

Flow Connectivity and Sediment Transport Modeling in Flashy Ephemeral Channel Networks

Sandra Glasgo¹, Daniel Cadol¹, Madeline Richards³, Jonathan Laronne², Kyle Stark¹

¹ New Mexico Institute of Mining and Technology, Socorro, NM || ² Ben Gurion University of the Negev || ³ Army Corps of Engineers, Albuquerque District

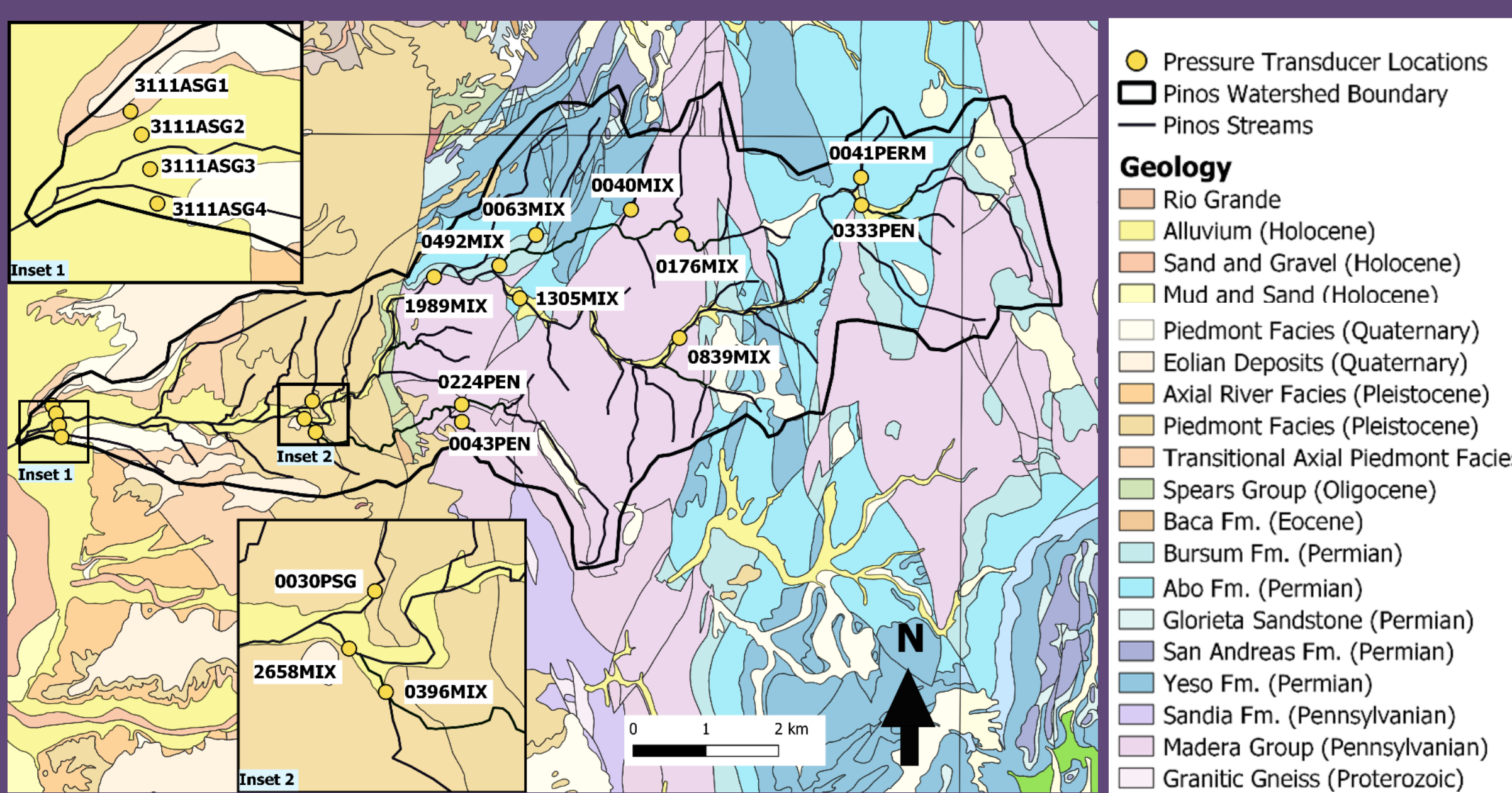
Abstract

In large river systems such as the Rio Grande, sediment influx and water delivery from ephemeral streams is difficult to quantify and track. Yet it has major management implications to such diverse issues as reservoir sedimentation, sediment plugs and avulsions, flooding, and additions to streamflow. In the Arroyo de los Pinos watershed, one such ephemeral system, we have been monitoring discharge at 18 different points for two years in an effort to quantify water and sediment delivery from the ephemeral channels. The data collected in the past, present, and future will allow for a better understanding of how the network connects across a range of precipitation intensities and magnitudes, and how these interactions control water and sediment delivery to the watershed outlet. Preliminary data support the prevailing understanding that the primary controls on local runoff generation are rainfall intensity, lithology, and sub-basin size (Richards, 2020).

To investigate how these flow events influence sediment discharge, my proposed work will focus on building open channel flow models with sediment transport capability. The first step will be to build a model framework for a reach where sediment flux is monitored near the confluence of the Pinos and Rio Grande (Stark, 2018). Discharge, bedload, and topographic data collected during the monsoon seasons of 2018, 2020, and – if there are floods – 2021 will be used to calibrate open channel flow models with sediment transport capability. Initially we will utilize the sediment transport simulation capabilities within the Bureau of Reclamation's BORAMEP model, because Reclamation has supported work at the Pinos and is interested in evaluating their model's performance. Modeled sediment flux will be compared against monitored sediment flux near the confluence of the Pinos and Rio Grande. If successful, we will then be able to model sediment transport using the calibrated sediment parameters in other upstream reaches in the channel network. Combined with our flow connectivity data, this would enable an unprecedented quantification of sediment transport connectivity, and potentially disconnectivity, within ephemeral fluvial systems.



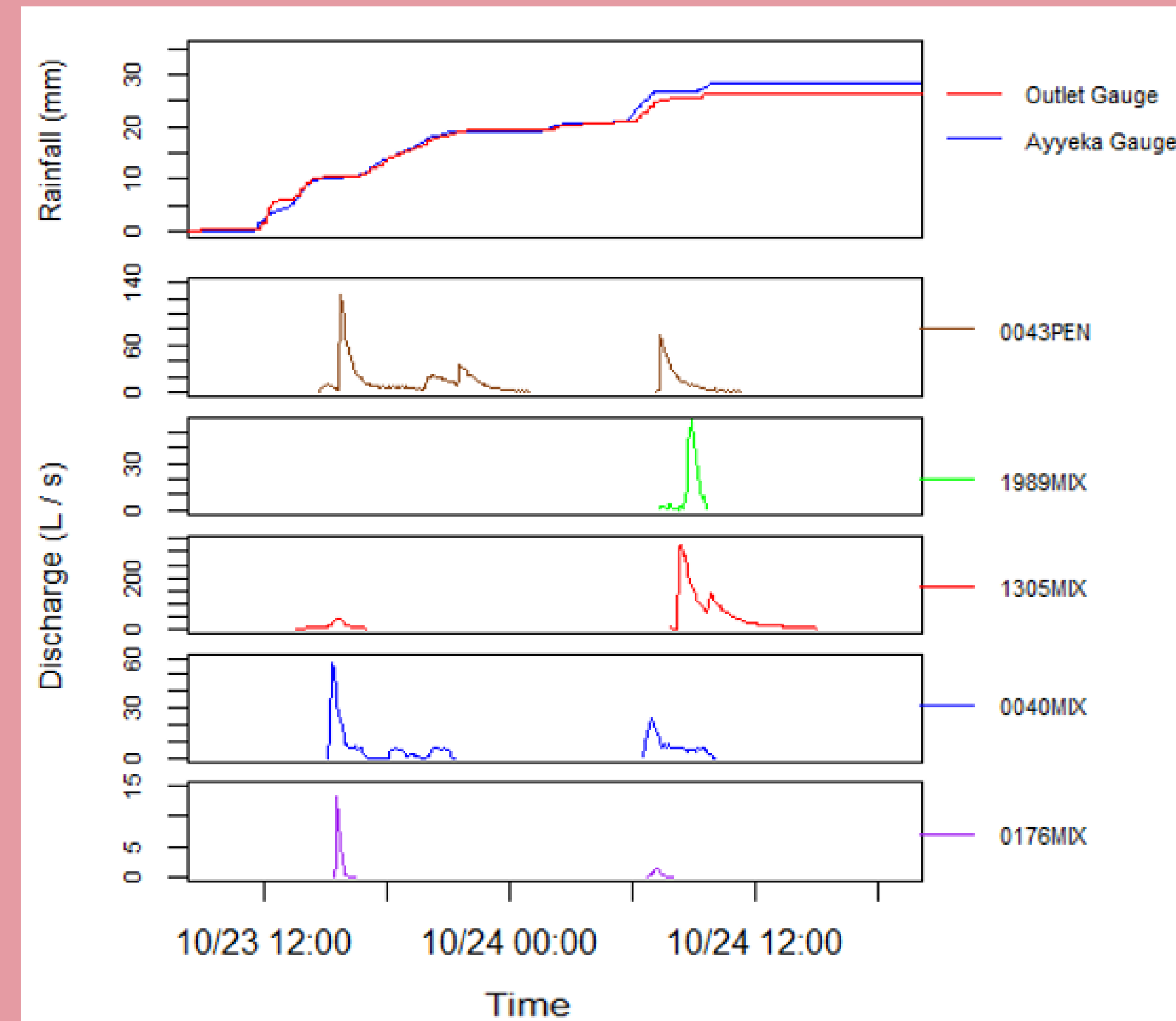
Location map of basins of interest and the planform geometry of the confluence. The arrows indicate flow.



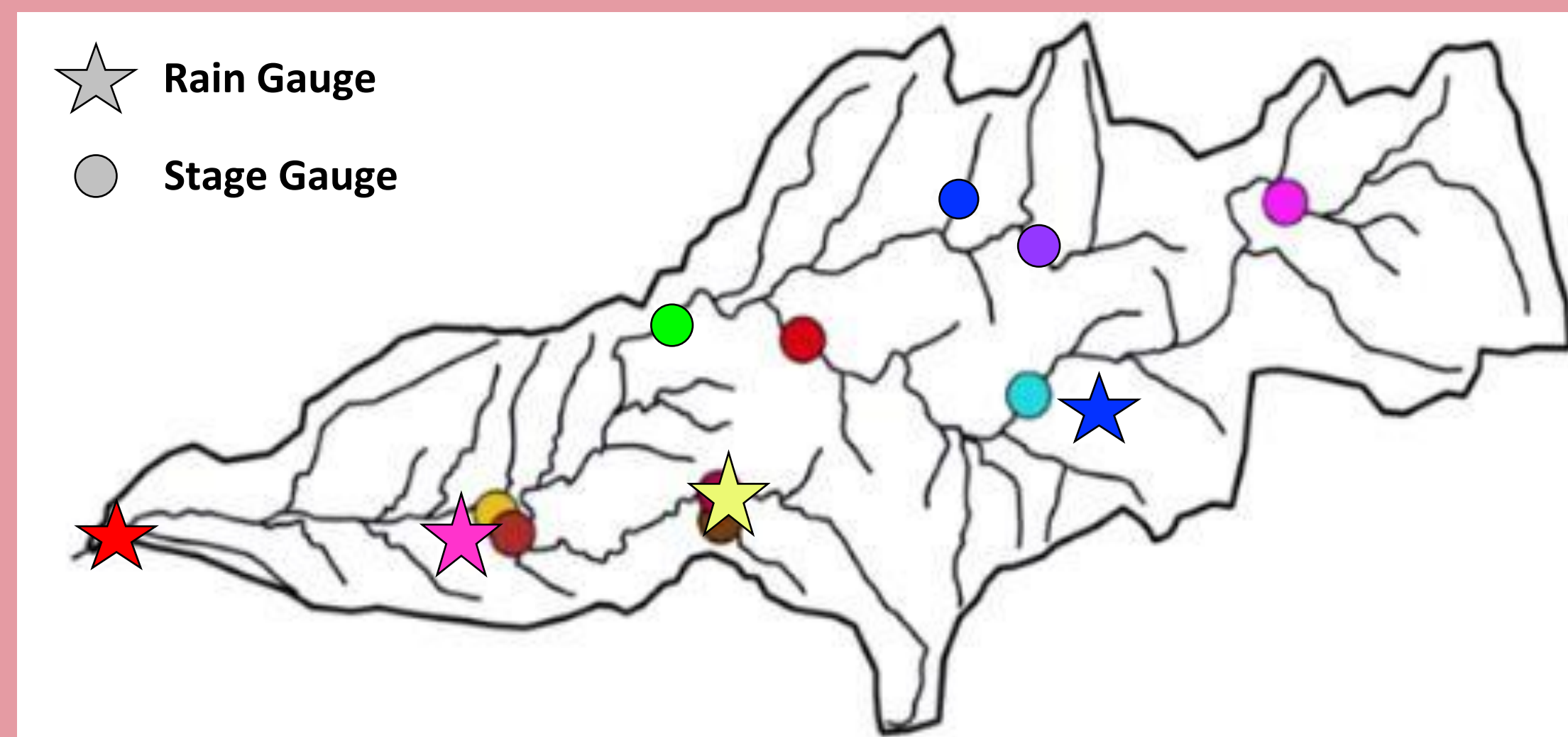
Location map of Arroyo de los Pinos streams and pressure transducer sites

Flood Events

Small Event: October 23-24, 2018

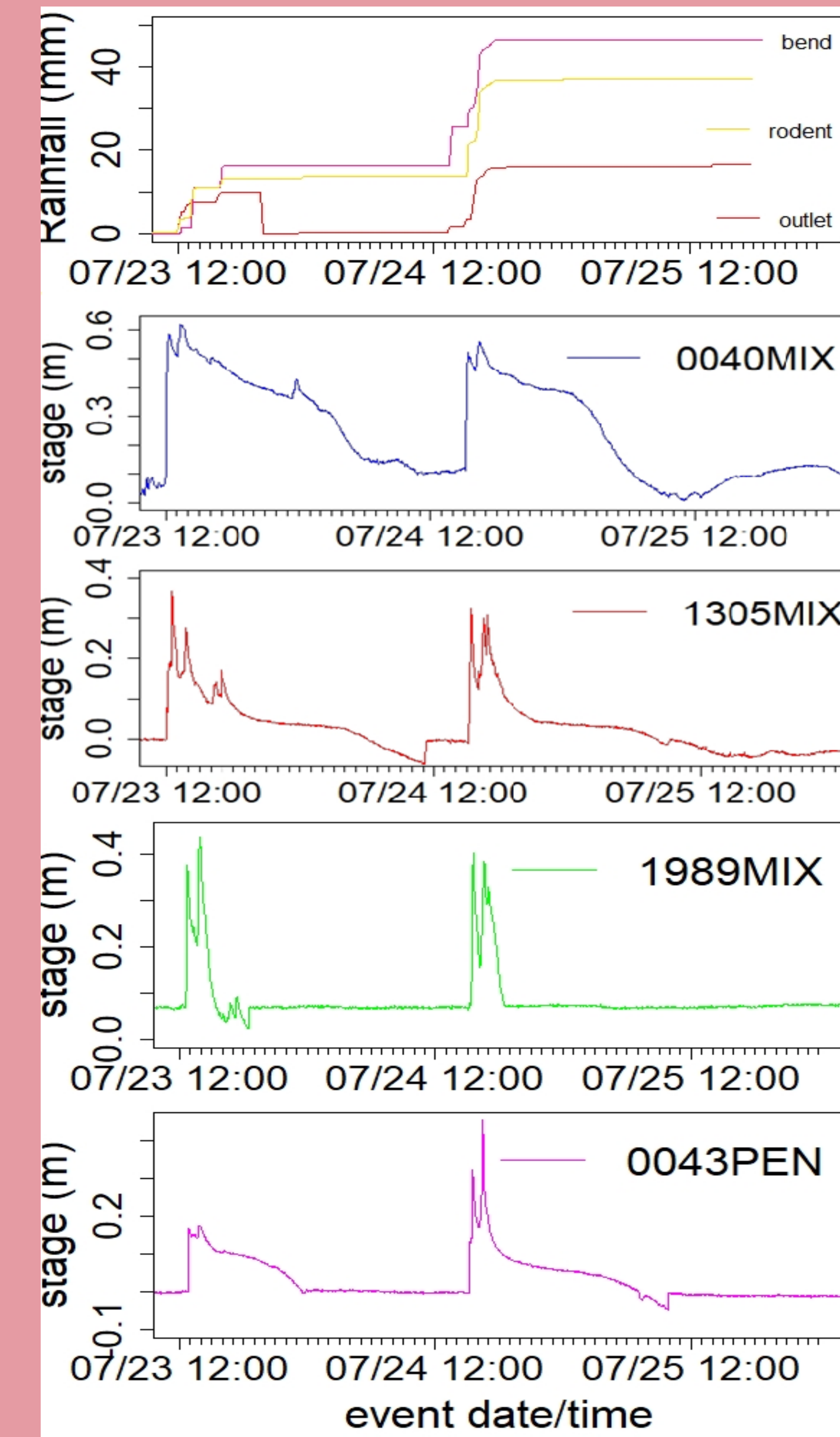


Hyetographs and discharge hydrographs that show the recorded runoff for 10/23/2018.



Schematic of watershed with locations of transducers

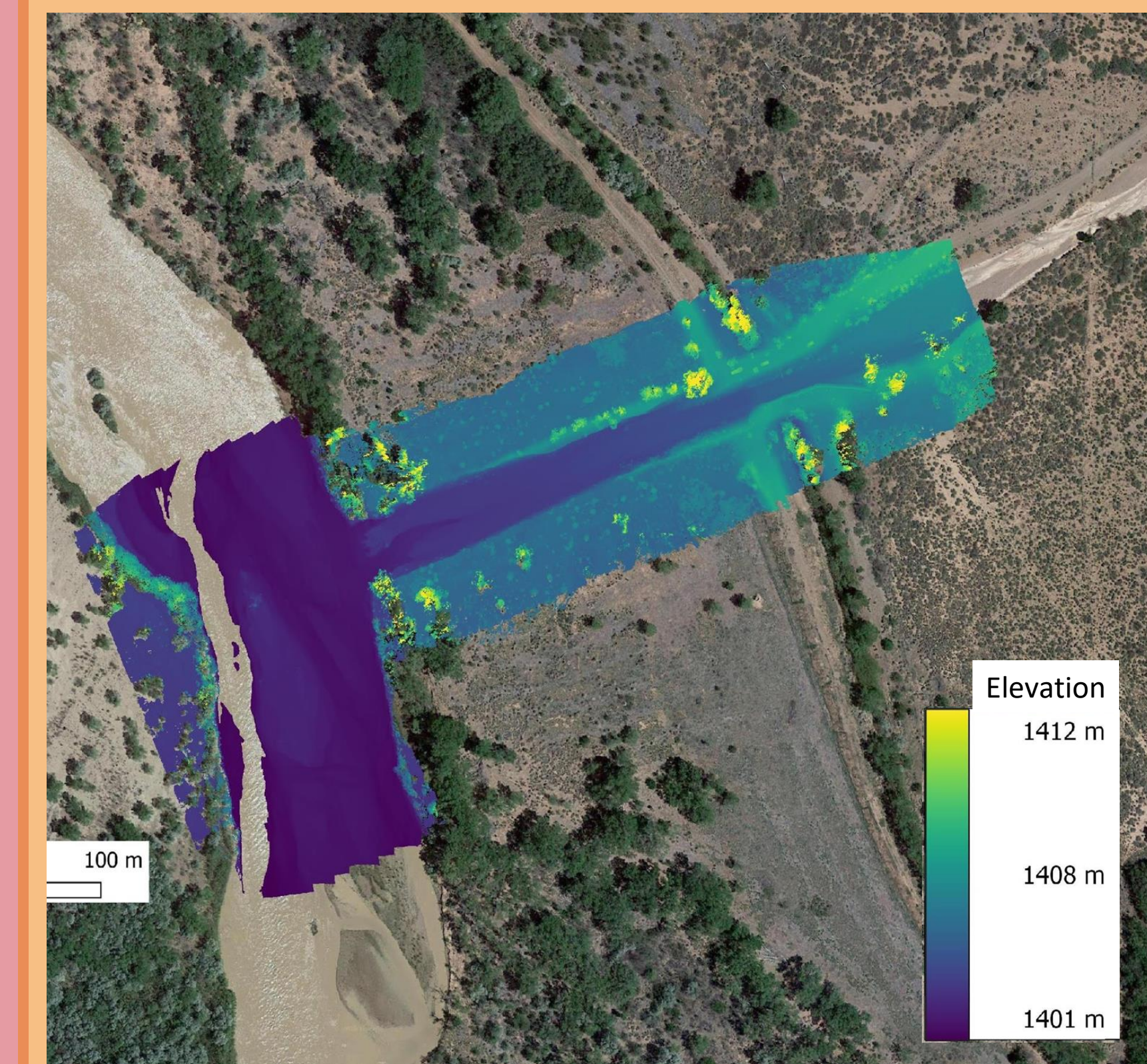
Larger Event: July 23-24, 2020



Stage hydrographs from loggers that recorded the flood events on 7/23/20 and 7/24/20.

Future Work

Discharge, bedload, and topographic data collected during the monsoon season of 2018 will be used to build open channel flow models with sediment transport capability. These models will be used to evaluate the quality of the sediment transport simulation capabilities within Bureau of Reclamation's BORAMEP model. Modeled sediment flux will be compared against monitored sediment flux near the confluence of the Pinos and Rio Grande.



References

Richards, M. (2020). RAINFALL-RUNOFF RELATIONSHIPS IN THE ARROYO DE LOS PINOS SOCORRO NEW MEXICO. MS Thesis, New Mexico Institute of Mining and Technology, Socorro New Mexico.

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Contact Information

Sandra Glasgo: Sandra.glasgo@student.nmt.edu

Discussion

- Greater integration of flow from downstream sites in the large watershed.
- Small sub-watersheds produced larger runoff ratios
- Large watersheds have higher rainfall threshold to produced runoff
- Storms with greater rainfall depth are more likely to produce flow in large sub-basins but have similar probabilities of missing small sub-basins
- Comparison of downstream gauging sites shows significant channel transmission losses (bed seepage)