, WA. Estimated discharge at the Touchet gage using Higgins is low but the estimates using NHD Plus (EROM and Vogel) are too high. Higgins (2003) discharge estimate at Tucannon gage is close as is the EROM estimate. Vogel equation estimate is too high again. The acronym MAP is mean annual precipitation and N/A means not applicable

Discharge estimate methods	MAP (inches)	Touchet (361 mi ²)	Tucannon (431 mi ²)	Whetstone at SMP point (97mi ²)	Whetstone at confluence (102 mi ²)
Mean annual discharge at gages (cfs)		231.6	171.5		
Higgins 2003					
Region 5 equation	20	N/A	N/A	20.4	21.6
Region 5 equation	16.4	N/A	N/A	13	13.6
Region 5 equation	18.6	N/A	N/A	18	19
Region 5 equation MAP-Higgins (2003)	25.7	197	N/A		
Region 5 MAP-Higgins (2003)	23.14	N/A	181		
EROM		417	182	18.4	21
Vogel		312	237	26	32
Estimate based on average areal runoff (as cfsm)	0.15	N/A	N/A	14.5	15.3
Average: Higgins at 20 MAP, areal estimates, and EROM				17.7	19.3

Higgins (2003) equation for Region 5, Blue Mountains, was also used to estimate MAF at the gage locations on the Touchet and Tucannon Rivers. The mean annual precipitation (MAP) specified in Higgins (2003) was used for comparison. The discharge estimates obtained from the EROM and Vogel regression equations in the NHD Plus data are also included. All locations are in Region 5, Blue Mountains. Higgins (2003) MAF estimates for Touchet are lower than measured discharge and slightly higher compared to Tucannon measured discharge (Table 1). EROM MAF estimates for Touchet are much higher but similar to Higgins (2003) for Tucannon. Since Vogel is too high for both stations, the Vogel MAF estimates for Whetstone Hollow are not used.

There are errors in each method. However the range between estimates is not extraordinarily different (Table 1). The original Higgins MAF estimate is averaged with areal runoff and EROM estimates. The average suggests that Whetstone Hollow is not a SMP stream. But there is at least 55% error associated with averaging the estimated discharges. In other words it can be in or out. A decision for you and the county.

Dayton WA452030_3357: Annual departure from mean annual precipitation

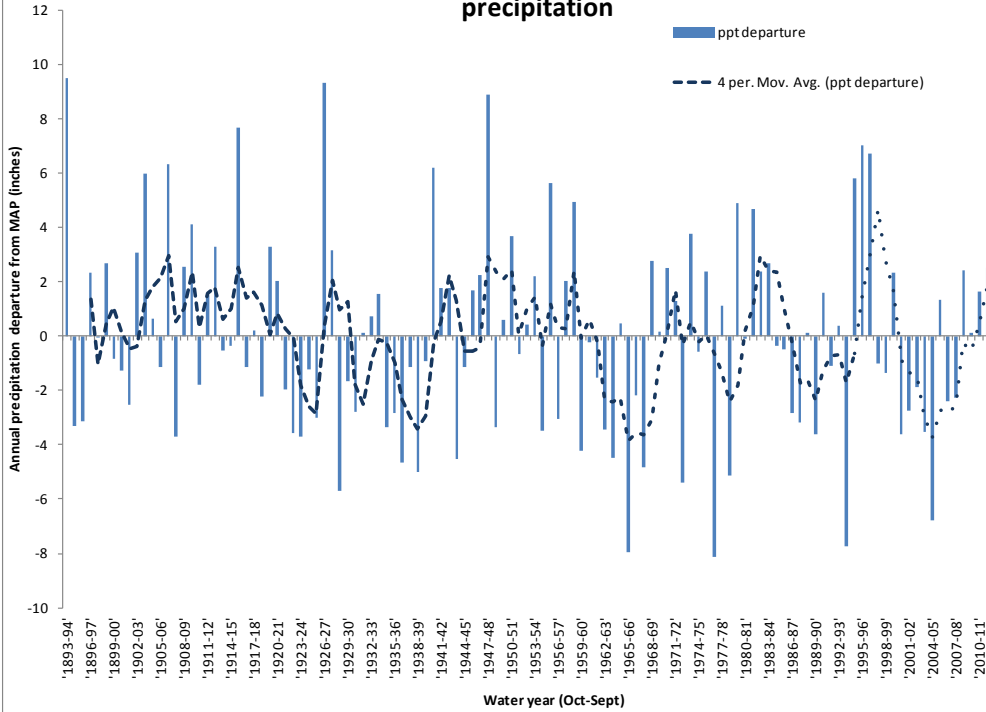


Figure 2: There are no significant trends (increase or decrease) in mean annual precipitation data or mean annual discharge. Dayton USHCN station and Touchet River at Bolles are used for examples.

Mean annual discharge (cfs)

