Current PMP Estimation and Meteorological Parameter Development for Mining Facilities in Data Limited Regions

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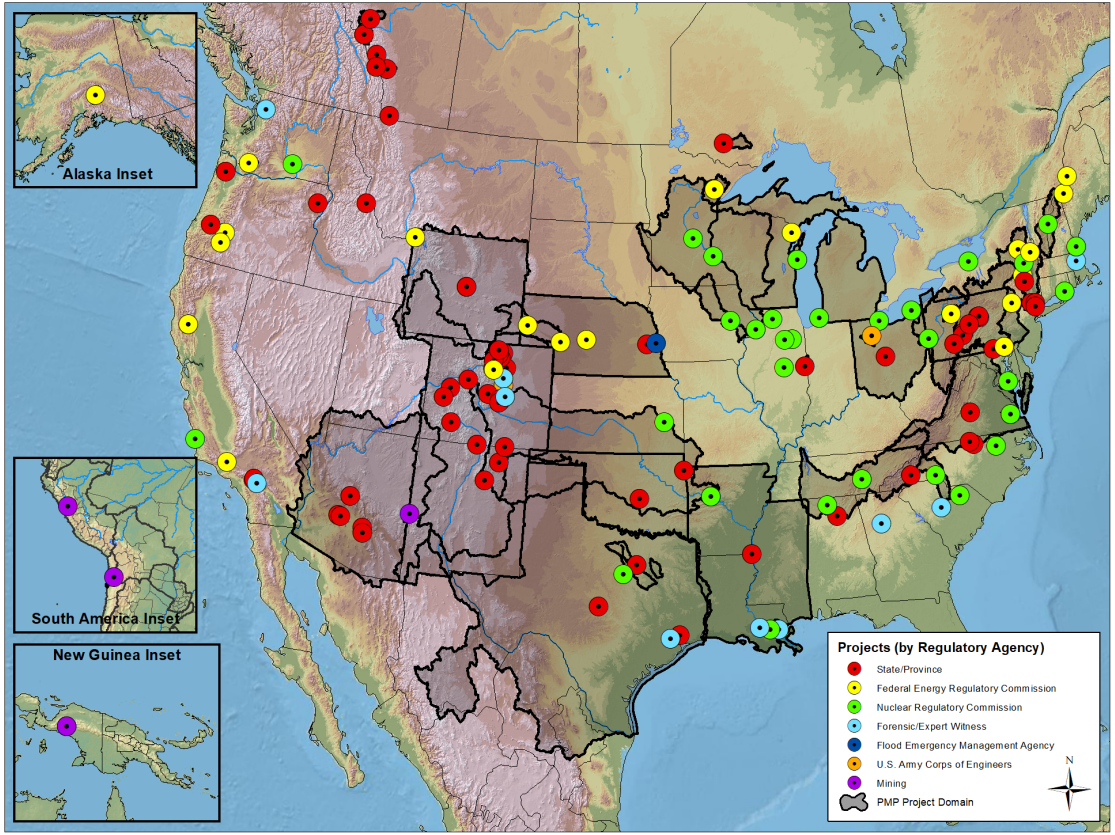
Probable Maximum Precipitation

Definition: The *theoretically* greatest depth of precipitation for a given duration that is *physically possible* over a given storm area at a particular *geographic location* at a certain time of year (HMR 59, 1999)

Probable Maximum Precipitation - Overview

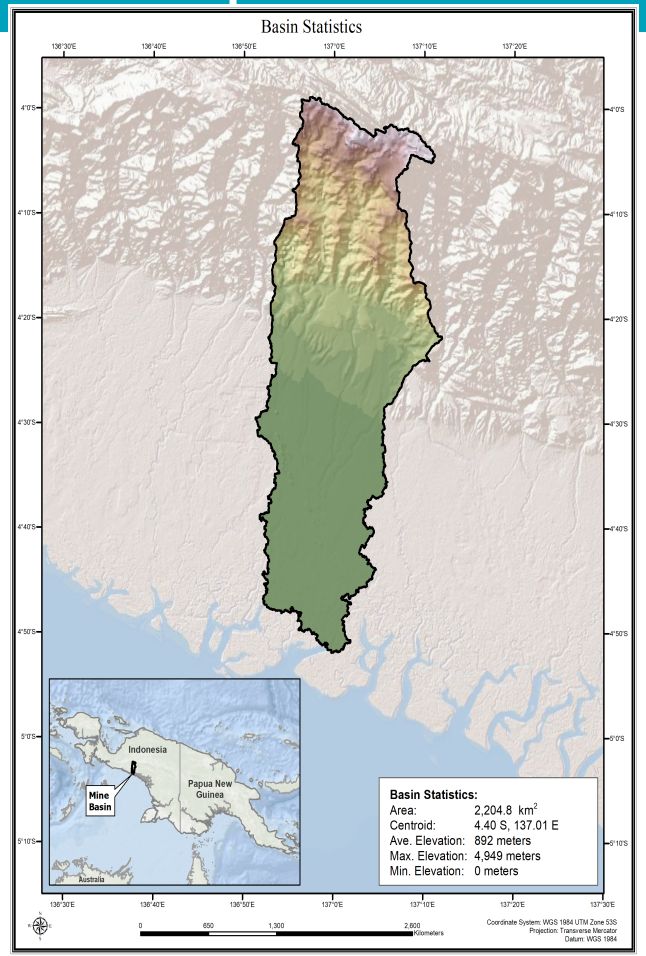
- Storm Based Approach-Deterministic
  - Maximize storms
  - Transposition storms
- Combine into PMP design storm
  - By storm type
  - By area size
  - By duration
- Subjective decisions involved
- Probabilistic estimates now available as well

AWA Probable Maximum Precipitation Studies



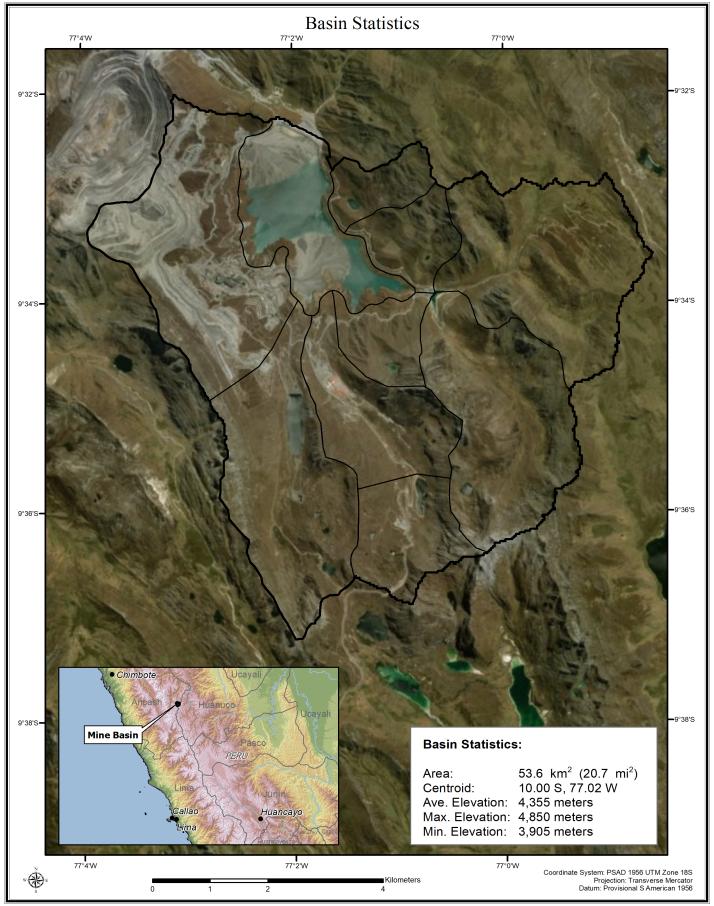
AWA-Data Limited with High Precipitation

- Tropical Climate
- Two wet/monsoon seasons
- Limited data, especially sub daily
- Mining company-great job of monitoring-providing in situ data
- Utilize remote sensing
- Extreme topography nearly 5000 meters to sea level



AWA-Data Limited with Low Precipitation

- High Altitude-Dry Climate
- Distinct wet/dry seasons
- Limited data, especially sub daily
- Many days of light precip-volume important
- Utilize remote sensing
- High elevations 4000-5000 meters in very protected Andean region



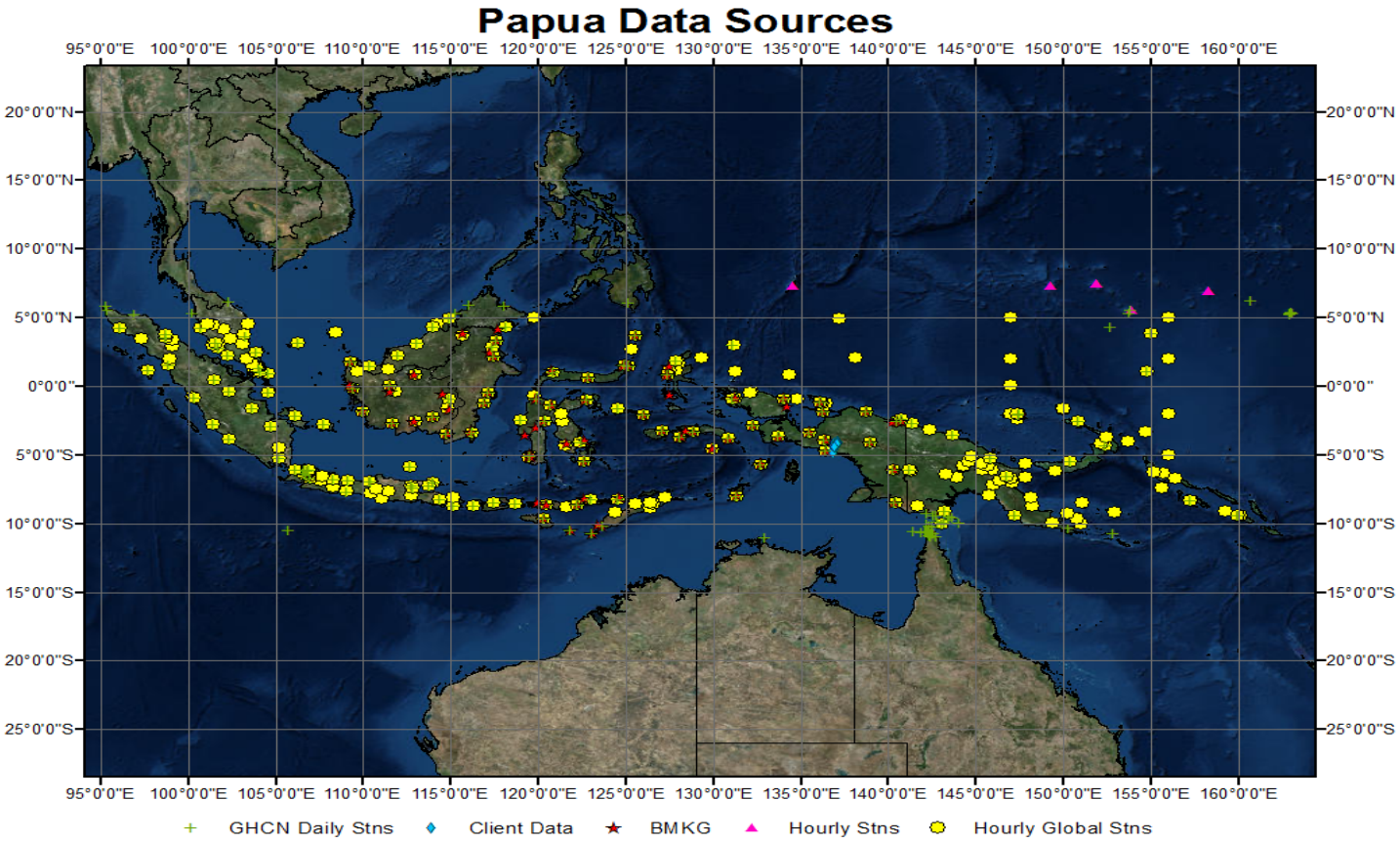
Probable Maximum Precipitation - Major Tasks

- Review Previous/Ongoing Work
  - AWA PMP studies
  - Previous H&H/meteorological studies
  - At site and in similar regions
  - Information from client/on site personnel

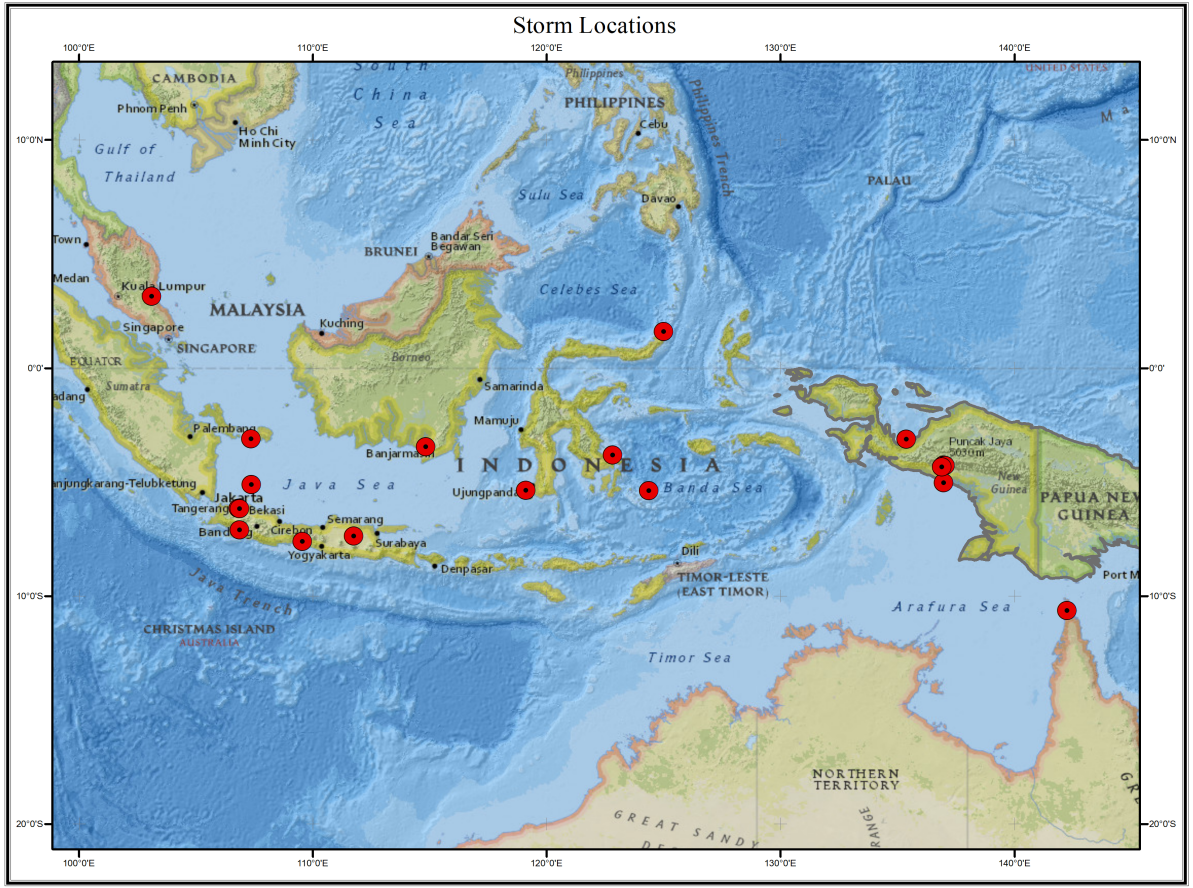
Probable Maximum Precipitation – Storm Search

- Storm Search and Storm List
  - Complete a storm search to identify the most significant storms that could have occurred over the region where storms are transpositionable
  - Identify the most significant flood events that have occurred in region
  - Identify storms used in other PMP studies
  - Identify extreme rainfall-producing storm types and seasons
  - Use SPAS to analyze
- Storm must have similar meteorology/topography to be considered transpositionable

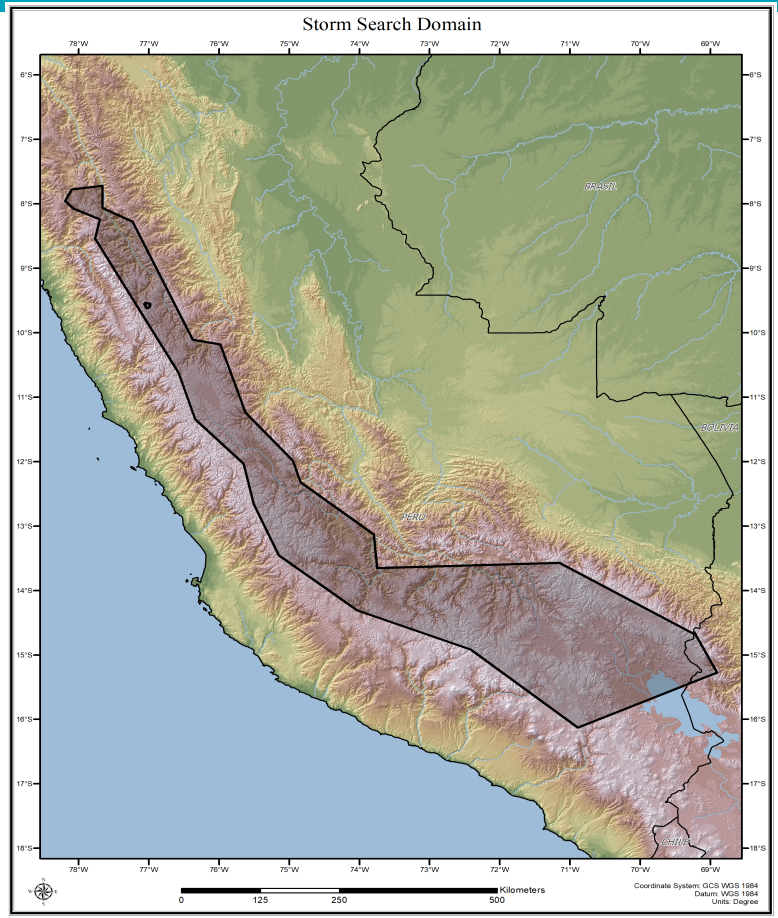
Probable Maximum Precipitation – Storm Search Domain

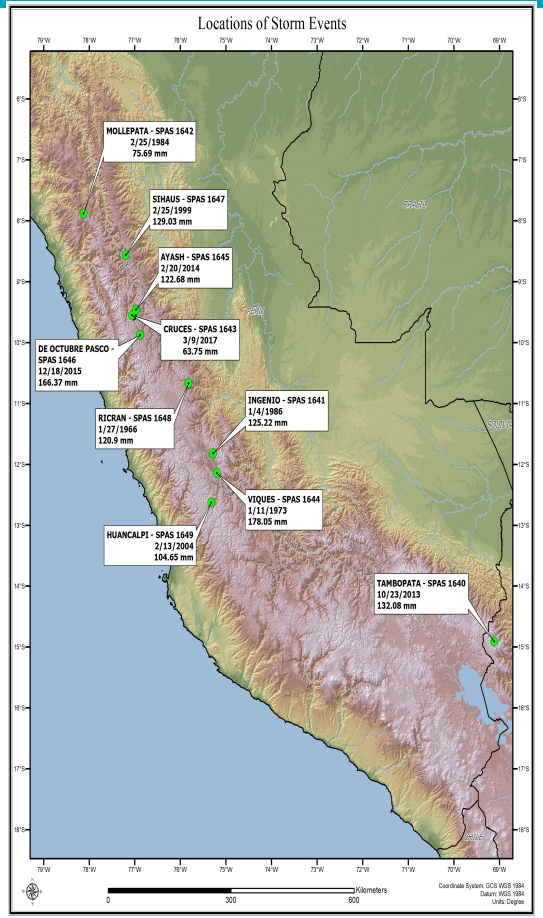


Probable Maximum Precipitation – Short Storm List

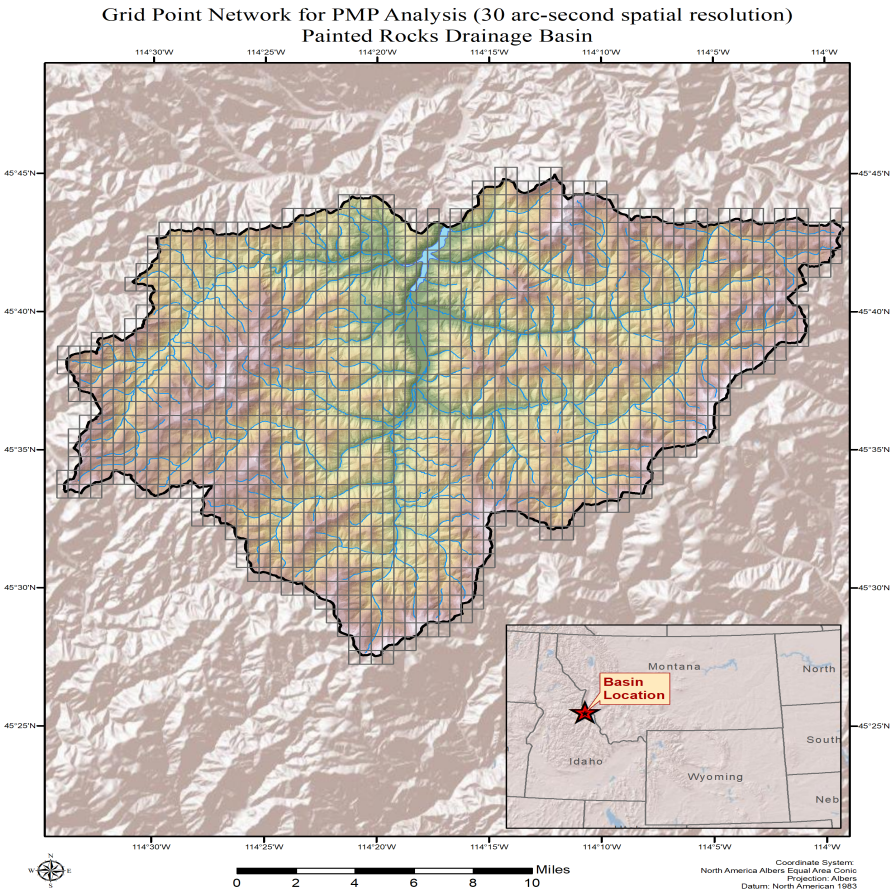


Probable Maximum Precipitation – Storm Search Domain

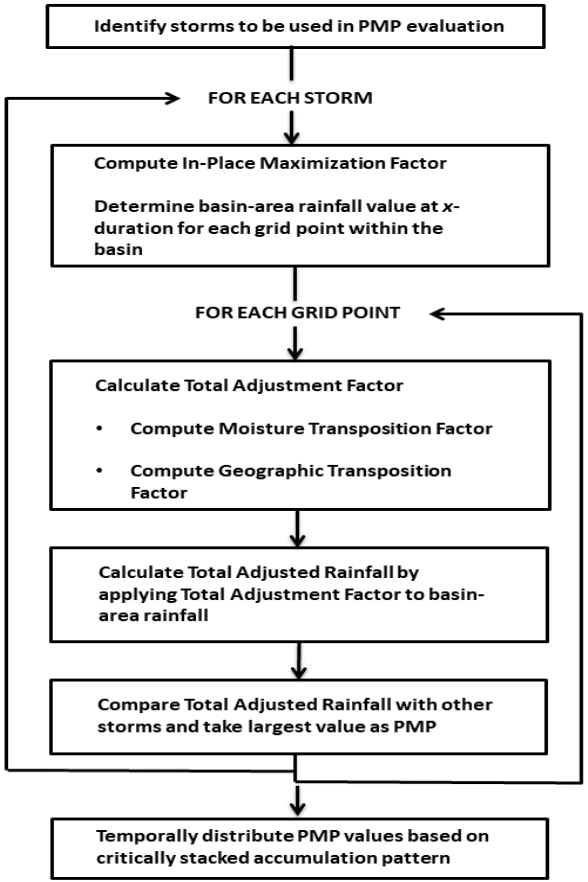




Example Grid Network



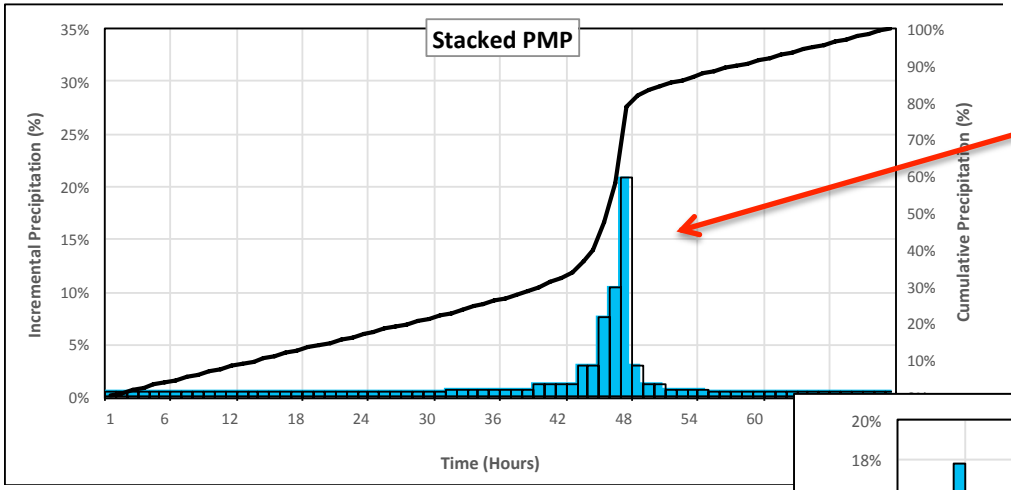
Gridded PMP Application



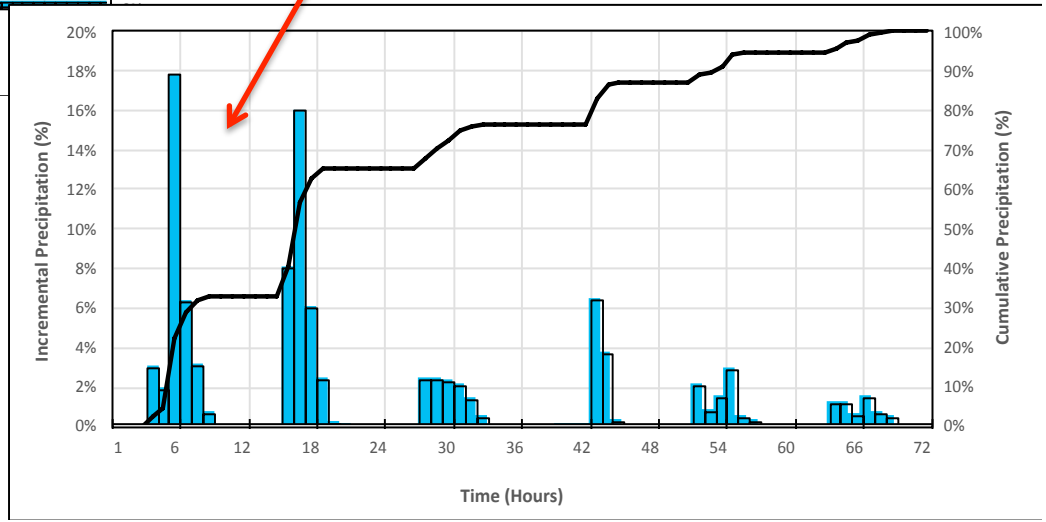
Probable Maximum Precipitation - Application

- Develop PMP, Spatial, Temporal Information
  - PMP provided by storm type
  - Unique accumulation patterns for each
  - Spatial information from gridded data
- Can apply other spatial patterns based on past storms

Site-specific Temporal Patterns

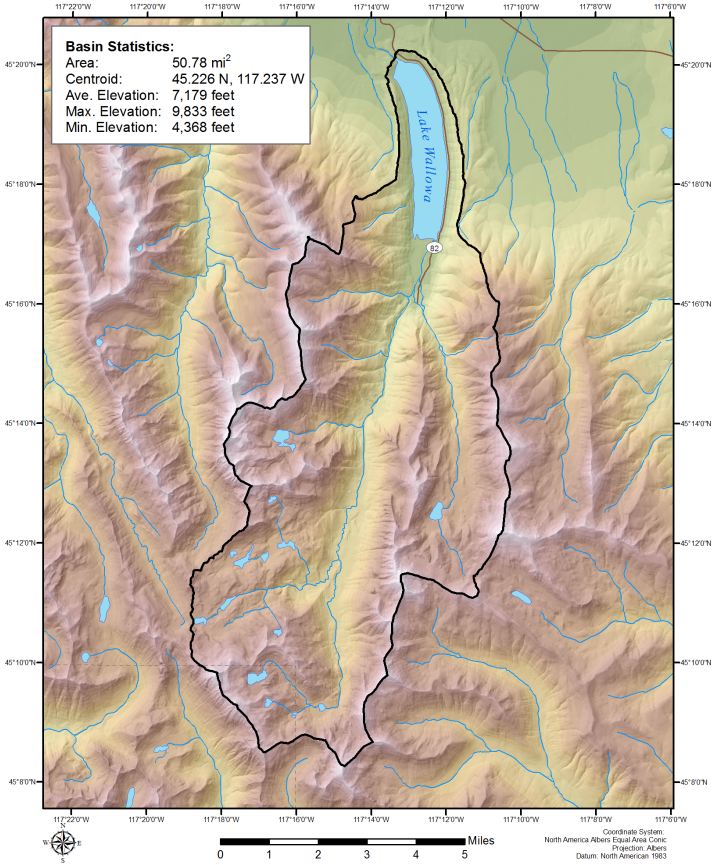


- Temporal pattern can make a big difference
- Utilize actual storm data for best information

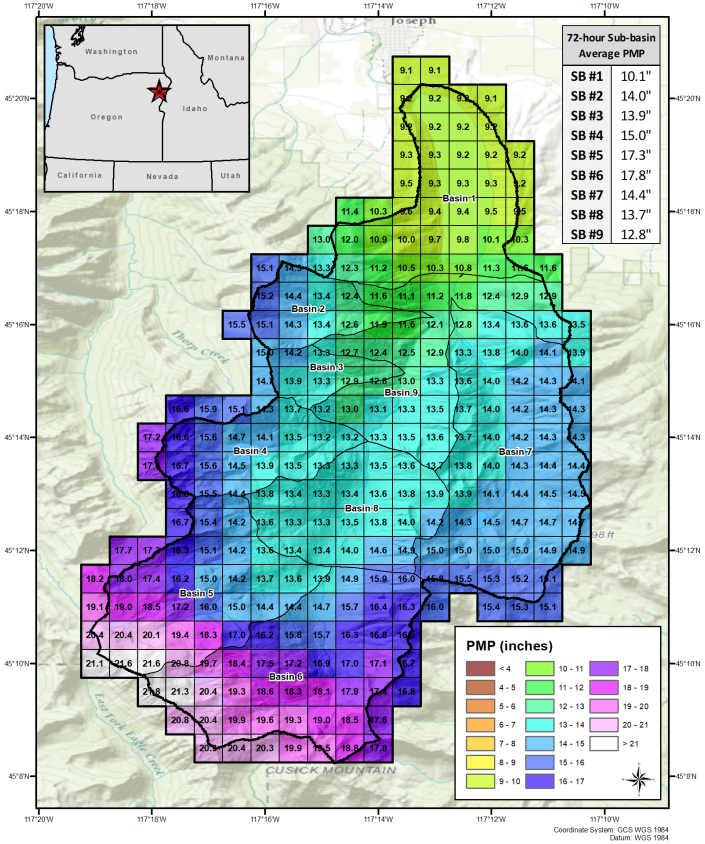


Example Results

Wallowa Lake Dam
Drainage Basin Statistics

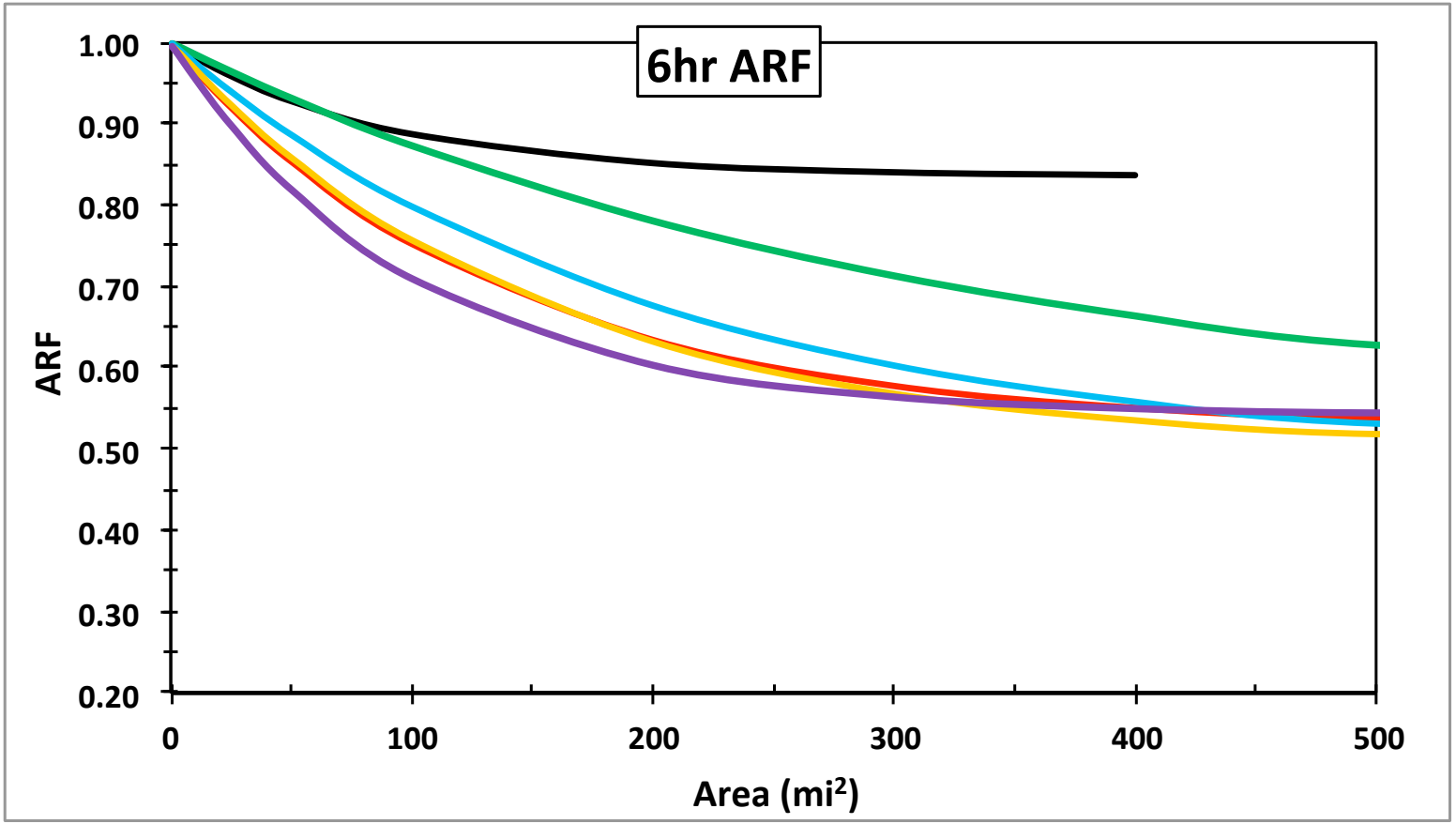


72-hour General Storm PMP (51 mi²)
Wallowa Lake Watershed



72-hour Sub-basin Average PMP	
SB #1	10.1"
SB #2	14.0"
SB #3	13.9"
SB #4	15.0"
SB #5	17.3"
SB #6	17.8"
SB #7	14.4"
SB #8	13.7"
SB #9	12.8"

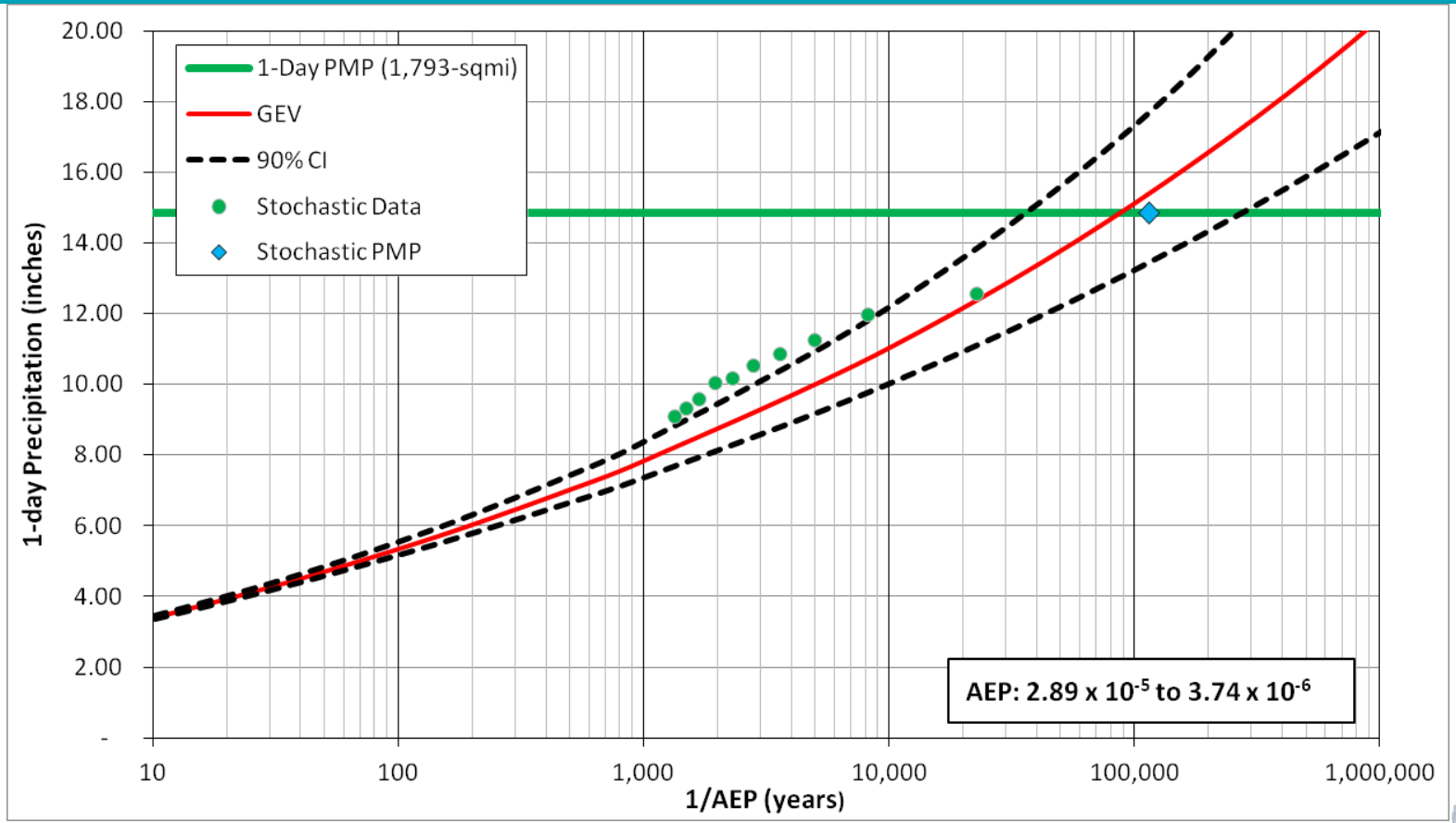
Site-specific Areal Reduction Factors



Annual Exceedance Probability

- Utilize two methods
  - Regional Lmoments
  - Stochastic Storm Transposition
  - Follows methods developed by USBR/USACE/NRC
  - Both utilize site-specific data
  - Storms, storm search domain, related station data, etc

Annual Exceedance Probability-Summary



Summary

- Reliable, reproducible, updated values

Consistent methods, reviewed and accepted processes

- Current/Future/Closure conditions
- Precipitation and meteorological data for more than just PMP
- Precipitation frequency: Probabilities: Depth-duration frequency
- Most importantly-more confidence in design/operations/regulatory processes
- Safety of lives/Safety of property

Questions

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Extra Slides