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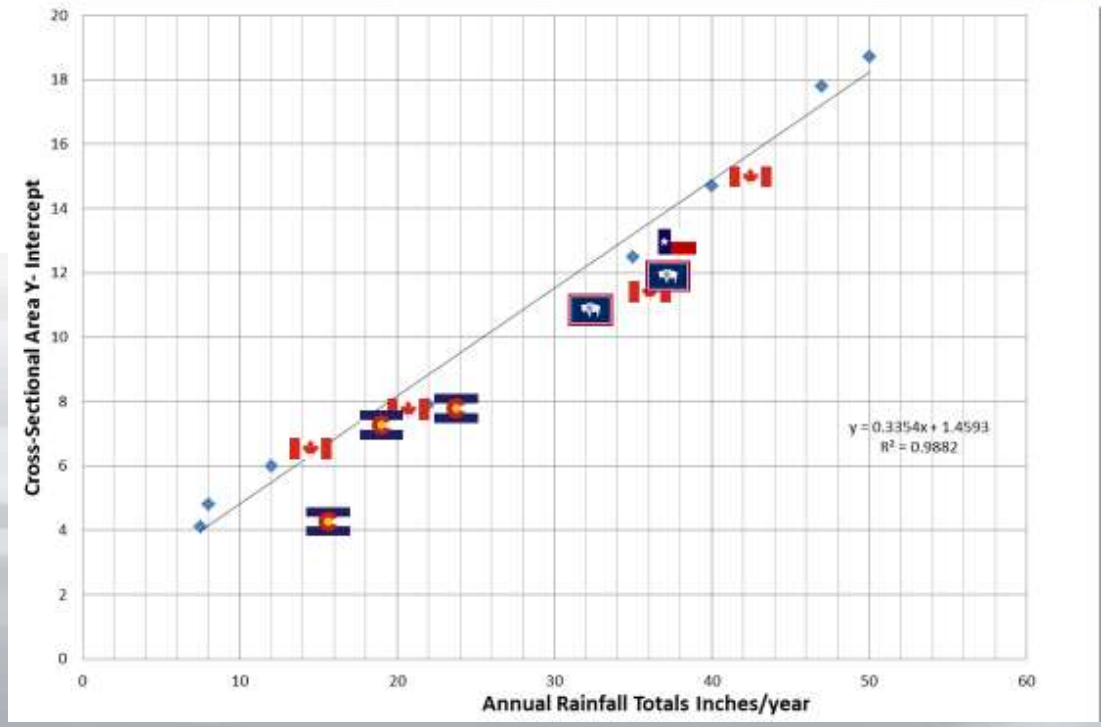
Precipitation-Driven Watershed Response Factor "C"

A New Tool for the Prediction of Hydraulic Geometry Relationships

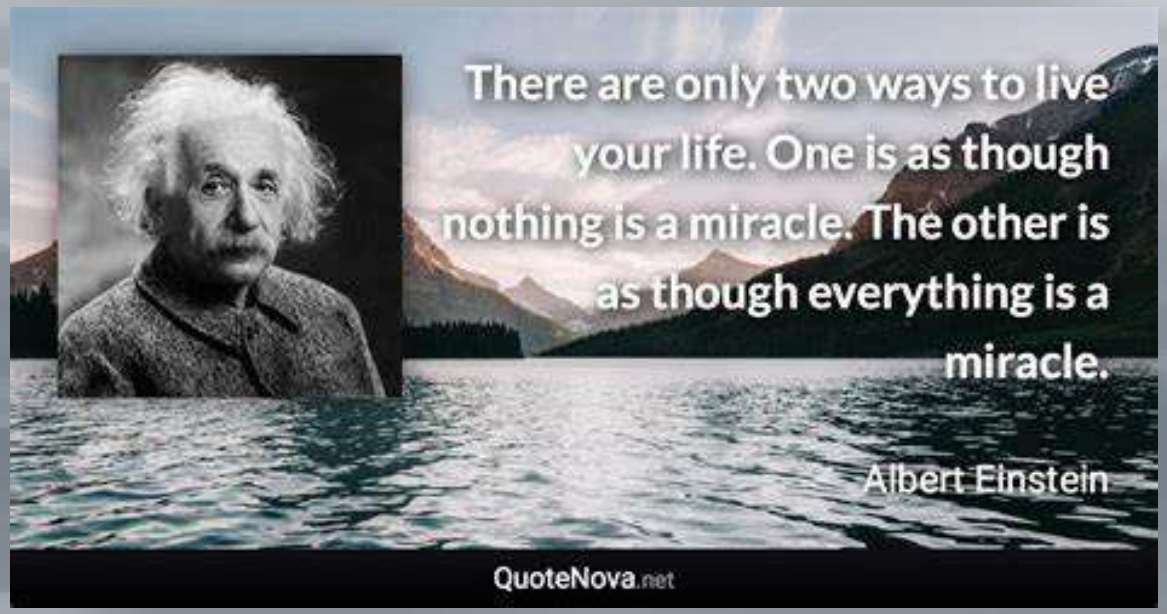


Tuesday August 2nd

8:50am

Presented By : David Bidelspach

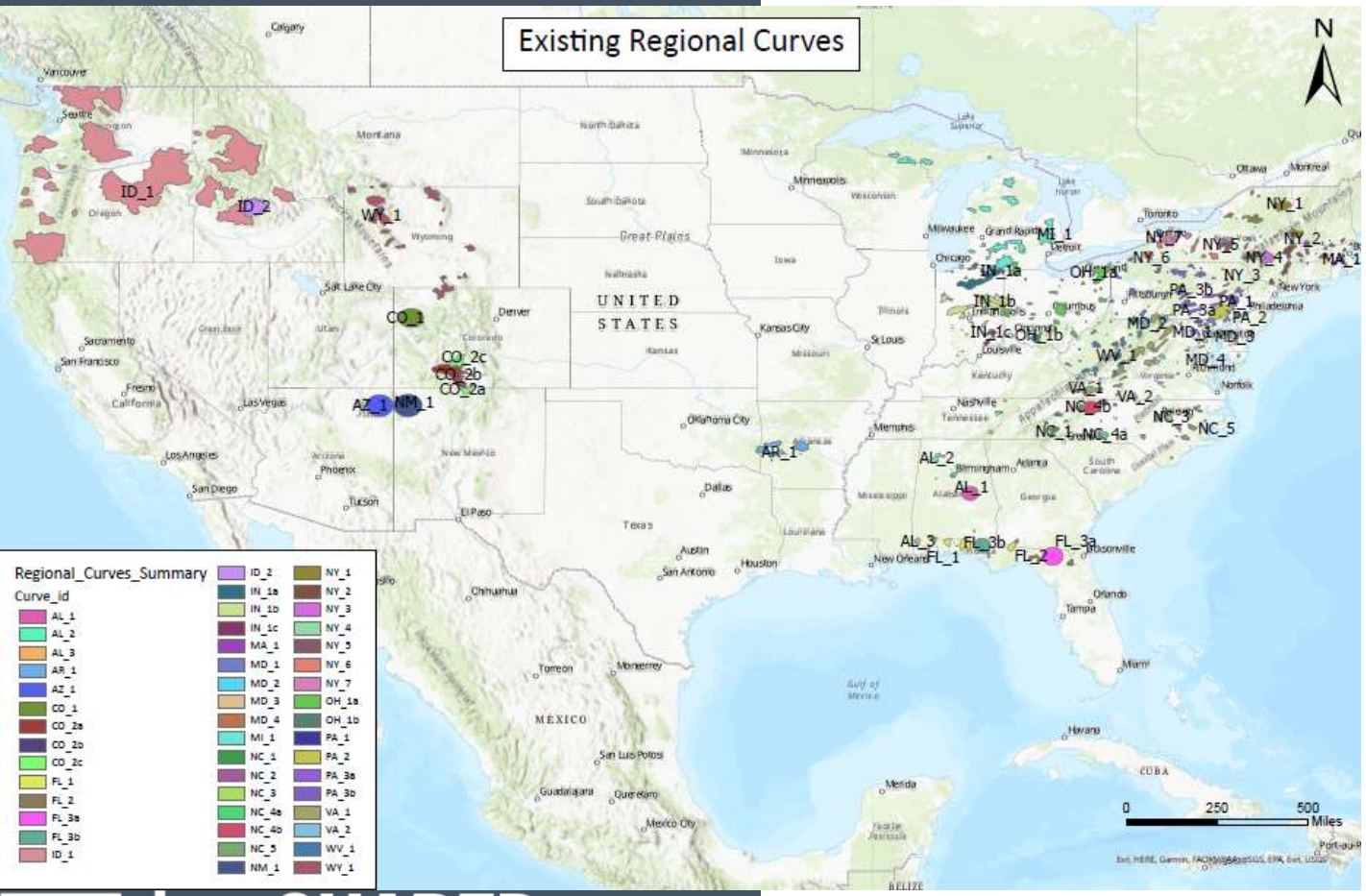
Greg Jennings, Mike Geenen and Ryan Baird



“C” = A_{BKF} /$DA^{0.68}$

Watershed Response Factor

CSU Department of Civil and Environmental Engineering - Baird 2022



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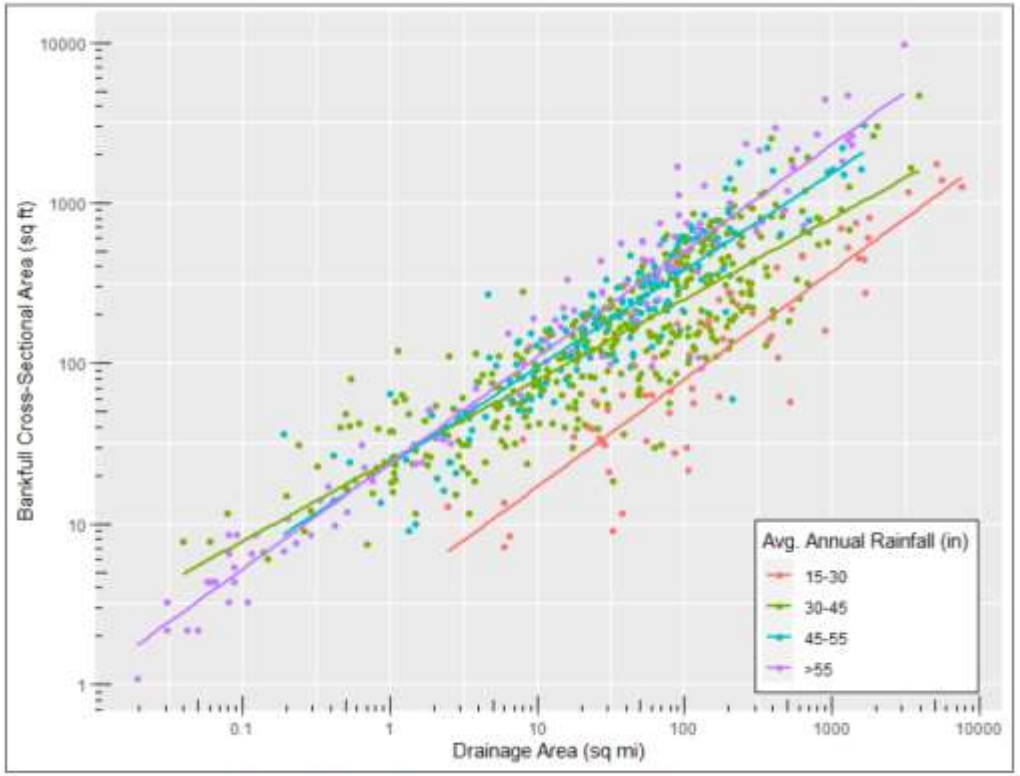

Figure 8. Rainfall-based regional curves with data points

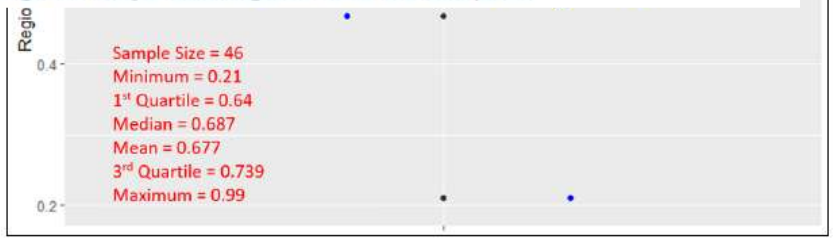

Figure 5. Existing regional curve regression slope distribution

Summer 2010 Geomorphic Assessment

- Northern Routt County Colorado
- Greenback Cutthroat

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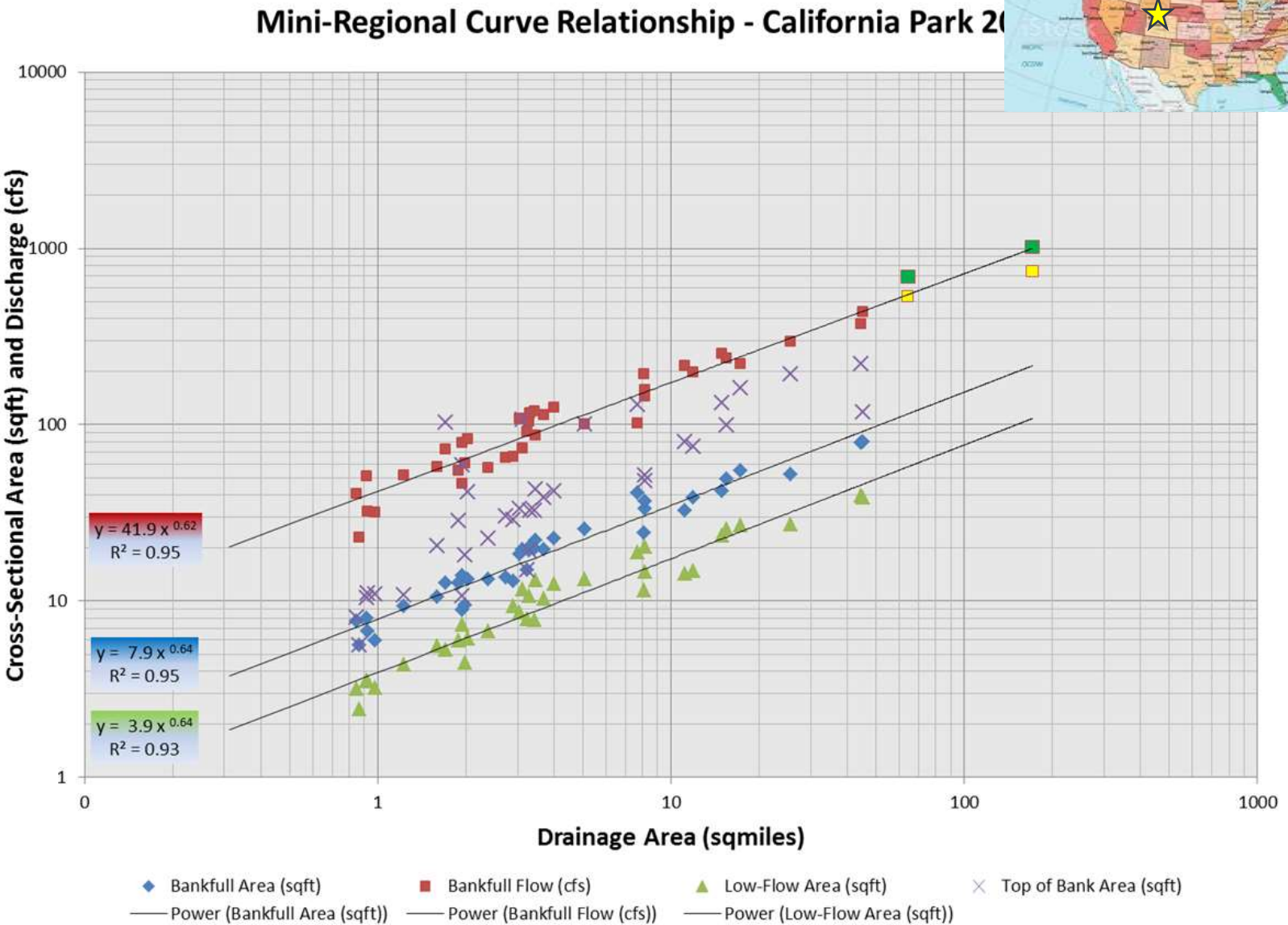

Fall 2010
Geomorphic Assessment

- Mayo Yukon Territory Canada
- Artic Grayling

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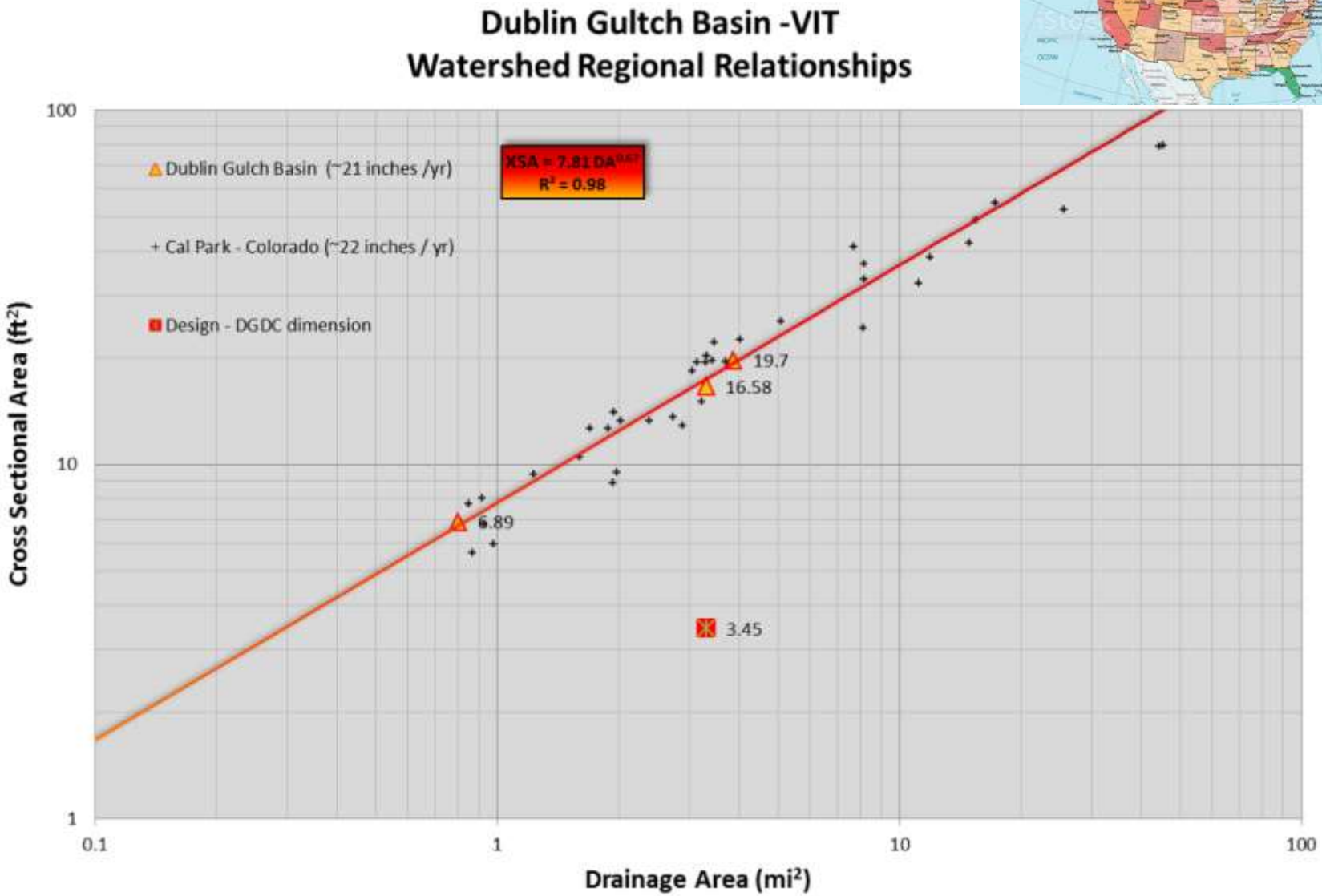
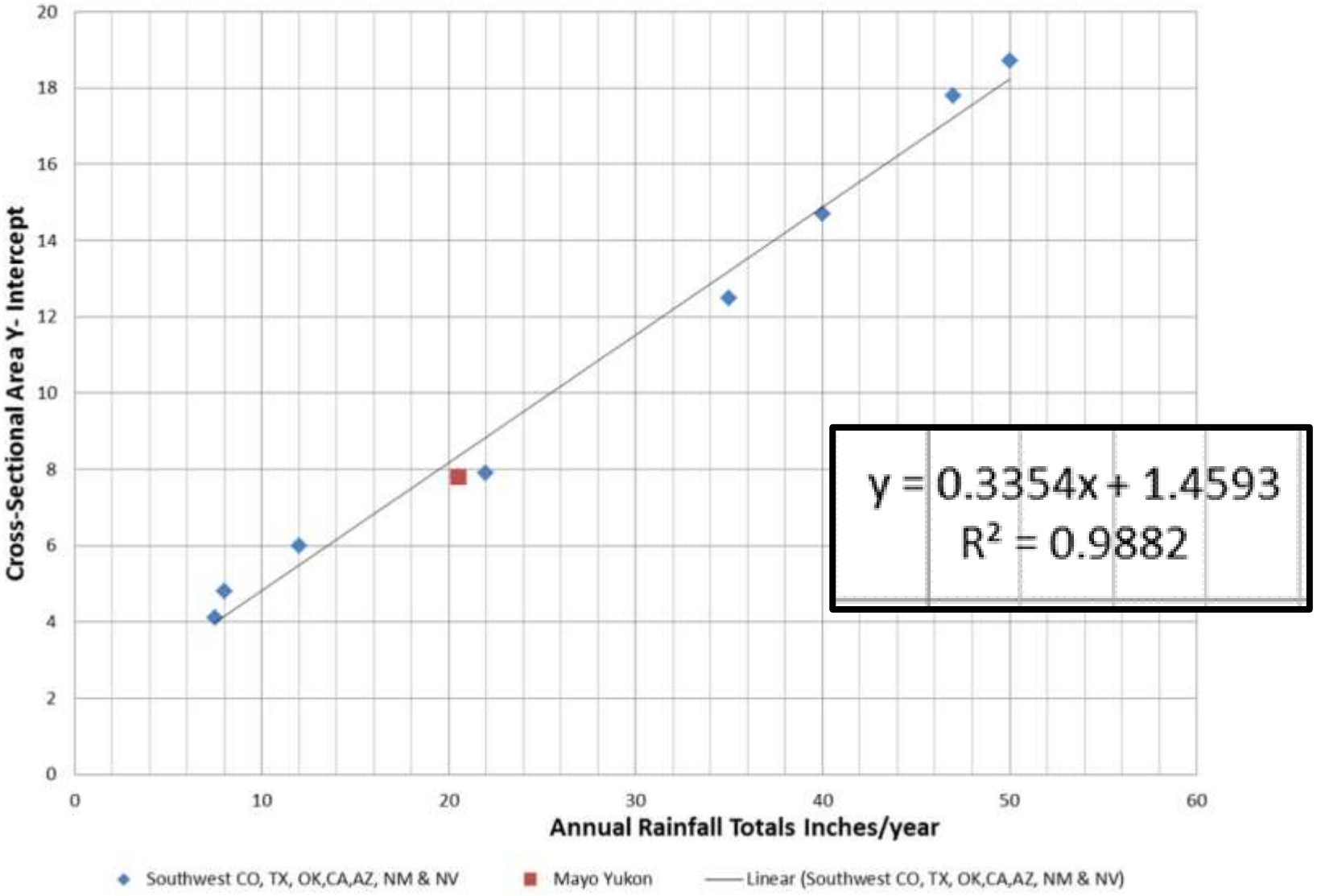


"C" = A_{BKF} /$DA^{0.68}$

Regional Curve Intercept - WRF

- What could affect the WRF
  - ***Rainfall***
    - Precipitation
    - Intensity
    - Slope
    - Watershed Area
    - Runoff
    - % Impervious
    - Geology
    - Basin Transfer
    - Dams
    - Etc.



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Synthesizing a Regional Curve

-From Precipitation

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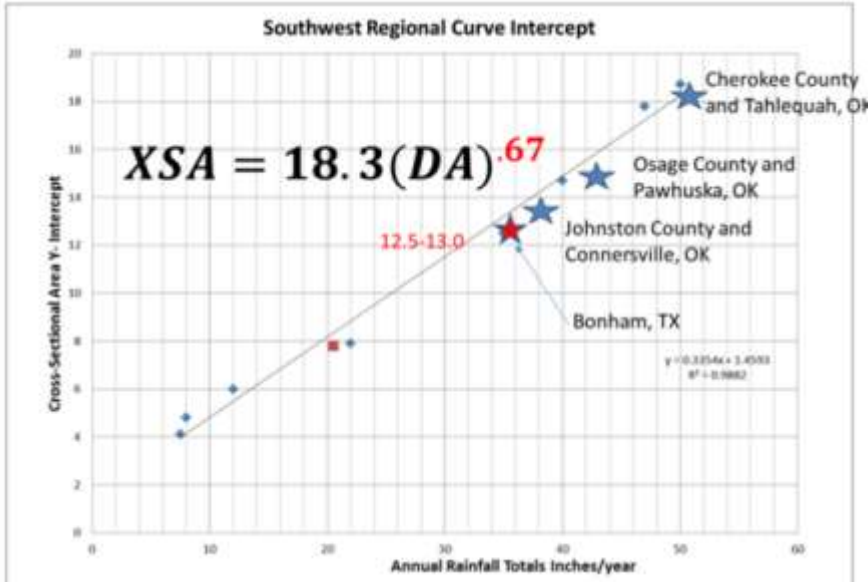
- What if we could get “close” to design channel Dimension without a Regional Curve
- Oklahoma and Texas (Tulsa District USACOE) 2010 -2021
- What Effects the WRF
  - Rainfall
    - Slope
    - Watershed Area
    - Runoff
    - % Impervious
    - Geology



Published Oklahoma Regional Curve

Russ Dutnell, OU

- R^2 0.62-0.77

Regression is not great

- Slope 0.39 - 0.42

Average Baird (2022) = 0.68

- Y Intercept “C”

44.6 – 46.5

Average Baird (2022) = 23.6

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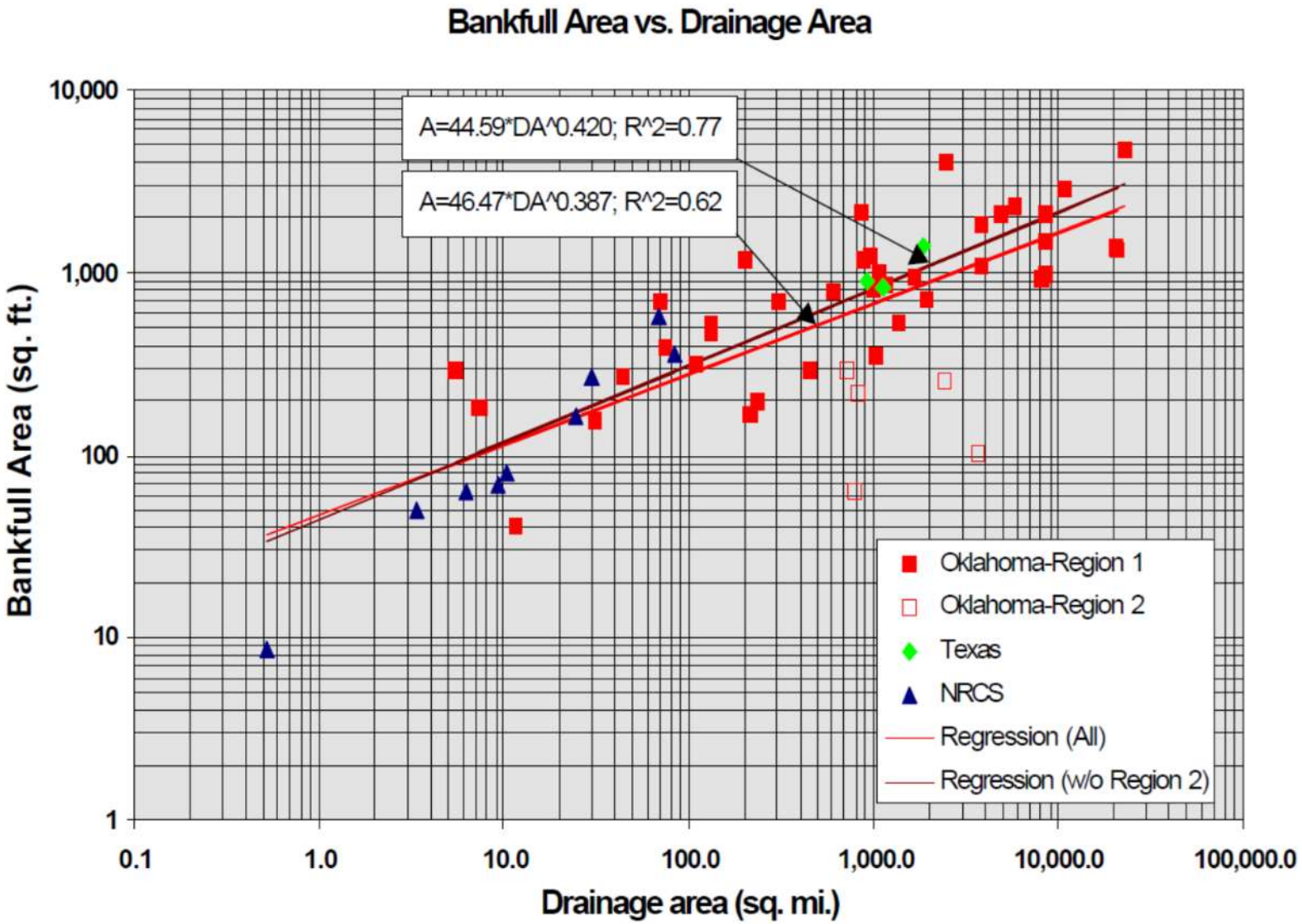

Fall 2010
Geomorphic Assessment

Oklahoma OCC – Tahlequah

- R^2 0.99

Regression is questionable

- Slope ~0.63

Average Baird (2022) = 0.68

- Y Intercept “C”

~18.5

Average Baird (2022) = 23.6

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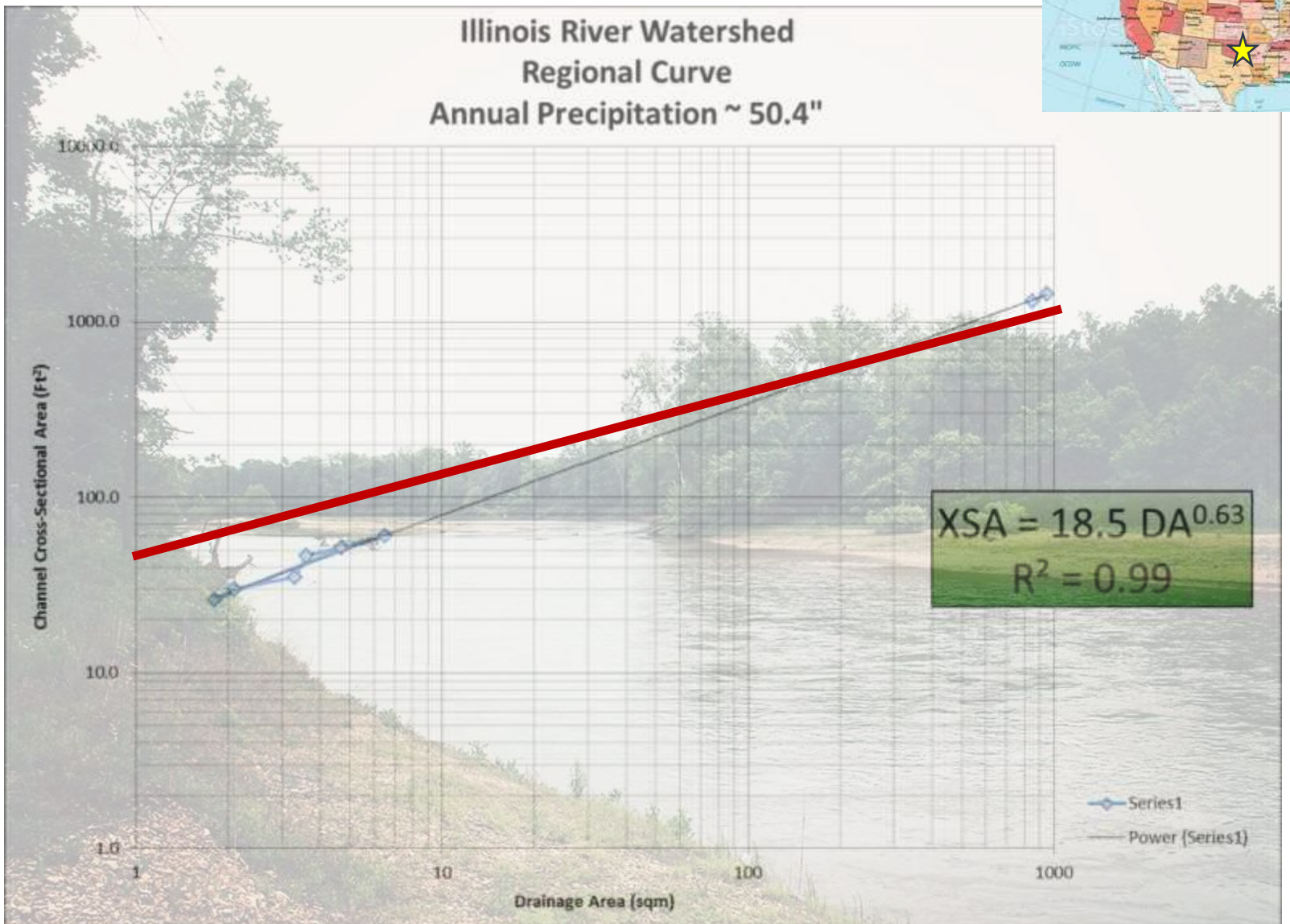

Fall 2011
Geomorphic Assessment

Oklahoma TNC - Pawhuska

- R^2 0.92-0.98

Regression is better

- Slope ~0.61

Average Baird (2022) = 0.68

- Y Intercept “C”

~14.7

Average Baird (2022) = 23.6

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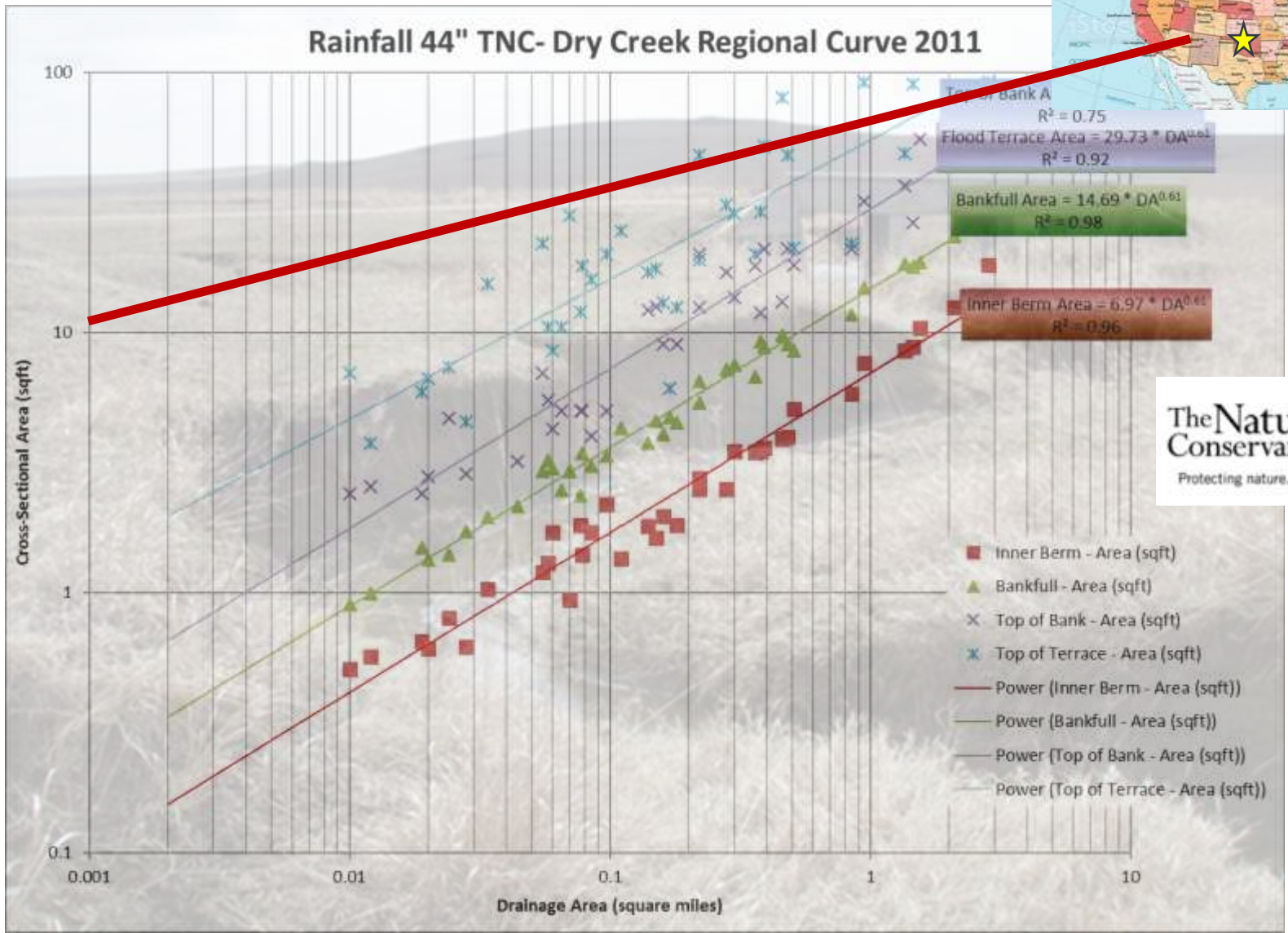

The Nature Conservancy
Protecting nature. Preserving life.

Fall 2016
Geomorphic Assessment

Oklahoma TNC - Connersville

- R^2 0.83-0.92

Regression is ok

- Slope ~0.61 – 0.68

Average Baird (2022) = 0.68

- Y Intercept “C”

~13.8

Average Baird (2022) = 23.6

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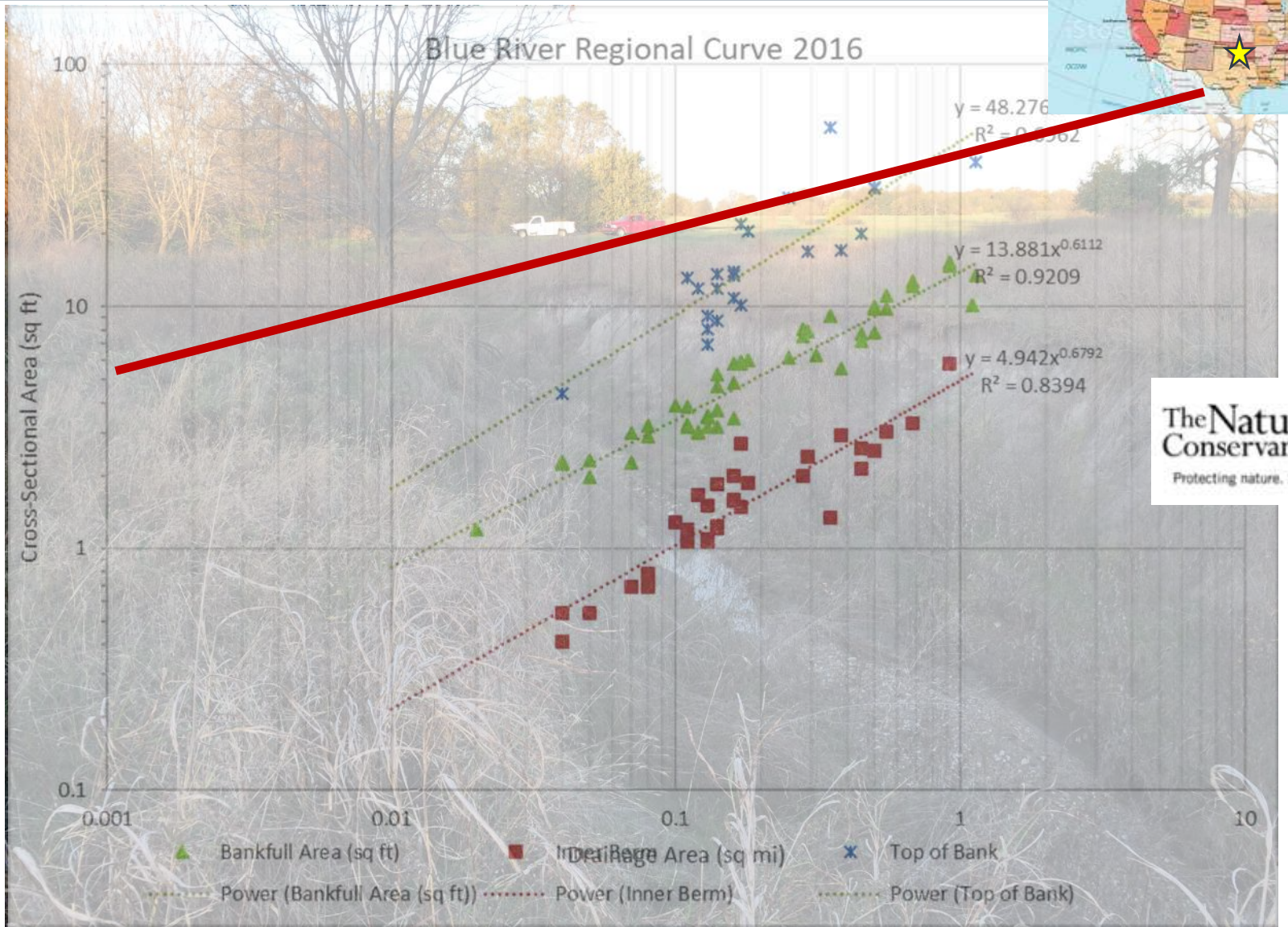


The Nature Conservancy
Protecting nature. Preserving life.

Spring 2018
Geomorphic Prediction based on WRF

North Texas Water– Riverby Texas

- R^2 N/A

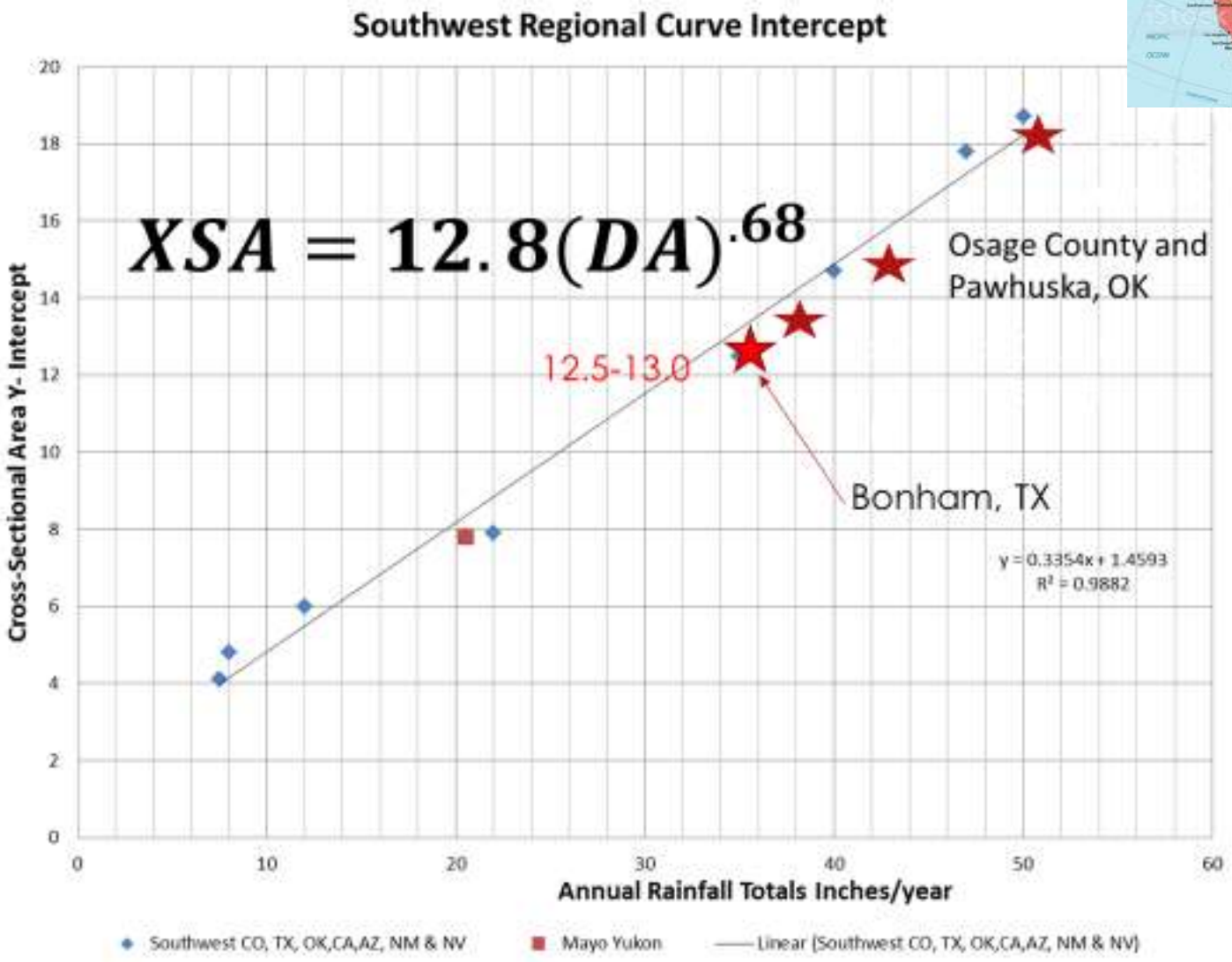
- Slope ~0.68

Average Baird (2022) = 0.68

- Y Intercept “C”

~12.8

Average Baird (2022) = 23.6



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Oklahoma and Northern Texas

- Tulsa District USACOE

- Bankfull channel cross-sectional area at streams ~10 square mile and below is 25% - 33% of the prediction from the Oklahoma regional curve

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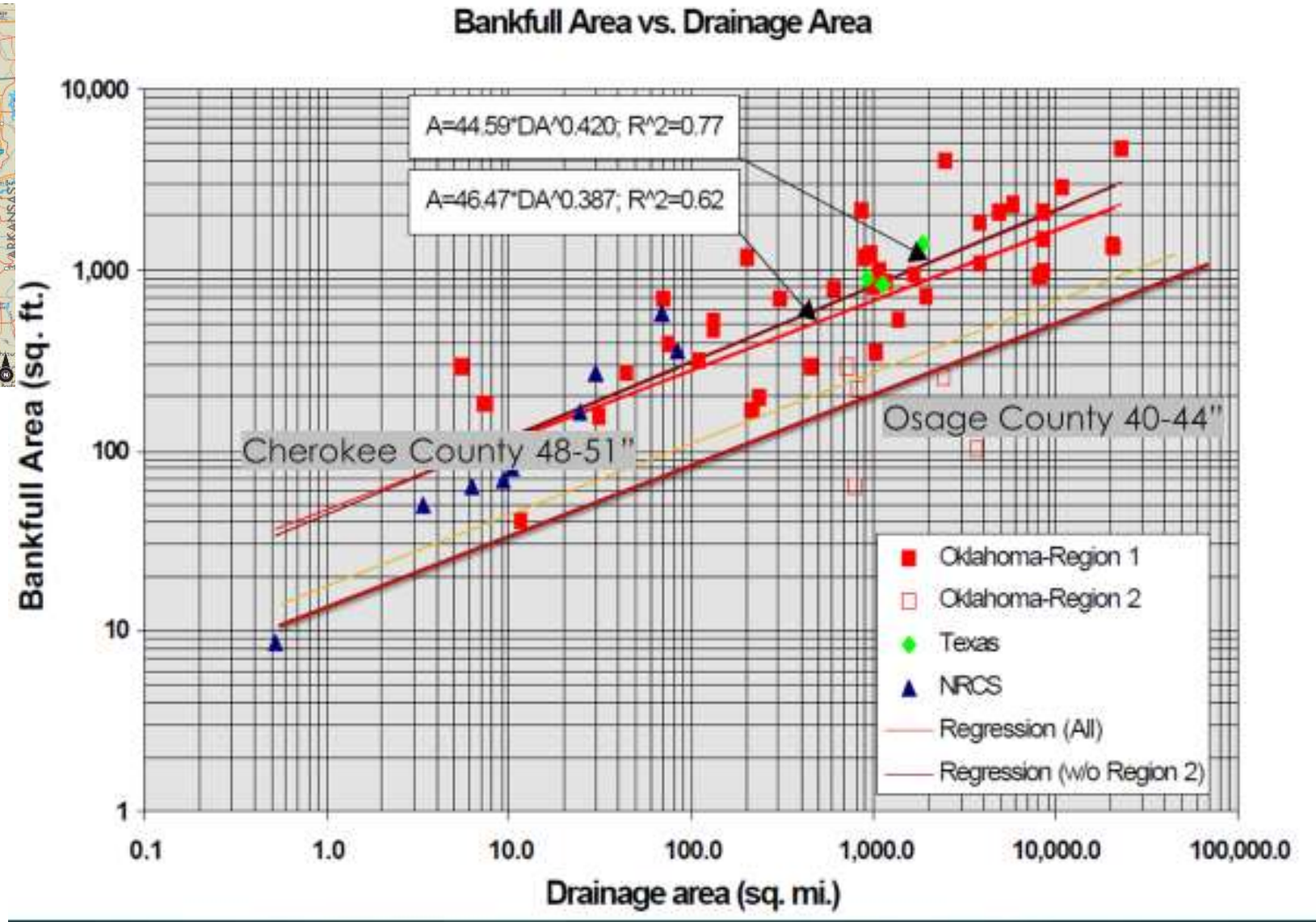

Riverby Ranch – RES 2018

- Prediction based on WRF
- Spring 2018
  - $A_{BKF} = 12.8 * DA^{0.68}$
- Mini-Regional Curve
- Fall 2018
  - $A_{BKF} = 13.1 * DA^{0.60}$

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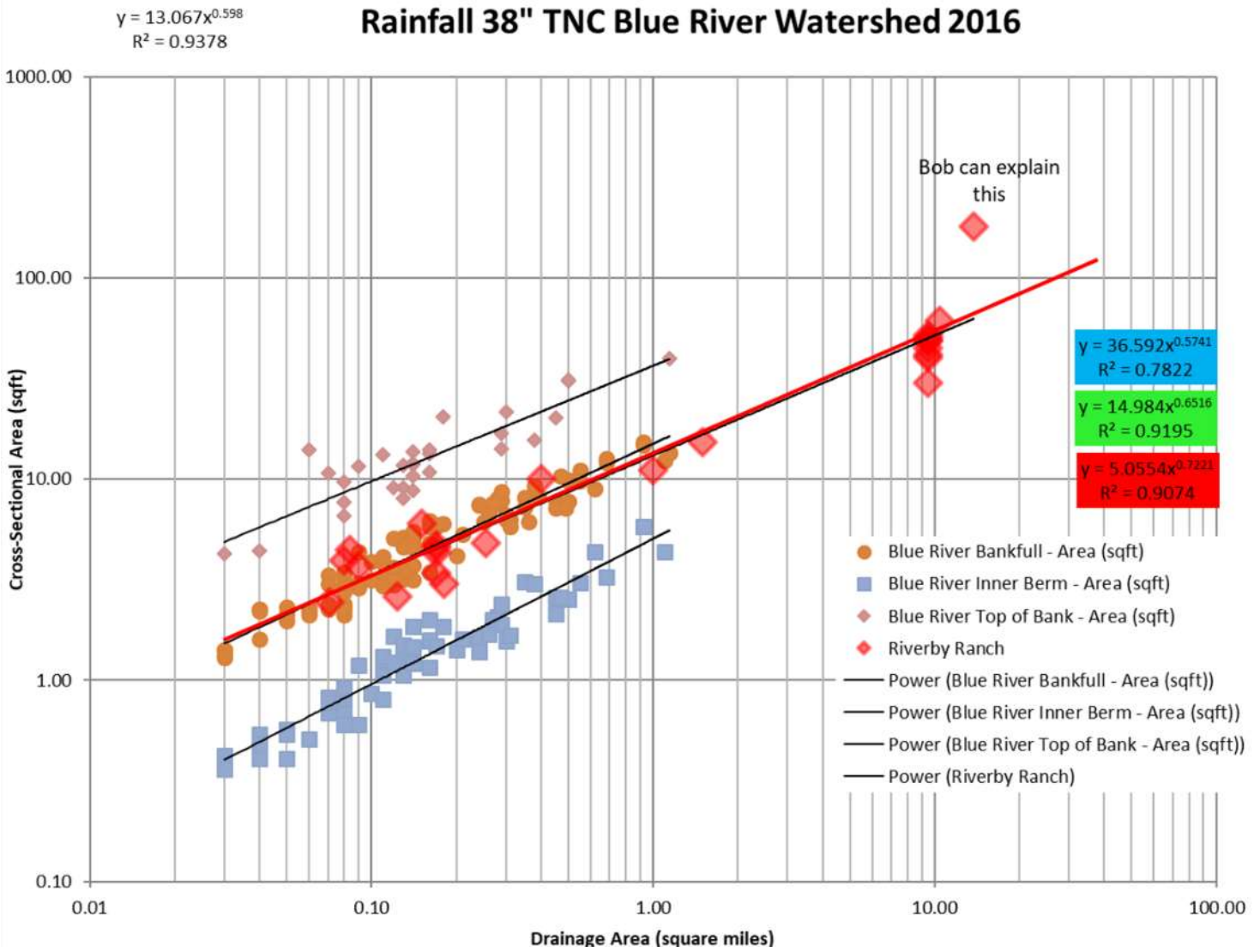


shed Response Factor vs. Annual itation

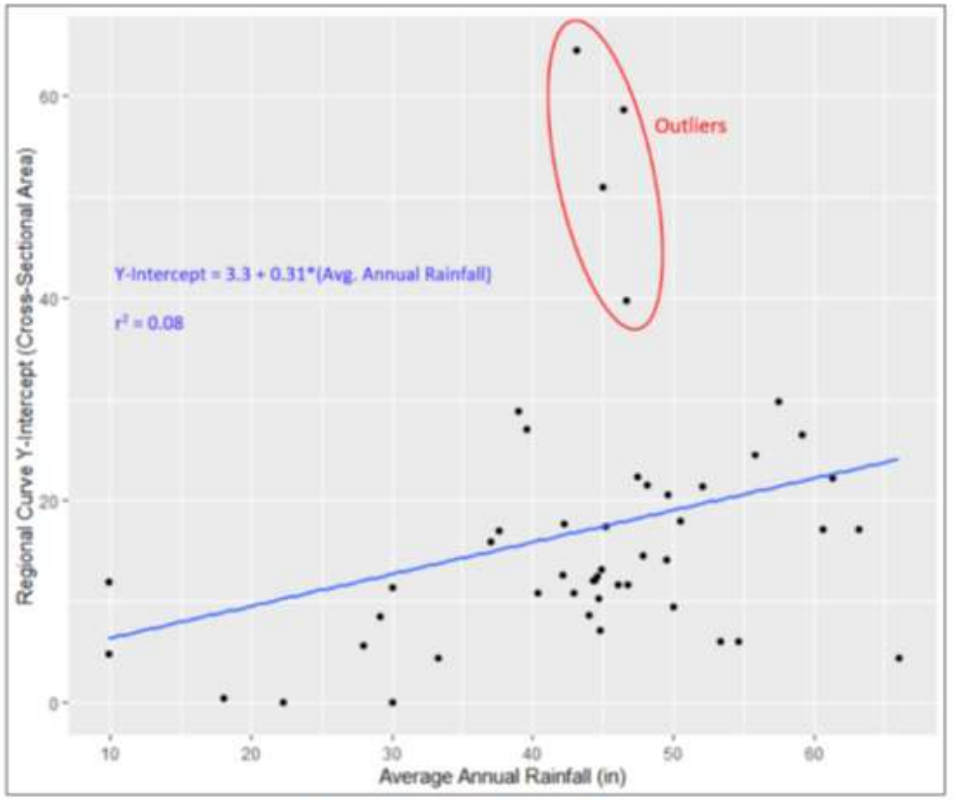
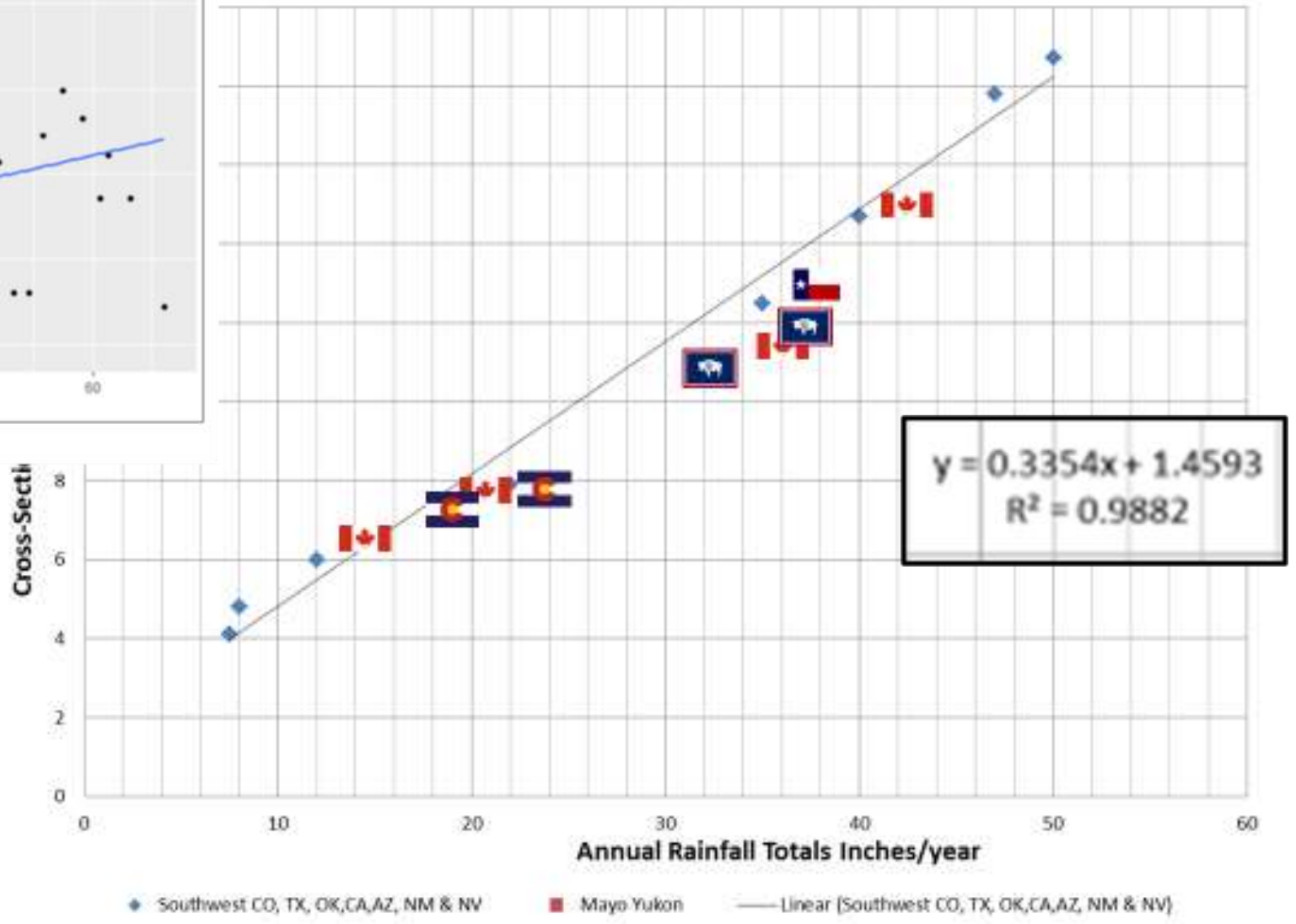


Figure 6. Watershed Response Factor

- Baird 2022 (CSU)



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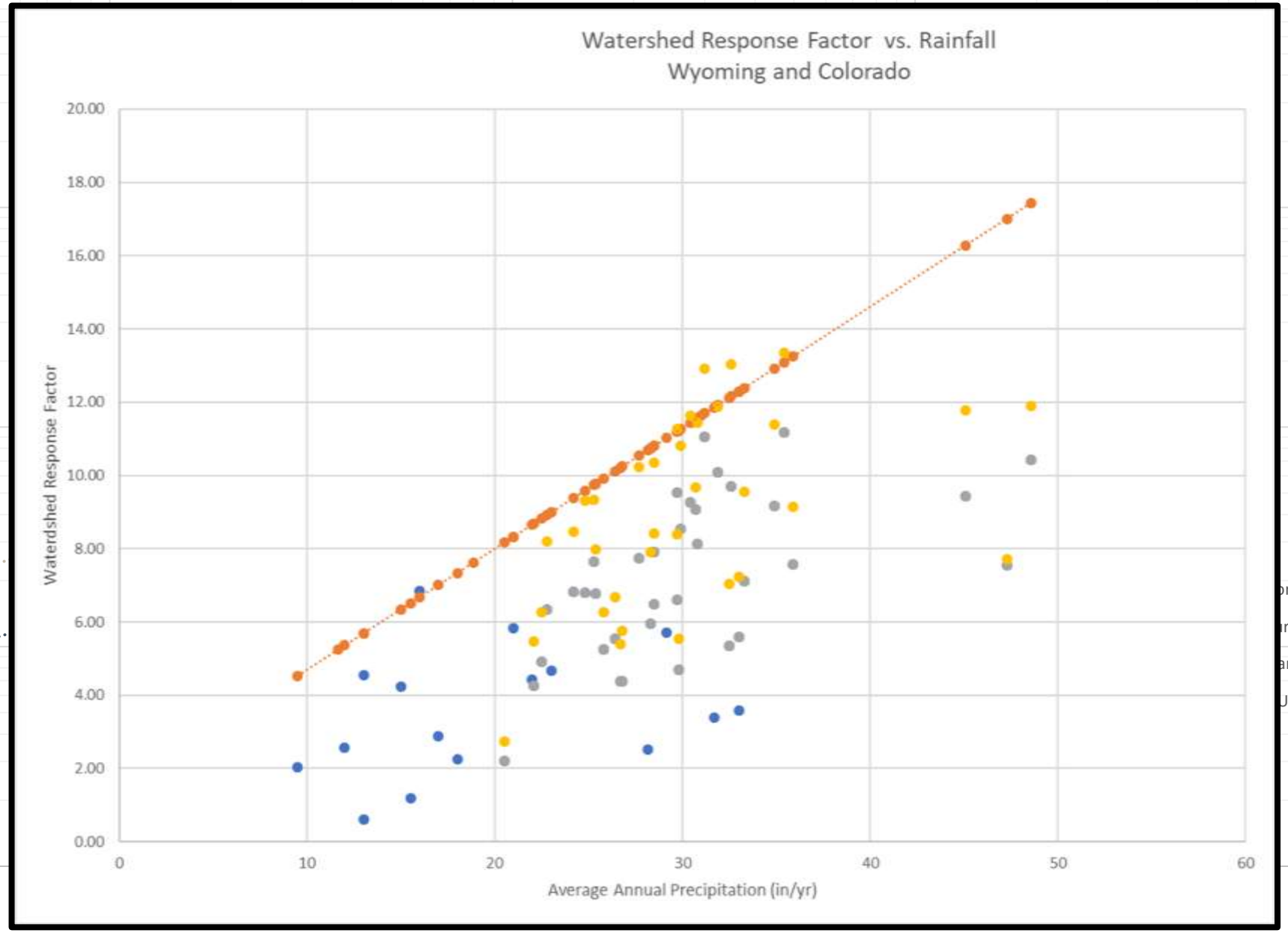
Wyoming and Colorado - Bankfull Regional Curve



Bankfull Cross-Sectional Area ft²

10000
1000
100
10
1
1
10000

orado Data
rve Data
and Colorado Data)
USGS Curve Data)

Watershed Response Factor

- Next
  - CO/WY Diversion
  - CO/WY Transfers
  - Canada
  - Uganda
  - Costa Rica
  - Sri Lanka
  - Your Suggestion

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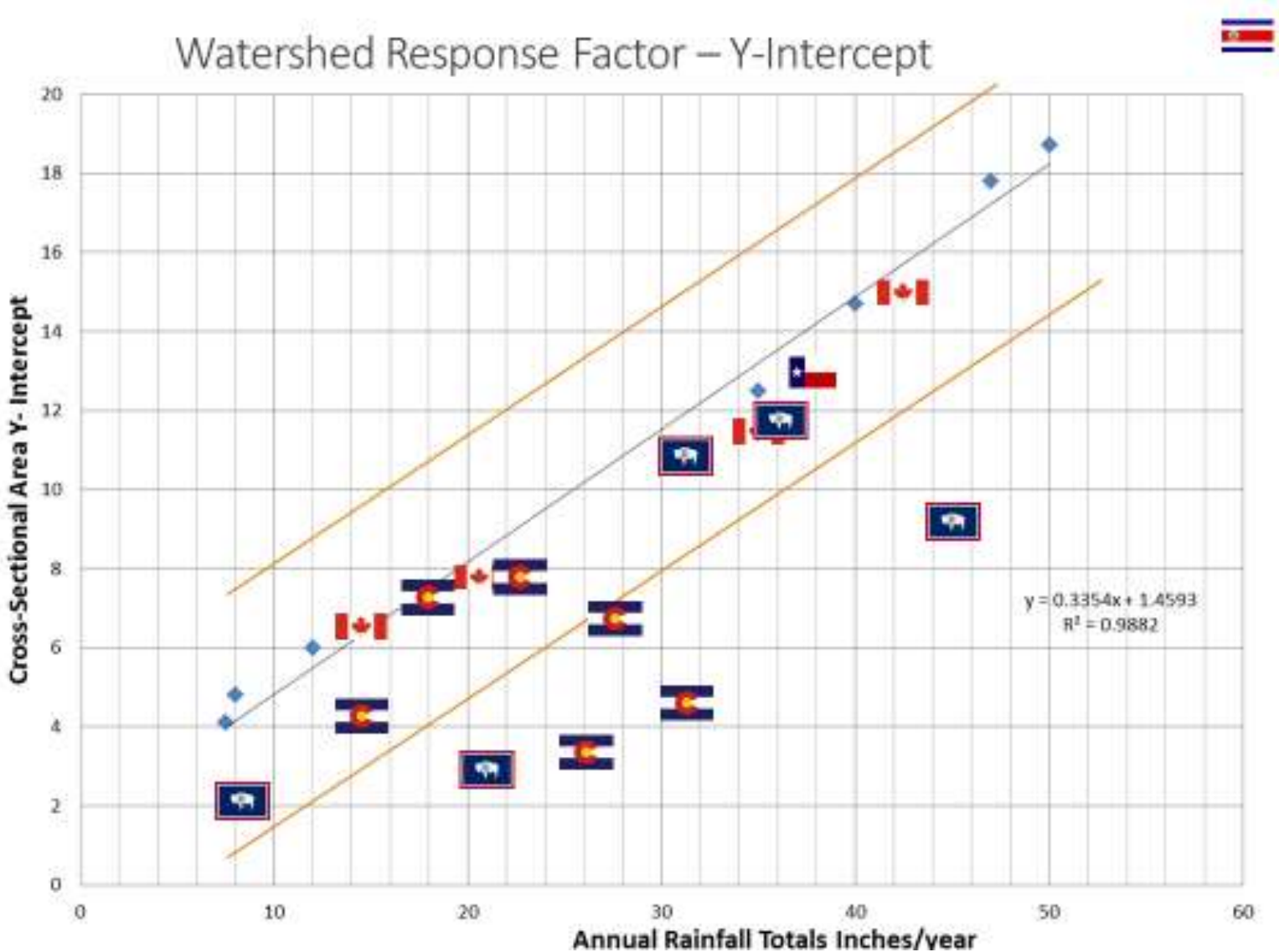
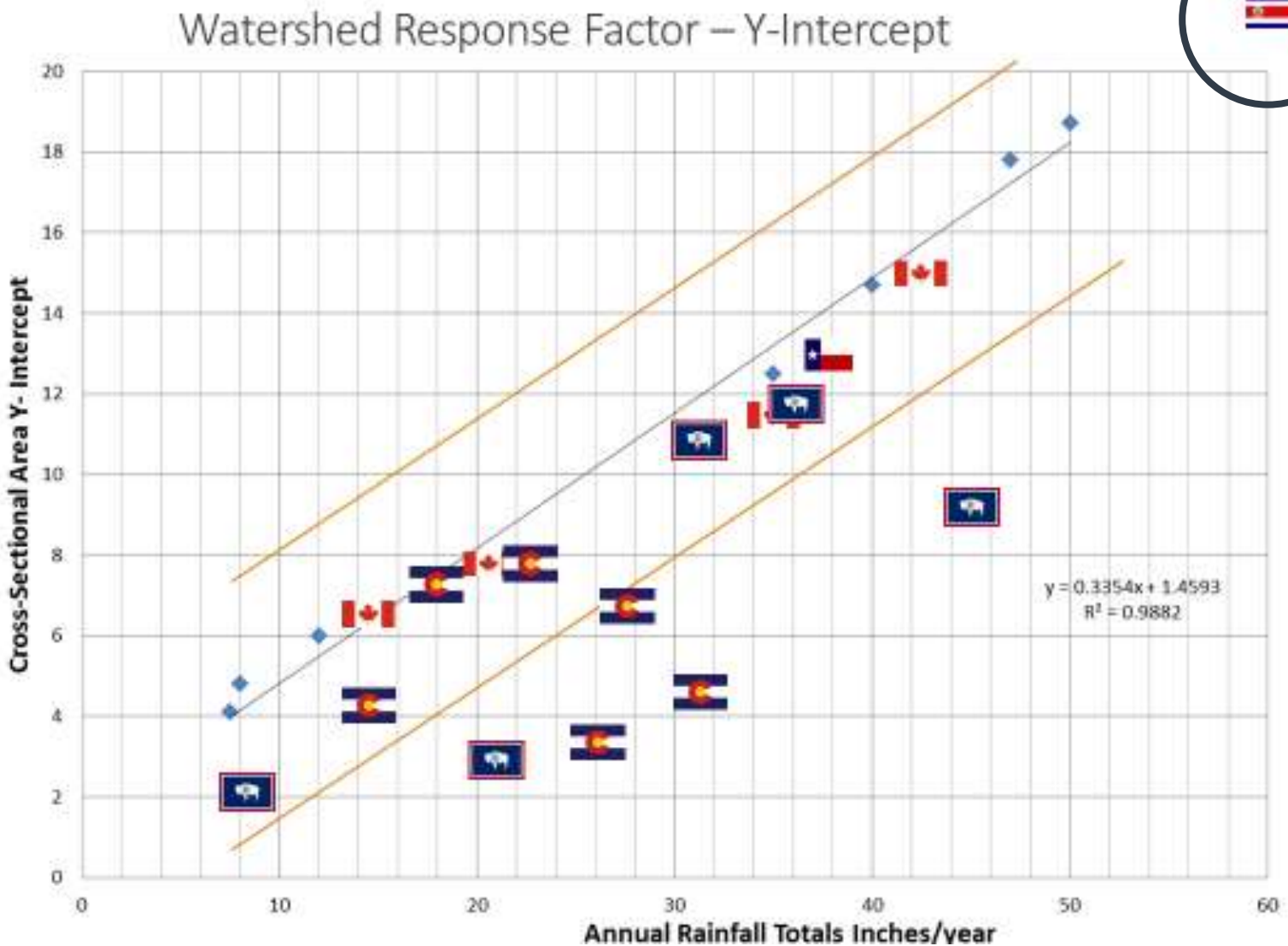


Example - River Grande de Orosi

- Next
  - Costa Rica
  - Your Suggestion



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River Grande de Orosi

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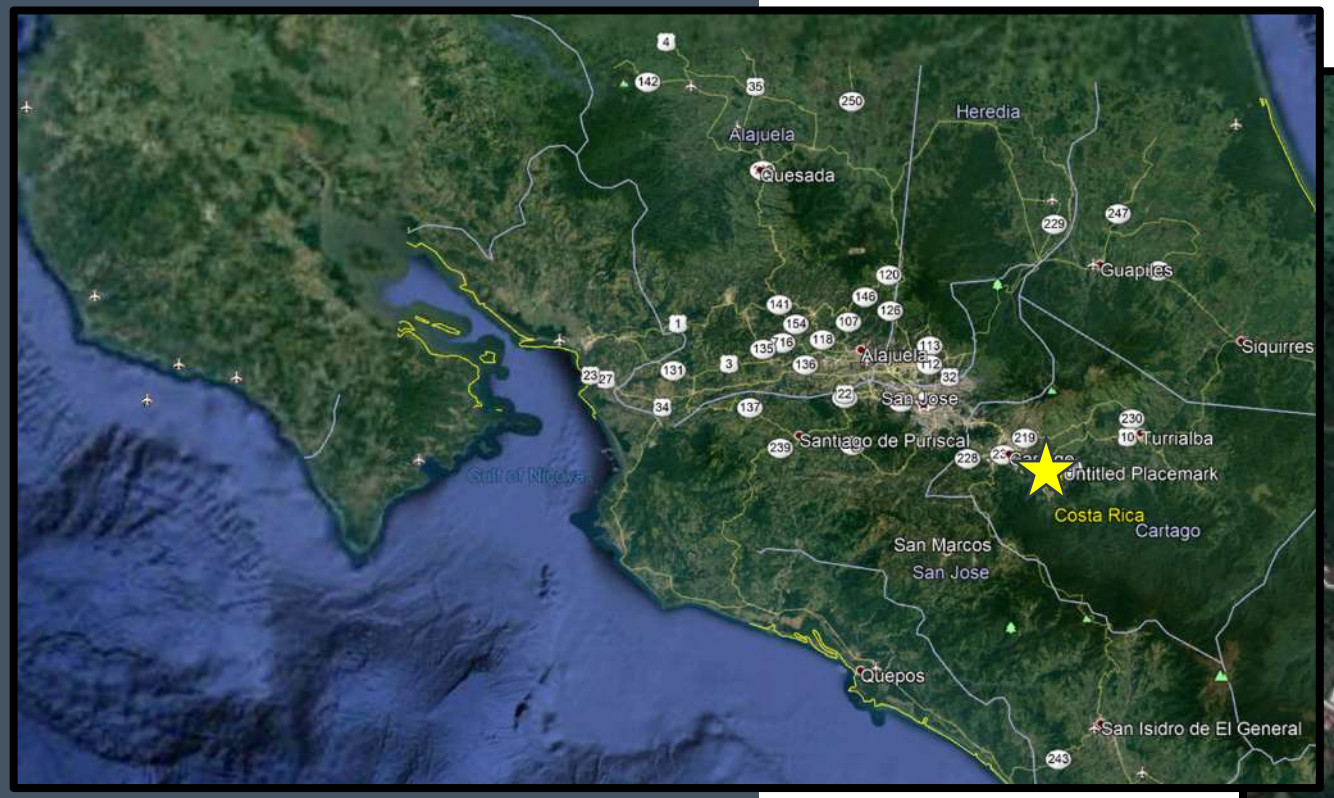
Engineers Mission International

- www.emiworld.org



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2009-2018

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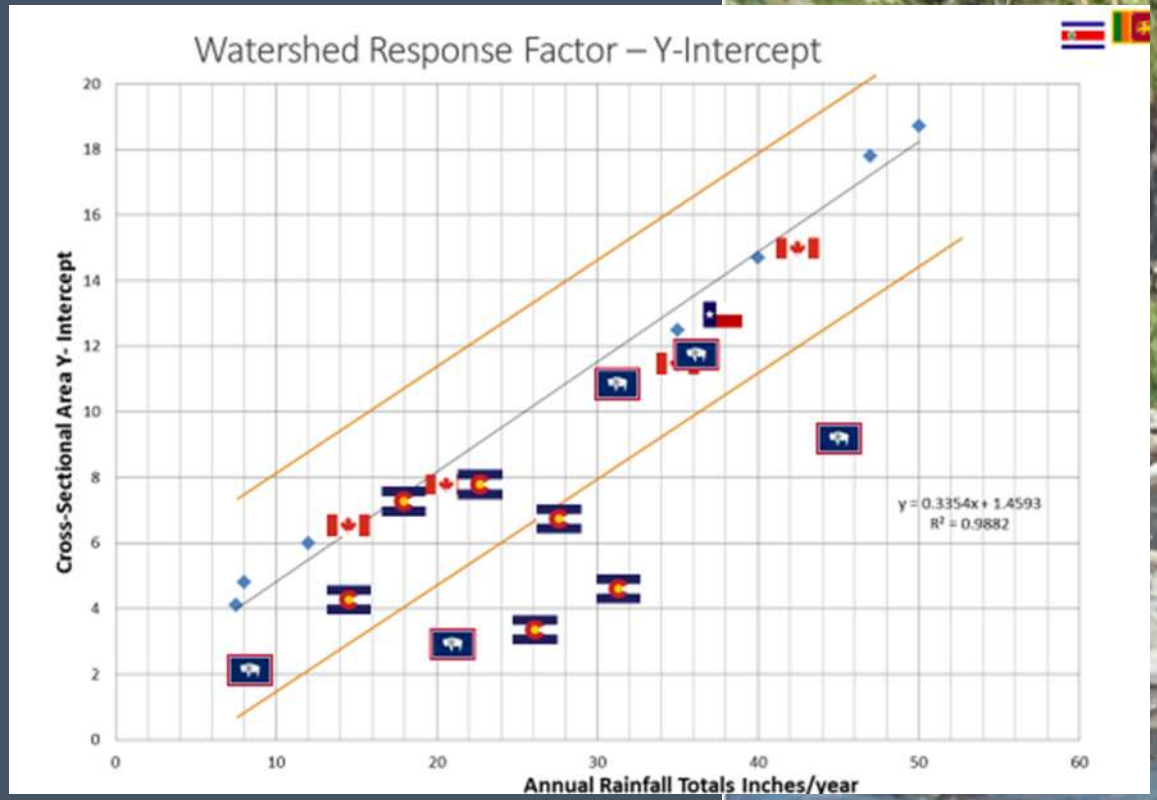
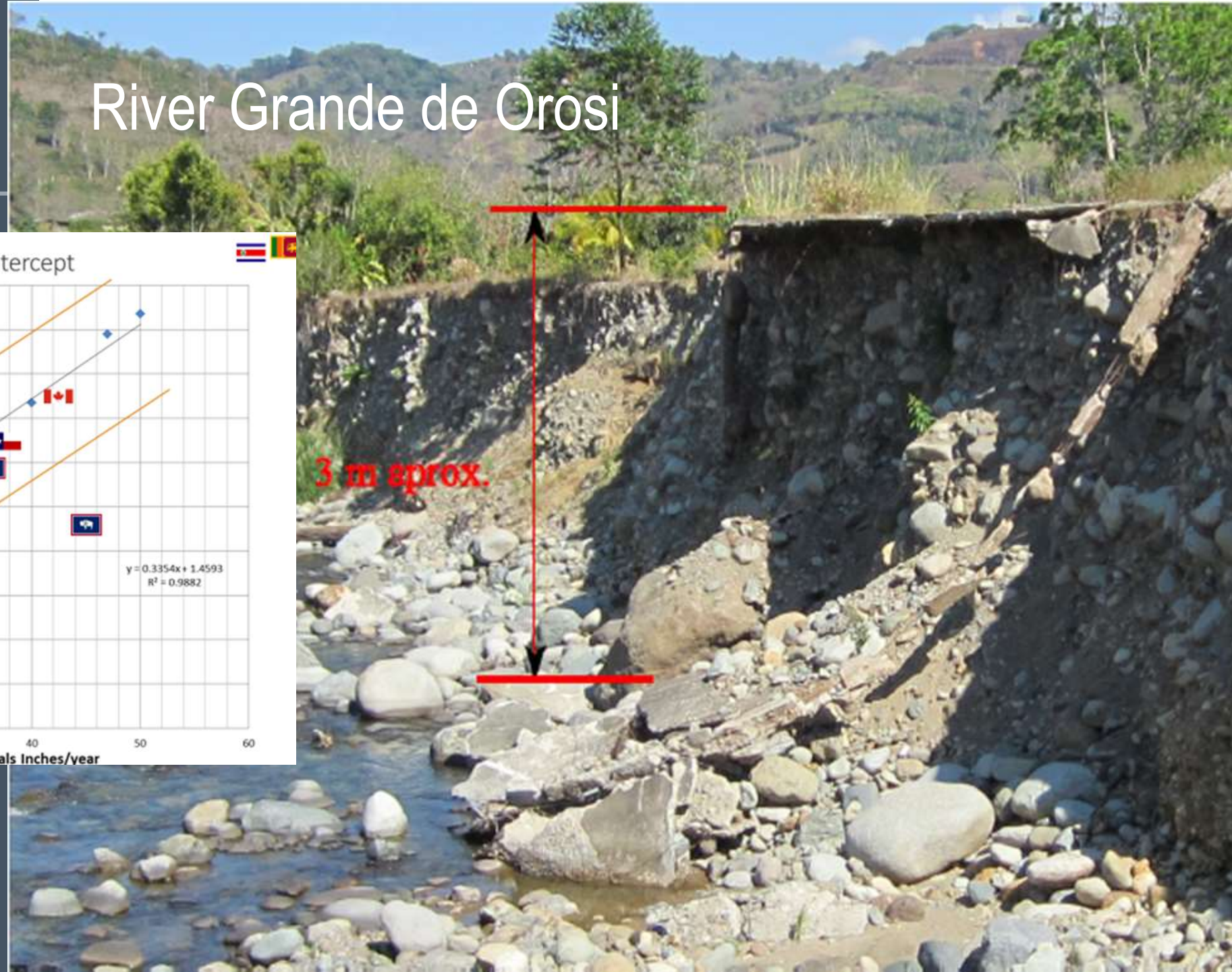
River Grande de Orosi





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Precipitation-Driven Watershed Response Factor “C”

— A New Tool for the Prediction of Hydraulic Geometry Relationships

Summary:

- Watershed Response Factor as a geomorphic indicator
- Compare relationships to published USGS Regressions as well as other bankfull regional curves
- Regional curve development for new regions of the Southwest US should always be compared to existing data as a reference
- The Y-intercept is strongly dependent on Rainfall
- Localized mini-regional curves can be used for design purposes
- The 46 single-variate regional curves were used to develop equations applying the Watershed Response Factor methodology.
- The resulting WRF equation is similar to an equation developed by RiverSHARED which adds validity to the approach.

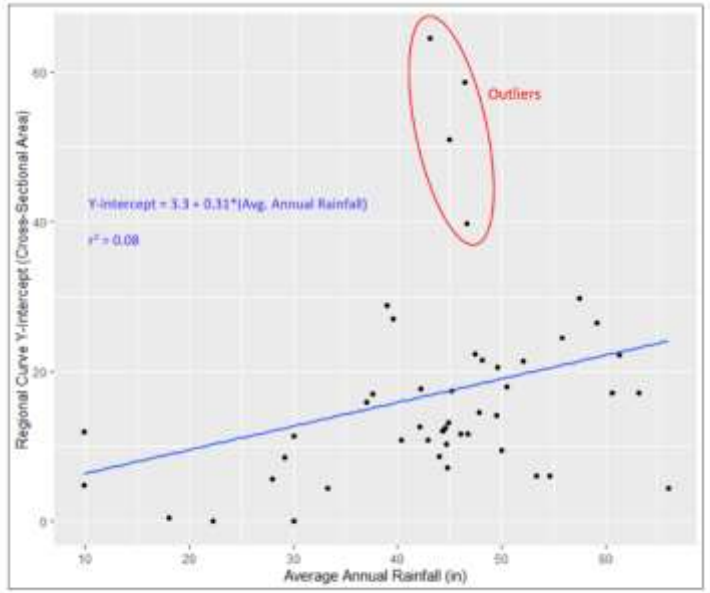
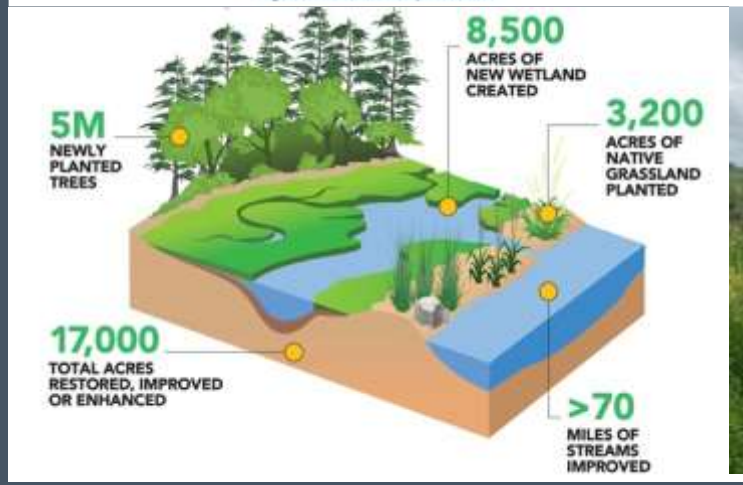


Figure 6. Watershed Response Factor



Additional research should be conducted to apply this methodology to a larger dataset

Questions ?

Comments !

Thank you for your time

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919-218-0864

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