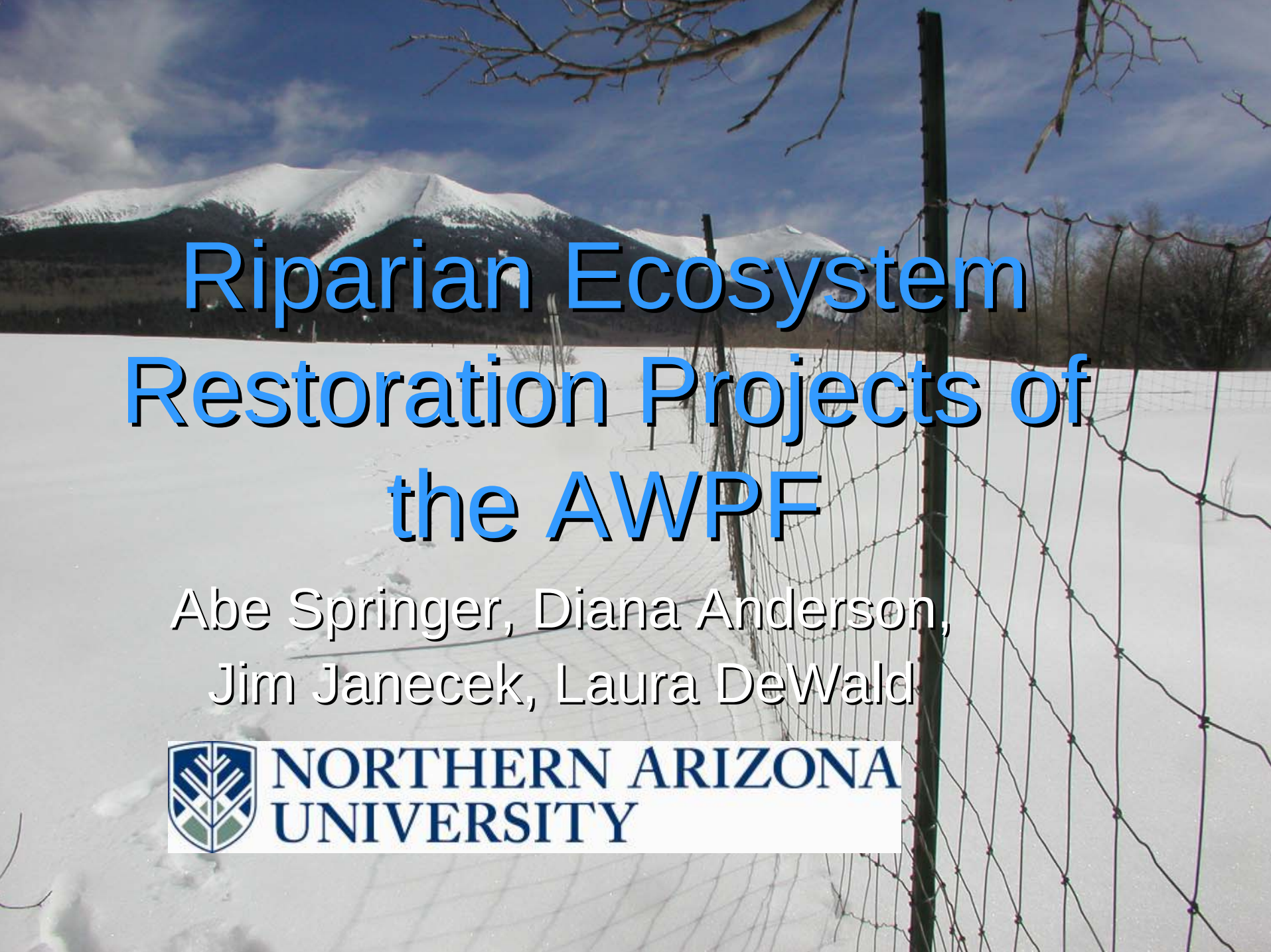


Riparian Ecosystem Restoration Projects of the AWPF

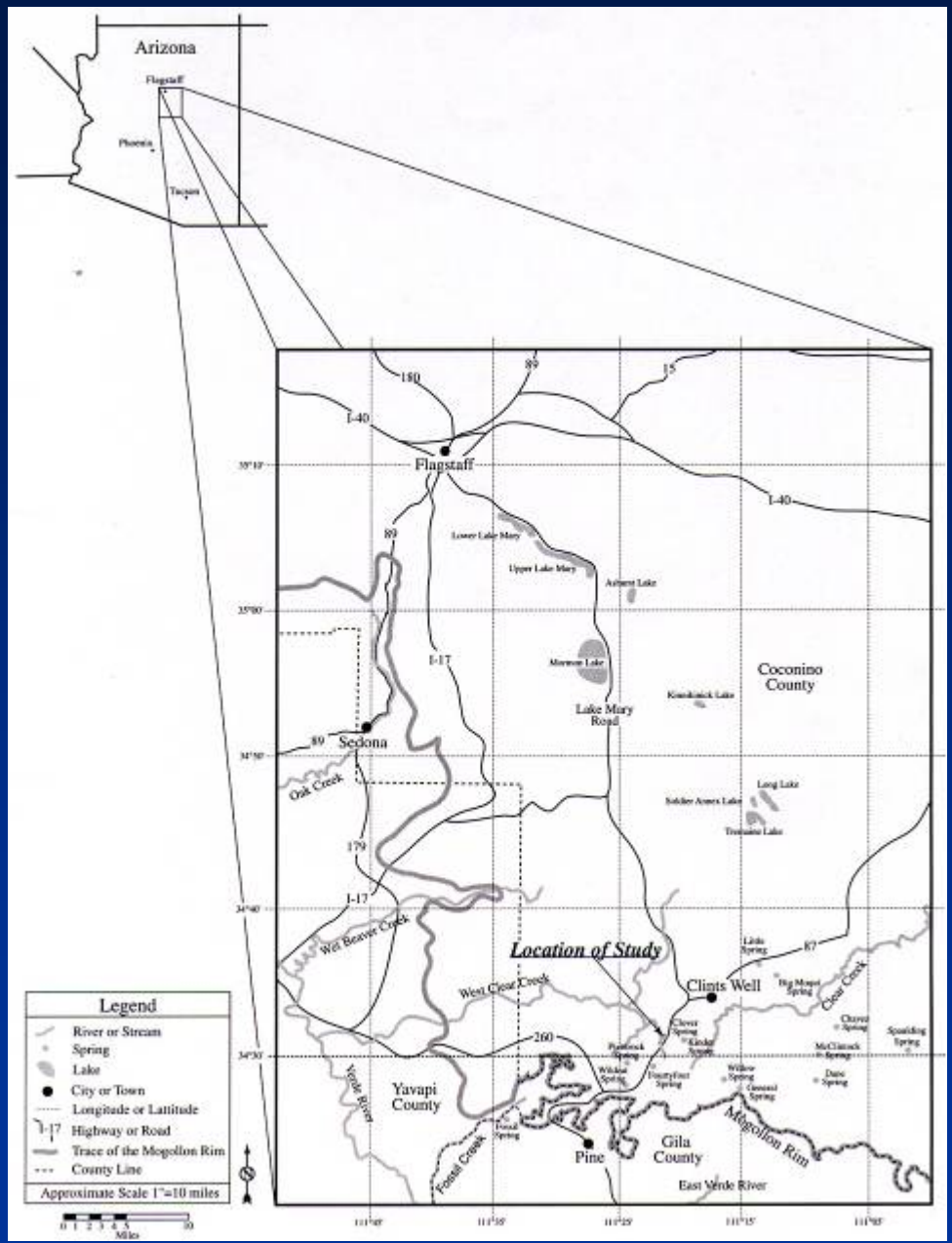
Abe Springer, Diana Anderson, Jim Janecek, Laura DeWald

NORTHERN ARIZONA UNIVERSITY

Outline

- Clover Springs
  - Geomorphic setting
- Hoxworth Springs
  - Climate change
- Lake Mary Watershed
  - Institutional challenges
- Hart Prairie
  - Fire as a management tool

Clover Springs Project



Channel stabilization in July 2001

Reconfigured channel was rejoined with the abandoned floodplain.

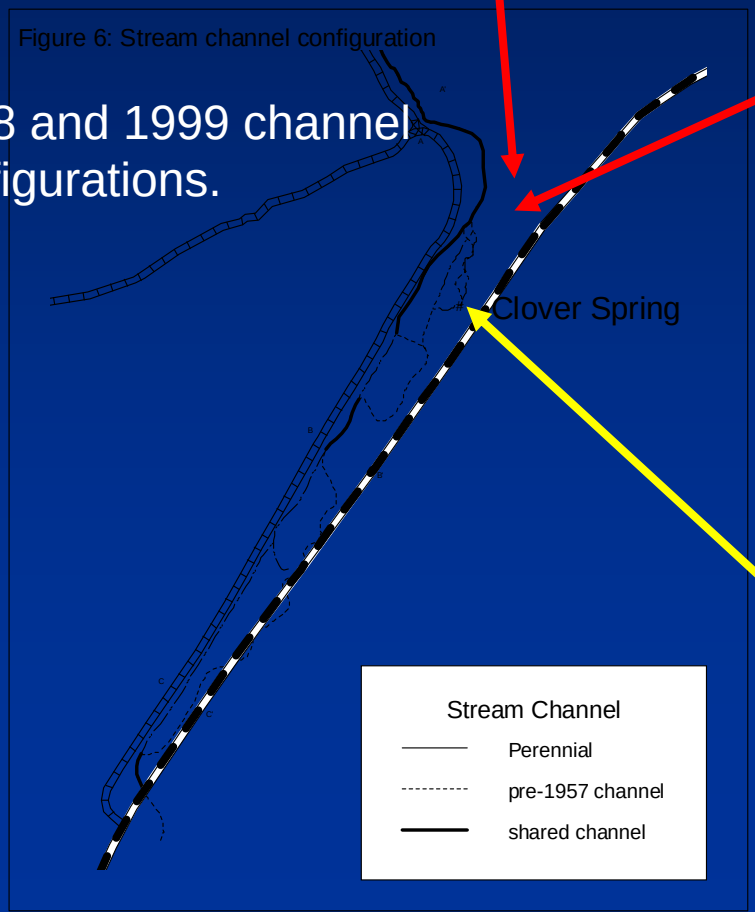
Revegetation led to increase in the proportion of riparian and terrestrial species.

Geomorphic analyses suggest that the natural channel configuration has withstood several moderate climatic changes during the past 7,000 years.

Changes in land use coupled with climate change at the turn of the 20th century resulted in dramatic downcutting.

Pre-construction, view downstream

Post-construction, view downstream

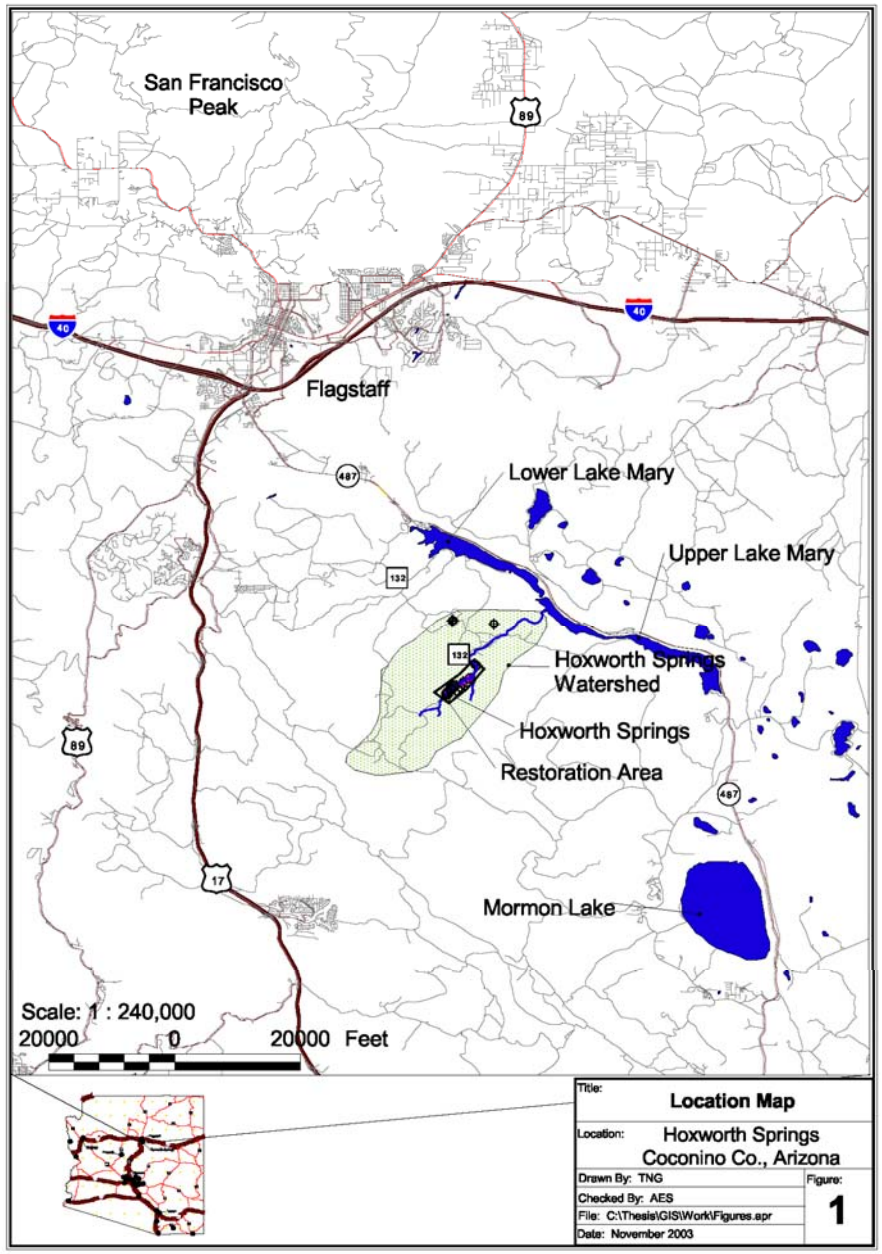


1948 and 1999 channel configurations.

Clover Springs

Clover Springs Outreach

- Two information kiosks
- 25-minute education video available through NAU's Bilby Research Center (ISBN 0-9718786-4-1)



Hoxworth Springs

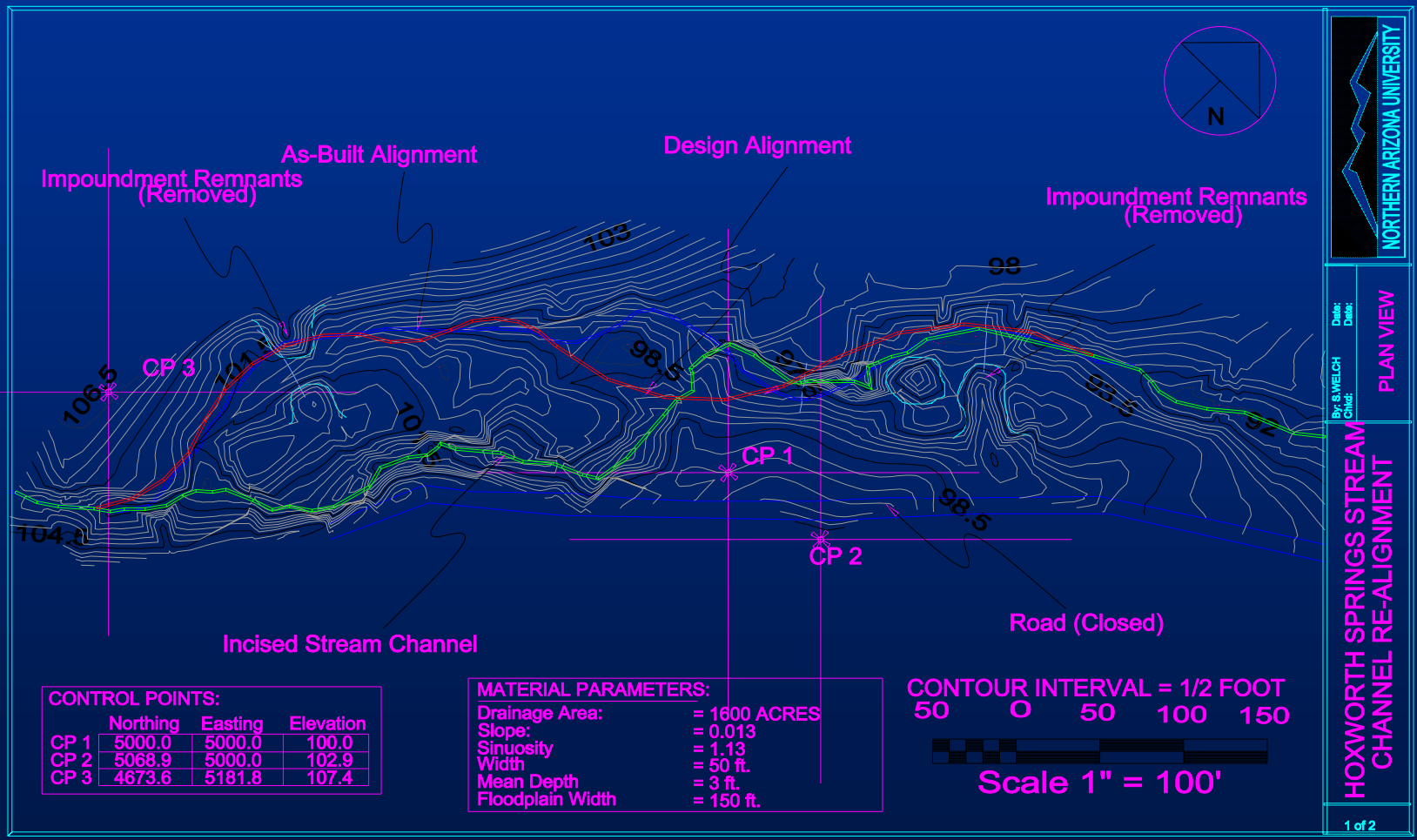
Stabilized spring-fed stream channel by carbon-copy technique in 1997 and 1998.

Revegetation with erosion control netting, seeding mix, and plug transplanting.

Fences constructed to manage elk and cattle grazing.

Extensive monitoring of vegetation and spring discharge.

Hoxworth Springs Design



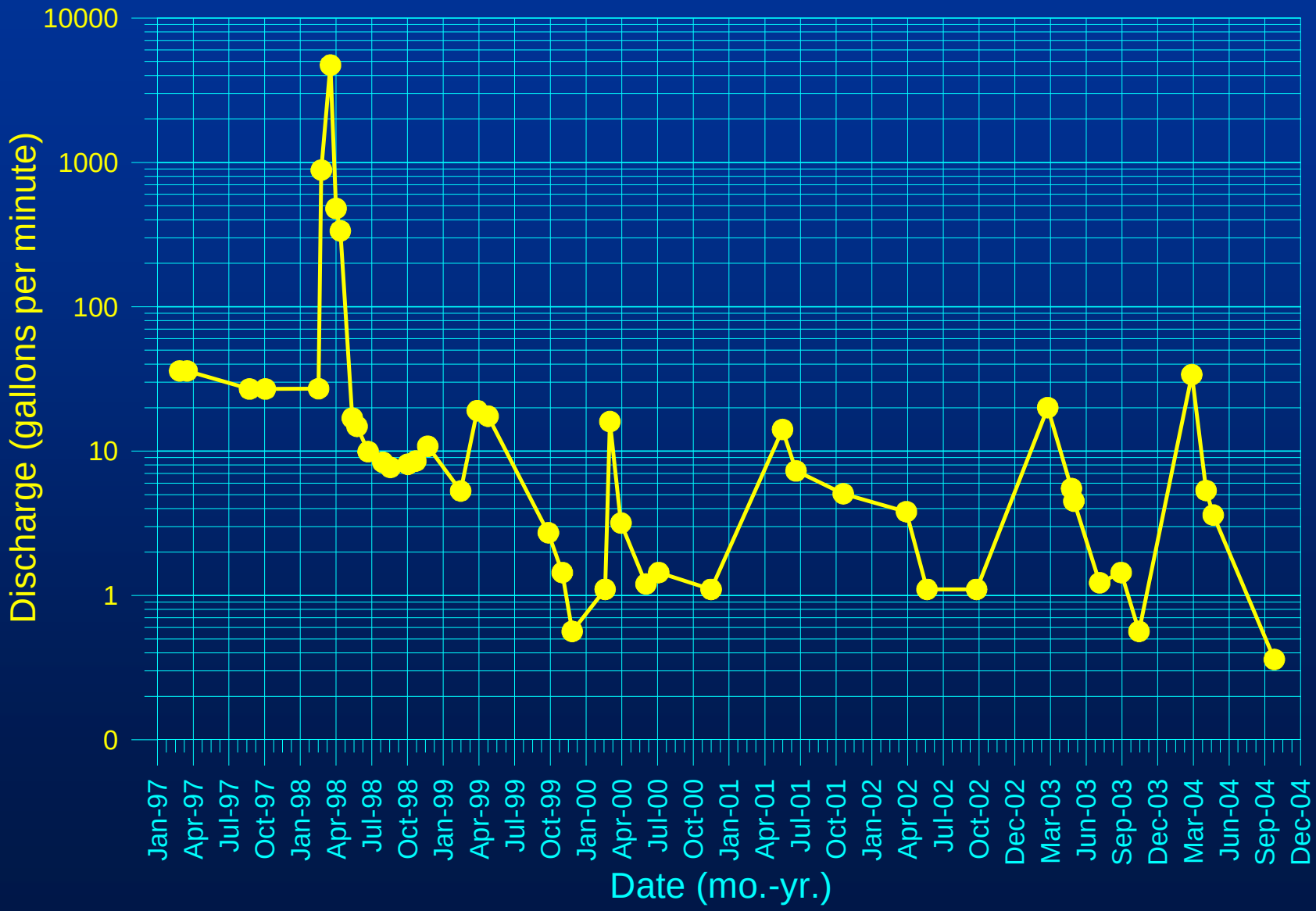
Pre-stabilization, 1995

Earth moving, November 1998

Post-stabilization, 1999

Post-stabilization, 2004

Hoxworth Springs Discharge



Hoxworth Springs Modeling

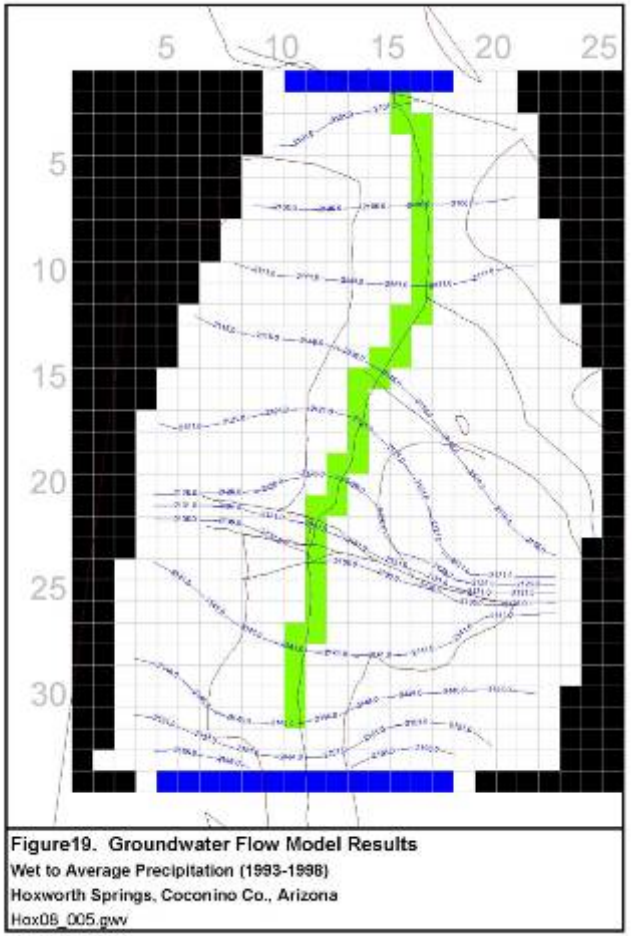


Figure19. Groundwater Flow Model Results
Wet to Average Precipitation (1993-1998)
Hoxworth Springs, Coconino Co., Arizona
Hox08_005.gwv

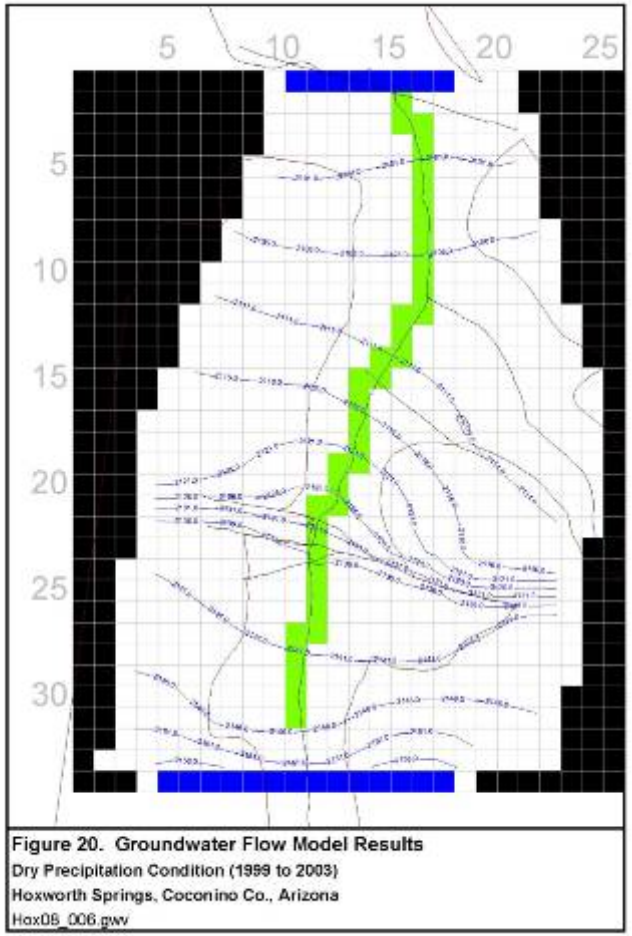


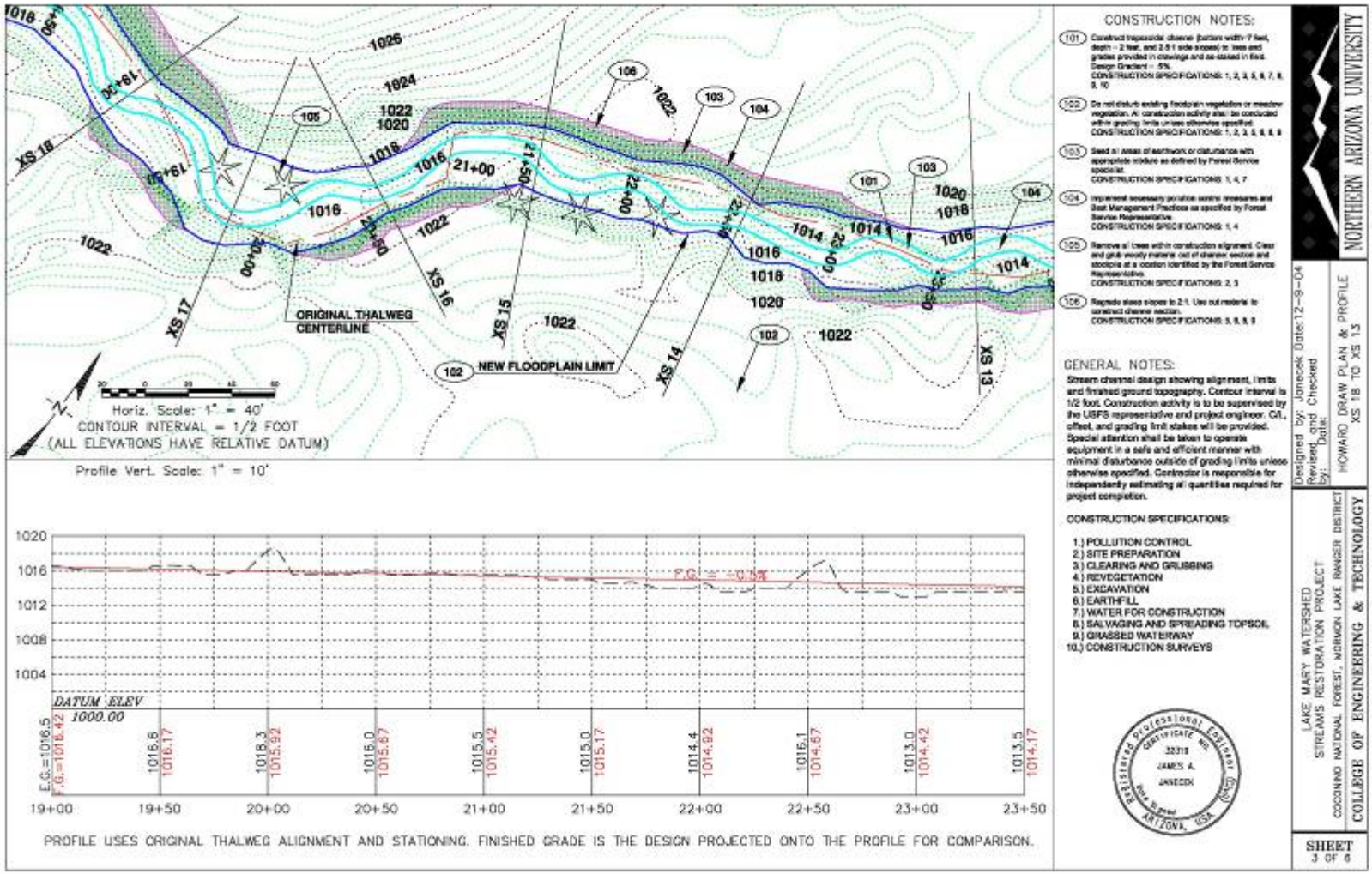
Figure 20. Groundwater Flow Model Results
Dry Precipitation Condition (1999 to 2003)
Hoxworth Springs, Coconino Co., Arizona
Hox08_006.gwv

Reduction in length of perennial flow by 325 m simulated by model and observed in field.

Lake Mary Watershed Restoration

- Constructed stable channel for Priest Draw that allows for reduced shear stress by increasing floodplain inundation and modifying existing unstable morphology.
- Collaboration between NAU, the USFS and the AWPF to resolve institutional differences and maintenance responsibilities.
- Final design incorporated a hybrid of different approaches
  - Rosgen Stream Classification
  - Hydraulic analysis using the Army Corps of Engineers HEC-RAS software,
  - Sediment transport models
  - Stability design of grass lined open channels
  - Years of stream restoration experience of the USFS.
- Re-establishment of native grasses in upland meadows of Arizona are challenged by very erratic rainfall and temperature patterns, and success requires patience and persistence.

Lake Mary Watershed



Lake Mary Watershed

Channel Stabilization and crest Stage gage

Re-establishment of native grasses.

Hart Prairie Restoration

- Goal to restore structure and function to a Bebb willow-mixed grass, upland wet meadow in Hart Prairie.
- Over $800,000 of resources expended by BLM, USGS-Section 104b, Arizona Game and Fish, U.S. Fish and Wildlife Service,Northern Arizona University, Arizona Water Protection Fund, The Nature Conservancy, Coconino National Forest.
- Critical collaborations between Northern Arizona University, The Nature Conservancy, and Coconino National Forest.
- Extensive hydrological and vegetation monitoring of soil moisture, shallow groundwater, climate, stream flow, and willows.
- Tree thinning from 80 acres and prescribed burn of over 300 acres.

Diversion restoration 1996

Weather Tower 1999

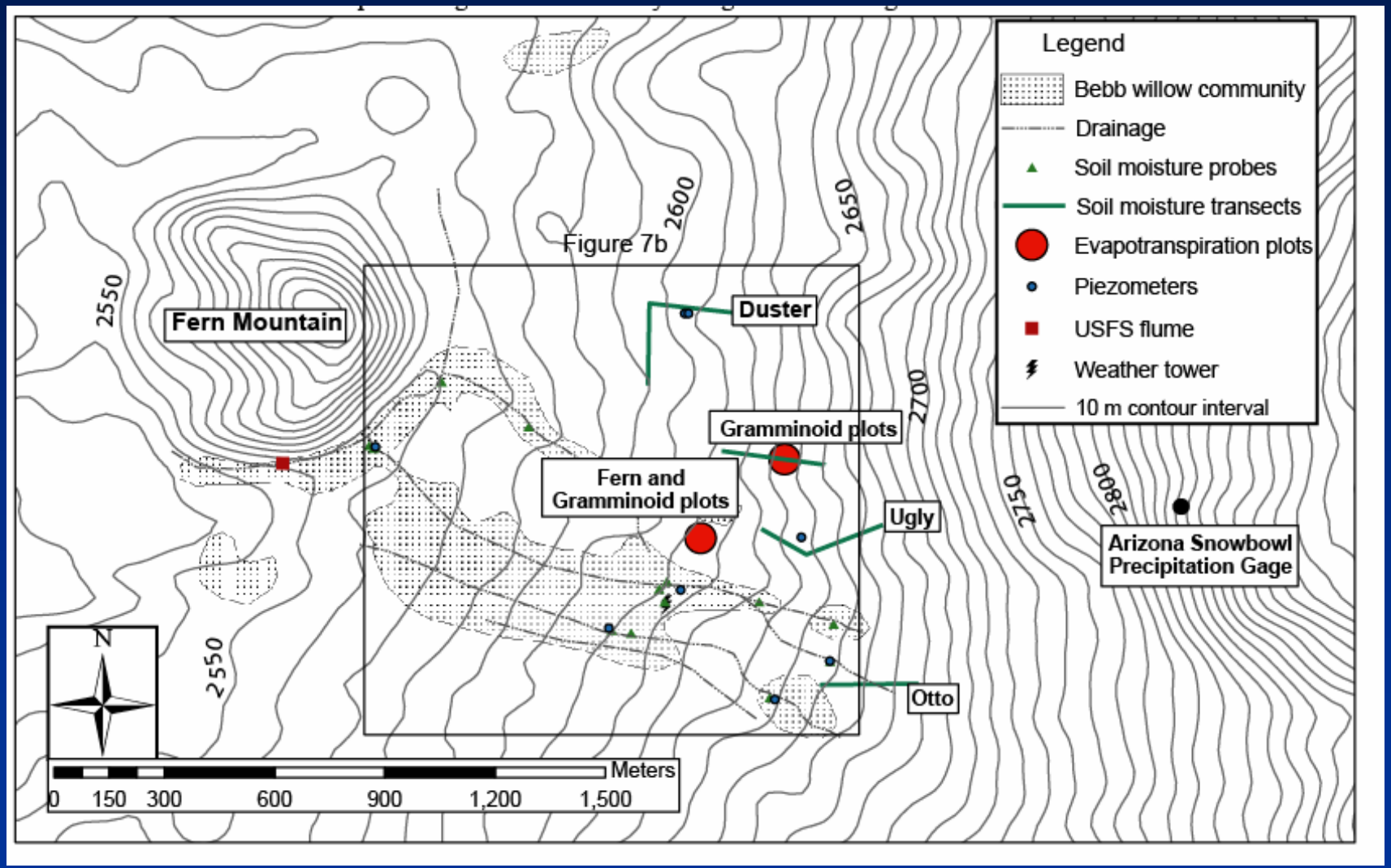
Flume and well installation 1995

Fence Construction 1995, 1997

300 acre prescribed burn 2003

Tree thinning and slash pile burning 2001

Hydrological monitoring



Prescribed Burn Study

- Burned 10, 2-m diameter plots in 2001 both pre- and post-monsoon.
- Measured soil-water content (0-30 cm) weekly in 2001, 2002, and 2003.
- Both early- and late-season burning reduced herbaceous biomass
  - Fern-dominated community in 2002 and 2003, and
  - Grass-dominated community in 2002, but not in 2003.
- Soil-water content increased for approximately four weeks in 2001 following the early-season burn.

Prescribed Burn Study

- Early-season and late-season burns reduced soil-water content in both communities over much of the 2002 and 2003 growing seasons.
- Early-season burning may benefit willow seed germination by increasing soil-water content immediately following burning
  - But, may be detrimental to germination in the second and third growing seasons after burning because of drier soil.
- Large temporal variation in the effect of prescribed burning on soil-water content complicates the use of fire as a restoration tool to manage soil water available for threatened plants such as Bebb willow, and for recharge of groundwater.

Summary

- Efforts underway or completed to restore many springs ecosystems in Northern Arizona.
- Successful projects need a multidisciplinary team which
  - Communicates well,
  - Has strong agency proponent,
  - Has good science incorporated, and
  - Determines and studies measures of success.
- Recognition of climate and land management issues critical for project success.

Acknowledgements

- Willie Odem, Sean Welch
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  - And many others at the USFS
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