Climate change and water scarcity: The potential for social responses and institutional resiliency in the Pacific Northwest

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Outline

1. Overview of WW2100 Model
2. A few main results
3. Focus on drought mitigation policy

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Willamette Water 2100

Anticipating water scarcity and informing integrative water system response

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& engagement with ~100 water managers & stakeholders

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Willamette Water 2100

Anticipating water scarcity and informing integrative water system response

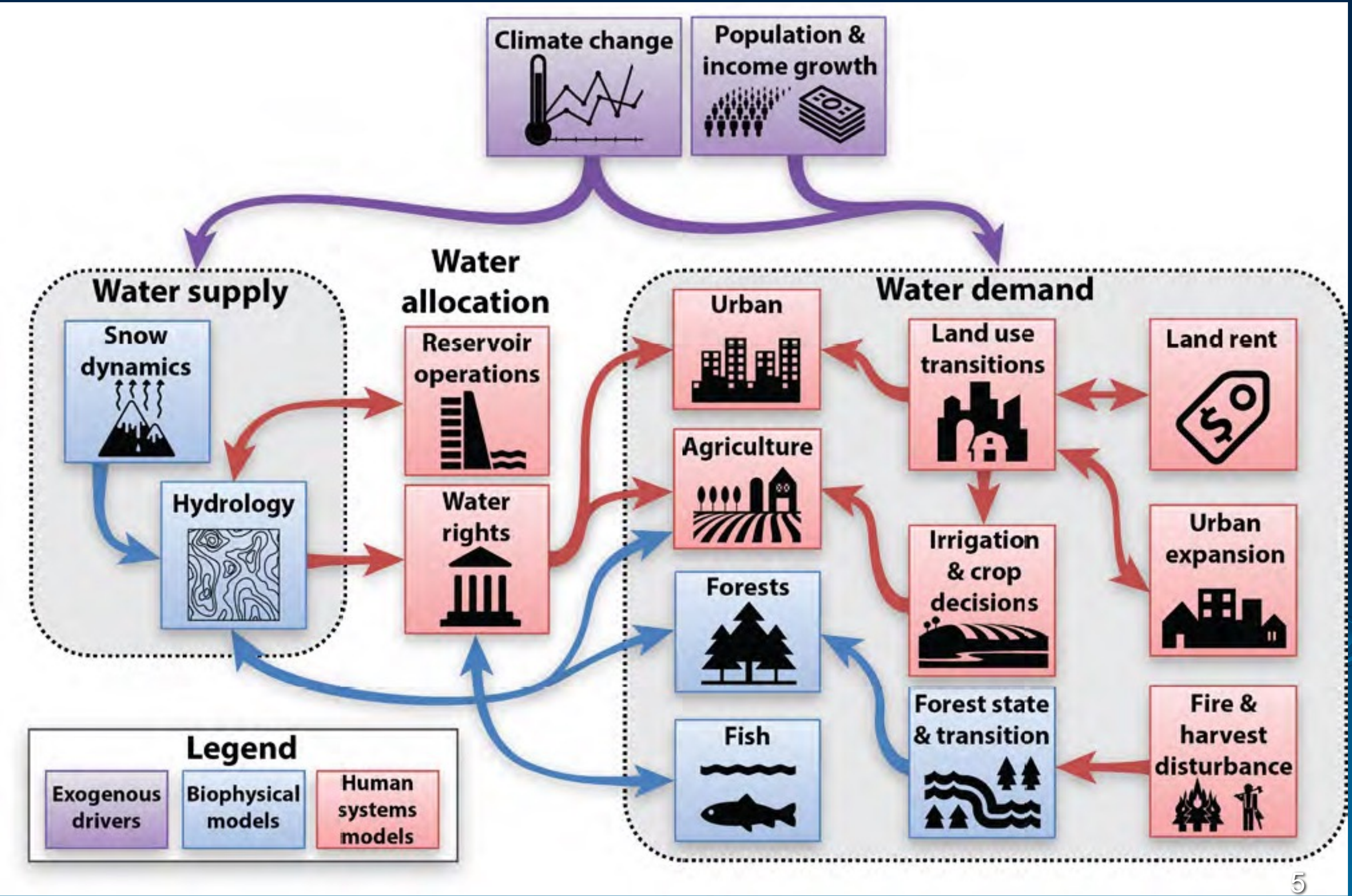
The main goals of the WW2100 study:

(1) To project where, when, and under what institutional conditions (laws, regulations, and rights) water scarcity might increase in the WRB.

(2) To consider what kinds of policies and other actions might be warranted to prepare for, mitigate, or adapt to changes in water scarcity.

See: : http://inr.oregonstate.edu/ww2100

The WW2100 Model of the WRB



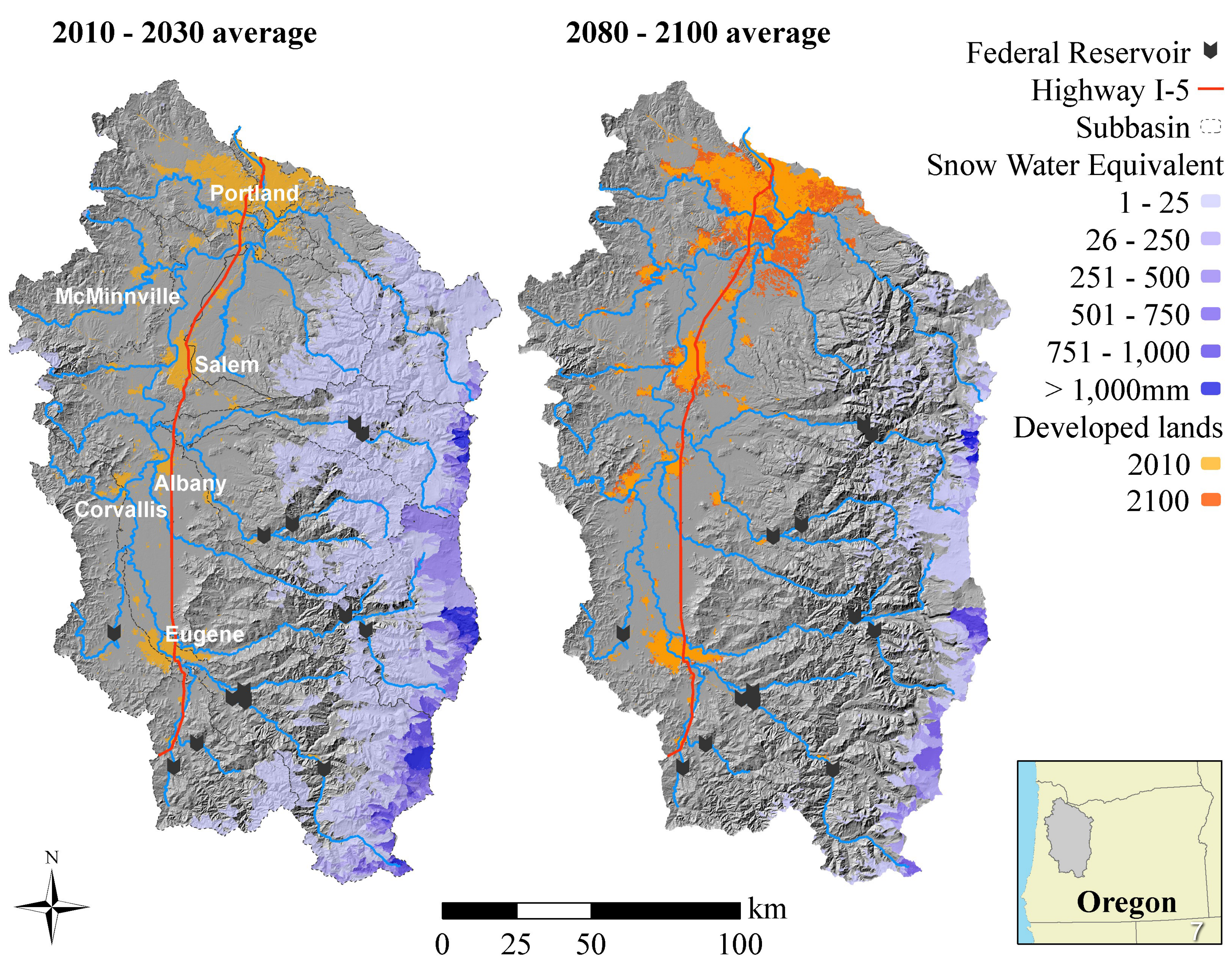
Coupled Human-Natural System

Natural System Components

- Mass balance
- Energy balance
- Water balance
- Productivity
- Competition
- Efficiency
- Infrastructure

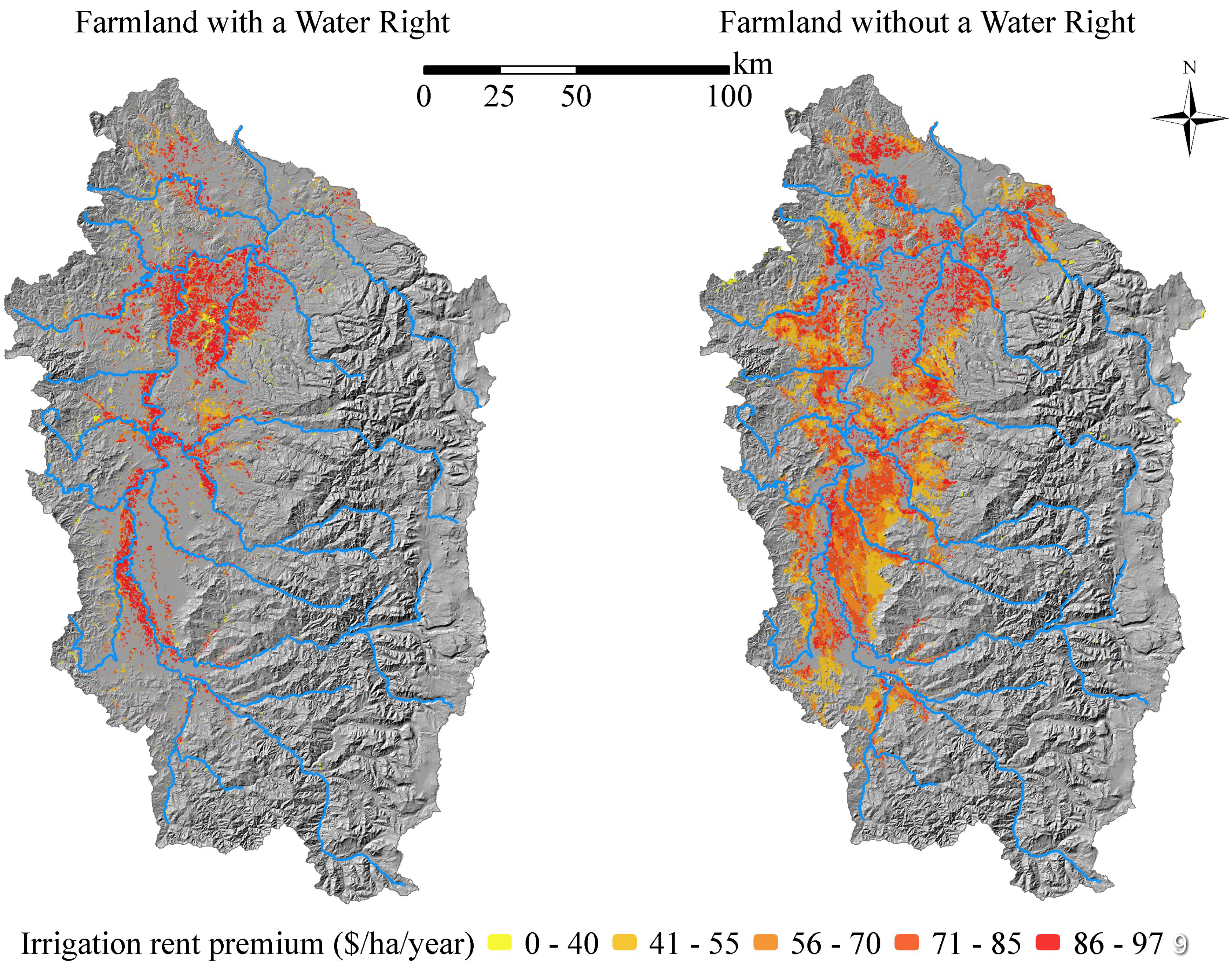
Human System Components

- Laws of supply & demand
- Market failure
- Productivity
- Competition
- Efficiency
- Institutions


2010 - 2030 average
2080 - 2100 average
Federal Reservoir
Highway I-5
Subbasin
Snow Water Equivalent
1 - 25
26 - 250
251 - 500
501 - 750
751 - 1,000
> 1,000mm
Developed lands
2010
2100
Portland
McMinnville
Salem
Albany
Corvallis
Eugene
N
0
25
50
100
km
Oregon

What did we learn?

- Water scarcity varies greatly across small distances and brief time periods, even in basins where water may be relatively abundant overall
- Key determinants of water scarcity are found to be the cost of transporting and storing water, and society's institutions that circumscribe human choices
- Critical to take account of "unexercised or inherent discretionary authority" in the law


Farmland with a Water Right
Farmland without a Water Right
km
0
25
50
100
N
Irrigation rent premium ($/ha/year)
0 - 40
41 - 55
56 - 70
71 - 85
86 - 97

Irrigation conveyance costs

(from a river downstream of a dam, to a field currently without an irrigation water right)

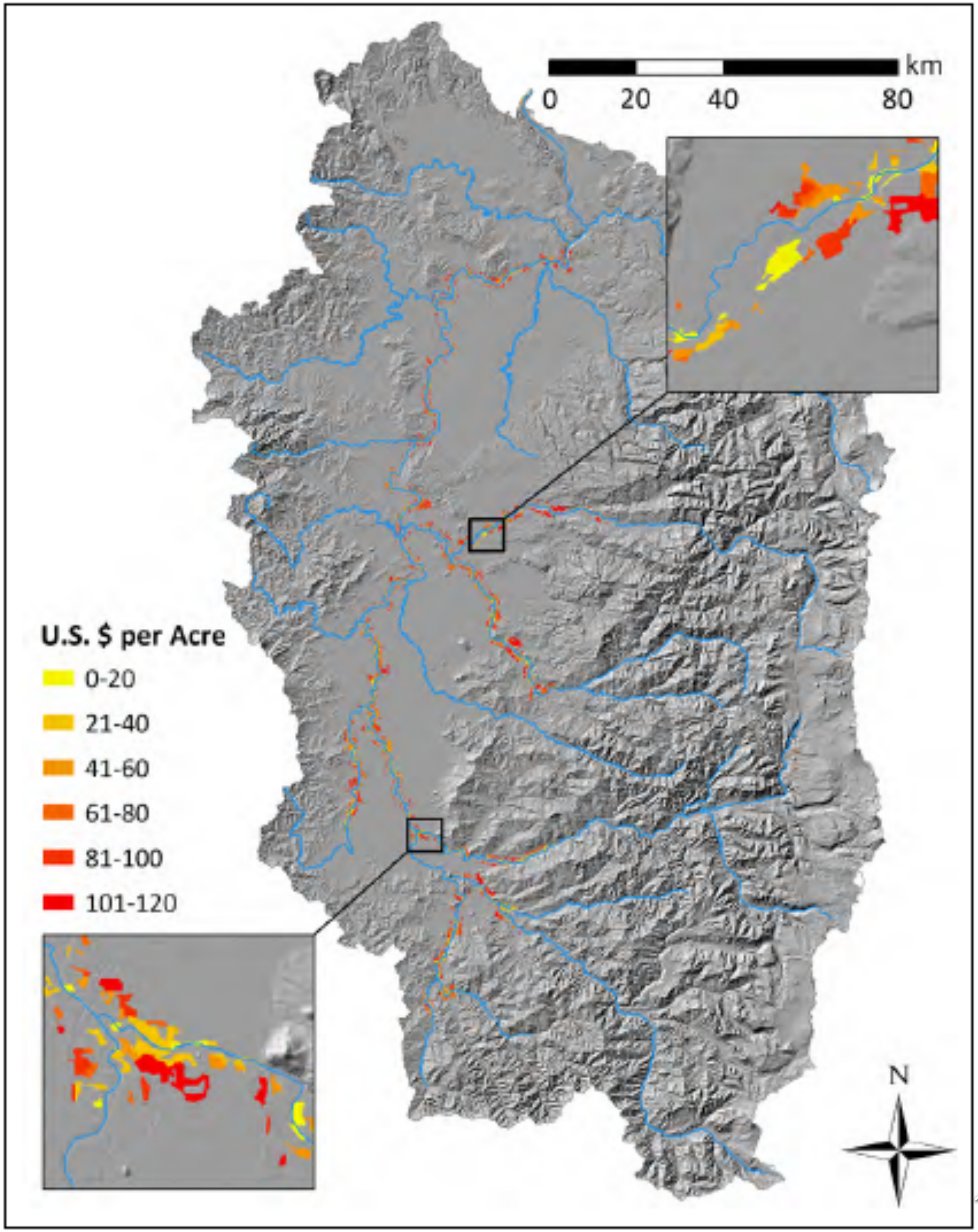


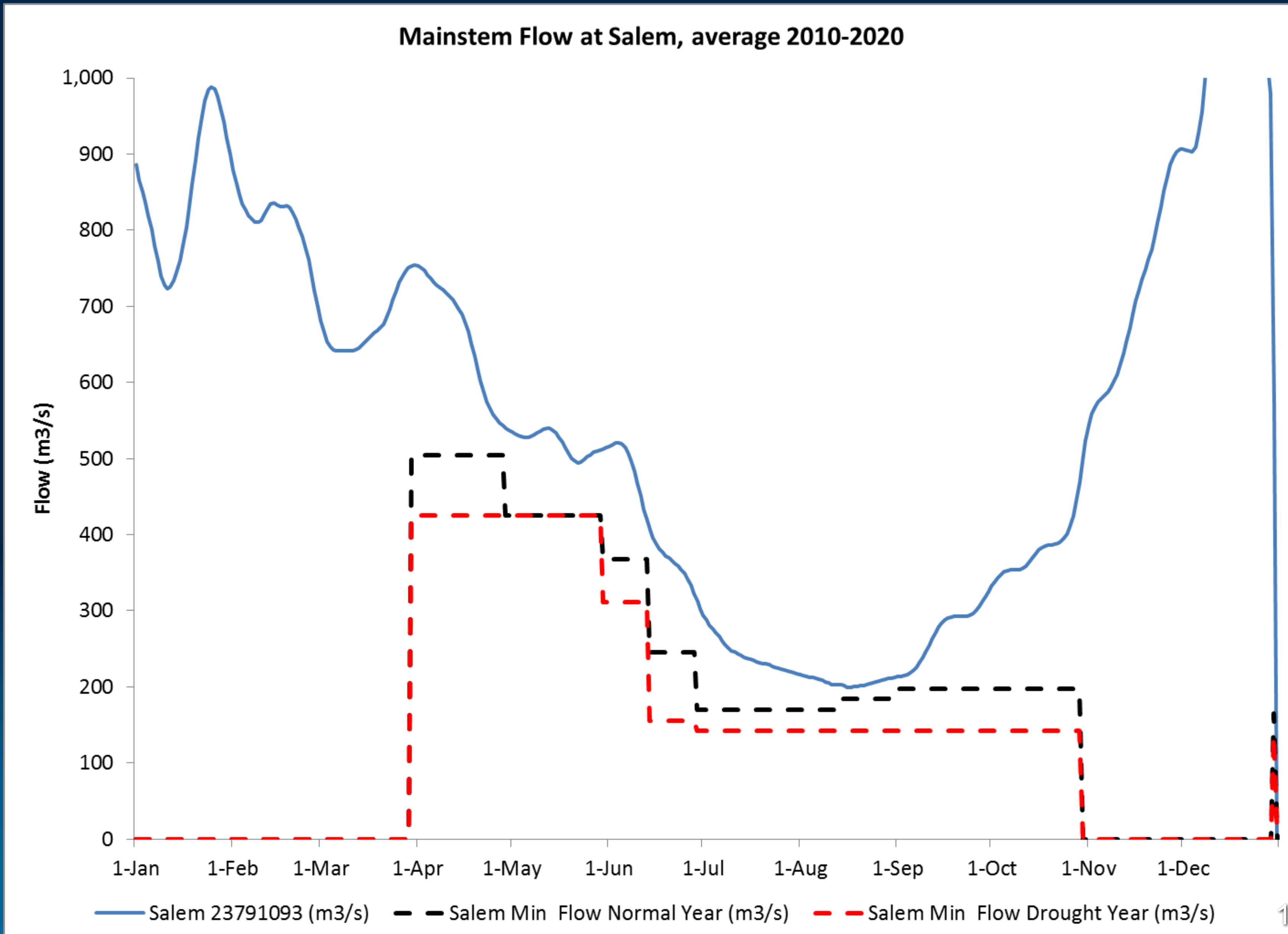
Figure 38. Irrigation conveyance costs.

Using models for “Policy Analysis” - asking “What if?” questions

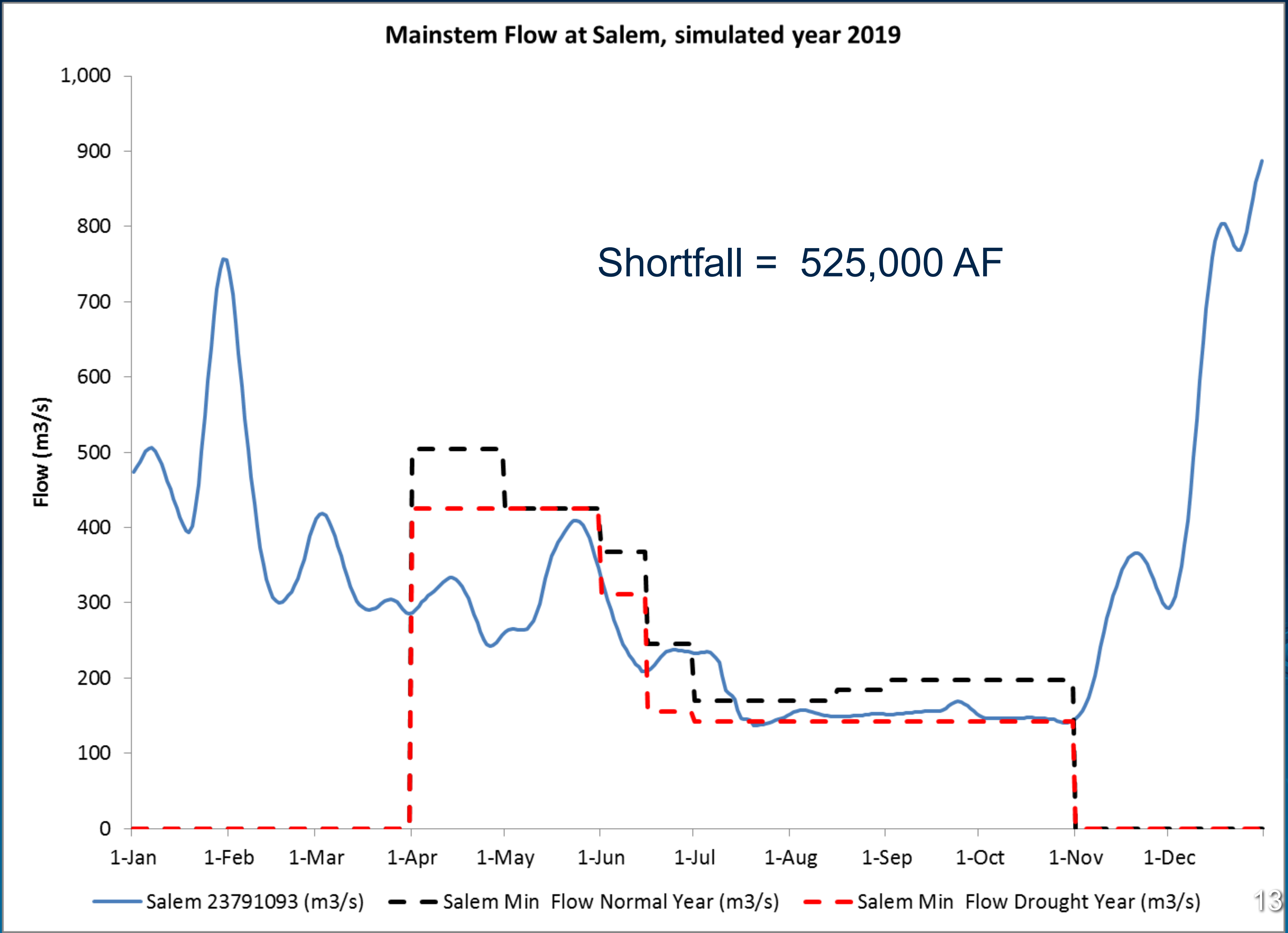
In drought year, can mitigation succeed?

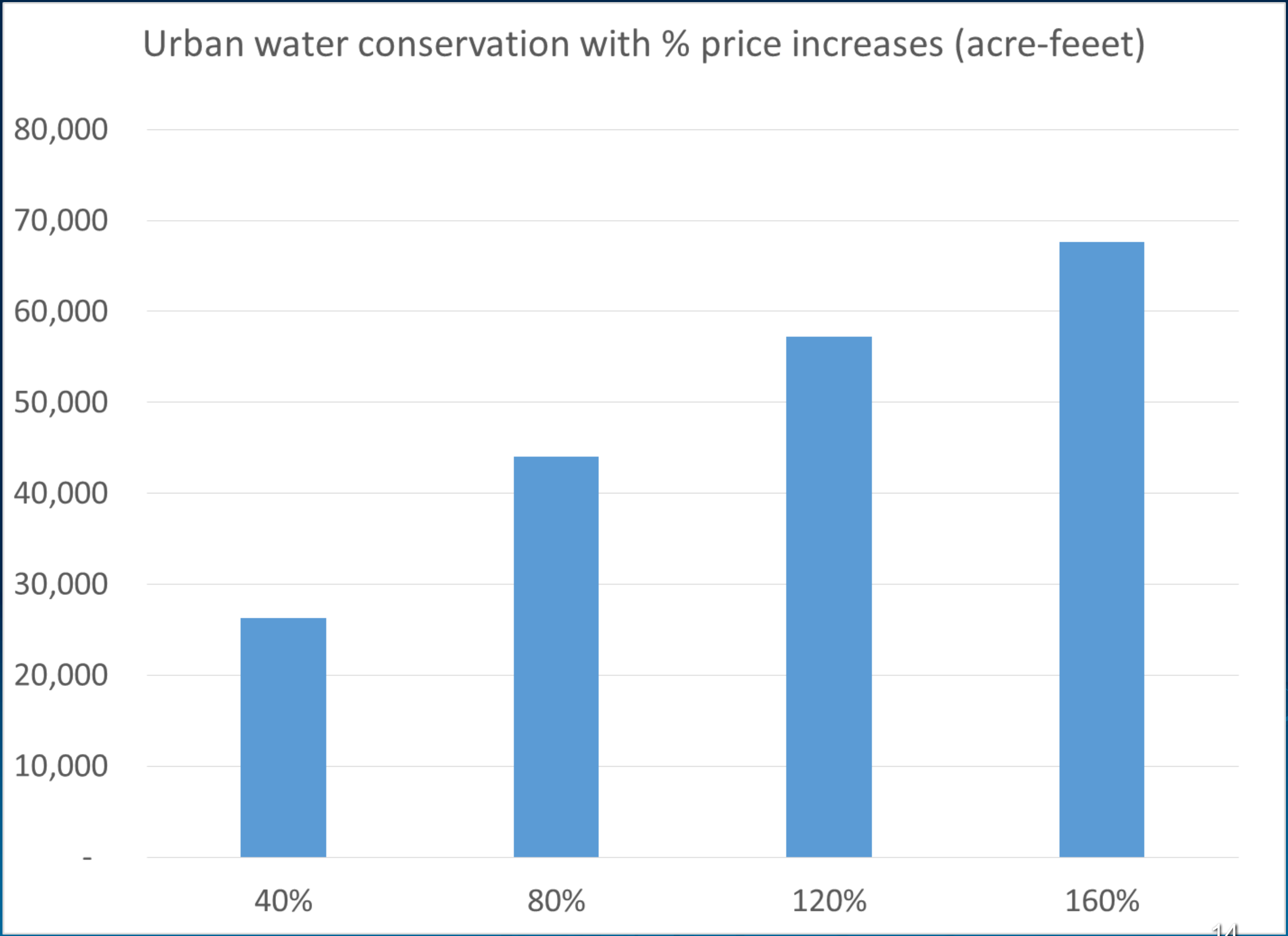
- Urban demands were met
- Irrigation demands were mostly met
- Reservoirs unable to fill in spring
- Mainstem regulatory BiOp flow not met – reservoirs at minimum pool

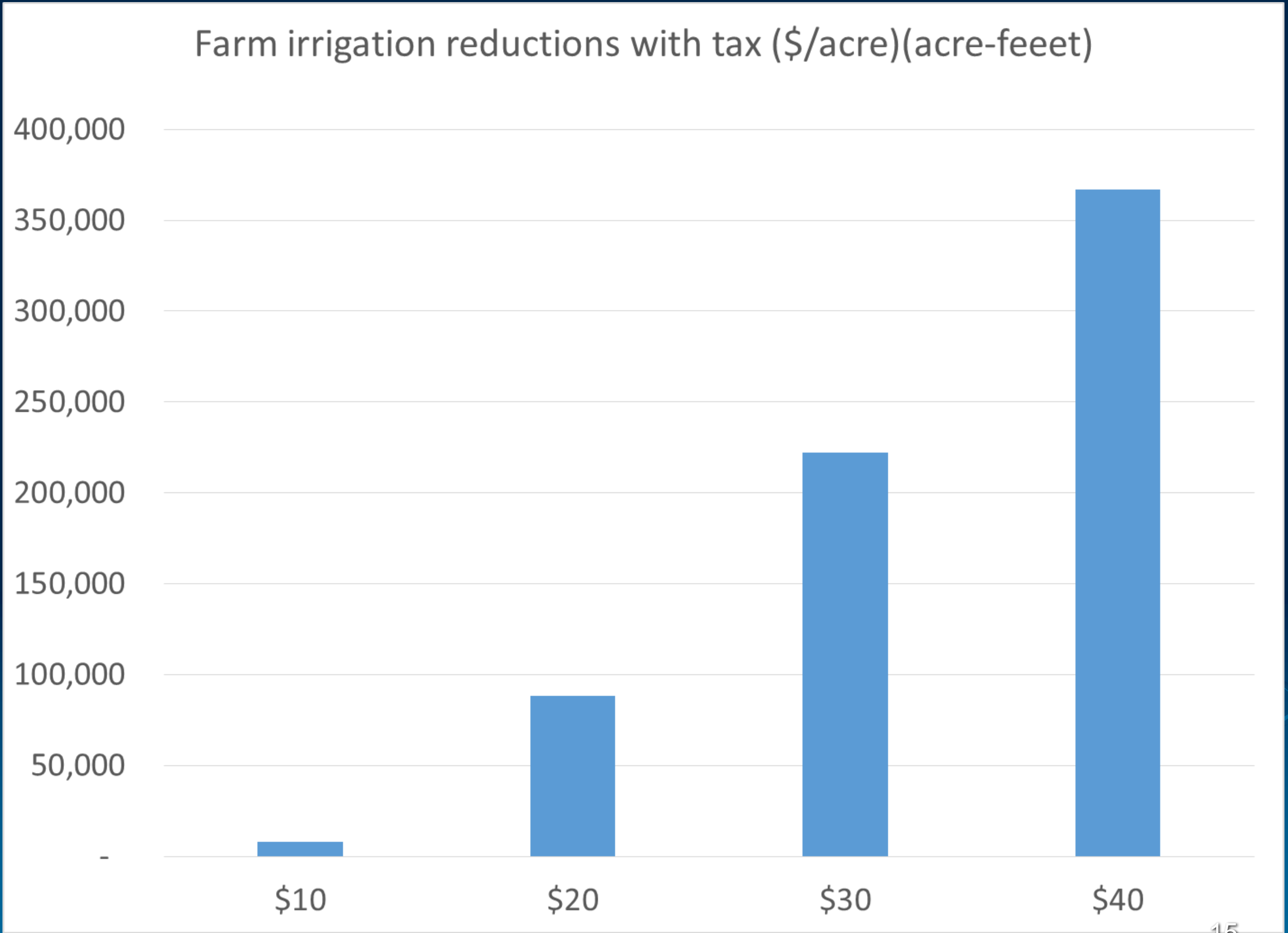
Mainstem Flow at Salem, average



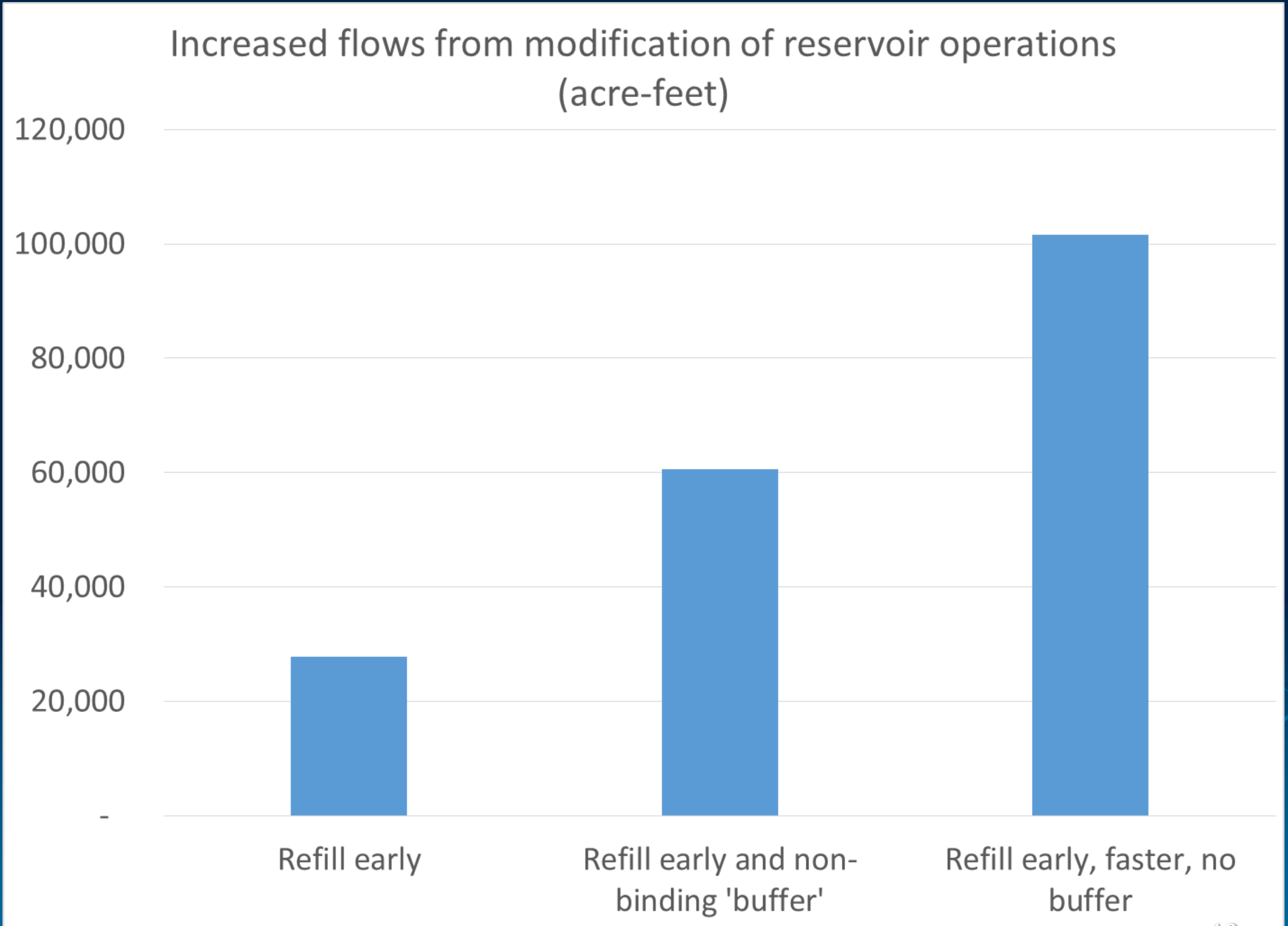
Drought year – from simulations




Urban water conservation with % price increases (acre-feeet)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
-
40%
80%
120%
160%



Farm irrigation reductions with tax ($/acre)(acre-feeet)
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
$10
$20
$30
$40


Increased flows from modification of reservoir operations (acre-feet)
120,000
100,000
80,000
60,000
40,000
20,000
-
Refill early
Refill early and non-binding 'buffer'
Refill early, faster, no buffer

Policy Analysis Findings:

- Combining these policy interventions could conserve up to 536,000 AF, enough to offset the entire 525,000 AF shortage.

- However, due to the spatial, temporal and sequencing differences between shortages and conservation measures, only about 25% of the shortage can be mitigated.

- Farm irrigation contributes 5%, urban 1%.

- Jaeger, W.K., et al., Water, Economics, and Climate Change in the Willamette Basin, Oregon" Oregon State University EM 9157. https://catalog.extension.oregonstate.edu/em9157
- Jaeger, W.K., et al., Finding Water Scarcity Amid Abundance Using Human-Natural System Models, Proceedings of the National Academy of Sciences, 2017 forthcoming.

- The WW2100 interactive website:
- http://inr.oregonstate.edu/ww2100