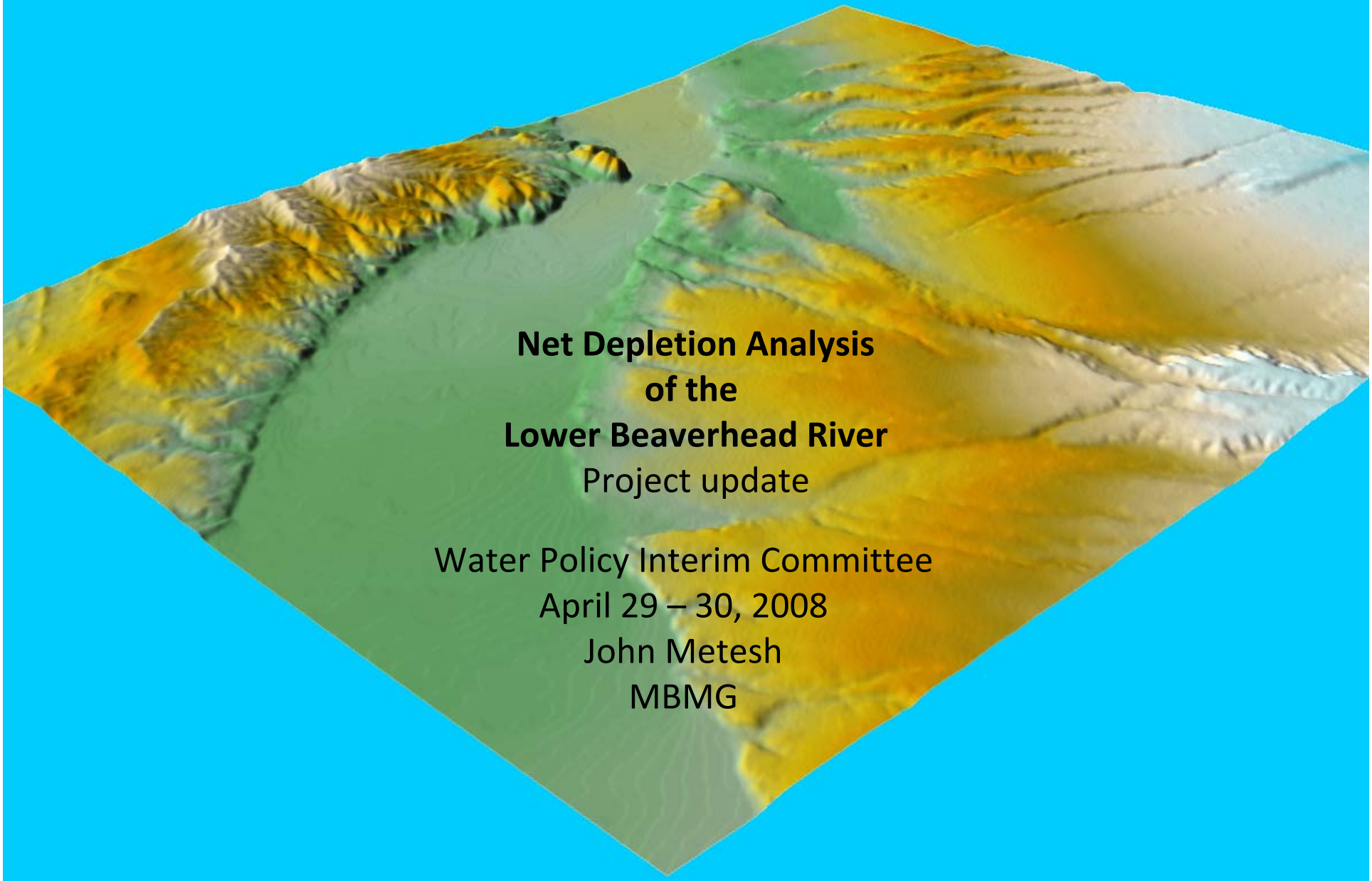


Net Depletion Analysis of the Lower Beaverhead River

Project update

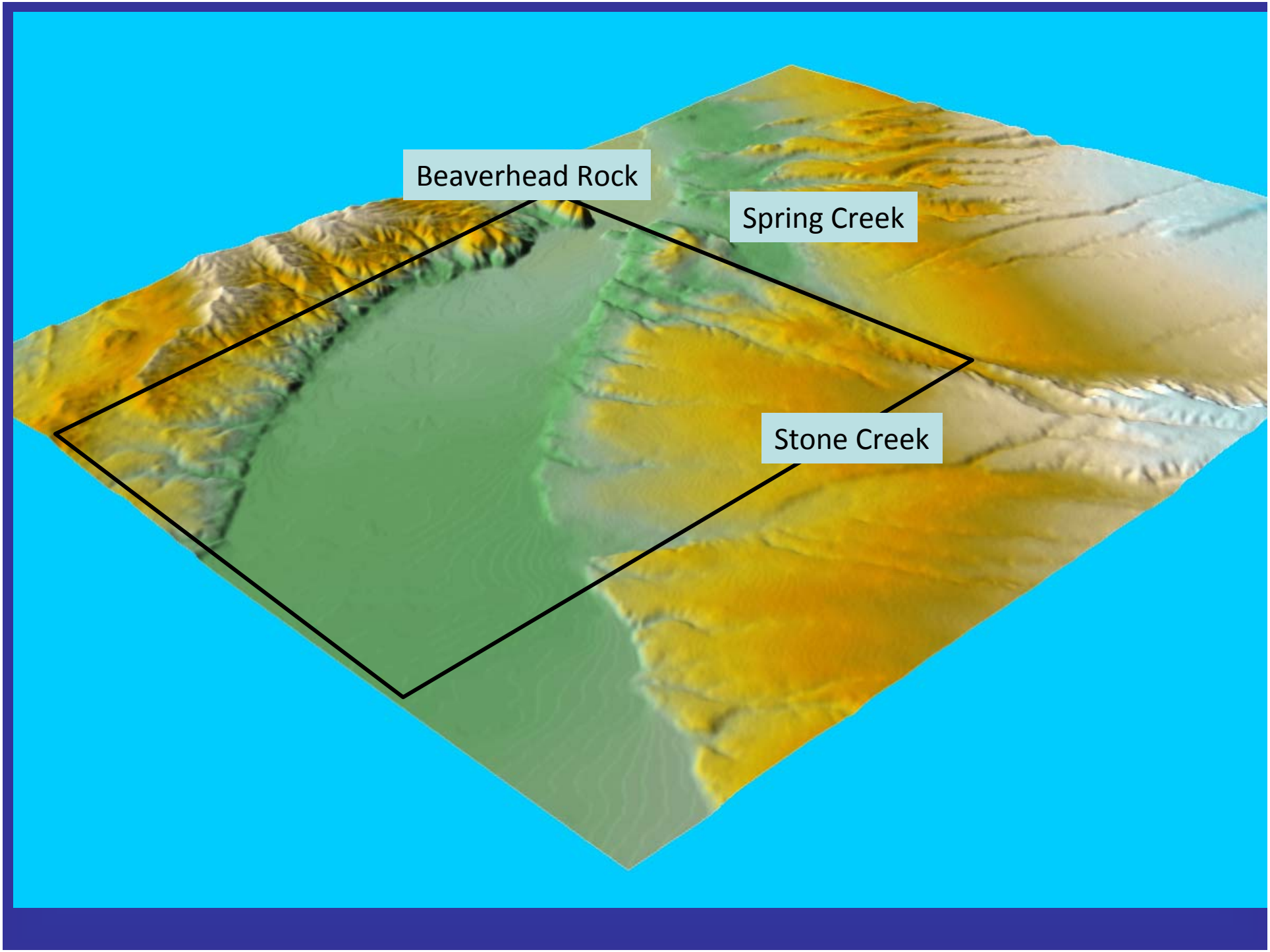
Water Policy Interim Committee
April 29 – 30, 2008

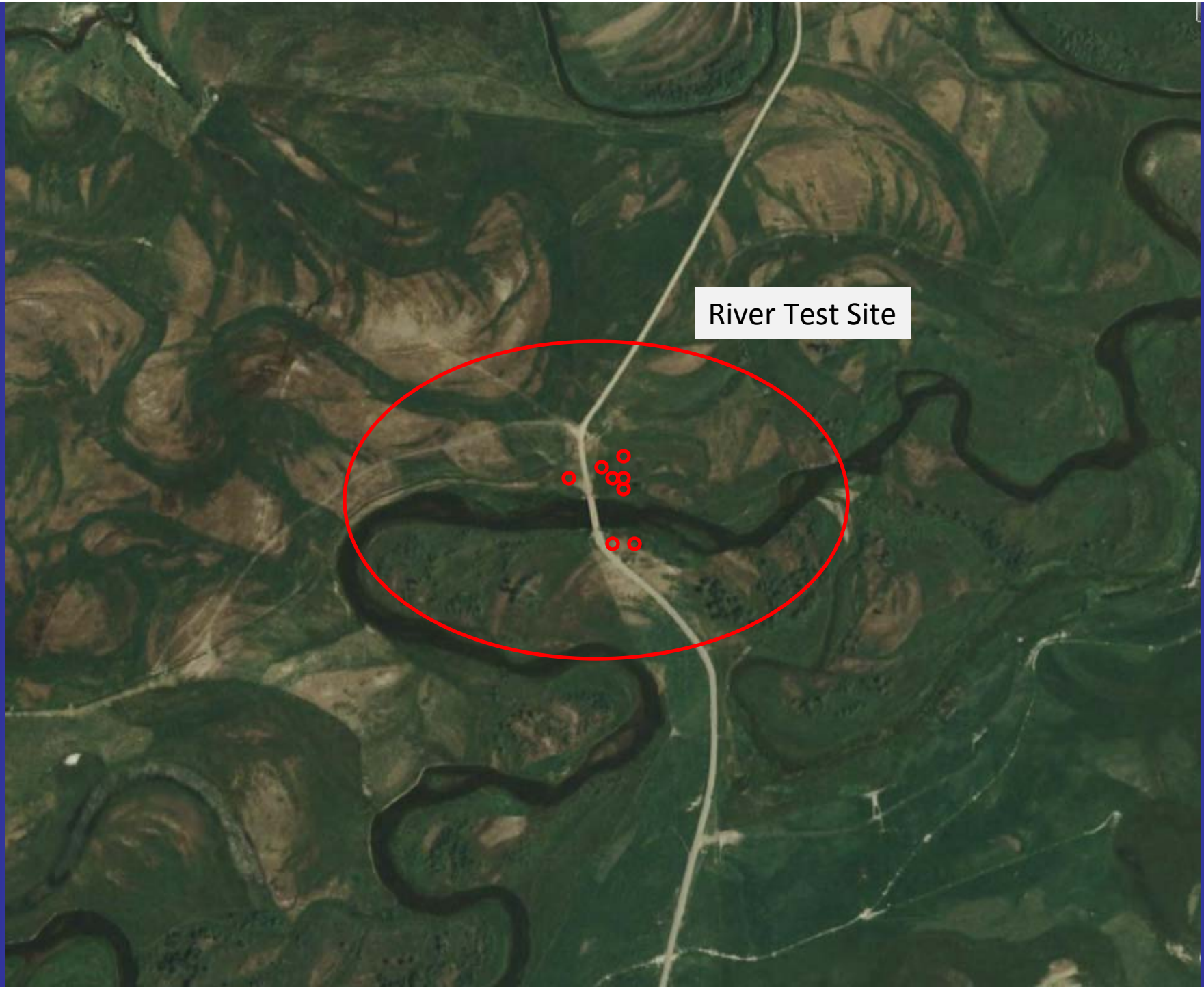
John Metesh
MBMG

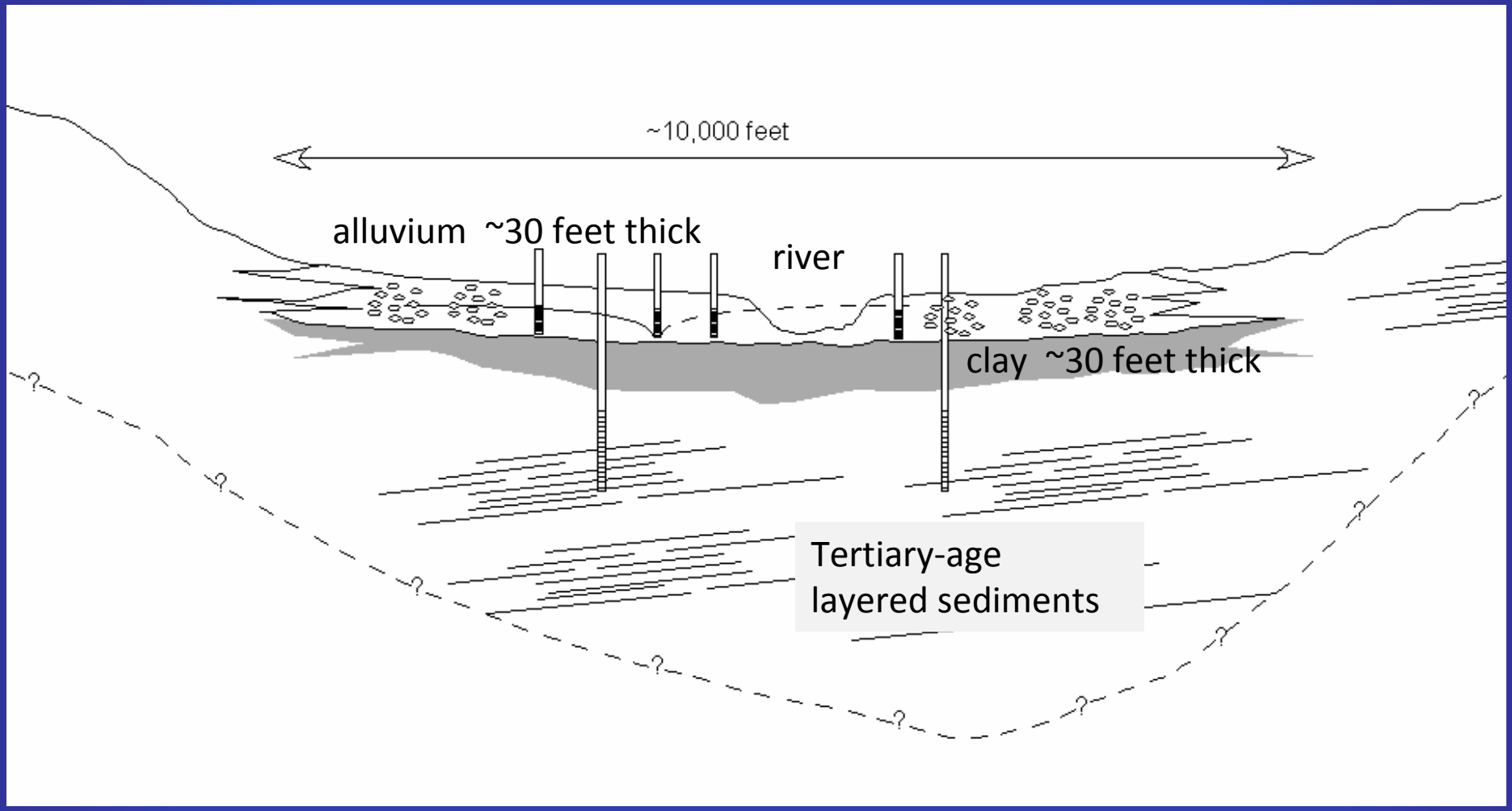
The Montana Water Use Act (Title 85, chapter 2, parts, 1-4, MCA)

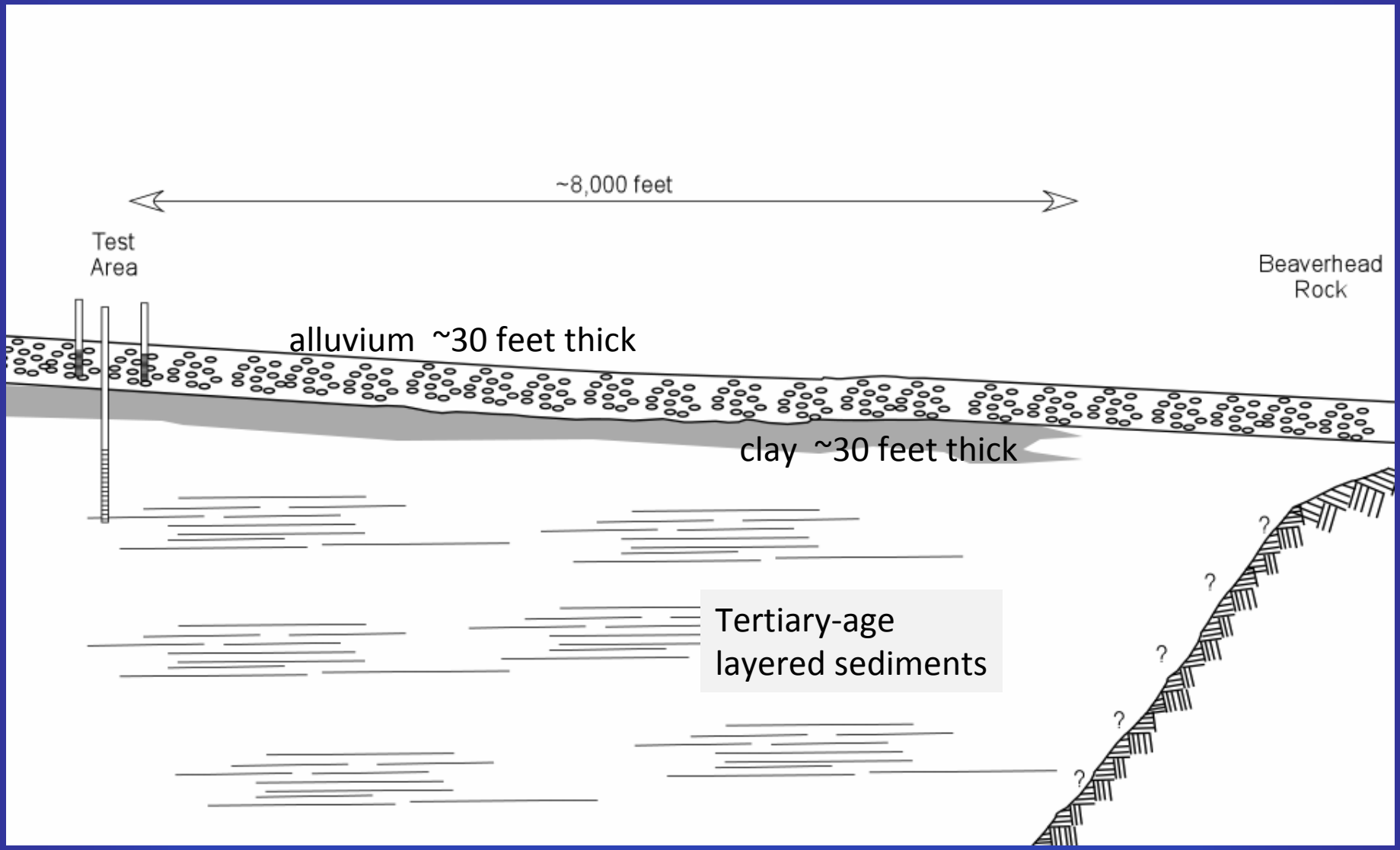
Net depletion:

"the **calculated** volume, rate, timing and location of reductions to surface water resulting from a proposed groundwater appropriation that is not offset by the corresponding accretion to surface water that is not consumed and subsequently returns to the surface water".

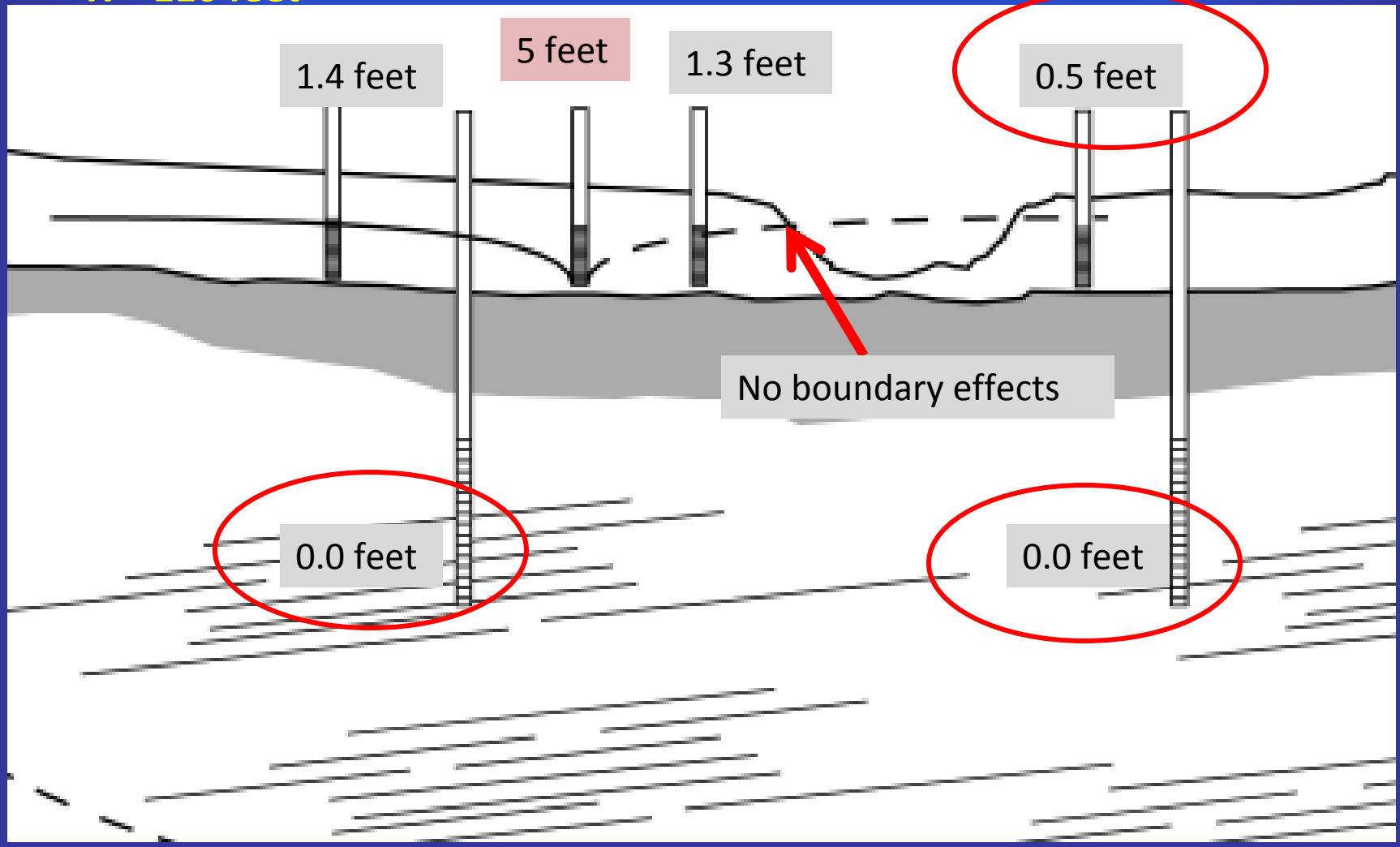

Beaverhead Rock
Spring Creek
Stone Creek


River Test Site

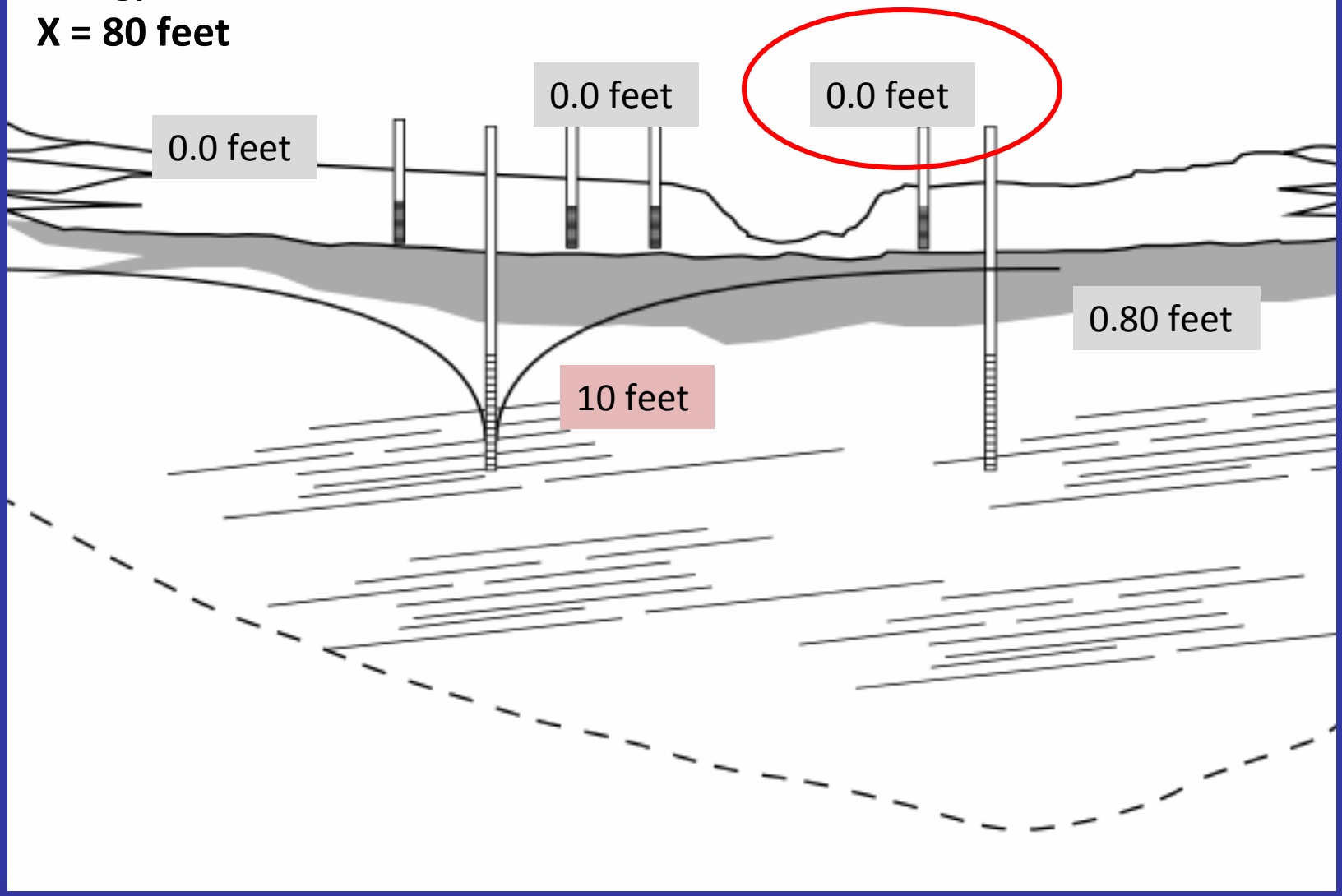

~10,000 feet
alluvium ~30 feet thick
river
clay ~30 feet thick
Tertiary-age
layered sediments


~8,000 feet
Test Area
Beaverhead Rock
alluvium ~30 feet thick
clay ~30 feet thick
Tertiary-age layered sediments
?
?
?
?
?

72-Hour
Alluvial aquifer
200 gpm
X = 110 feet



72-Hour
deep aquifer
325 gpm
X = 80 feet



The Problem(s)

1) no drawdown in the shallow aquifer from pumping deeper aquifer
so, no net depletion?

2) drawdown as expected in the shallow aquifer near the pumped well
BUT no boundary (stream) observed in the data and
drawdown was observed across the river
so, minimal or no net depletion?

The Solution(s)

A) Numerical: McDonald and Harbaugh (1988) MODFLOW

B) Analytical: **but which one?**

T=80,000 ft²/day
Q=600gpm for 120 days
X=1,000 and 8,000 (analytical method)
X= river cell at 1,000 and 8,000 feet (model)

Analytical methods for Stream Depletion

Glover and Balmer (1954)

Grigoriev (1957)

Bochever (1966)

Jenkins (1968, 1970)

Schroeder (1987)
"Colorado model" *

Wilson (1993)

Sophocleous et al (1995)

Hunt (1999)

Integrated Decision Support Group (2004)*

Butler et al (2001)

Hunt (2003, 2007)*

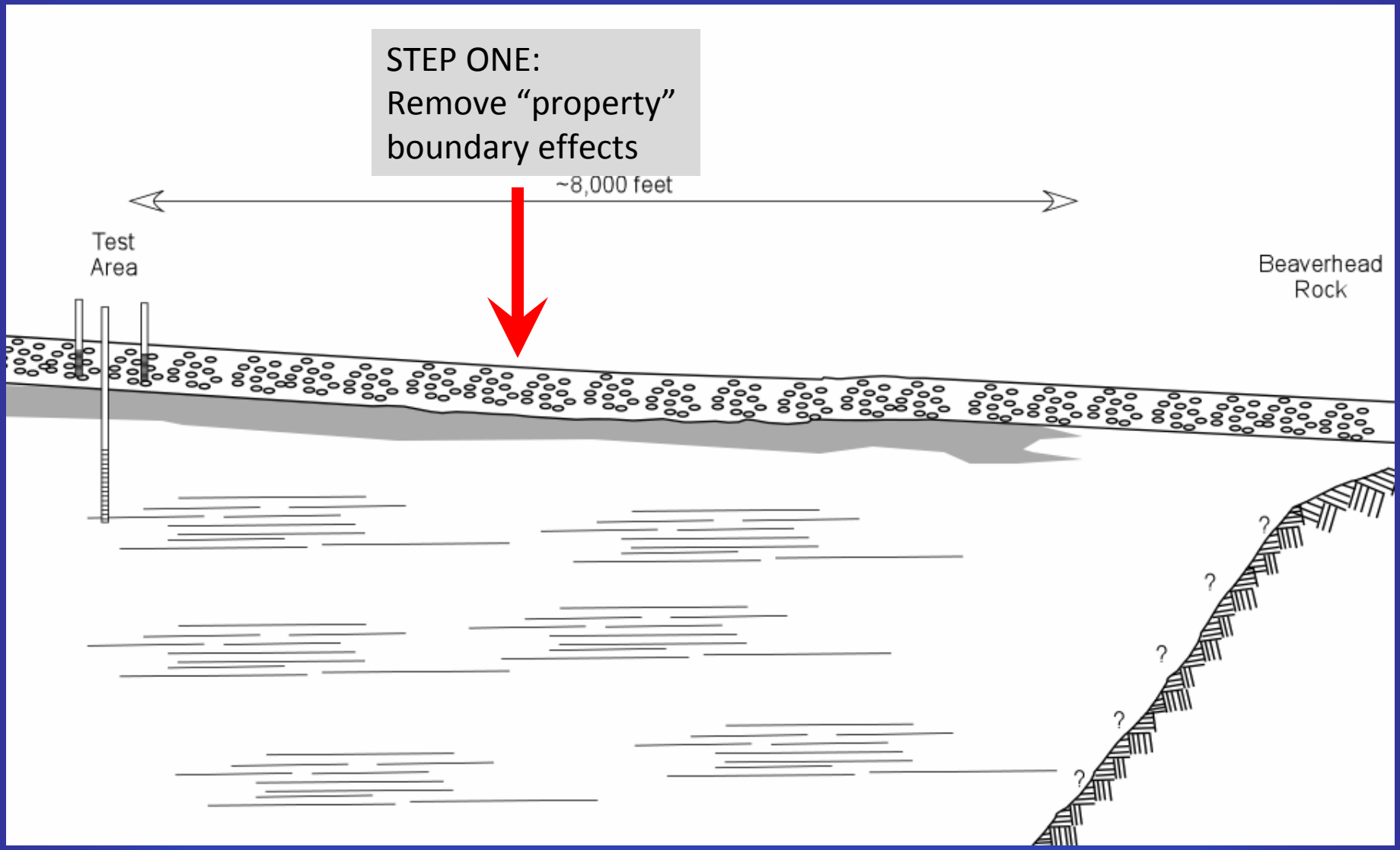
Di Matteo and Dragoni (2005)

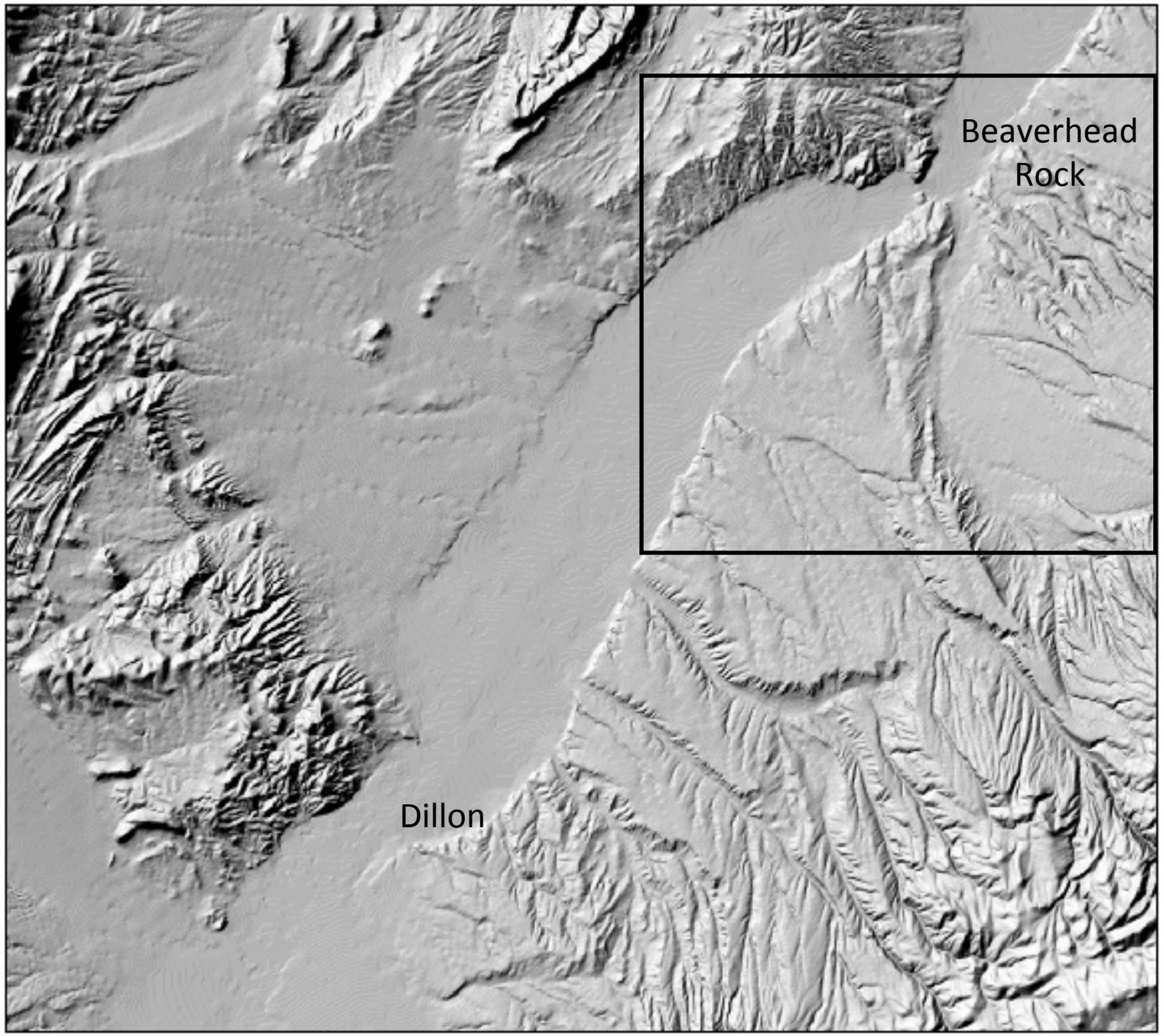
Miller et al (2007)

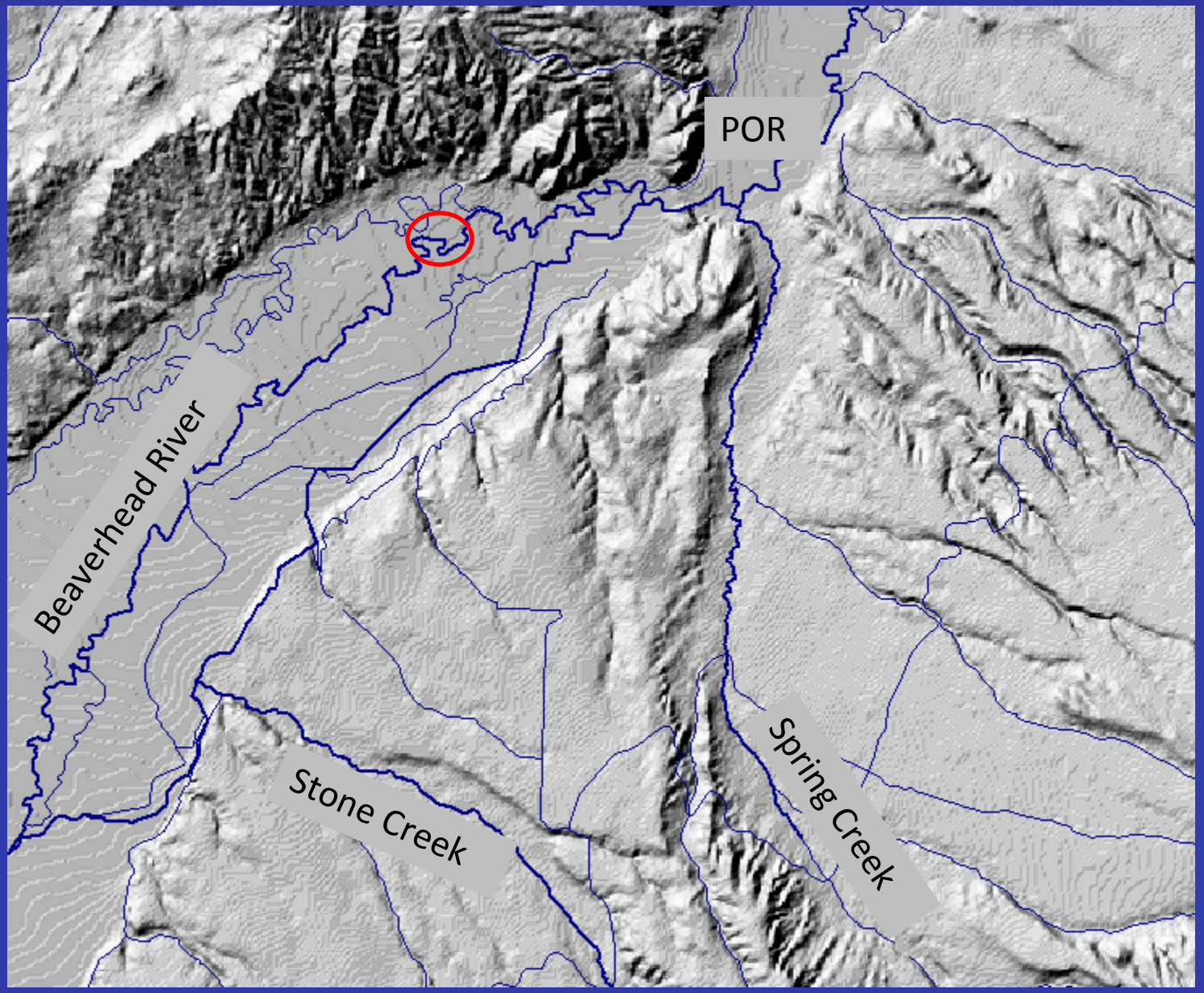
revisions, refinements, and re-definements

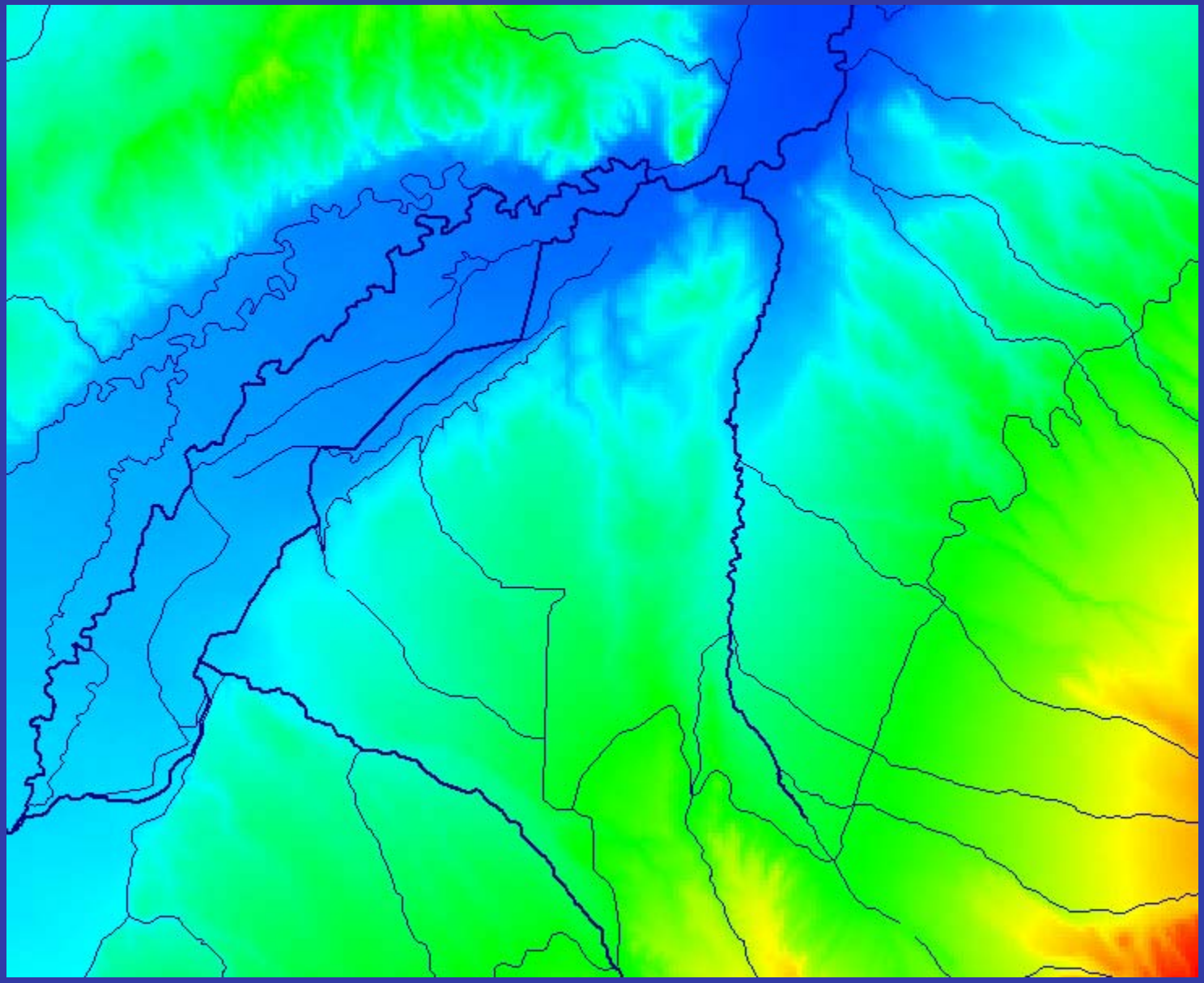
*spreadsheet or desktop software available

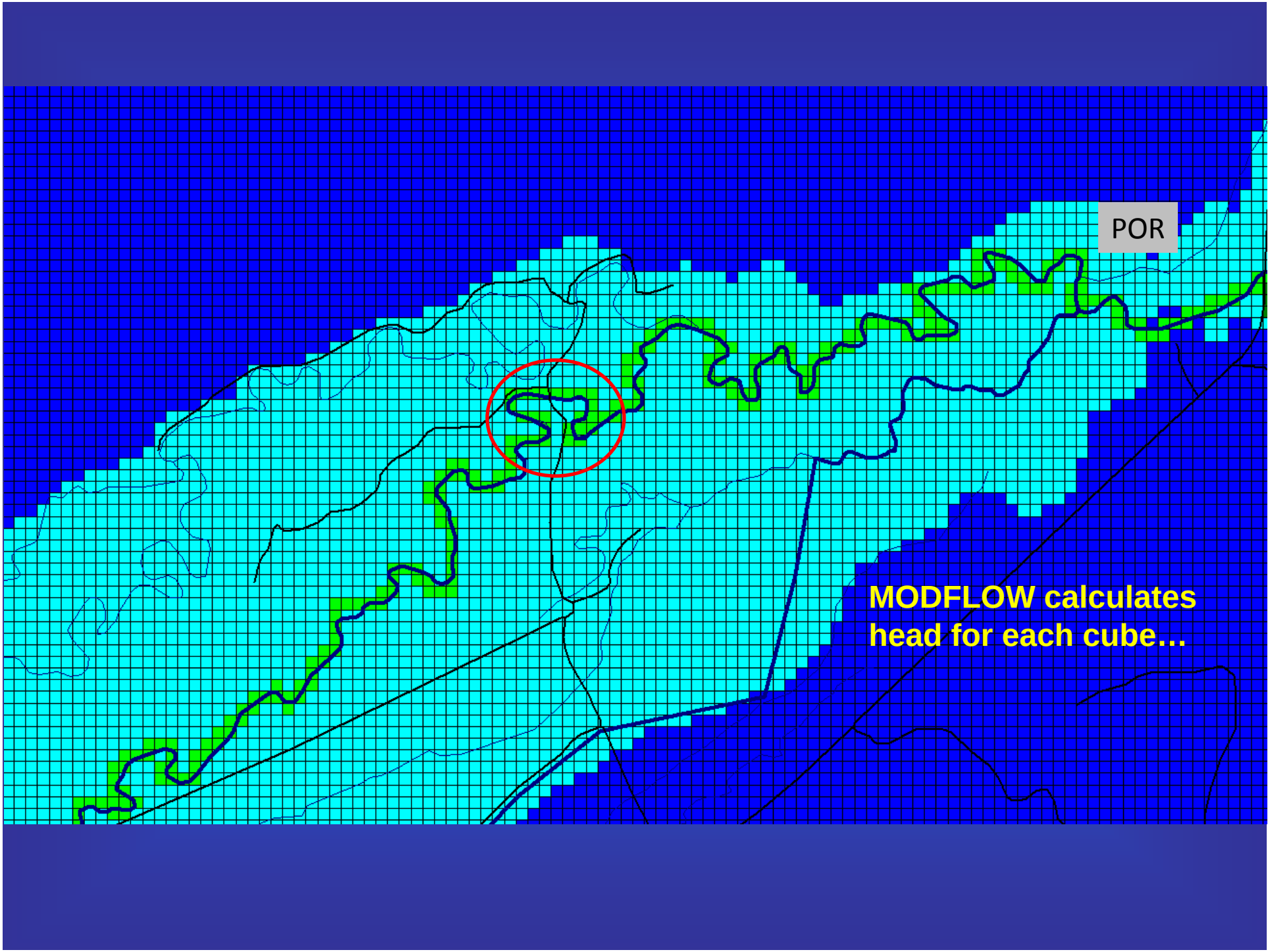
STEP ONE:
Remove “property” boundary effects

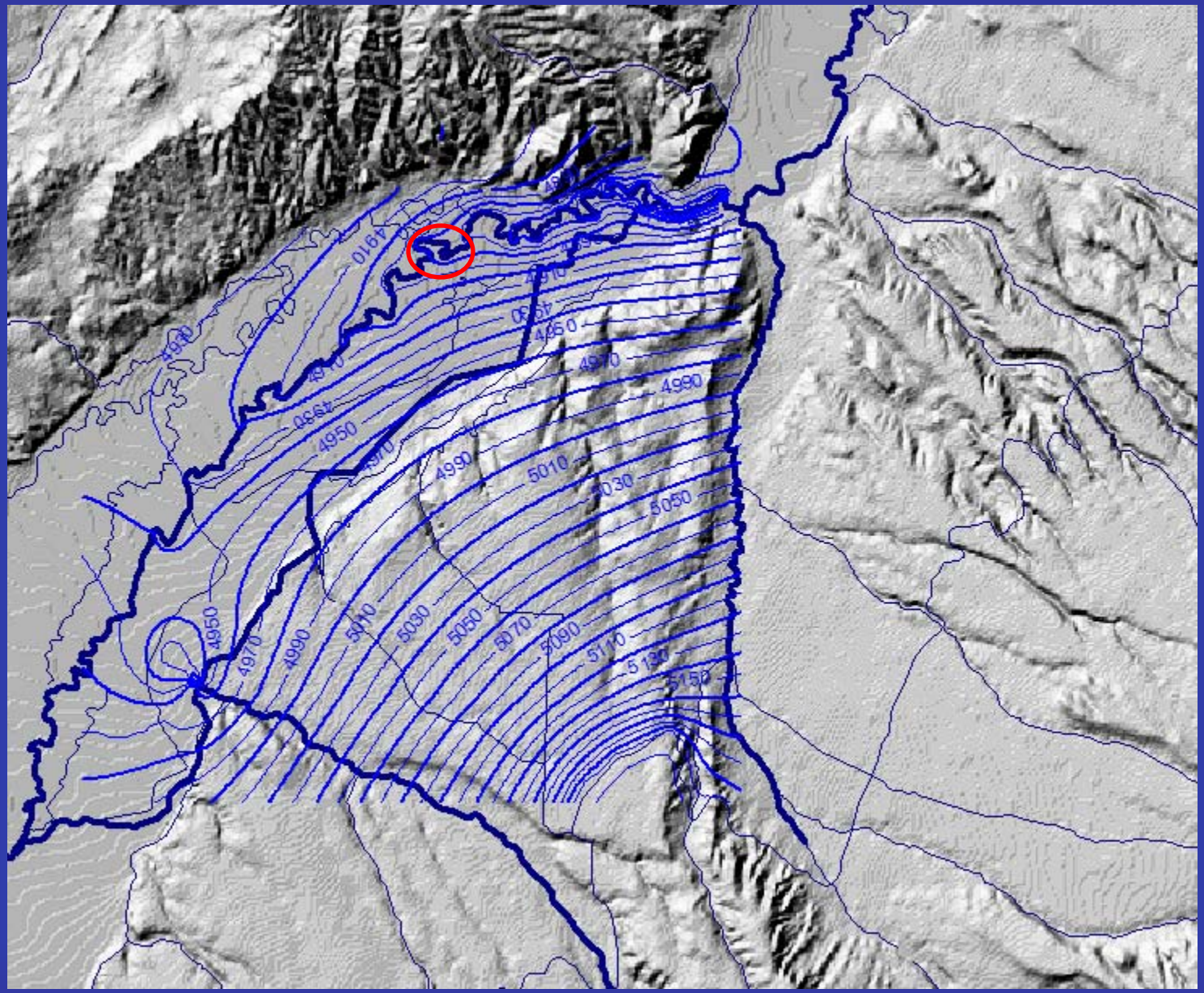


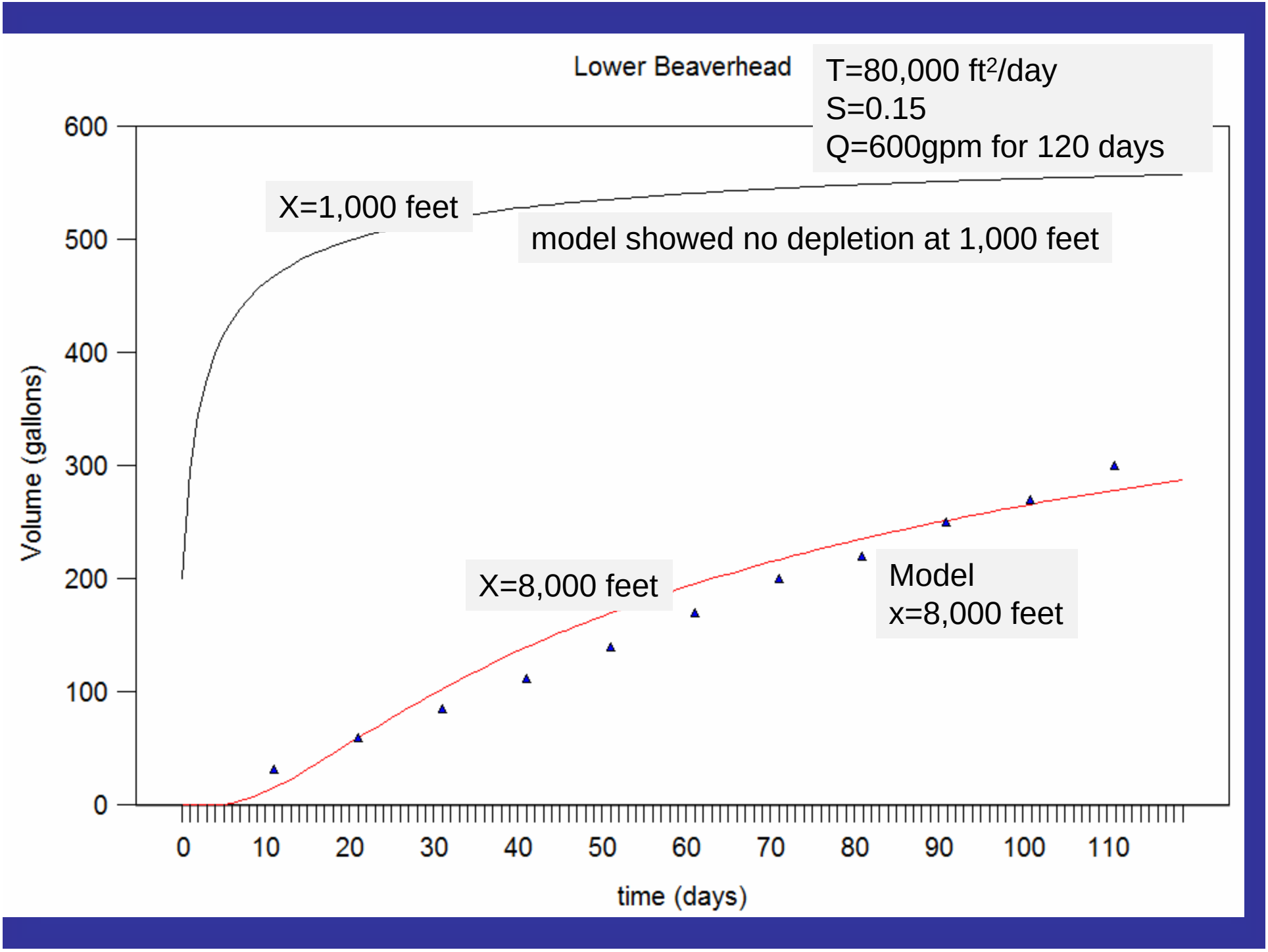

Beaverhead
Rock
Dillon


POR
Beaverhead River
Stone Creek
Spring Creek



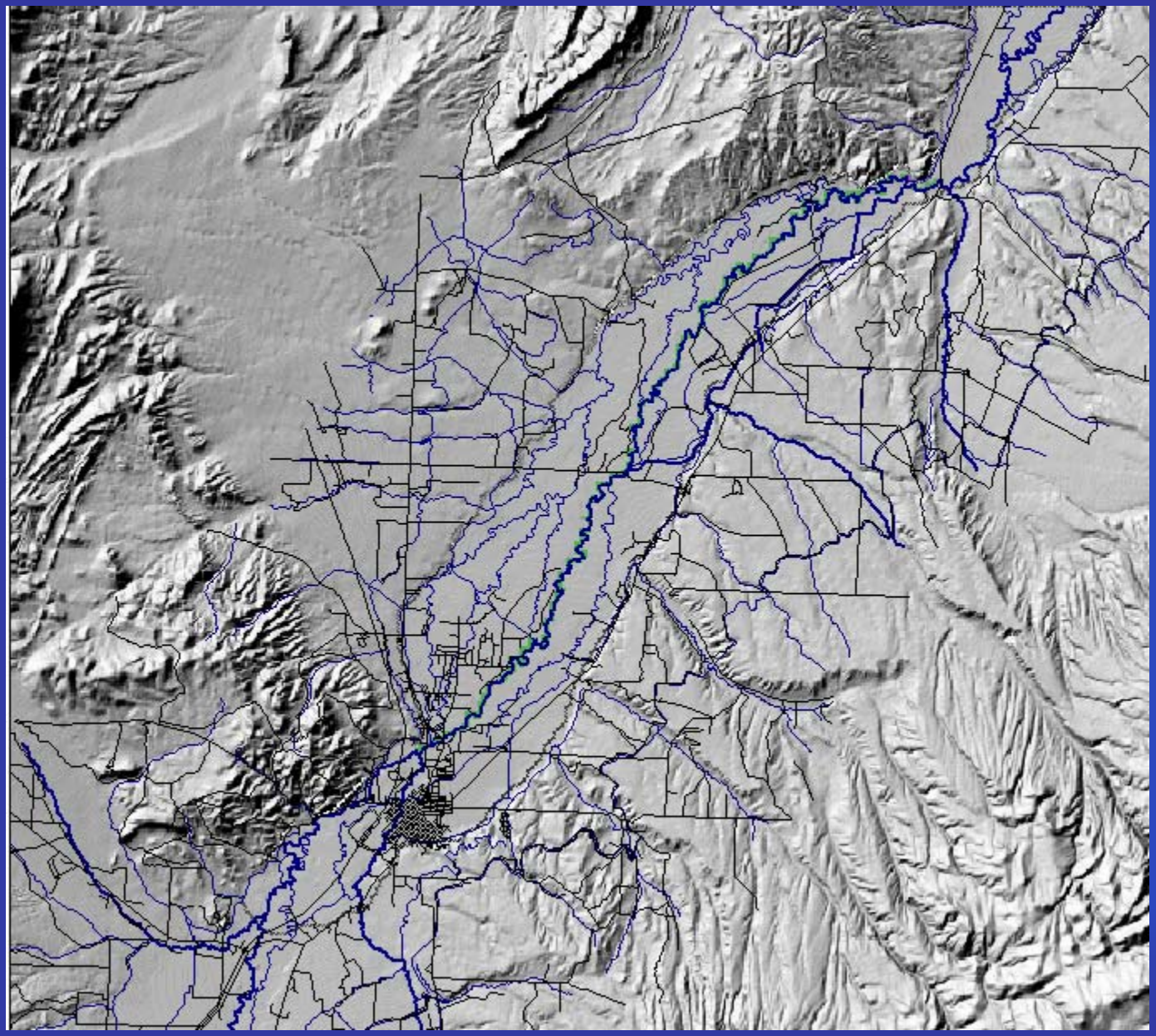

POR
MODFLOW calculates
head for each cube…

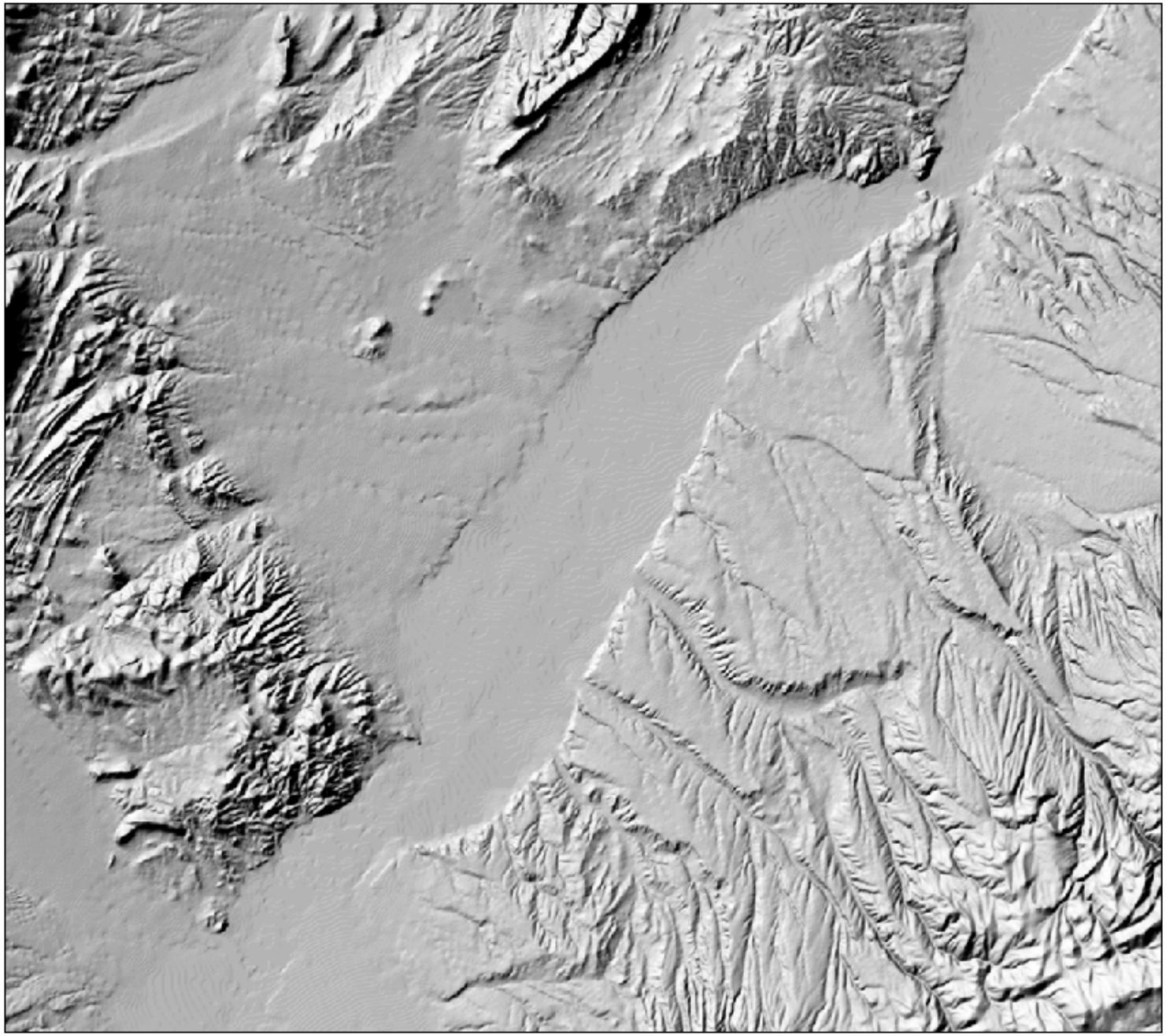

4910
4930
4950
4970
4990
5010
5030
5050
5070
5090
5110
5130
5150

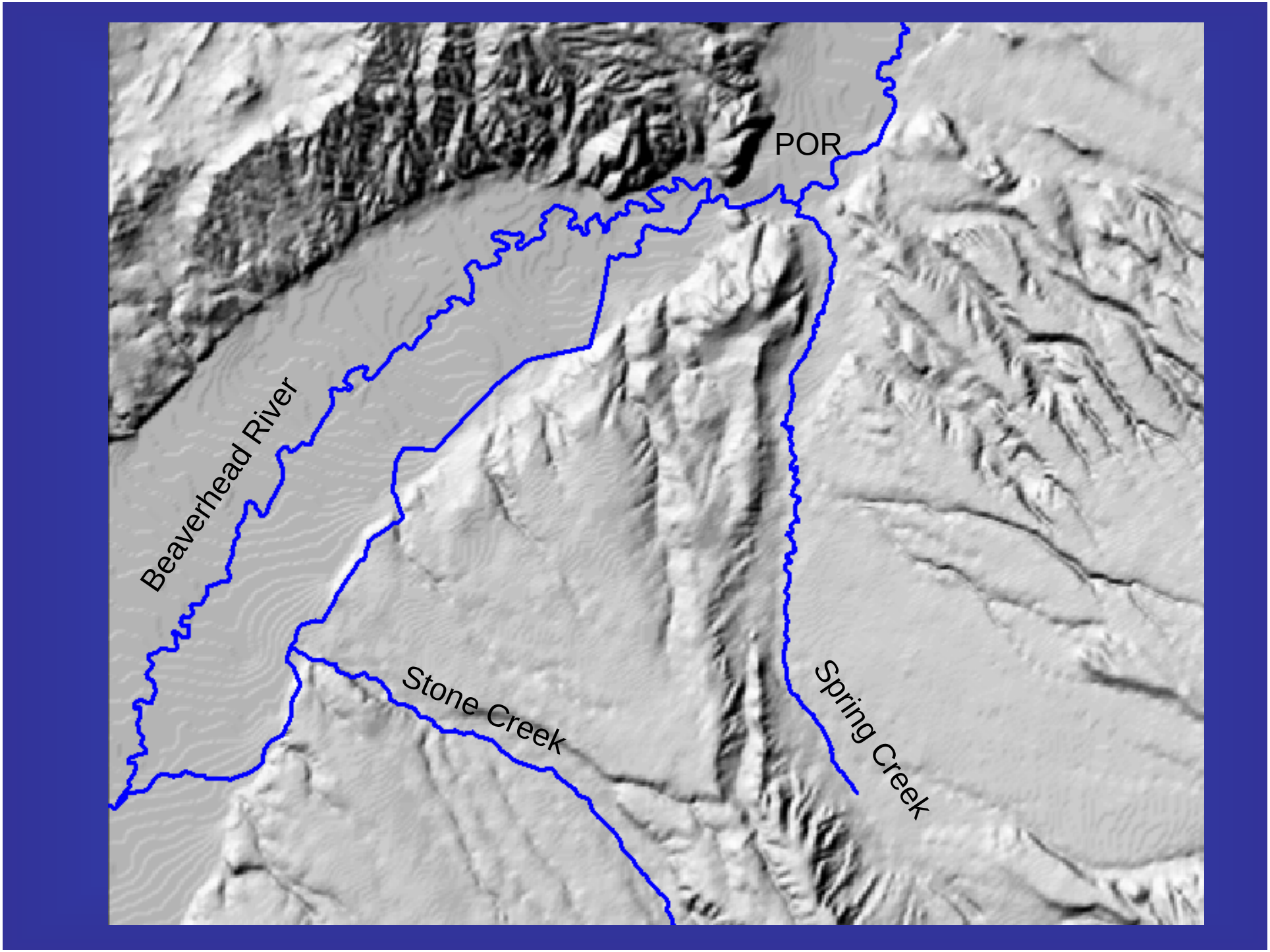

Lower Beaverhead
T=80,000 ft2/day
S=0.15
Q=600gpm for 120 days
X=1,000 feet
model showed no depletion at 1,000 feet
X=8,000 feet
Model
x=8,000 feet
Volume (gallons)
time (days)
0
100
200
300
400
500
600
0
10
20
30
40
50
60
70
80
90
100
110

Analytical methods versus Numeric (modeling)

	Analytical	Model
Time required (after data has been compiled)	low	moderate to high
Data required	T,S,x,Q(t)	more
Cumulative effects (e.g. multiple wells and/or streams)	no	yes
Boundary conditions (other than stream)	no flow only	all you want
Anisotropy (e.g. multiple layers)	method specific	yes
Mitigation	indirect only (consumptive use)	yes






POR
Beaverhead River
Stone Creek
Spring Creek