STREAM CHANNEL MORPHOLOGY ALONG THE URBAN FRINGE: FLOOD FREQUENCY AND HAZARDS IN THE HASSAYAMPA RIVER REGION

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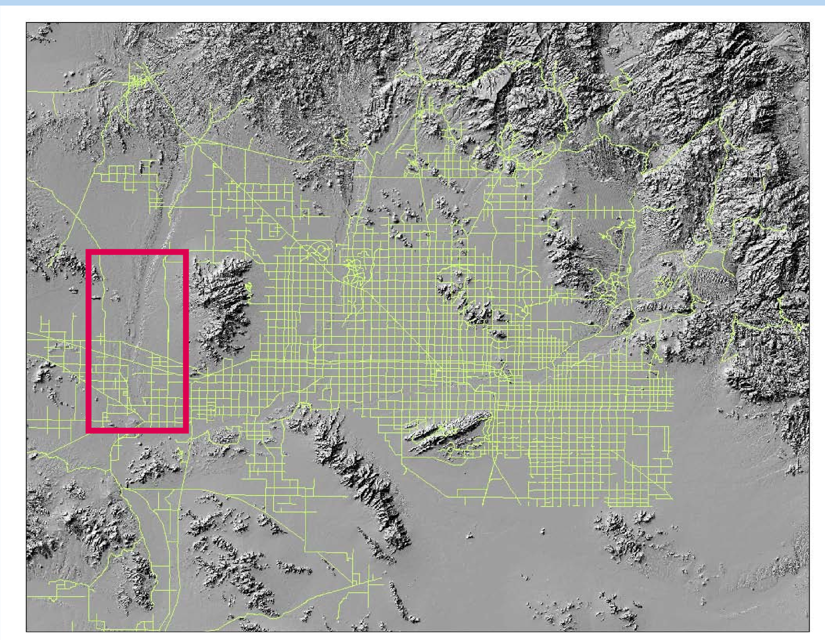
ABSTRACT

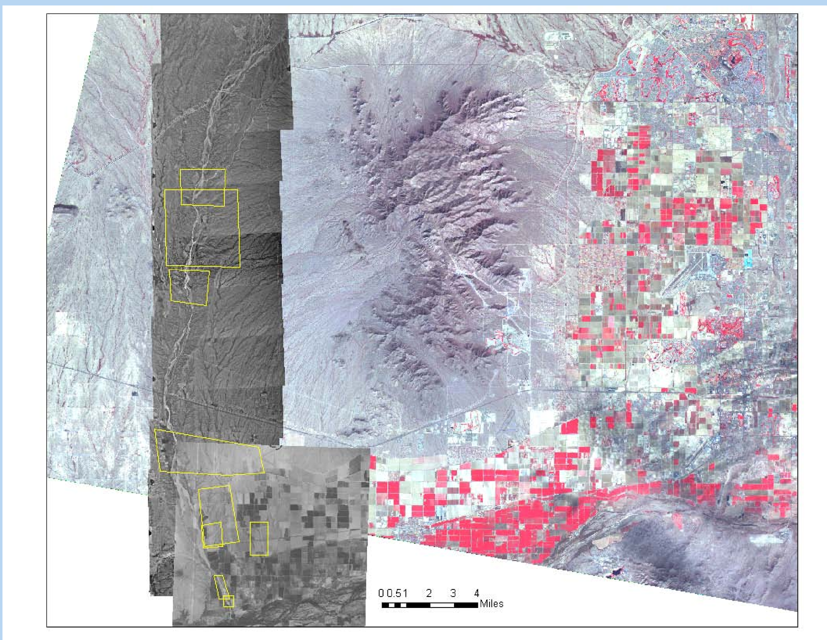
In order to understand the effects of human modifications to watersheds and main stem channel systems in desert environments, it is necessary to characterize the un-modified system before human activities change it. With progressive urbanization in greater Phoenix, development is expanding beyond the valley onto the piedmonts and the uplands. With this growth comes exposure to channel instability, as well as feedbacks to the channel system by urbanization-driven surface changes. Some of these changes include surficial material changes that change rainfall-runoff relationships, channel engineering, damming, and construction of gravel pits in the channel bed. The bulk of the Hassayampa River region, west of Phoenix, has not yet been affected by human modification, but there are several plans for development along the river channel over the next 30 years. In this project, I have investigated how the Hassayampa River's channel morphology has changed over time in order to compare it to other channel systems in greater Phoenix that have already been urbanized, and consider how it may change as it urbanizes in the near future.

I used aerial photography, flood frequency analyses, public agency reports, and historical documentation including private and newspaper accounts to document lateral changes in channel position caused by lateral erosion and over-bank flooding along the Hassayampa River over time in order to understand flooding frequency, magnitude, and the tendency of these channels to change during varying magnitudes of precipitation events.

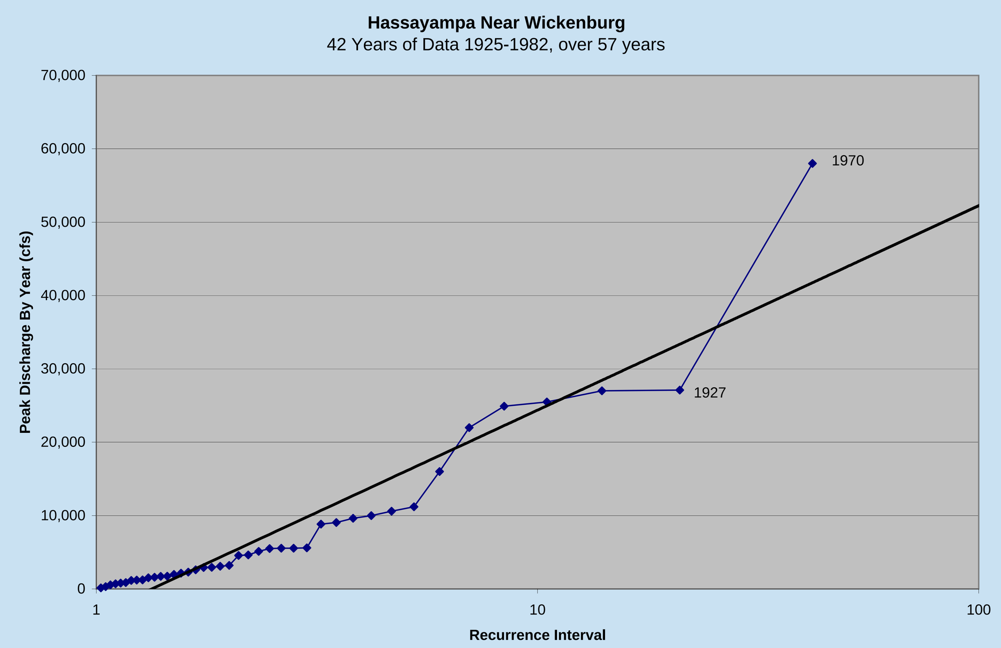
Regional Map

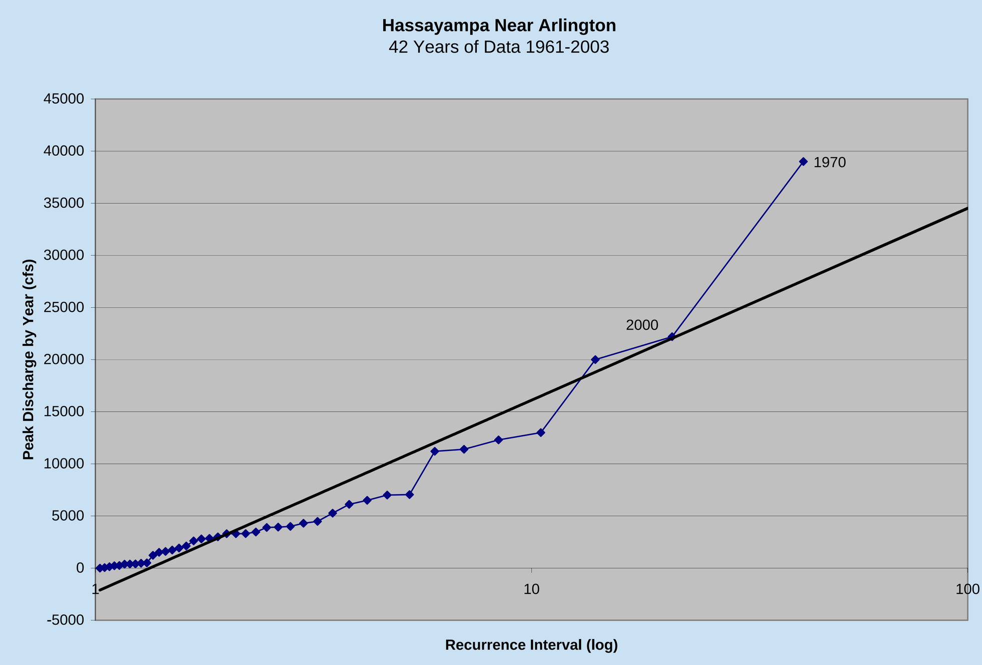


Metro Phoenix streets overlaying topography. The Hassayampa River study region is located in the red box.



FLOOD FREQUENCIES





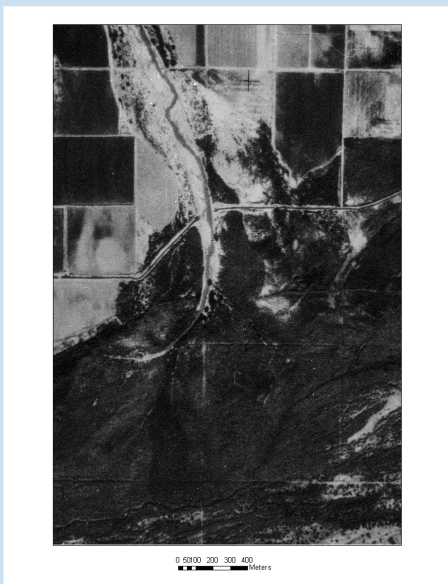
The frequency of recorded peak discharges on the Hassayampa River are plotted above for upstream (Wickenburg) and downstream (Arlington) locations. The blackline fits the trend of the flooding frequencies and is projected to a 100-year interval. As you can see, the minimal data limits accuracy to a 100-year flooding magnitude. Known years of high flow are 1890, 1951, 1970, 1978, 1980, 1984, 1992.

CHANNEL CHANGE AND LANDUSE CHANGE

Between 1953 and 1992 the mainstem channel changed shape and width due to precipitation events. Note that southwestern and northeastern tributaries have also changed.

Agricultural modification has narrowed and straightened the natural path of the lower Hassayampa. Between 1934 and1997 all evidence from tributaries havebeen removed as well.

Here, between 1953 and 1997, agriculture has diverted the braided tributary in the southwestern portion of the photo southward and then westward along the highway.

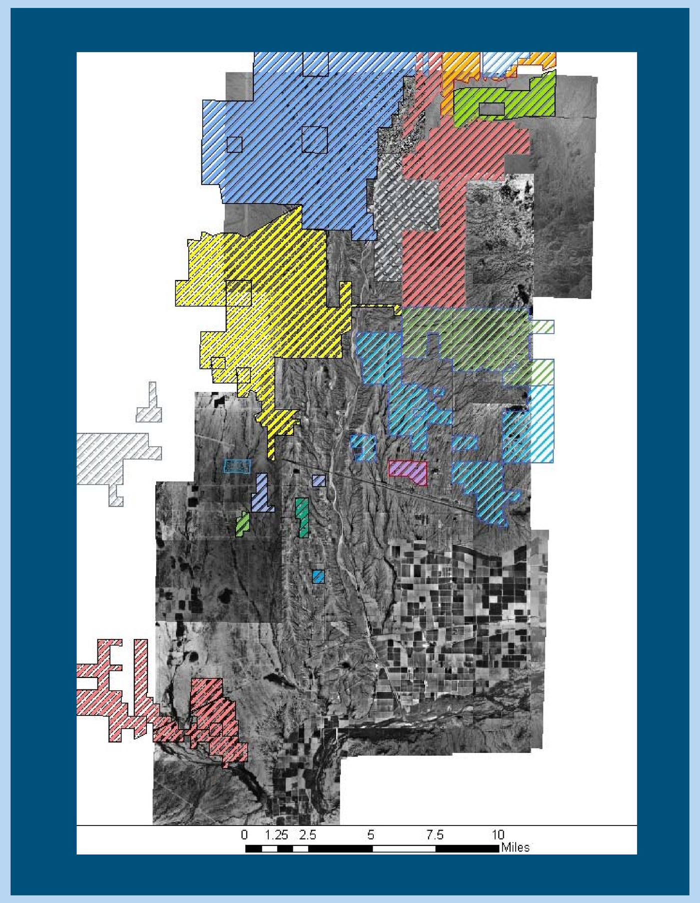


At the confluence of the Hassayampa and Gila Rivers, the channel form of the Hassayampa has changed from braided and sinuous to straight, narrow, and more vegetated to the south, 1934-1972.

HOW WILL FUTURE URBANIZATION AFFECT CHANNEL CHANGE AND ECOLOGICAL PROCESSES?

Current State of Hassayampa River 2004

(Digital Air Photography provided by Maricopa County Flood Control District)



Planned Developments by 2030

(Extent of planned developments provided by ADWR)

CONCLUSIONS

The results show that in desert environments, any storm of significance will create changes to the fluvial system, but magnitude and frequency of the events are important factors to quantifying hazard. I also discovered that because most of the Hassayampa River is not yet urbanized, not much historical documentation exists regarding the channel, thus limiting long-term projections of flood frequencies.

The development of gravel mines in the Hassayampa stream bed and the requirement of retention basins in housing developments may shut down the fluvial system completely, therefore eliminating flooding hazards on the Hassayampa River Watershed. However, precipitaiton and flooding history is poorly documented, and the magnitude of a 100 or 500 year flood is roughly estimated.

The fluvial system will likely respond with the dramatic changes in sedimentation rates as each development is constructed. There will be a pulse of sedimentation during construction. After completion, sediment input to the system will be shut down, and the result may be channel incision.

Acknowledgements

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