May 2019

Dependence of Hydrological Modeling on Spatial Resolution in Lake Whatcom Watershed

Emily McGinty
Western Washinton University

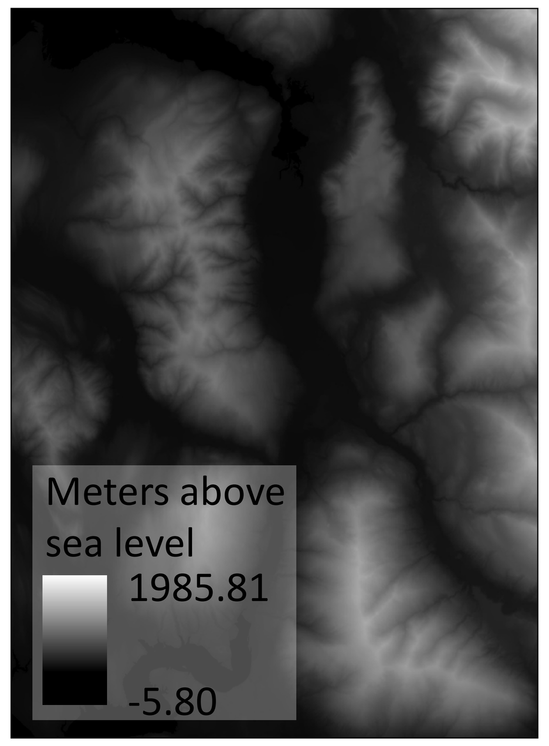
RESOLUTION MATTERS

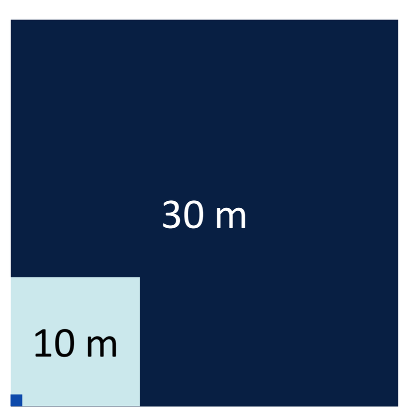
The Effect of Raster Resolution on Hydrological Modeling

Emily McGinty, Dr. Aquila Flower, Western Washington University

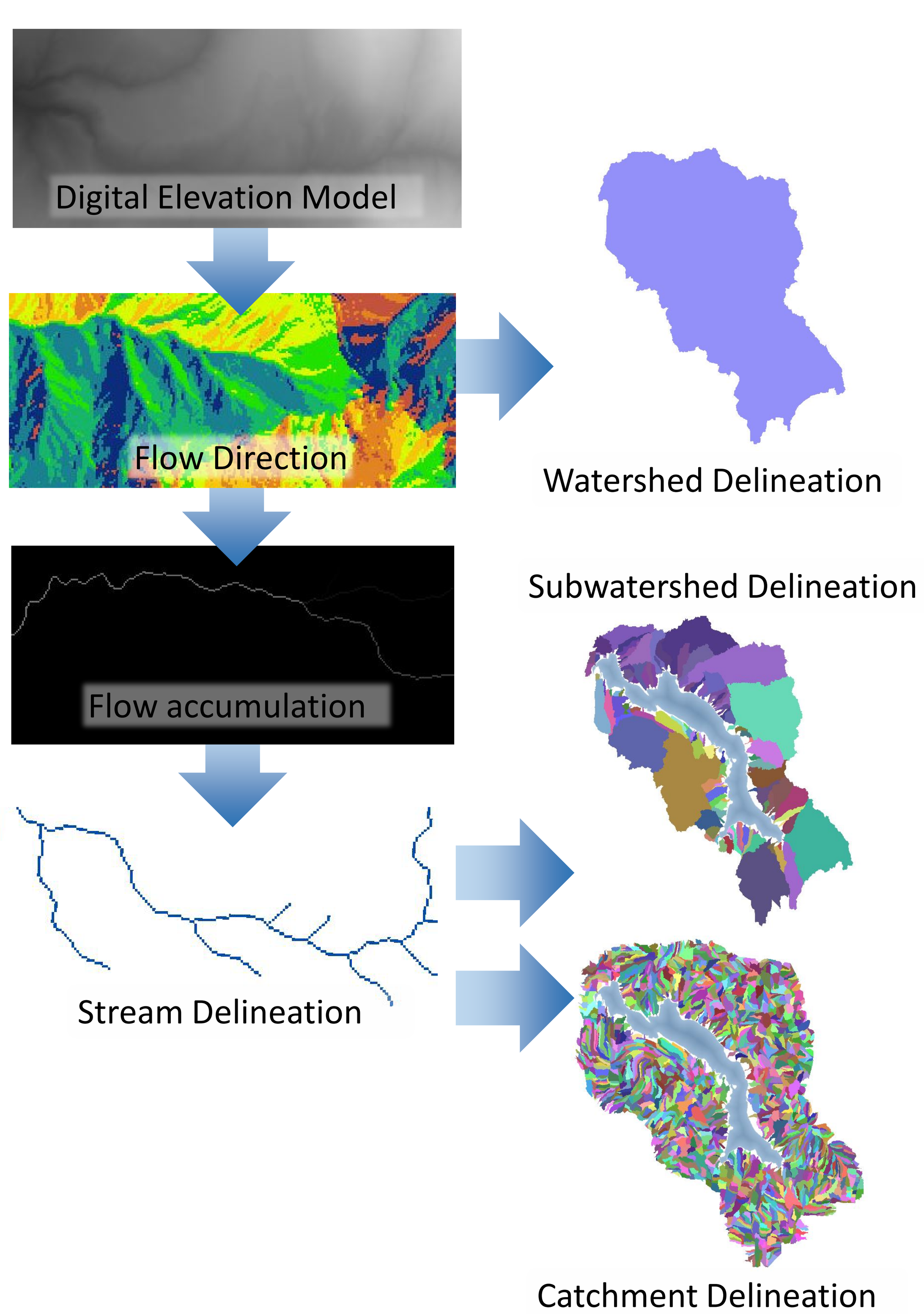
INTRODUCTION & METHODS

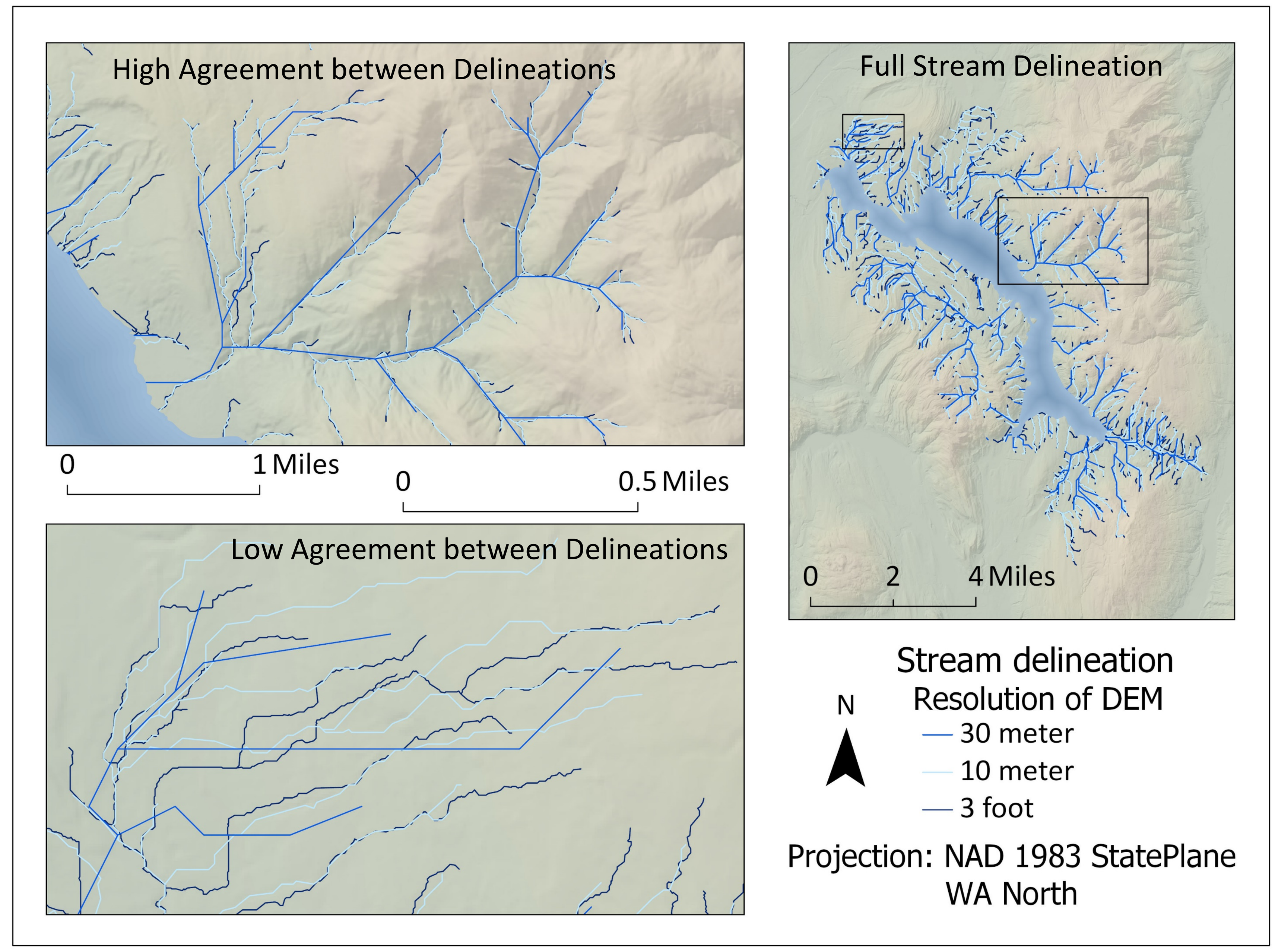
Geographic information science (GIS) provides a means for modeling hydrological systems based on a digital elevation model (DEM) of the area, like the one pictured at right. Modeling hydrological systems through GIS reduces long, intense field work, allows for modeling of inaccessible areas, and provides a depiction of how water moves across landscapes for further analyses.

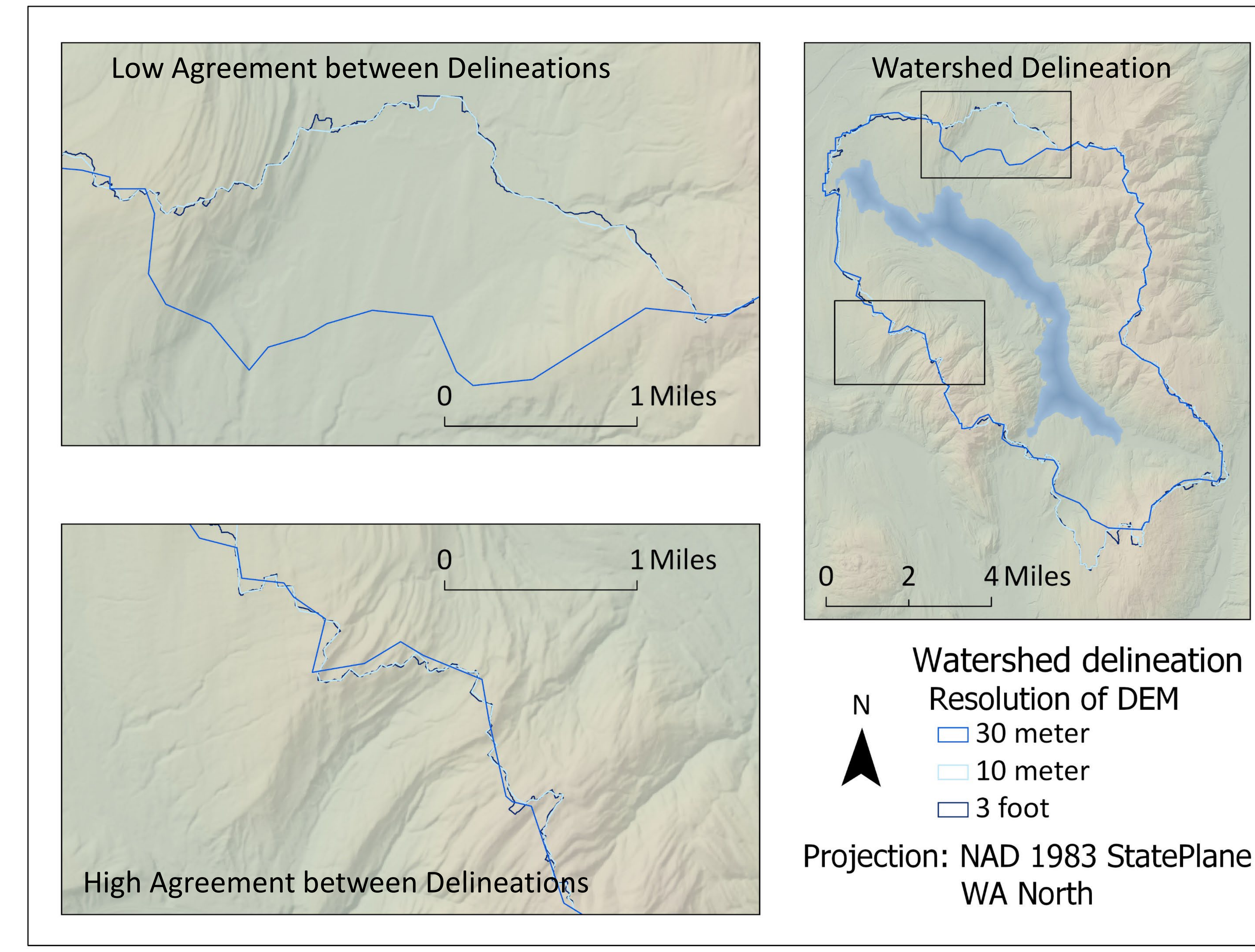


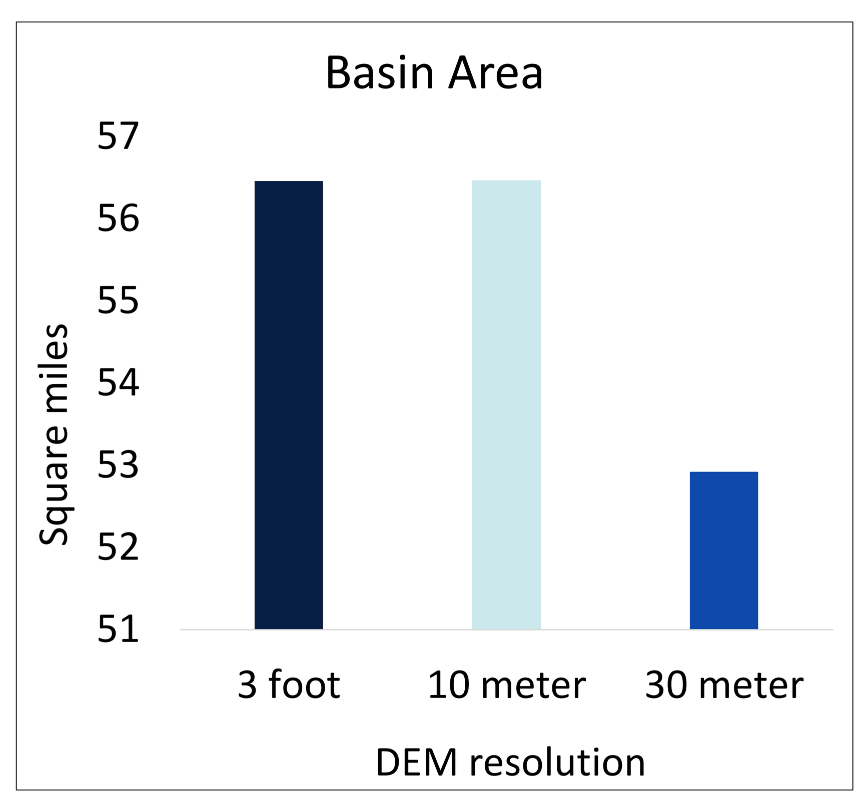


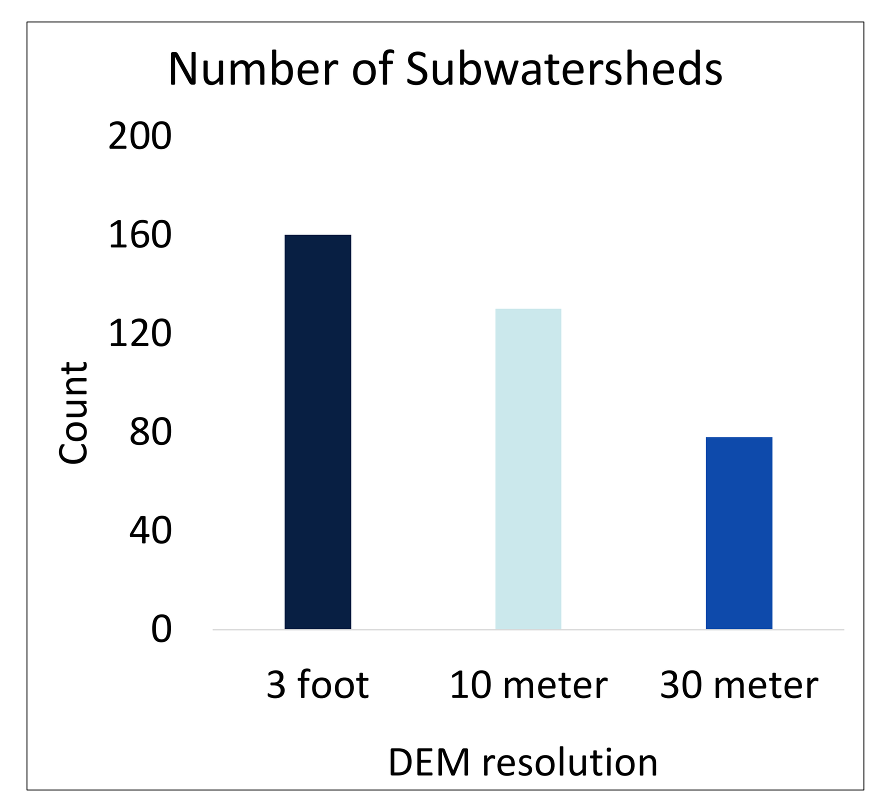
A DEM is a square grid dataset which carries one value per cell. DEMs range in resolution. Each resolution will produce a slightly different hydrological model. I produced delineations of the Lake Whatcom watershed, subwatersheds, catchments, and streams at 3 foot, 10 meter, and 30 meter resolutions, visualized at left, to quantify and analyze the impact of DEM resolution on the resulting hydrological models.

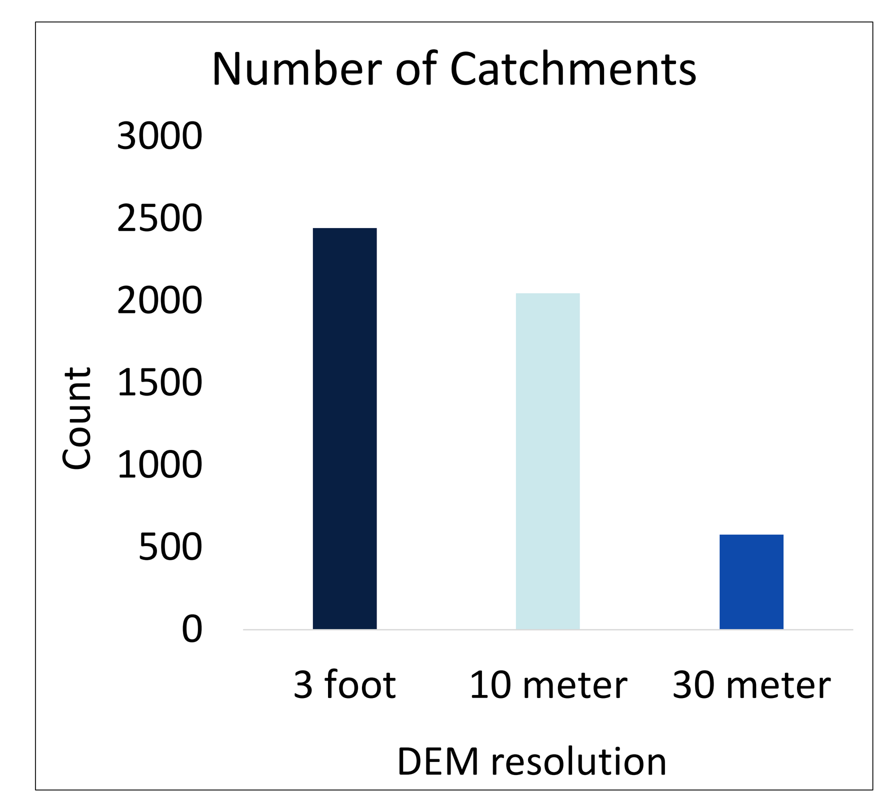


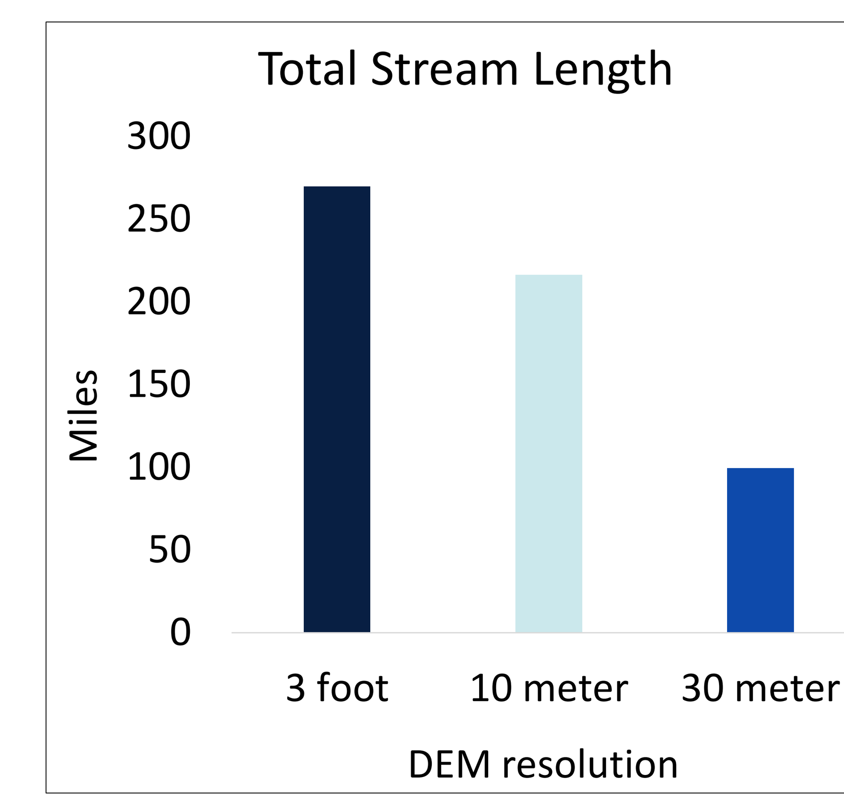












RESULTS

The table below presents the percent difference of a number of metrics (corresponding to the graphs above) between different resolution stream and watershed delineations.

Percent difference between resolutions	Resolution comparisons: 3 foot & 10 meter	Resolution comparisons: 3 foot & 30 meter
Watershed area	0.03	6.3
Number of subwatersheds	18.8	51.3
Number of catchments	16.3	76.4
Total stream length	19.9	63.1

DISCUSSION

- The watershed delineations produced at 3 foot and 10 meter resolutions were comparable, while the delineation at 30 meters produced notable discrepancies.
- The 3 foot DEM produced the most detailed delineations of subwatersheds, catchments, and streams. The 10 meter resolution DEM produced slightly less detailed delineations, and the 30 meter resolution produced the least detailed delineations.
- The degree of discrepancy between the resolutions increased as the smallest unit to be delineated decreased.
- With larger raster cell size comes a higher degree of data aggregation. For every 30x30 meter cell holding one value, there are approximately 328 3x3 foot cells, each containing an independent value.

Lake Whatcom Watershed Locator

Projection: NAD 1983 StatePlane WA North

Data credits
WDNR, NASA, USGS, WWU

Contact
ermcginty.weebly.com
linkdin.com/in/ermcginty