



A NEW PERSPECTIVE IN STORMWATER MANAGEMENT



HELM

Holistic Engineering and Land Management

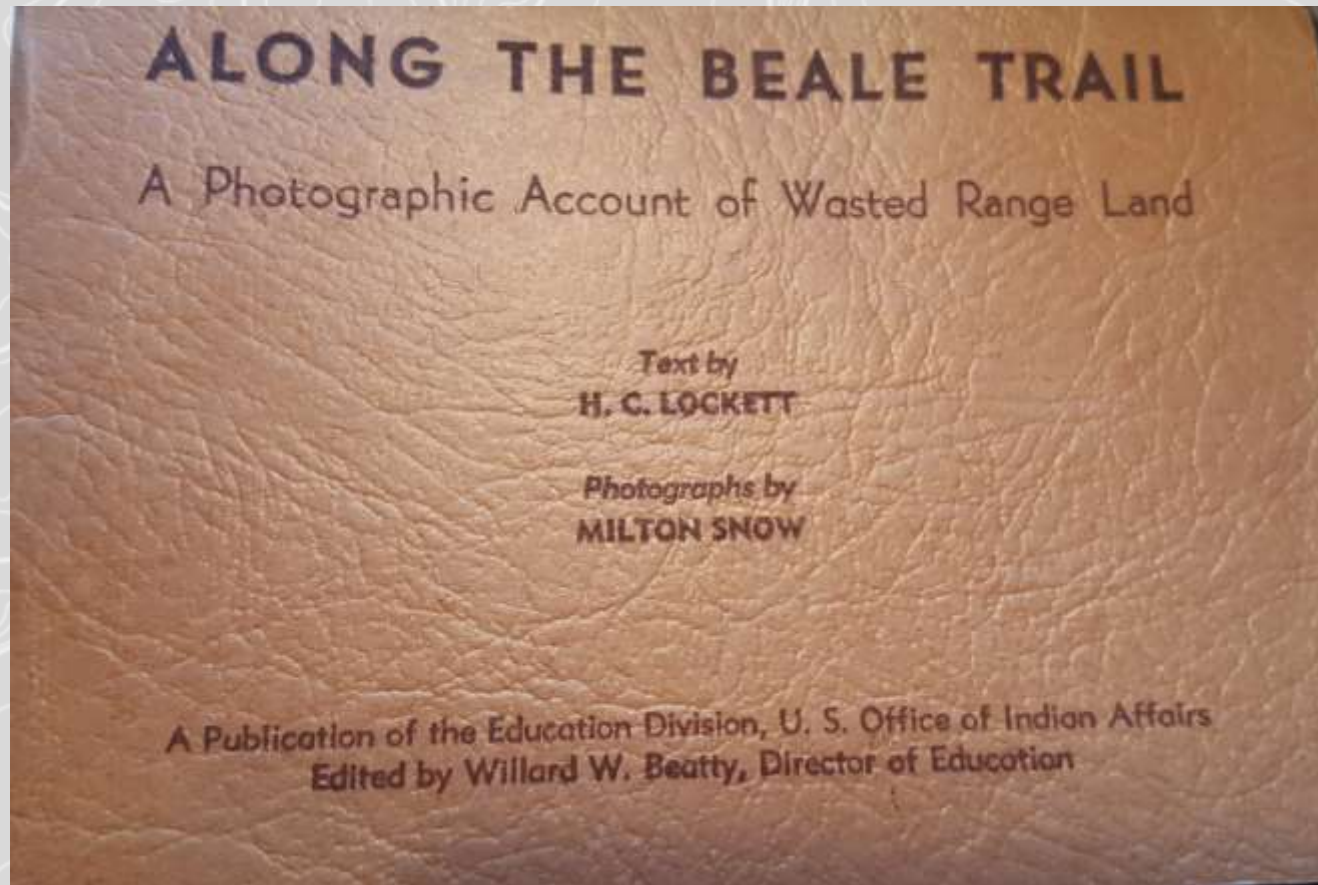
OVERVIEW

- **My Background**
- **Historic Conditions vs Current Conditions**
- **Brittleness Scale**
- **Non-Effective and Effective Water Cycles**
- **Benefits of Animal Impact**
- **New Approach to Site Design**

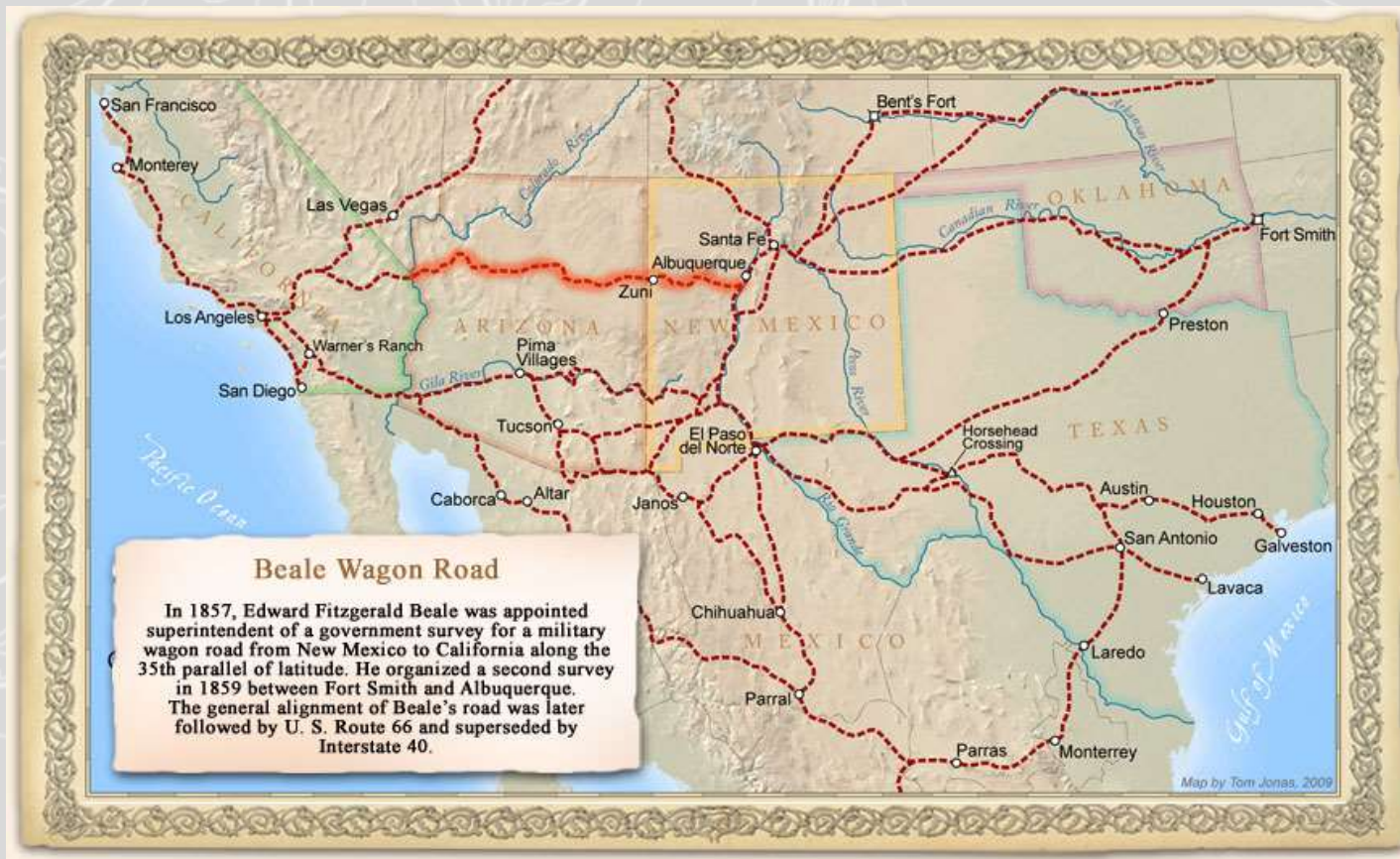
MY BACKGROUND



HISTORIC CONDITIONS



HISTORIC CONDITIONS



HISTORIC CONDITIONS

LAVA BEDS NEAR McCARTYS NEW MEXICO

AS BEALE SAW IT IN 1857:

"The whole valley is so completely filled with the solid lava as to leave only here and there a narrow belt of meadow: But this is knee deep with the finest and greenest grass, and almost hidden by it, and winding its way through it is the clear, sparkling brook of the Gallo. The stream is quite narrow, in fact nowhere over six feet in width, but the water clear as crystal and very cool. . . . The stream seems filled with fish, and with a proper net an abundance for any number of men might be taken. . . . We found the grass on the other side of the creek best, and our mules are now grazing in it belly deep."

81 YEARS LATER—THE PLACE BEALE DESCRIBED

Terrific erosion has followed years of over-grazing in this area. When plant cover is destroyed there is nothing left to hold the soil in place.

HISTORIC CONDITIONS



HISTORIC CONDITIONS

NEAR MT. TAYLOR NEW MEXICO

AS BEALE SAW IT IN 1857:

"The meadow here embraces, in all, probably two thousand acres of uncommonly fine land, and is covered with a beautiful grass, of a kind I have not met before within this country. It grows quite tall, and is very pleasant to the taste and seemingly nutritious; in color a blue green and very much resembling the blue grass of Jamaica."

81 YEARS LATER—THE PLACE BEALE DESCRIBED

Horses, sheep and cattle far exceeding the carrying capacity of the range have gradually ruined this area. Scattered remnants of sod are all that remain of the once rich grass.

HISTORIC CONDITIONS



HISTORIC CONDITIONS

ON THE PUERCO RIVER ARIZONA

AS BEALE SAW IT IN 1857:

"On arriving at the banks of this river, we found no difficulty in getting down without locking a wheel."

81 YEARS LATER—THE PLACE BEALE DESCRIBED

Thundering walls of soil are dumped into the Rio Puerco with each flood of water. Once a small stream that could easily be crossed, the Rio Puerco has become a barrier cutting the country like a knife. When the grass was gone, the water carried away the soil. Each year more soil is lost. (Note the figure, upper left.)

HISTORIC CONDITIONS



HISTORIC CONDITIONS

NEAR LEUPP ARIZONA

AS BEALE SAW IT IN 1857:

"Today nothing has impeded our progress but the grass, and this trail, travelled by one large emigrant train, will make as firm and fine a natural road as could be desired."

81 YEARS LATER—THE PLACE BEALE DESCRIBED

Grass impeded Beale's party, but dead Sacaton clumps made travel slow for the photographer. From six inches to a foot of soil have disappeared.

HISTORIC CONDITIONS



HISTORIC CONDITIONS



Santa Cruz River Perennial Flow North of Tucson, late 1800's

TODAY



Santa Cruz River Bordering the Roger Road Wastewater Treatment Facility

HISTORIC CONDITIONS

Recent Schumacher Lecture

- A passage written by American zoologist William Hornaday in 1875:

The great herd along the Arkansas River through which I passed . . . was from my own observation not less than twenty-five miles wide and from the reports of hunters and others it was about five days in passing a given point, or not less than 50 miles deep. From the top of the Pawnee Rock, KS (heart of the dust bowl) I could see from 6 to 10 miles in almost every direction. This whole vast space was covered with buffalo, looking at a distance like one compact mass, the visual angle not permitting the ground to be seen. I have seen such a sight a great many times but never on so large a scale.

HISTORIC CONDITIONS

Predators



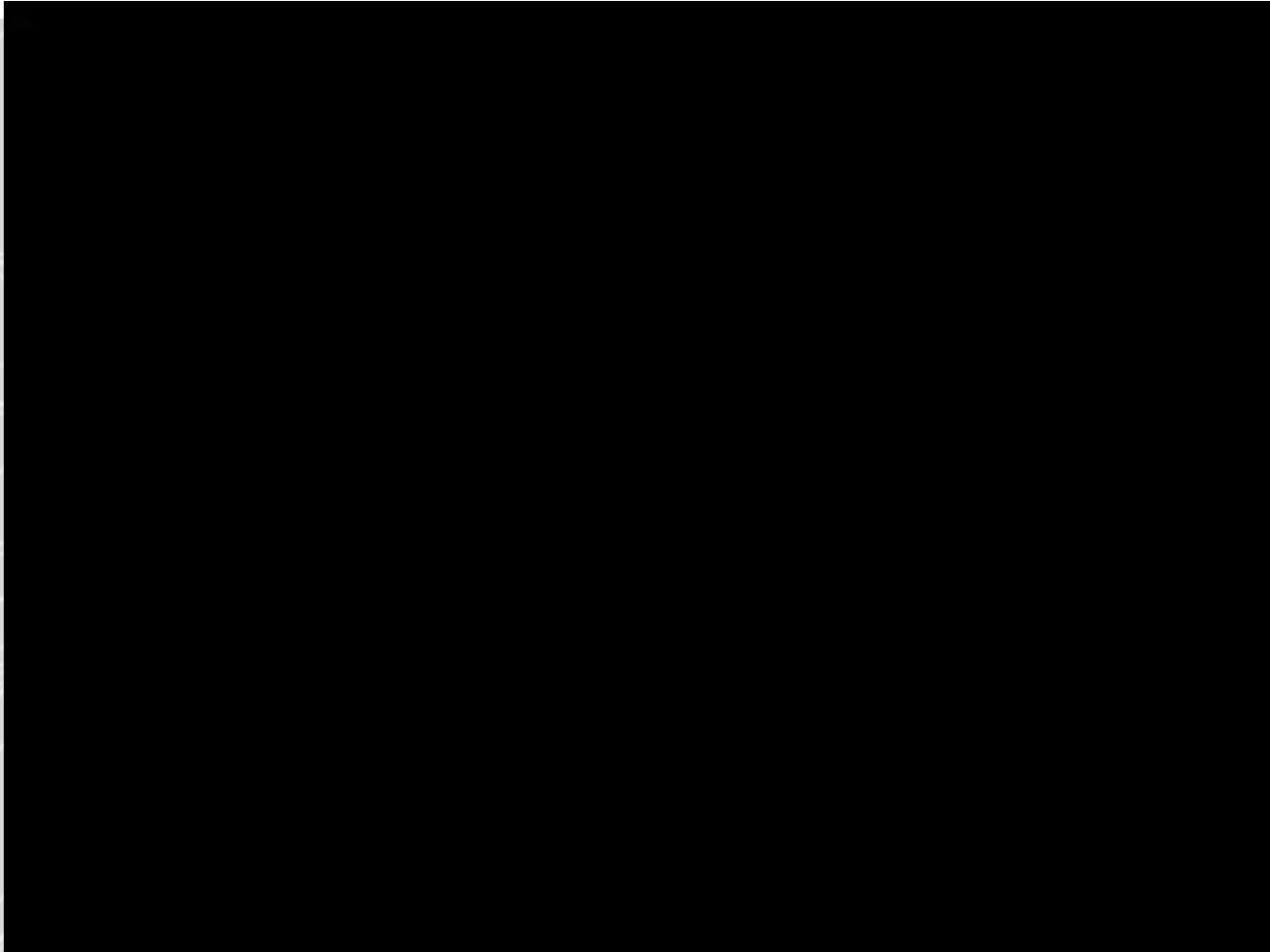
Prey



Grass



HOW DID WE GET HERE?



HOW DID WE GET HERE?

- Functional and simple
- Any color you want, so long as it was black
- The assembly line was the real invention
- Other businesses had borrowed the same techniques
- It was the beginning and the end of imagination all at the same time.

HOW DID WE GET HERE?



HOW DID WE GET HERE?

- **Ceteris Paribus – other things being equal**
 - Scientific Method
- **Education system**
 - Medicine
 - Economics
 - Education
 - Ecology
 - Agriculture
 - Engineering
- **Reductionist Science**

CENTRALIZED SYMPTOMATIC RELIEF

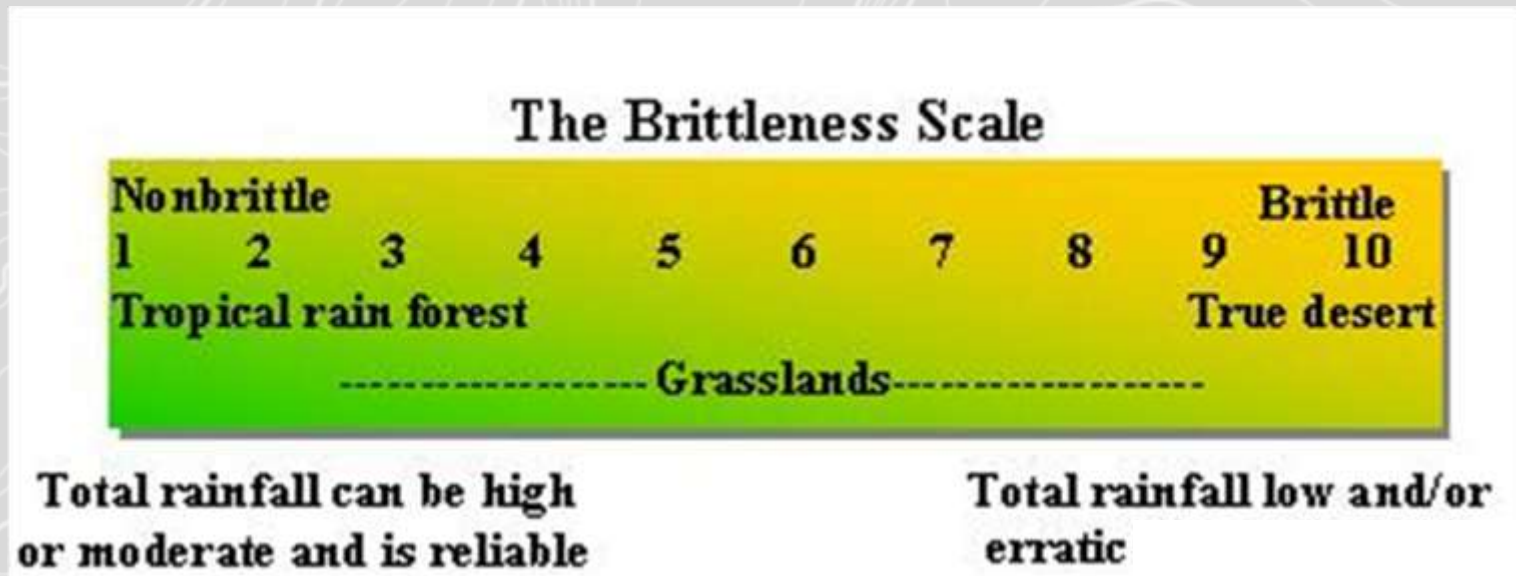


Santa Cruz River Bordering the Roger Road Wastewater Treatment Facility

Some inherent risks (side effects)
???

- Downstream head cutting
- Interrupt geomorphic cycle
- Dropping water table

BRITTLENESS SCALE



BRITTLENESS SCALE

Midwest

Arid Southwest

The Brittleness Scale



Total rainfall can be high
or moderate and is reliable

Total rainfall low and/or
erratic

BRITTLENESS SCALE



- **Non-brittle environmental features**
 - humidity is not erratic and is distributed throughout the year despite volume
 - decay occurs rapidly
 - can take place without the presence of herbivores
 - involves small soil organisms that require constant humidity to survive.

BRITTLENESS SCALE



- Brittle environmental features (without herbivores)
 - humidity is erratic
 - decay is slower
 - little to no soil organisms to break down organic matter

BRITTLENESS SCALE



- Brittle environmental features (with herbivores)
 - humidity is erratic
 - decay is facilitated by herbivores
 - Animals trample, dung, and urinate on plants
 - Humidity and micro-organisms is maintained in their gut

BRITTLENESS SCALE

Results of Resting the Land from the Impact of Animals



NON-EFFECTIVE AND EFFECTIVE WATER CYCLES

Soil Organic Matter 1.7%
Next Day - Practically no infiltration

Symptom: After $\frac{1}{2}$ " Rainfall



Soil Organic Matter 5%
Next Day - Practically total infiltration

Adequate Infiltration: 13.2" in 6 Hours



- **Soil Organic Matter (SOM) and Soil Water Holding Capacity**
- **On average 1% of SOM can retain 60,000 gallons of water / acre**

HOLISTIC PLANNED GRAZING



HOLISTIC PLANNED GRAZING RESULTS

Partial Rest and Overgrazing



Holistic Planned Grazing



HOLISTIC PLANNED GRAZING RESULTS

Partial Rest and Overgrazing



Holistic Planned Grazing



HOLISTIC PLANNED GRAZING RESULTS



TWO PERSPECTIVES

Decentralized Animal Impact



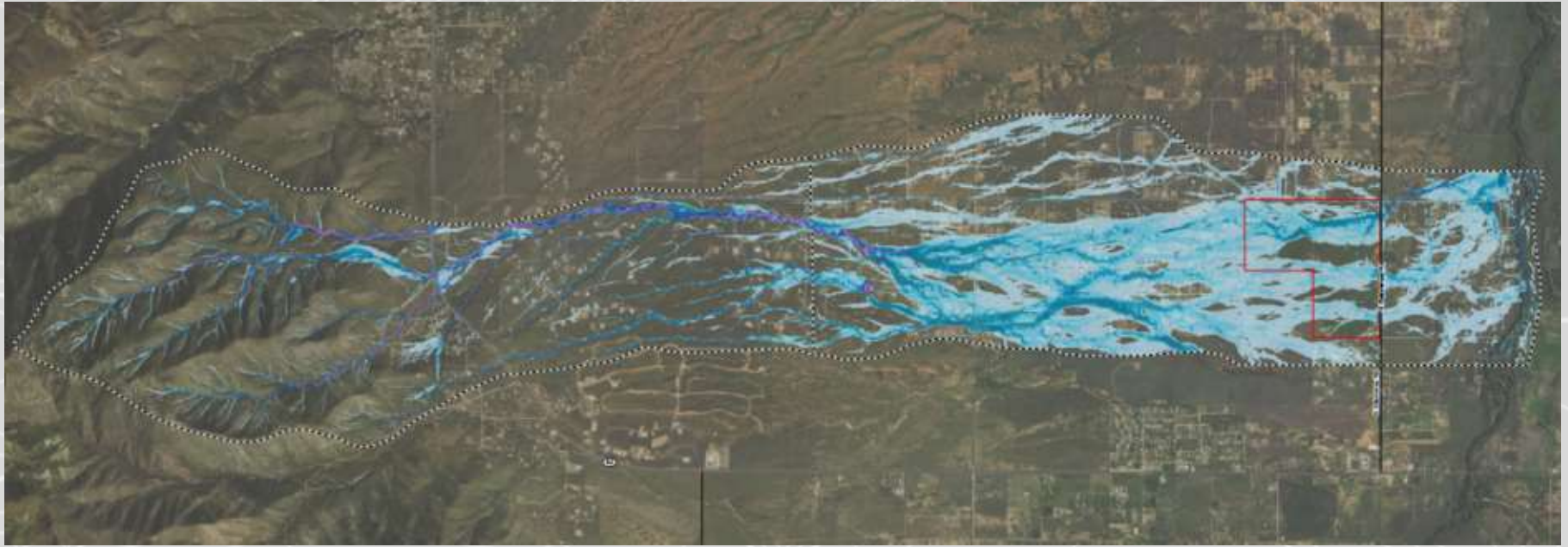
Centralized Expensive Infrastructure



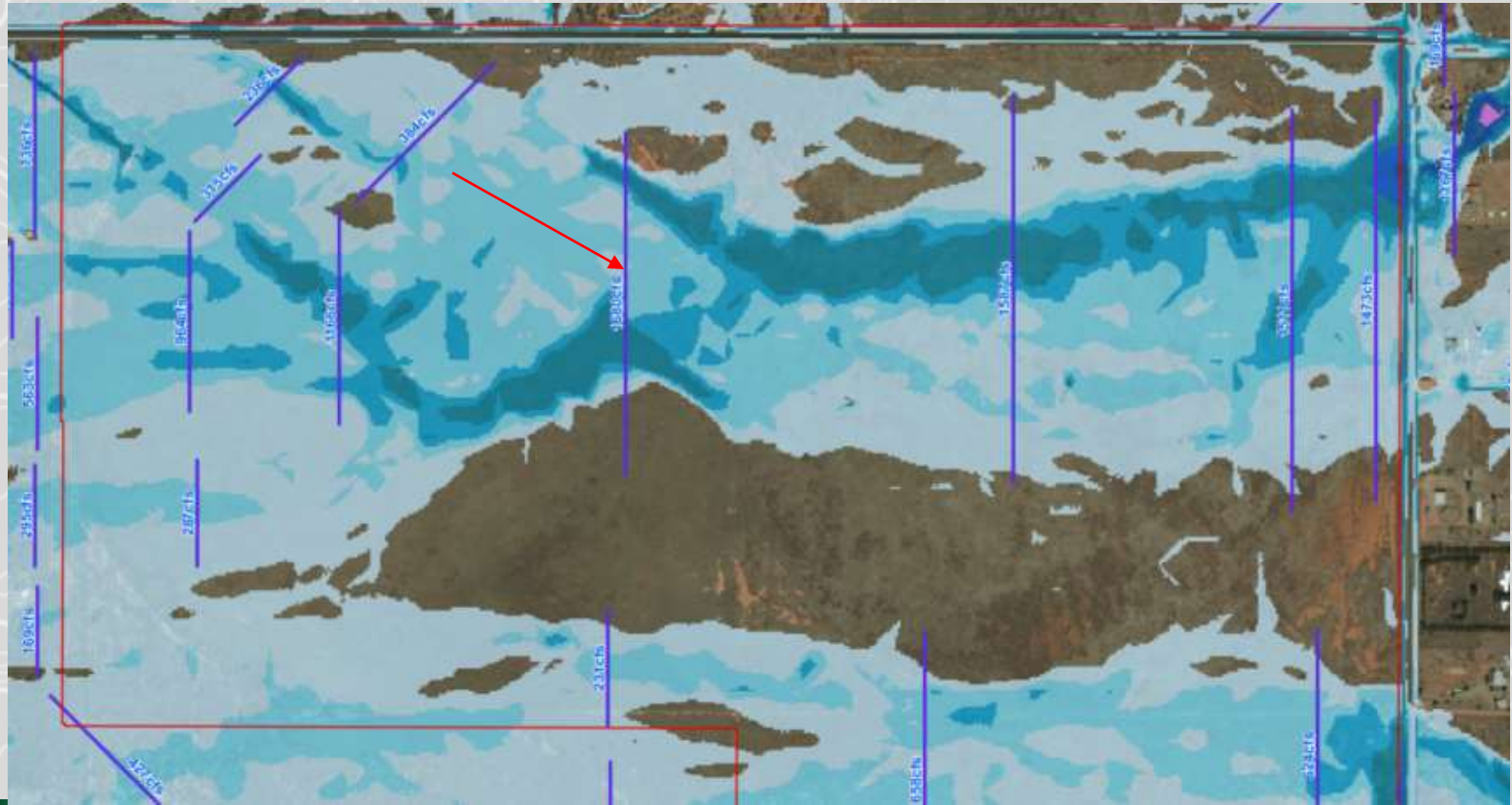
In Arizona (Flood Control and Stormwater Quality)

- Cochise County
- Yavapai County

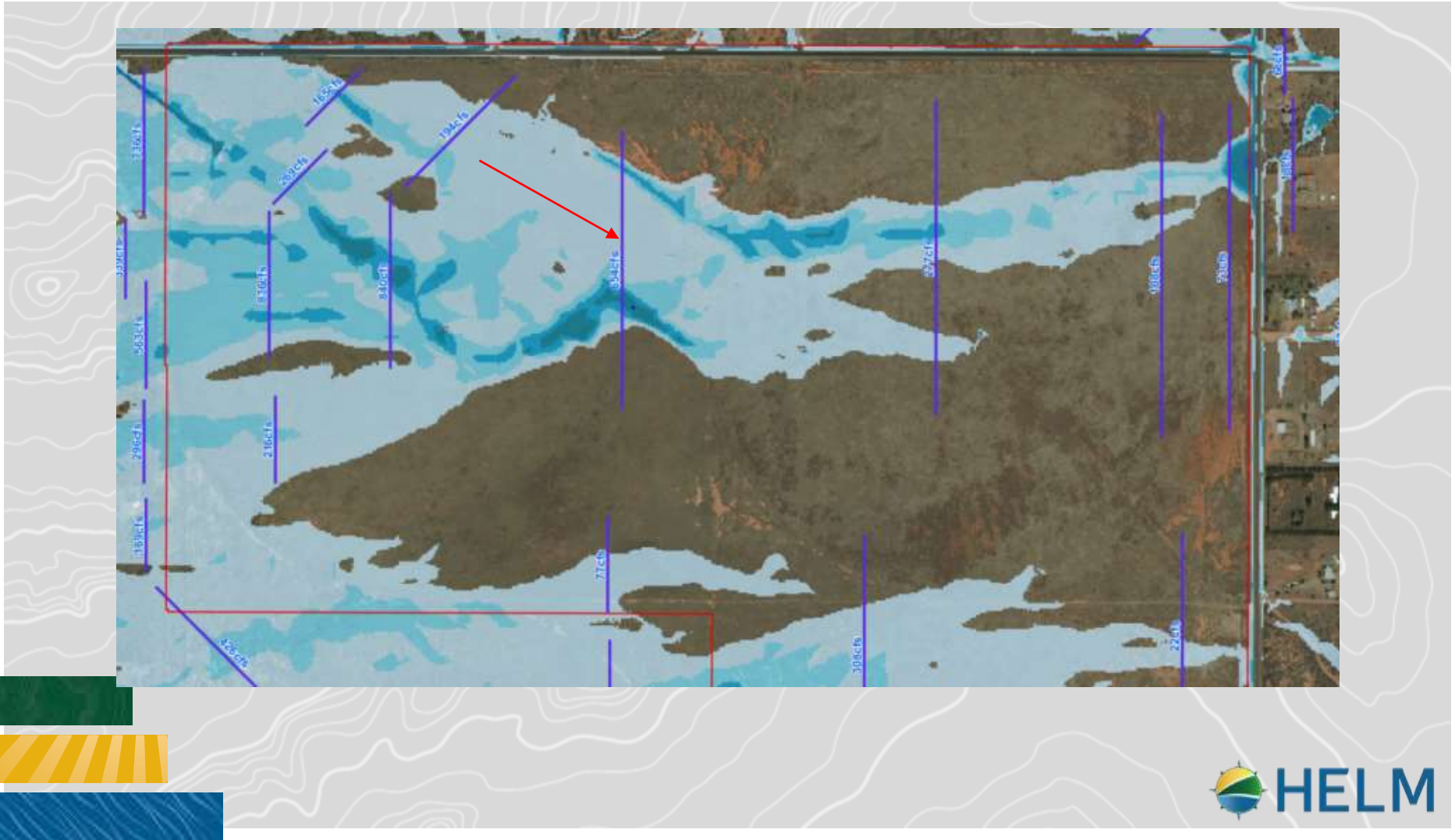
COCHISE COUNTY



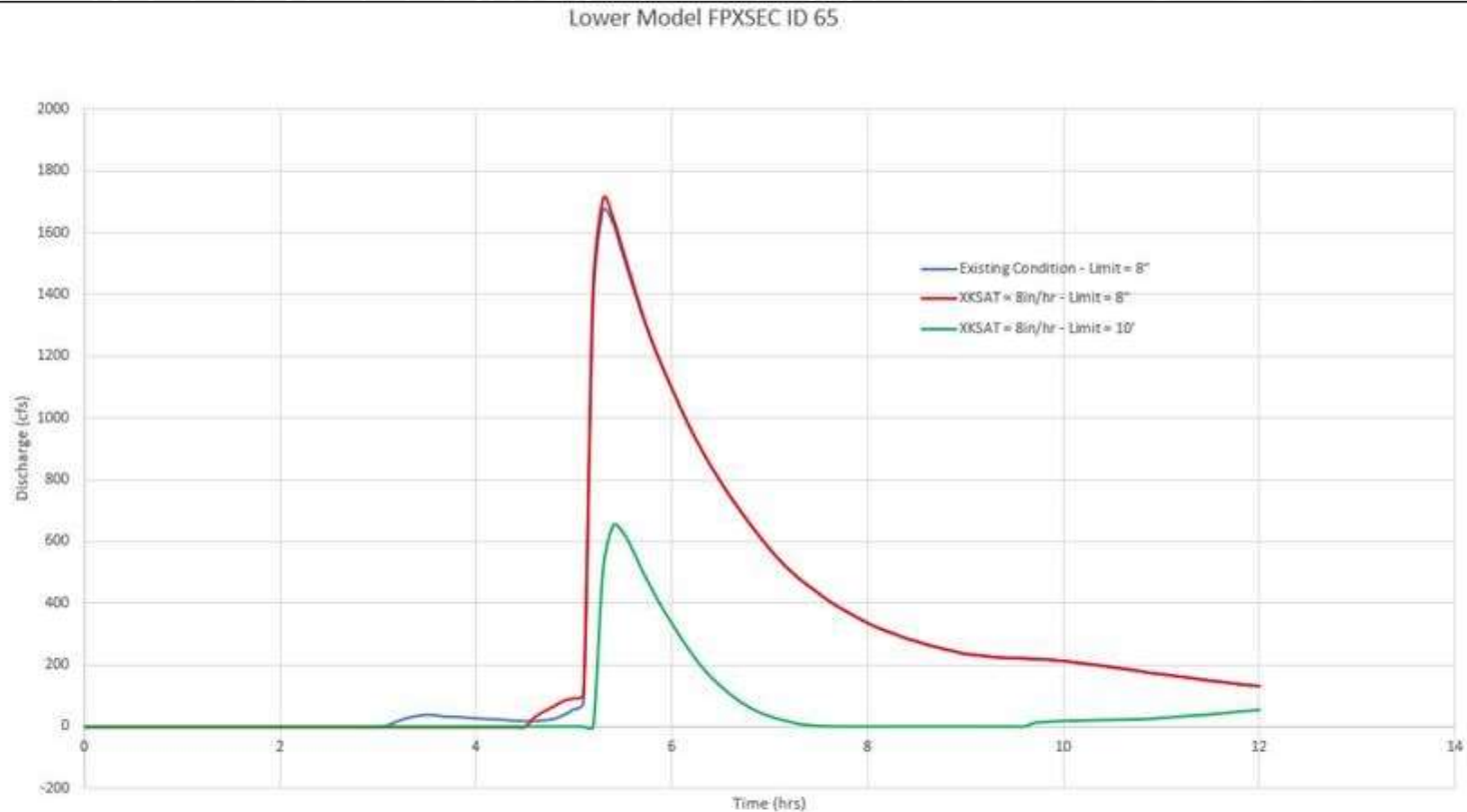
COCHISE COUNTY



COCHISE COUNTY



COCHISE COUNTY



DECENTRALIZATION

Rural Stormwater Solution (biological decentralization)



DECENTRALIZATION

**Rural Stormwater Solution
(biological decentralization)**



**Urban Stormwater Solution
(mechanical decentralization)**



TYPES OF PERMEABLE SYSTEMS

Permeable Concrete



Porous Asphalt



PICP



MAINTENANCE ISSUES WITH PERMEABLE SYSTEMS

CLOGGING



- Requires remedial maintenance
- Remove and replace aggregate (10 – 15 yrs)
- Costly
- Knowledgeable Labor Needed

PERMEABLE BLOCK



<https://www.youtube.com/watch?v=NcXvMVtQzGE>

PERMEABLE BLOCK

Franciscan Renewal Center Permeable Block Project



CONCLUSION

- Biological or Mechanical Decentralization as a main focus in design

Bundled Benefits

- Water Retention / Flood Reduction
- Watershed / Ecosystem Restoration
- Water Quality
- Soil Quality

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