Changes In Stream Discharge Following Fire Disturbance:
A Case Study of The Methow Sub Basin

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To better understand how fire can affect the hydrology of an area, our team performed a site suitability analysis to find a location with a relatively recent and substantial fire, a USGS stream gauge monitoring station downstream of that fire, and a NOAA climate monitoring station near by. In the scope of the Pacific Northwest, the only location that met our criteria was the Carlton Complex fire that burned about approximately 14% of the Methow sub basin (right) in Northern Central Washington in 2014.

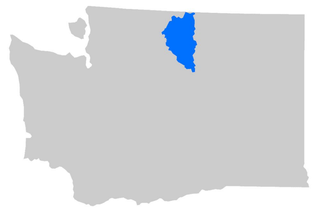


Figure 1 (Below): Screenshot of drone footage showing the aftermath of the Carlton Complex fire in 2014 (Mischke, 2014).

In order to understand how fire affected the hydrology, we first examined precipitation data from the NOAA climate monitoring site. We searched for similar and isolated rain events that took place before and after the fire. In both the spring of 2013 and 2015, a 0.70" precipitation event was located (24 hour total). There was no rain for a week prior to these precipitation events with the exception of 0.15" 2 days prior to the 2013 date.

Using the USGS stream monitoring station data, we then created 7-day hydrographs centered around our precipitation events. Trend lines were calculated with similar R2 values, and the equations were used to graph discharge rates as if they had started with the same flow rate (see figure 3). The difference between the graphed lines was integrated to determine that an additional 335,510 cubic feet, or approximately 20% more water passed through the stream post fire disturbance for a 0.70" precipitation event.

$$\int_0^{672} -0.0068x^2 + 6.1984x + 2143.6 - \int_0^{672} -0.007x^2 + 4.8021x + 2143.6 = 335,510$$

This increase in discharge corresponds with similar research on the subject dealing with decreases in infiltration rates of 10% to 40% in post fire disturbance areas (Robichaud, 2000).

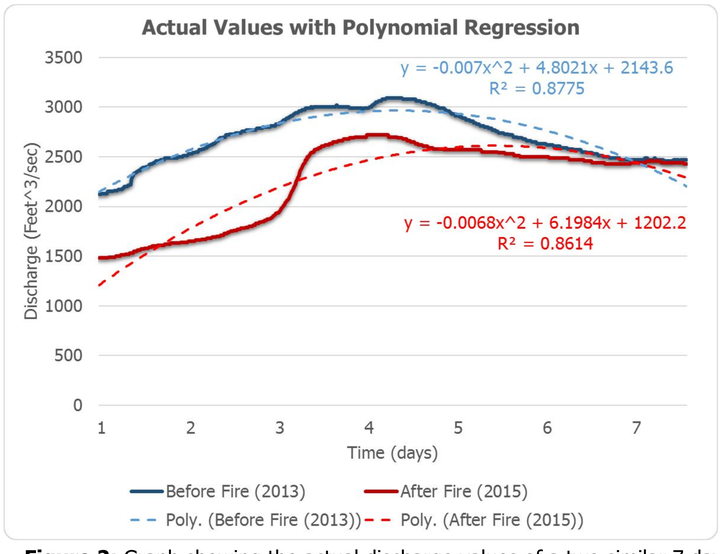


Figure 2: Graph showing the actual discharge values of a two similar 7 day weather periods, one in the spring of 2013, and one in the spring of 2015. Also depicted are the trend lines, their equations and the R2 values for the discharge rates. Each period had single precipitation even with 0.7" of rain on the 3rd day, with little to no precipitation for 3 days prior or 3 days afterwards.

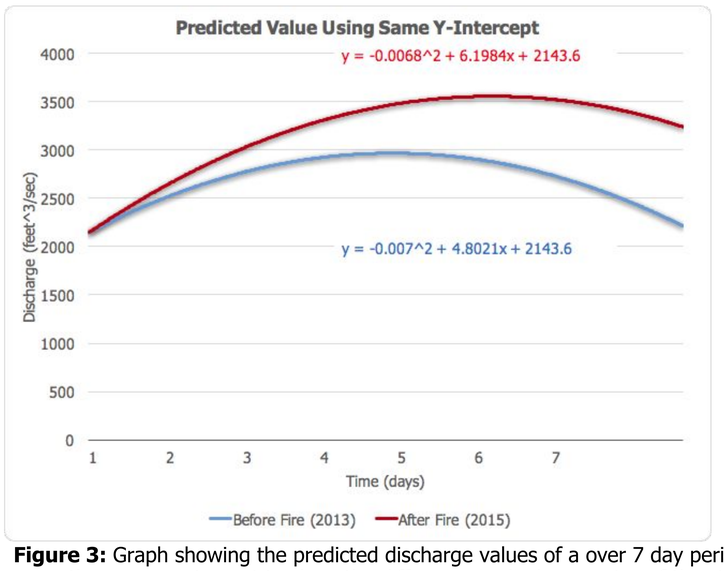
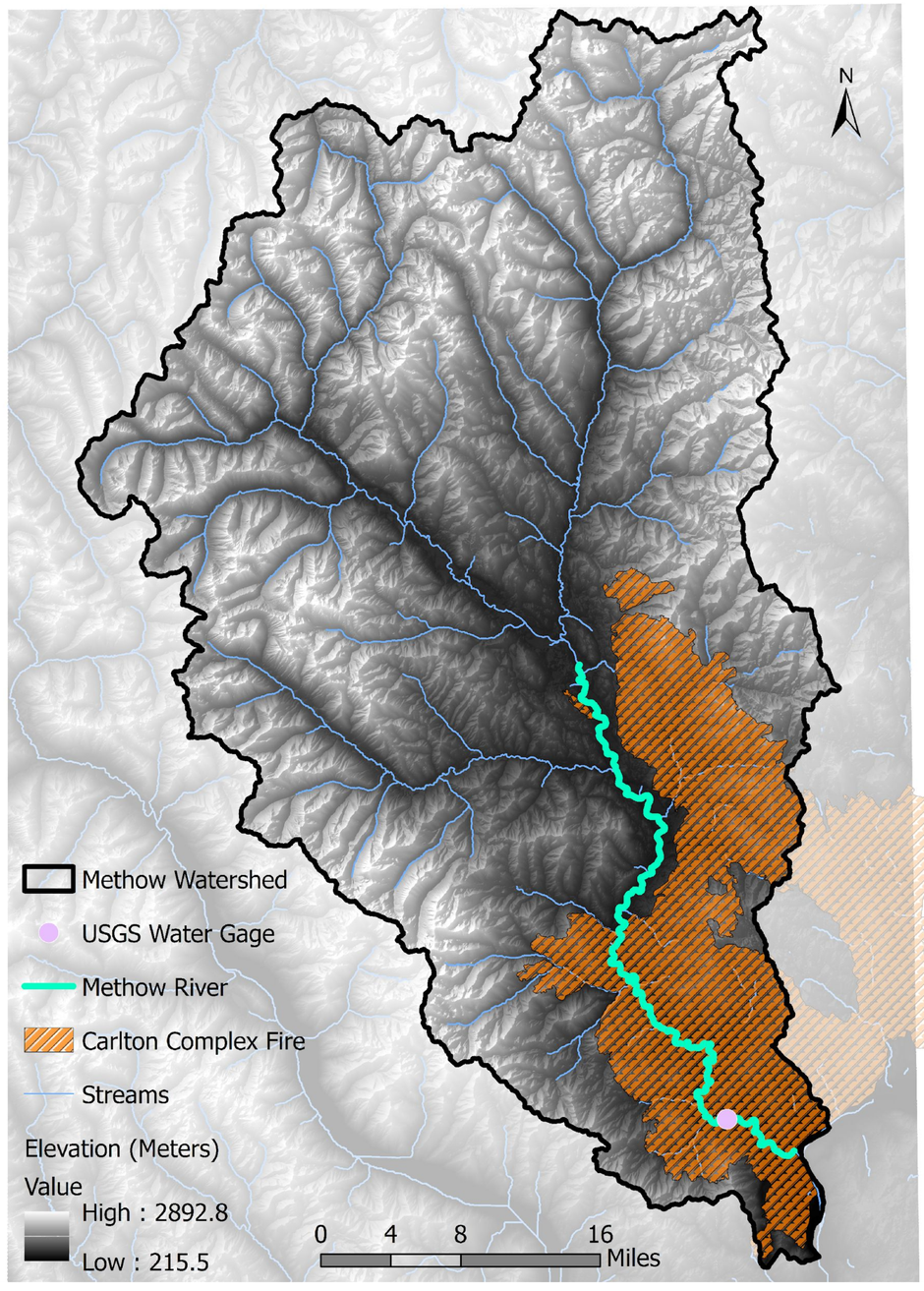


Figure 3: Graph showing the predicted discharge values of a over 7 day periods, using the same y-intercept to show the difference in discharge rates of the stream before the fire versus after the fire, given the same initial base flow and precipitation amounts.



P value and statistical significance:

The two-tailed P value is less than 0.0001

By conventional criteria, this difference is considered to be extremely statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals 441.62

95% confidence interval of this difference: From 404.60 to 478.65

Group	Before Fire	After Fire
Mean	2701.21	2259.58
SD	252.80	418.03
SEM	9.75	16.13
N	672	672

Intermediate values used in calculations:

t = 23.4338, df = 1342, standard error of difference = 18.845

Sources:
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- Mischke, N. 2014. INCREDIBLEa drone video shows fire destruction over Pateros/Brewster. *KHQ Home - Spokane, North Idaho News & Weather KHQ.com*. http://www.khq.com/story/26060429/incredible-drone-video-shows-fire-destruction-over-paterosbrewster (last accessed 13 March 2018).