United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

January 4, 2017

Mr. Andrew C. Weaver
Envalue Engineering
3100 Parker Drive
Lancaster, PA 17601

Dear Mr. Weaver,

The U.S. Geological Survey (USGS) received your request for correction of information dated February 10, 2016, submitted under the USGS Information Quality Guidelines. The request, which regarded the June 23, 1972 annual maximum peak flow associated with USGS streamgage 01576500 Conestoga River at Lancaster, PA and subsequent gage record, proposed an increase in the peak flow and revision of the gage record prior to or after 1990. Information related to the request may be viewed on our Web page at http://www.usgs.gov/info_qual/1972_PA_streamflow_data.html. This letter serves as the final USGS response to your request.

The 1972 peak for streamgage 01576500 was initially determined to be 88,300 cubic feet per second (cfs) using indirect methods (http://pubs.usgs.gov/twri/twri3-a1/twri_3-A1_a.pdf). The peak was later revised in 1990 to 50,300 cfs, primarily based on eccentric flow as determined from previously unused high water marks. This revision resulted in a 43-percent decrease. The stage associated with this peak was also changed from 27.80 feet to 27.90 based on new high water mark information. Your request for revision of the 1972 peak from 50,300 cfs to 58,600 cfs is based on the following information: 1) empirical analysis of data, 2) re-analysis of a 1978 HEC-2 model, and 3) re-analysis of a 2013 HEC-RAS model.

As a Federal science-based agency, the USGS helps serve the Nation by operating and maintaining a network of more than 9,000 streamgages that provide reliable and impartial information regarding the rivers and streams. One of the primary functions of a streamgage is to collect stage data. Stage data can be related to streamflow, or discharge by establishing a stage-discharge relation typically referred to as a rating curve. A rating curve is unique to each streamgage and is established by making a series of discrete streamflow measurements over a range of stages. Streamflow measurements can be made by either direct or indirect methods. Indirect discharge measurements are needed when a reliable direct measurement of discharge is unattainable due to inaccessibility to site as a result of road closures, unsafe conditions, or limited resources. Changes to channel geometry and drainage basin characteristics require continuous monitoring and adjustment of rating curves to accurately represent stage-discharge relations. Defining a rating curve at extreme high stages can be challenging because of the relative infrequency of extreme flood events and, in some cases, not being able to physically access or measure a river or stream that is flooding.

Annual maximum peak flows published for a streamgage (http://nwis.waterdata.usgs.gov/pa/nwis/peak) often are not measured, but rather are computed from recorded stage using the rating curve that was in effect during the flood event. If a rating curve is revised due to changing hydrologic conditions, such as reconstruction of a bridge, removal of a dam, or scour from a flood event, previously computed annual maximum peak flows are not recomputed. Annual maximum peak flows are typically revised, or recomputed, with a new rating curve if the values were found to have been published in error and the revision results in a greater than 10 percent change in discharge (http://pubs.usgs.gov/of/1985/0480/report.pdf). In the case of streamgage 01576500, when the 1972 annual maximum peak flow was revised in 1990, it was based on new information that improved the historical indirect flow computation resulting in the development of a new rating curve and a revised value for the 1972 peak. Because the previous rating curve had been developed using the inaccurate 1972 peak value of 88,300 cfs, the annual maximum peak flows since 1972 should have been reviewed and revised using the new rating curve if the percent change in peak flow was greater than 10 percent. Upon further review, three peaks (1974, 1975, and 1977) were found in non-compliance with this requirement and have been revised according to recommendations found in http://pubs.usgs.gov/of/1985/0480/report.pdf.

In your documentation included with the request for correction of information, you plot the annual maximum peak flows for the period of record for streamgage 01576500 on the current effective rating curve (rating 9.0). In doing so, you observed a difference between pre- and post-1990 annual maximum peak flow plotting positions. One would expect to see this because of the explanation above regarding how rating curves are developed. It would be misleading to plot the stage and associated annual maximum peak flow that was computed using a previous rating curve on a newer rating curve and expect that those points fall on the new rating curve, depending on the magnitude and scope of the changes made to the rating curve.

As a basic check of the ratings around 1990, discharge measurements prior to 1990 and greater than 8,700 cfs (as you defined to be the 2.33-year flood) were plotted on the effective rating for the period leading up to 1990. The measurements plotted an average of 1.3 percent from the rating curve. Similarly, discharge measurements since 1990 and greater than 8,700 cfs were plotted on the current effective rating. The measurements plotted an average of -3.15 percent from the rating curve. This indicates that the ratings do not appear to be in error and are within our established guidelines.

The 1990 contracted-opening indirect measurement for the 1972 peak was reviewed for accuracy but was not recomputed at this time. The major change made at the time of the revision was to define the flow through the bridge opening as eccentric, which affected the placement of the upstream cross-section and other subsequent parameters in the analysis. Other changes to the analysis included the bridge skew, slope, and Manning's roughness coefficient. There are known uncertainties associated with any measurement of discharge (direct or indirect) as well as the associated rating curves that are developed as a function of

the measurements. The 1972 peak made from indirect measurement was rated as "fair", indicating a possible error of 15 percent.

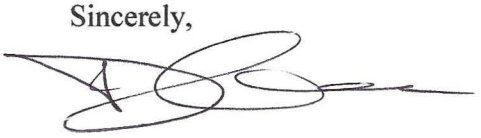
As a part of evaluating your request, a two-dimensional model was developed to reconstruct the water surface elevation during the June 23, 1972 event. Computations were run using the program System for Transport and River Modeling, which is part of the International River Interface Cooperative software suite. Modeled and surveyed high water marks (HWMs) were compared with an average difference in elevation of 0.1 feet. This average difference is reasonable as the majority of surveyed HWMs were considered poor/fair. The estimate of probable discharge resulting from the two-dimensional model was 48,000-55,000 cfs. This estimate of discharge supports the published value of 50,300 cfs.

Consequently, our decision with regard to your request is that the 1972 annual maximum peak flow for 01576500 Conestoga River at Lancaster, Pa will remain unchanged at 50,300 cfs and the accuracy statement associated with the peak will remain "fair", indicating a possible error of 15 percent.

The right to appeal is available if there is any dissatisfaction with our decision regarding this request. The appeal should be addressed to the Director, USGS, and it must be submitted to the USGS (via email to InfoQual@usgs.gov) within 21 calendar days of the date of this final USGS response. Additional information on the procedure for submitting an appeal is found on the USGS Information Quality Guidelines Web site at http://www.usgs.gov/info_qual/, under section IV, item 4.

We appreciate your interest in this USGS information product.

Sincerely,



Donald Cline
Associate Director for Water